Technology and Industrial Arts

Food Technology

Junior High
Grade 9

Teacher Guide

Standards-Based

Department of Education

Technology and Industrial Arts

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Papua New Guinea
Department of Education

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Content

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Acronyms

AAL	Assessment as Learning
ARS	Audience Response System.
AFL	Assessment for Learning
AOL	Assessment of Learning
BoS	Board of Studies
CDD	Curriculum Development Division
CP	Curriculum Panel
DA	Diagnostic Assessment
IHD	Integral Human Development
GoPNG	Government of Papua New Guinea
KSVA	Knowledge Skills Values and Attitudes
MTDG	Medium Term Development Goals
NDoE	National Department of Education
OBC	Outcomes-Based Curriculum
OBE	Outcomes-Based Education
PNG	Papua New Guinea
SAC	Subject Advisory Committee
SBC	Standards-Based Assessment
SBC	Standards-Based Curriculum
SBE	Standards-Based Education
SCG	Subject Curriculum Group
STEAM	Science, Technology, Engineering, Arts and Mathematics
SRS	Student Response System
UOW	Unit of Work

Secretary's Message

The ultimate aim of Standards-Based Education in Papua New Guinea (PNG) is to prepare students for careers, higher education, and citizenship. This means that education should focus on developing and equipping students with essential knowledge, skills, values, and attitudes that they can use in all aspects of their lives. Education must also aim to motivate and prepare students to pursue Science, Technology, Engineering, Arts, and Mathematics (STEAM) courses in higher education institutions and pursue careers in STEAM related fields.

Technology and Industrial Arts is a significant curriculum framework for teaching students and enabling them to progressively develop proficiency on fundamental ideas and skills of Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology. Food Technology is designed to build the capacity of students to make informed food choices and develop their confidence when working with food. Students will be given learning opportunities to explore food from a wide range of perspective with emphasis on nutritional value of food, health and wellbeing, techniques in food preparation, and aspects of food science and technology advancement.

Technology and Industrial Arts as a subject of which Food Technology is a strand, is envisioned to benefit students in enabling them to utilise technology knowledge, skills, values and attitudes, and systems and processes to solve problems using the design process in a methodical and precise manner to innovate and invent design solutions. The integration of STEAM in the teaching and learning of Food Technology will instill in students the abilities and capabilities to be highly proficient and competent end users and possibly creators of technology as STEAM is an integral component of the core curriculum.

Teachers are encouraged to read this teacher guide carefully to become familiar with the content so that they can be confident to use the new concepts and strategies as well as teach the content well. They can also adjust to suit the learning needs of the students.

I commend and approve this Grade 9 Technology and Industrial Arts: Food Technology Teacher Guide to be used in all High Schools throughout Papua New Guinea.

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UKE W KOMBRA, PhD
Secretary for Education

Introduction

Technology and Industrial Arts aims to equip students with the 21st century skills in critical creativity, decision making and collaboration in producing design products. The Technology and Industrial Arts (TIA) comprise of the strands; Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology. Students are expected to learn and master the knowledge, skills, and values of studying food and textiles, construction, communication and computer technology.

The overall study of Food Technology in this guide caters for all students' needs and interest by which it promotes integral human development, provides both vocational and life experiences relevant to equip a student to apply in local, national, domestic, commercial, industrial and global settings. The growing introduction of processed food has contributed to the changes of food habits as a result of economic, social, cultural, technological and environmental factors. Students will be equipped with the fundamental concepts, knowledge, skills, values, attitudes and understanding of food properties, processing, preparation and their interrelationships, nutritional considerations and consumption patterns. It also provides students the ability and skills that can be applied in a range of contexts through which to examine the richness, pleasure and variety food adds to life. The broad set of skills in the course can be integrated to other study, work and life contexts that students may confront.

There are increasing lack of information and concerns about food issues, including hygiene and safety, nutritional quality of food, genetic engineering (food science), functional food and the environmental, social, physical, cultural, technological and economic impact of food production and security. Students will be given opportunities to explore food related issues through a range of theory and practical experience and develop the ability to solve problems, design and produce, and evaluate solutions to situations involving food.

Students' employability and career development will be enhanced through the study and application of STEAM principles. STEAM is an integral component of the core curriculum. It is envisioned that the study of STEAM will motivate students to take up academic programs and careers in STEAM related fields. STEAM has been embedded in the Technology and Industrial Arts: Food Technology curriculum.

Teachers of Food and Textile Technology strands will plan and program the two strands for 13 weeks on a rotational basis with the other 3 strands as they are taught concurrently, hence the total coverage of learning Technology and Industrial Arts as a subject. The learning integration is more relevant including the STEAM approach to teach the essential knowledge, skills, values and attitudes, and processes.

Technology and Industrial Arts: Food Technology is to be timetabled for 200 minutes (5 periods) per week in Junior High School.

Structure of the Teacher Guide

The Food Technology Teacher Guide comprises of four main sections that provide essential information that all teachers should know and do to effectively implement the Food Technology curriculum.

1. General Information of the Subject

The general information section of the Teacher Guide informs teachers on the Food Technology Strand under the following headings below;

- Introduction of the Teacher Guide
- Structure of the Teacher Guide
- Purpose of the Teacher Guide
- How to use the Teacher Guide

2. Teaching and Learning Section

The teaching and learning section of the Teacher Guide informs and guides teachers to apply the teaching and learning theories, principles, pedagogies and practices in planning, programing, teaching and assessing students. They are outlined in the headings bulleted below;

- Syllabus and Teacher Guide Alignment
- Learning and Performance Standards
- Core Curriculum
- Science Technology Engineering Arts Mathematics (STEAM)
- Curriculum Integration
- Essential Knowledge, Skills, Values and Attitudes
- Teaching and Learning Strategies
- Strands, Units and Topics
- Planning and Programming
- SBC Lesson Planning

3. Assessment Section

The assessment section of the Teacher Guide informs and guides teachers to plan and program assessment activities, formulate assessment rubrics and apply assessment strategies to assess students. This section also guides teachers to monitor and report students' progress of learning and performances of the attainment of standards.

4. Glossary, References and Appendices Sections

These sections guide teachers to refer to terms and definitions of the strand/ subject content, references outlined to guide the development of this teacher guide. The appendices section provides essential information to guide teachers on the content and the delivery of this subject.

Purpose of the Teacher Guide

This teacher guide describes what teachers should know and do to effectively plan, program, teach and assess Grade 9 Food Technology content to enable all students to attain the required learning and proficiency standards. Sufficient information with thorough guidelines is provided for the teacher to use to achieve the essential Knowledge, Skills, Attitudes and Values (KSAV) embedded in the set national content standards and grade level benchmarks.

The overarching purpose of this teacher guide is to assist teachers to;

- understand the significance of aligning all the elements of standards-based curriculum (SBC) as the basis of achieving the expected level of education quality,
- effectively align all the components of SBC when planning, programming, teaching, and assessing students learning and levels of proficiency,
- effectively translate and align the Technology and Industrial Arts Syllabi and Food Technology Strand teacher guides to plan, program, teach and assess different Food Technology Strand Teacher Guide units and topics, and the essential knowledge, skills, attitudes and values (KSAVs) described in the grade-level benchmarks,
- understand the Food Technology Strand national content standards, grade-level benchmarks, and evidence outcomes,
- effectively make sense of the content (KSAVs) described in the Food Technology Strand national content standards and the essential components of the content described in the grade-level benchmarks,
- effectively guide students to progressively learn and demonstrate proficiency on a range of Food Technology Strand skills, processes, concepts, ideas, principles, practices, values and attitudes,
- confidently interpret, translate and use Food Technology Strand content standards and benchmarks to determine the learning objectives and performance standards, plan and program appropriately to enable all students to achieve these standards,
- embed the core curriculum in the Food Technology Strand lesson planning, programming, instruction, and assessment to permit all students to learn and master the core knowledge, skills, values and attitudes required of all students,
- provide opportunities for all students to understand how STEAM has and continues to shape the social, political, economic, cultural, and environment contexts and the consequences, and use STEAM principles, skills, processes, ideas and concepts to inquire into and solve problems relating to both the natural and physical worlds (human-made) as well as problems created by STEAM,

- integrate cognitive skills (critical, creative, reasoning, decision-making, and problem solving skills), high level thinking skills (analysis, synthesis and evaluation skills), values (personal, social, work, health, peace, relationship, sustain values), and attitudes in lesson planning, programming, instruction and assessment,

- meaningfully connect what students learn in Food Technology Strand with what is learnt in other subjects to add value and enhance students learning so they can integrate what they learn and develop in-depth vertical and horizontal understanding of subject content,

- formulate effective SBC lesson plans using learning objectives identified for each of the topics,

- employ SBC assessment approaches to develop performance assessments to assess students' proficiency on a content standard or a component of the content standard described in the grade–level benchmark,

- effectively score and evaluate students' performance in relation to a core set of learning standards or criteria, and make sense of the data to ascertain status of progress towards meeting grade-level and nationally expected proficiency standards, and

- use evidence from the assessment of students' performance to develop effective evidence-based intervention strategies to help students making inadequate or slow progress towards meeting the grade-level and national expectations to improve their learning performances.

How to use the Teacher Guide

The Grade 9 Food Technology Strand Teacher Guide is an expansion of the content in the Technology and Industrial Art Syllabus. The Syllabus contains the content standards, benchmarks and evidence outcomes which are expanded into teaching and learning activities in the Teacher Guide. The Teacher Guide provides essential information about what the teacher needs to know and do to effectively plan, teach and assess students' learning and proficiency on learning and performance standards. It should be read in conjunction with the syllabus in order to understand what is expected of teachers and students to achieve the envisaged quality of education outcomes.

Teachers should read and understand each of the sections of the Teacher Guide to help them understand the key SBC concepts and ideas. A thorough understanding of these components will help teachers meet the teacher expectations for implementing the SBC curriculum, and therefore the effective implementation of Grade 9 Food Technology Strand in TIA Curriculum. Based on this understanding, teachers should be able to effectively use the teacher guide to do the following;

Determine Learning Objectives and Lesson Topics

The teaching and learning Standards are derived from the Content Standards and Benchmarks in the Syllabus. The Learning Objectives are extracted from the grade-level benchmarks and are used for teaching topics. Lesson titles are deduced from the learning objectives. Teachers should familiarize themselves with this process as it is essential for lesson planning, instruction and assessment. However, depending on the context and students' learning abilities, teachers would be required to determine additional lesson objectives and lesson titles. Teachers should use the samples provided in the teacher guide to assist them to formulate additional lesson objectives and lesson titles to meet the educational or learning needs of their students.

Identify and Teach Grade Appropriate Content

Grade appropriate content has been identified and scoped and sequenced using appropriate content organisation principles. The content is sequenced using the spiralling sequence principles. This sequencing of content will enable students to progressively learn the essential knowledge, skills, values and attitudes as they further their education. What students learn in previous grades is reinforced and deepens in scope with an increase in the level of complexity and difficulty in content and learning activities. It is important to understand how the content is organised so that grade appropriate content and learning activities can be selected, if not already embedded in the benchmarks and learning objectives, to not only help students learn and master the content, but ensure that what is taught is rigorous, challenging and comparable. Teachers should use the units of work provided in this teacher guide to help them identify appropriate content for teaching and learning.

Integrate the Core Curriculum in Lesson Planning, Instruction and Assessment

Teachers should integrate the core curriculum - values, cognitive and high level skills, 21st Century Skills, STEAM principles and skills, writing and communication skills in their annual teaching program and give prominence to these skills in lesson planning, instruction, teaching and learning activities, performance assessment, and performance standards for measuring students' proficiency and application of these skills.
In this field of study, students are expected to learn, promote and use work, relationship, peace, health, social, personal, family, community, national and global skills and values in work and study environments as well as in their conduct as community, national and global citizens.

In addition, it is envisaged all students attaining expected proficiency levels in these skills and will be ready to pursue careers, and higher education academic programs that demand these skills, and use them in their everyday life. Teachers should refer to the core curriculum section in this teacher guide to source information where necessary to guide them in lesson planning, instruction and assessment.

Integrate Science, Technology, Engineering, Arts and Mathematics (STEAM) principles and skills in lesson planning, instruction and assessment

STEAM teaching and learning requires both the teacher and student to participate as core investigators and learners and to work in partnership and collaboration with relevant stakeholders to achieve maximum results. Teachers should use the syllabus, teacher guides and other relevant resources to guide them to plan and implement this and other innovative and creative approaches to STEAM teaching and learning to make STEAM principles and skills learning fun and enjoyable and, at the same time, attain the intended quality of learning outcomes.

Identify and Use Grade and Content Appropriate, Innovative, Differentiated and Creative Teaching and Learning Methodologies

The selection of grade and contextually appropriate teaching and learning methodologies is critical to enabling all students to achieve the expected standard or quality of education. Teaching and learning methodologies must be aligned to content, learning objective, essential concepts, skills, values, attitudes and performance standard in order for the teacher to effectively teach and guide students towards achieving the desired learning outcome. They should be equitable and socially inclusive, differentiate, student-centered, and lifelong. Teachers are encouraged to use the teacher guide to help them make informed decisions when selecting the types of teaching and learning methodologies to use in their teaching of the subject content, including STEAM principles and skills.

Plan Standards-Based Lessons

SBC lesson planning is quite challenging and will become easier with more practice and experience over time. Effective SBC lesson plans must meet required standards or criteria so that the learning objectives and performance standards are closely aligned to attain the expected learning outcomes. If standards are not met, instruction will not lead to the attainment of intended performance and proficiency standards. The guidelines and standards for SBC lesson planning with samples are provided in the SBC lesson planning section of this teacher guide to assist teachers to plan their lessons.

Use Standards-Based Assessment

Standards-Based Assessment has a number of components. These components are intertwined and serve to measure, evaluate report and monitor students' achievement of the national and grade-level expectations, i.e., the essential knowledge, skills, values and attitudes they are expected to master and demonstrate proficiency on. Teachers should use the assessment guidelines and standards for SBA provided with samples in the assessment section of this teacher guide.

Make informed Judgements About Students' Learning and Progress Towards Meeting Learning Standards

It is important that teachers evaluate the performance of students in relation to the performance standards and progressively the grade-level benchmarks and content standards to make informed judgements and decisions about the quality of their work and their progress towards meeting the content standards or component of standards. Evaluation should not focus on only one aspect of students' performance. It should aim to provide a complete picture of each student's performance. The context, inputs, processes, including the teaching and learning processes, and the outcomes should be evaluated to make an informed judgement about each student's performances. Teachers should identify the underlying factors for poor performance, gaps in students' learning, gaps in teaching, teaching and learning resource constraints, and general attitude towards learning. Evidence-based decisions can then be made regarding the interventions for closing the gaps to allow students to make progress towards meeting grade-level and national expectations.
The assessment section in this teacher guide should guide the teacher to effectively evaluate students' performance and use the evidence to help students to continuously improve their learning as well as their classroom practice.

Prepare Students 'Performance Reports

Reporting of students' performance and progress towards the attainment of learning standards is an essential part of SBC Assessment. Results of students' performance should be communicated to the students and their parents or guardians to keep them informed of students' academic achievements and learning challenges as well as what needs to be done to enable the students make positive progress towards meeting the proficiency standards in achieving the desired level of education quality. Teachers should use the information on reporting of students' assessment results and the templates provided to report the results of students' learning. Teachers can refer to the assessment section of this teacher guide to assist them in reporting student's performances.

Monitor Students' Progress Towards Meeting the National Content Standards and Grade – Level Benchmarks

Monitoring of students' progress towards the attainment of learning standards is an essential component of standards-based assessment. It is an evidence-based process that involves the use of data from students' performance assessments to make informed judgements about students learning and proficiency on the learning standards or their components, identify gaps in students' learning and the casual factors, set clear learning improvement targets, and develop effective evidence-based strategies (including preplanning and re-teaching of topics), set clear time frames, and identify measures for measuring students' progress towards achieving the learning targets.

Teachers should use the teacher guide to help them use data from students' performance assessments to identify individual students learning weaknesses and develop interventions, in collaboration with each student and his/her parents or guardians, to address the weaknesses and monitor their progress towards meeting the agreed learning goals.

Develop Additional Benchmarks

Teachers can develop additional benchmarks using the examples in the teacher guide to meet learning needs of students and local communities. However, these benchmarks will not be nationally assessed as these are not comparable. They are not allowed to set their own content standards or manipulate the existing ones. The setting of national content standards is done at the national level to ensure that required learning standards are maintained and monitored to sustain the required level of education quality.

Avoid Standardisation

Teachers must use innovative, creative, culturally relevant, and differentiated teaching and learning approaches to teach the curriculum and enable their students to achieve the national content standards and grade-level benchmarks. And enable all students to experience success in learning the curriculum and achieve high academic standards.

What is provided in the syllabus and teacher guides are not fixed and can be changed. Teachers should use the information and suggested examples provided in the Syllabus and the Teacher Guide to guide them to develop, select and use the grade, context, and learner appropriate content, learning objectives, teaching and learning strategies, and performance assessment and standards. SBC is evidence-based hence decisions, about the content, learning outcomes, teaching and learning strategies, students' performance, and learning interventions should be based on evidence. Teaching and learning should be continuously improved and effectively targeted using evidence from students' assessment and other sources.

Plan and Address the Principles of "Inclusive Teaching and Learning"

Teachers are obliged to create an inclusive learning environment to include students with special needs to promote learning for all. These special needs may include students who are gifted or disadvantaged physically, socially, emotionally and intellectually. Students may display combinations of any of these needs and therefore, the teaching and learning activities must have students with special needs to participate to their fullest abilities. The different types of needs in students include;

- Physical disabilities
- Intellectual disabilities
- Hearing impairment
- Sight-vision impairment
- Speech impairment
- Behavioural and emotional disorders

It is important that the learning activities for Food Technology is inclusive and fosters the learning needs of all students.

Syllabus and Teacher Guide Alignment

The Grade 9 Food Technology Strand Teacher Guide is closely aligned and complementary to Technology and Industrial Art Syllabus.

They are the essential focus points for teaching and learning the essential knowledge, skills, values and attitudes.

Syllabus and Teacher Guide Alignment	
Syllabus Outlines the ultimate aim and goals, and what to teach and why teach it.	**Teacher Guide** Describes how to plan, teach, and assess students' performance.
• Overarching and SBC principles • Content overview • Core curriculum • Essential knowledge, skills, values and attitudes • Strands and units • Evidence outcomes • Content standards and grade-level benchmarks • Overview of assessment, evaluation, and reporting	• Determine topics for lesson planning instruction and assessment • Formulate learning objectives • Plan SBC lesson plans • Select teaching and learning strategies • Implement SBC assessment and evaluation • Implement SBC reporting and monitoring

The syllabus outlines the ultimate aim and goals of SBE and SBC, what is to be taught and why it should be learned by students, the underlying principles and articulates the learning and proficiency standards that all students are expected to attain. On the other hand, the Teacher Guide expands on what is outlined in the Syllabus by describing the approaches or the how of planning, teaching, learning, and assessing the content so that the intended learning outcomes are achieved.

This teacher guide should be used in conjunction with the syllabus. Teachers should use these documents when planning, teaching and assessing Grade 9 Food Technology Strand content.

Teachers should extract information from the syllabus (e.g., content standards and grade-level benchmarks) for lesson planning, instruction and is for measuring students' attainment of a content standard as well as progress to the next grade of schooling.

Learning and Performance Standards Alignment

Content Standards, Benchmarks and Evidence Outcomes are linked to Learning Objectives, Lesson Objectives and Performance Standards in the Teacher Guide (see table). There is a close linear relationship between these standards. Students' performance on a significant aspect of a benchmark (KSVA) is measured against a set of performance standards or criteria to determine their level of proficiency using performance assessment. Using the evidence from the performance assessment, individual student's proficiency on the aspect of the benchmark assessed and progression towards meeting the benchmark and hence the content standard are then determined.

Standards Alignment	
Standards in Syllabus	**Standards in Teacher Guide**
• SBC Aims and Goals • Content Standard • Benchmarks • Evidence Outcomes	• Learning Objectives • Lesson Objectives • Essential Knowledge, Skills, Values and Attitude • Performance Standard

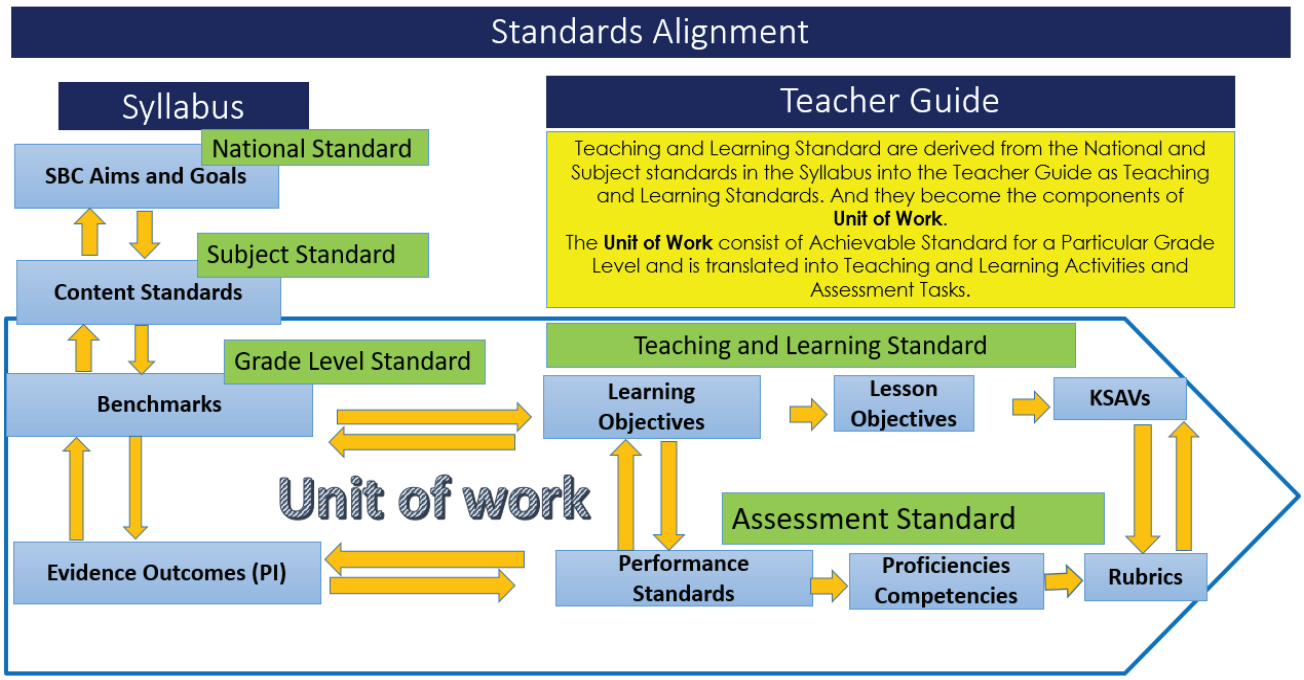
Standard Alignment

Standard Alignment shows the link between different standards in the Syllabus and Teacher Guide. It begins with SBC Aims and Goals which are National Standards in which the Syllabus Standards are derived from. The Content Standards or Subject Standards are expanded into Benchmarks which are achievable benchmarks for particular grade levels and are translated into the Teacher Guide as teaching and learning standards and assessment standards. And they become the components of Unit of Work.

The Unit of Work (UOW) consists of the achievable standards for a particular grade level and is translated into teaching and learning activities and assessment tasks.

It is essential that teachers know and can do standards alignment when planning, teaching, and assessing students' performance so that they can effectively guide their students towards meeting the grade-level benchmarks (grade expectations) and subsequently the content standards. (national expectations)

Below is a diagram to show the alignment of standards between standards in the Syllabus and the Teacher Guide.



Learning and Performance Standards

Standards-Based Education (SBE) and SBC are underpinned by the notion of quality. Standards define the expected level of education quality that all students should achieve at a particular point in their schooling. Student's progression and achievement of education standard(s) are measured using performance standards or criteria to determine their demonstration or performance on significant aspects of the standards. When they are judged to have attained proficiency on a content standard or benchmark or components of these standards, they are then deemed to have met the standard(s) that is, achieve the intended level of education quality.

Content standards, benchmarks, and learning objectives are called learning standards while performance and proficiency standards (evidence outcomes) can be categorized as performance standards. These standards are used to measure students' performance, proficiency, progression and achievement of the desired level of education quality. Teachers are expected to understand and use these standards for programming, lesson planning, instruction and assessment.

Content Standards

Content standards are evidence-based, rigorous and comparable regionally and globally. They have been formulated to target critical social, economic, political, cultural, environment, and employable skills gaps identified from a situational analysis. They were developed using examples and experiences from other countries and best practice, and contextualized to PNG contexts.

Content standards describe what **(content - knowledge, skills, values, and attitudes)** all students are expected to know and do **(how well students must learn and apply what is set out in the content standards)** at each grade-level before proceeding to the next grade. These standards are set at the national level and thus cannot be edited or changed.

Content Standards:

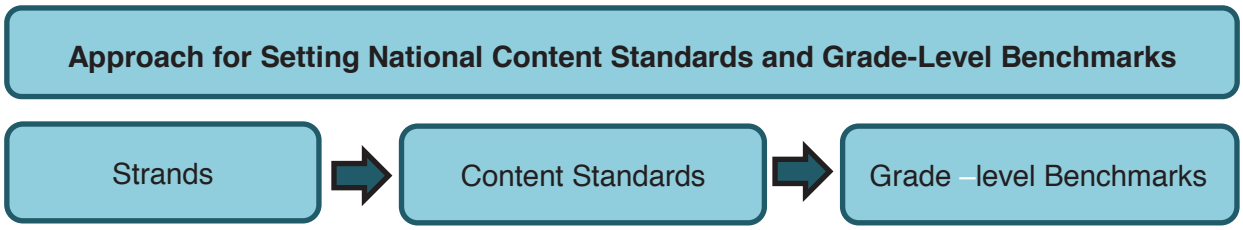
- are evidenced-based,
- are rigorous and comparable to regional and global standards,
- are set at the national level,
- state or describe the expected levels of quality or achievement,
- are clear, measurable and attainable,
- are linked to and aligned with the ultimate aim and goals of SBE and SBC and overarching and SBC principles,
- delineate what matters, provide clear expectations of what students should progressively learn and achieve in school, and guide lesson planning, instruction, assessment,
- comprise knowledge, skills, values, and attitudes that are the basis for quality education,
- provide teachers a clear basis for planning, teaching, and assessing lessons, and
- provide provinces, districts, and schools with a clear focus on how to develop and organise their instruction and assessment programs as well as the content that they will include in their curriculum.

Benchmarks

Benchmarks are derived from the content standards and benchmarked at the grade-level. Benchmarks are specific statements of what students should know (i.e., essential knowledge, skills, values or attitudes) at a specific grade-level or school level. They provide the basis for measuring students' attainment of a content standard as well as progress to the next grade of schooling.

Grade-level benchmarks;

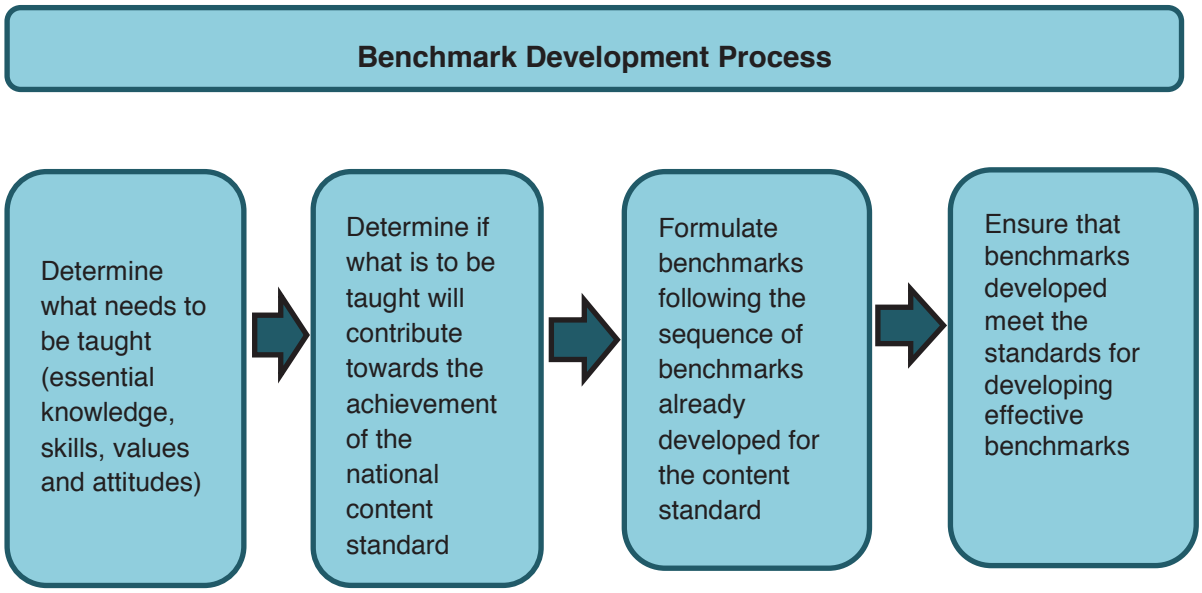
- are evidenced-based,
- are rigorous and comparable to regional and global standards,
- are set at the grade level,
- are linked to the national content standards,
- are clear, measurable, observable and attainable,
- articulate grade level expectations of what students are able to demonstrate to indicate that they are making progress towards attaining the national content standards,
- provide teachers a clear basis for planning, teaching, and assessing lessons,
- state clearly what students should do with what they have learned at the end of each school-level,
- enable students' progress towards the attainment of national content standards to be measured, and
- enable PNG students' performance to be compared with the performance of PNG students with students in other countries.



Development of Additional Benchmarks

Teachers should develop additional benchmarks to meet the learning needs of their students. They should engage their students to learn about local, provincial, national and global issues that have not been catered for in the grade-level benchmarks but are important and can enhance students' understanding and application of the content. However, it is important to note that these benchmarks will not be nationally examined as they are not comparable. Only the benchmarks developed at the national level will be tested. This does not mean that teachers should not develop additional benchmarks. An innovative, reflect, creative and reflexive teacher will continuously reflect on his/her classroom practice and use evidence to provide challenging, relevant, and enjoyable learning opportunities for his/her students to build on the national expectations for students.

Teachers should follow the following process when developing additional grade-level benchmarks.



Learning Objectives

Learning or instructional objectives are precise statements of educational intent. They are formulated using a significant aspect or a topic derived from the benchmark, and is aligned with the educational goals, content standards, benchmarks, and performance standards. Learning objectives are stated in outcomes language that describes the products or behaviours that will be provided by students. They are stated in terms of measurable and observable student behaviour.

Performance Standards

Performance Standards are concrete statements of how well students must learn what is set out in the content standards, often called the **"be able to do"** of "what students should know and be able to do." Performance standards are the indicators of quality that specify how competent a students' demonstration or performance must be. They are explicit definitions of what students **must do to demonstrate proficiency or competency at a specific level on the content standards.**

Performance standards:

- measure students' performance and proficiency (**using performance indicators**) in the use of a specific knowledge, skill, value, or attitude in real life or related situations,
- provide the basis (**performance indicators**) for evaluating, reporting and monitoring students' level of proficiency in use of a specific knowledge, skills, value, or attitude,
- are used to plan for individual instruction to help students not yet meeting expectations (**desired level of mastery and proficiency**) to make adequate progress towards the full attainment of benchmarks and content standards, and
- are used as the basis for measuring students' progress towards meeting grade-level benchmarks and content standards.

Proficiency Standards

Proficiency standards describe what all students in a particular grade or school level can do at the end of a strand, or unit. These standards are sometimes called evidence outcomes because they indicate if students can actually apply or use what they have learnt in real life or similar situations. They are also categorized as benchmarks because that is what all students are expected to do before exiting a grade or are deemed ready for the next grade.

Core Curriculum

Core curriculum refers to a core set of common learning (knowledge, skills, values, and attitudes) that are integrated into the content standards and grade-level benchmarks for all subjects. This is to equip all students with the most essential and in-demand knowledge, skills, and dispositions they need to be successful in modern/postmodern work places, higher-education programs and to be productive, responsible, considerate, and harmonious citizens. Common set of learning are spirally sequenced from Preparatory to Grade 12 to deepen the scope and increase the level of difficulty in the learning activities so that what is learned is reinforced at different grade levels.

The core curriculum includes:

- Cognitive skills (critical and creative thinking),
- Reasoning, problem-solving and decision-making skills,
- High level thinking skills (analysis, evaluation and synthesis),
- 21st century skills,
- STEAM principles and skills,
- Seven principles for teaching procedural and technical skills (plan ahead, demonstration, observation of learner in action, provide specific feedback, encourage self-evaluation, allow learner practice, prepare to modify approach)
- Working diagrams, (sketching and technical drawing)
- Reading, writing and communication skills,
- Essential values and attitudes (core personal and social values, and sustaining values), and
- Spiritual values and virtues.

Integrating Core Curriculum in the Teaching and Learning

Teachers can identify a set of core curriculum to teach in one lesson for example; in Food Technology, students may be posed with a dilemma to find solutions on how technology can be used to improve food security in their area.

Students will be required to use what they learnt in social science about the causal effects of climate change on the livelihood of people, they can use STEAM principles and skills in finding cause and solutions, use high level thinking skills to analyze and evaluate the effects and how to improve food security, use decision making and critical thinking skills to find the solutions for food security, use technology to design the best food security model.

They can be able to confidently and boldly communicate their findings and present intelligent and convincing arguments, which we can conclude that learning of the core curriculum is evident.

If students can be able to demonstrate mastery, proficiency and competency of core curriculum in such a manner, then the learning of core curriculum has been achieved.

Science, Technology, Engineering, Arts and Mathematics

STEAM education is an integrated, multidisciplinary approach to learning that uses Science, Technology, Engineering, Arts and Mathematics as the basis for inquiring about how STEAM has and continues to change and impact the social, political, economic, cultural and environments contexts and identifying and solving authentic (real life) natural and physical environment problems by integrating STEAM-based principles, processes, skills, values and attitudes to prepare them for careers, higher education and citizenship.

Food Technology utilises both the goals of STEAM rather than just the goal of problem-solving. This is to ensure that all students are provided opportunities to learn, integrate and demonstrate proficiency on all essential STEAM principles, processes, skills, values and attitudes to prepare them for careers, higher education and citizenship.

Through STEAM education students will be able to;

i. examine and use evidence to draw conclusions about how STEAM has and continues to change the social, political, economic, cultural and environmental contexts,
ii. investigate and draw conclusions on the impact of STEAM solutions to problems on the social, political, economic, cultural and environments contexts,
iii. identify and solve problems using STEAM principles, skills, concepts, ideas and process,
iv. identify, analyze and select the best solution to address a problem,
v. build prototypes or model of solutions to problems,
vi. replicate a problem solution by building models and explaining how the problem was or could be solved,
vii. test and reflect on the best solution chosen to solve a problem,
viii. collaborate with others on a problem and provide a report on the process of problem solving used to solve the problem,
ix. use skills and processes learnt from lessons to work on and complete STEAM related projects,
x. demonstrate STEAM principles, skills, processes, concepts and ideas through simulation and modeling, and
xi. explain the significance of values and attitudes in problem solving.

STEAM Problem-Solving Methods and Approaches

Problem-solving involves the use of problem- solving methods and processes to identify and define a problem, gather information to understand its causes, draw conclusions, and use the evidence to design and implement solutions to address it. Even though, there are many different problems-solving methods and approaches; they share some of the steps of problem-solving, for example;

- Identifying the problem,
- Understanding the problem by collecting data,
- Analyze and interpret the data,
- Draw conclusions,
- Use data to consider possible solutions,
- Select the best solution,
- Test the effectiveness of the solution by trialing and evaluating it, and
- Review and improve the solution.

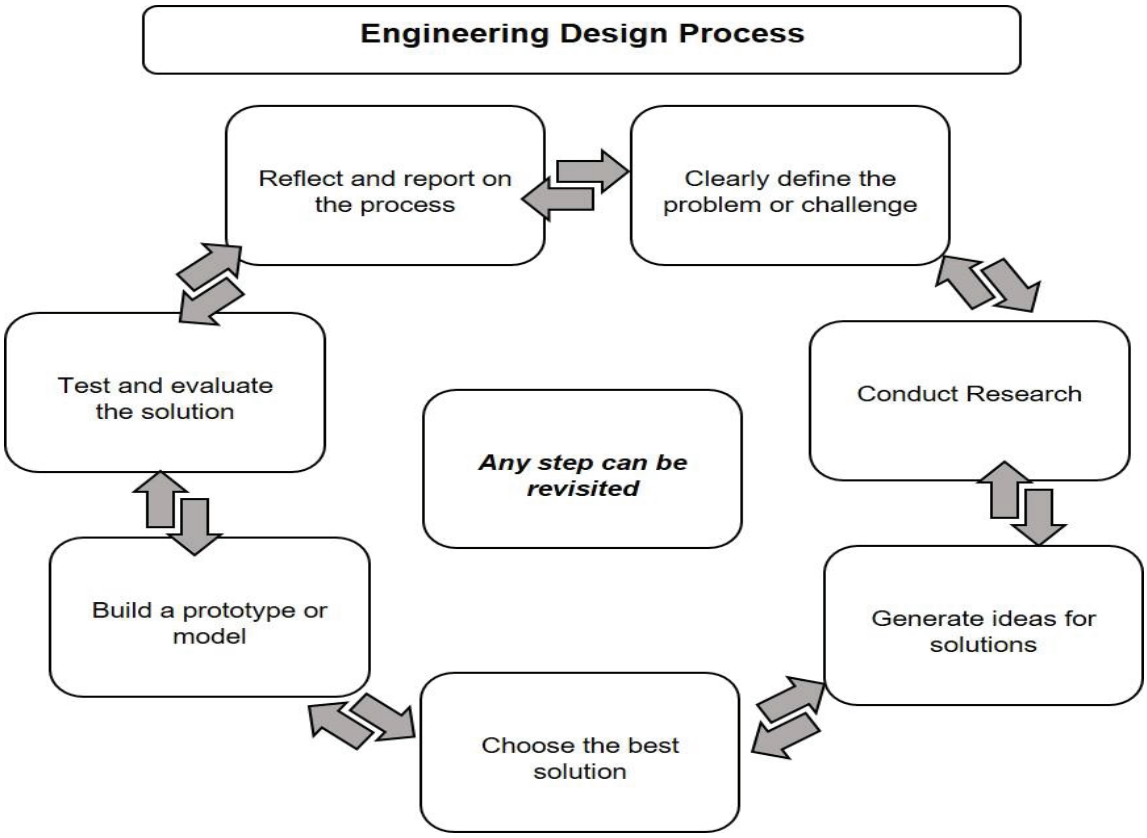
STEAM problem-solving processes go from simple and technical to advance and knowledge-based processes. However, regardless of the type of process used students should be provided opportunities to learn the essential principles and processes of problem solving and more significantly, to design and create a product that addresses a real problem and meets a human need.

Engineering Design Process

Technological fields used the engineering design process to choose the best solution to solve the problem.
It is an open-ended problem solving process that involves the full planning and development of products or services to meet identified needs. It involves the following sequence of steps;

- Analyze the context and background, and clearly define the problem,
- Conduct research to determine design criteria, financial or other constraints, and availability of materials,
- Generate ideas for potential solutions, using processes such as brainstorming and sketching,
- Choose the best solution,
- Build a prototype or model,
- Test and evaluate the solution,
- Repeat steps as necessary to modify the design or correct faults, and
- Reflect and report on the process.

This sequential engineering design process steps described are illustrated in the diagram below.



Students should be guided through every step of the process so that they can explain it and its importance, and use the steps and the whole process proficiently to identify, investigate and solve problems. They should be provided with opportunities to practice and reflect on each step until they demonstrate the expected level of proficiency before moving on to the next one.

It involves the following sequence of steps;

Step 1: Idea Generation

- Ideation, iteration, and brain storming new product ideas.

Students should be guided and provided opportunities to identify human made, natural and physical environment problems using their senses and describe what the problem is and its likely causes.

Example: *Many Teenagers are not eating healthy food and spend most of their time on their mobile phones or other activities that do not encourage fitness activities.*

Step 2: Research

- Questionnaires Feedback from a substantial and unbiased audience for product validation.

After the problem is identified and described, several questions should be derived from a main issue question. The questionnaire will be formulated and then will be answered in the survey. This questionnaire will guide the researcher in conducting research and investigation for the appropriate solution to the problem.

Example: *What they think and know about healthy eating and the effects of what they eat on their future health. What they feel about eating junk food and where they like to eat and with which people, how much exercise they take. Find out how food manufactures target teenagers for their food products and how manufacturers try to make their products appear healthy.*

Step 3: Planning (Design Brief)

- Bring the product to life through sketching, illustrations and working diagrams.

Creating working sketches, illustrations and working diagrams helps the researcher to better understand his or her research problem, refine the research question and decide on investigation approach before the investigation is conducted.

Example: *Description of an Authentic Situation*

Design and produce an alternative food to any fatty or sweet foods that could be sold in fast–food outlets or street markets and it targeted at teenagers. Try to include a good source of calcium and iron in the ingredients or meal that is nutritious and healthy.
Specification:
Write what your food product will be like;
Will your product be healthy?
How will your product be prepared and cooked? How will your product be package? Etc.

Step 4: Prototyping

- Create a finished prototype product to use as a sample for production.
- The researcher will make or develop a prototype of the solution and test how it would be used to solve the problem.

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Example: *Prototype – an alternative food product*
After the prototype has been produced, it is subjected to qualitative or sensory analysis such as;

- taste testing by the testing team and
- focus groups to evaluate
    - the appearance,
    - aroma,
    - flavour,
    - texture,
    - mouth feel of the product, and
    - suggestions for improvements are made.

Step 5: Production

- Gather materials and production begins.

This step is the gathering of materials and producing of the product from the best prototype. This involves the identification of lists of materials, procedural steps with their respective tools or equipment to be used to produce the intended product.

Example**:** *Producing the product when a successful prototype is developed. The group or team of people begins production trials in which the prototype is scaled up for production but in a smaller scale before the food product is certified by food experts or engineers. In this case the alternate food product for teenagers will follow the production line from being made or cooked, packaged and labelled.*

Step 6: Marketing/launch

- Launch product into market. A marketing awareness is developed to help launch the new product into the market place.

Product, Price, Place and Promotion

A key feature of the development of a successful marketing plan is establishing the marketing fundamentals for the campaign, the 4Ps – product, price, place and promotion. This means answering some key questions about the product:

Example:

- *What is the product and who is the target market?*
- *What price can it be marketed at to make a profit for the group etc. but still be acceptable to the target market?*
- *Where is the best market place or location to sell the product that it is accessible to the target market?*
- *What is the best way to promote the product so that it is widely recognized by consumers?*

Step 7: Evaluation of a New Product

- Evaluation of a new food product

Example: *One of the most important aspects of the food product development is to complete an evaluation of the physical and sensory properties of the product once the final prototype and scale-up have been completed.*

- **Valuation of the production process**

In manufacturing companies, or commercial food industries the process engineer and the production manager review all stages of the production. This includes:

- the resources used,
- the types of ingredients and availability, and
- other materials required to make the product.

Consideration is also given to the;

- suitability of the cooking methods,
- flavorings, and
- presentation of the food.

In addition, review is also done on;

- the technical expertise required to produce the product,
- whether staff require retraining or additional staff are needed,
- they evaluate the effectiveness of the production processes, and
- the problems that arose during the scale-up and full production process.

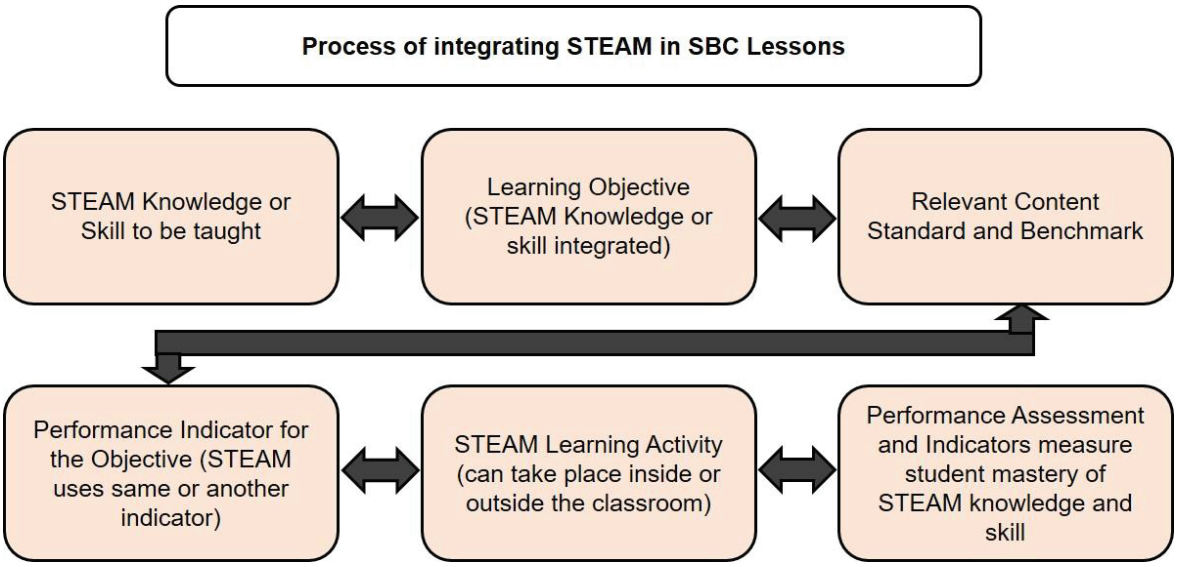
It is also important to review the **HACCP** system to determine if identified hazards were monitored effectively and the corrective actions were successfully implemented.

STEAM-Based Lesson Planning

Effective STEAM lesson planning is the key to the achievement of the expected outcomes. STEAM Skills can be planned and taught using separate STEAM-based lesson plans or integrated into the standards-based lesson plans. To effectively do this, teachers should know how to write effective standards and STEAM-based lesson plans.

Integration of STEAM problem-solving skills into standards-based lesson plans.

Process for Integrating STEAM Principles and Problem-Solving Skills into Standards-Based Lessons



Teachers should follow the steps given below when integrating STEAM problem-solving principles and skills into their standards-based lesson plans.

Step 1: Identify the STEAM knowledge or skill to be taught (From the table of KSAVs for each content standard and bench mark). **This is captured in the learning objective stated in the standards-based lesson plan.**

Step 2: Develop and include a performance standard or indicator for measuring student mastery of the STEAM knowledge or skill (e.g. level of acceptable competency or proficiency) **if this is different from the one already stated in the lesson plan.**

Step 3: Develop student learning activity (An activity that will provide students the opportunity to apply STEAM knowledge or skill specified by the learning objective and appropriate statement of standards). Activity can take place inside or outside the classroom and during or after school hours.

Step 4: Develop and use performance descriptors (standards or indicators) to analyze student STEAM related behaviors or products (results or outcomes), which provide evidence that the student has acquired and mastered the knowledge or skill of the learning objective specified by the indicator(s) of the standard(s).

STEAM Teaching Strategies

There are a variety of STEAM teaching strategies. However, teaching strategies selected must enable teachers to guide students to use the engineering and artistic design processes to identify and solve natural and physical environment problems by designing prototypes and testing and refining them to effectively mitigate the problems identified. The following are some of the strategies that could be used to utilise the STEAM approach to solve problems and coming up with technological solutions.

- Inquiry-Based Learning
- Problem-Based Learning
- Project-Based Learning
- Collaborative Learning

Collaborative learning involves individuals from different STEAM disciplines and expertise in a variety of STEAM problem solving approaches working together and sharing their expertise and experiences to inquire into and solve a problem.

Developing STEAM partnerships with external stakeholders e.g., high education institutions, private sector, research and development institutions, and volunteer and community development organizations can enhance students' learning and application of STEAM problem solving principles and skills.

Some examples of STEAM–related partnership experiences may include:

- Participatory Learning
- Group-Based Learning
- Task Oriented Learning
- Action Learning
- Experiential Learning
- Modelling
- Simulation

STEAM Learning Strategies

Teachers should include in their lesson plans STEAM learning activities. These activities should be aligned to principle or a skill planned for students to learn and demonstrate proficiency on at the end of the lesson to expose students to STEAM and giving them opportunities to explore STEAM-related concepts, they will develop a passion for it and, hopefully, pursue a job in a STEAM field. Providing real life experiences and lessons, for an example; by involving students to actually solve a scientific, technological, engineering, or mathematical, or Arts problem, would probably spark their interest in a STEAM career path. This is the theory behind STEAM/ education.

STEAM-Based Assessment

STEAM-based assessment is closely linked to standards-based assessment where assessment is used to assess student's level of proficiency or competency of a specific knowledge, skill, value or attitude taught using a set of performance standards (indicators or descriptors). The link also includes the main components such as the purpose, the assessment principles and assessment strategies and tools.

In STEAM-based assessment, assessment is designed for what the students should know and be able to do. In STEAM learning students are assessed in a variety of ways including portfolios, project/problem-based assessment, backward designs, authenticity assessment, or other students centered approaches. When planning and designing the assessment, teachers should consider the authenticity of the assessment by designing an assessment that relates to a real world task or discipline specific attributes (such as simulation, role play, placement assessment, live projects, debates) should make the activity meaningful to the student, and therefore be motivating as well as developing employability skills and discipline specific attributes.

Effective STEAM-Based Assessment Strategies

The following six sections describe six assessment tools and strategies shown to impact teaching and learning as well as help teachers foster a 21st century learning environment in their classrooms.

1. Rubrics
2. Performance-Based Assessment (PBAs)
3. Portfolios
4. Student Self-Assessment
5. Peer-Assessment
6. Students Response System (SRS)

Although the list does not include all innovative assessment strategies, it includes what we think are the most common strategies, and ones that may be particularly relevant to the educational context of developing countries in this 21st century. Many of the assessment strategies currently use fit under one or more of the categories discussed. Furthermore, it is important to note that strategies also connect in a variety of ways.

1. Rubrics

Rubrics are both a tool to measure students' knowledge and ability as well as an assessment strategy. A rubric allows teachers to measure certain skills and abilities not measurable by standardized testing systems that assess direct knowledge at a fixed moment in time. Rubrics are also frequently used as part of other assessment strategies including; portfolios, performances, projects, peer-review and self-assessment.

2. Performance- Based Assessments

Performance-Based Assessments (PBA), also known as authentic assessment are generally used as a summative evaluation strategy to capture not only what students know about a topic, but if they have the skills to apply that knowledge in a; 'real-world' situation by asking them to create an end product. PBA pushes students to synthesize their knowledge and apply their skills to a potentially unfamiliar set of circumstances that is likely to occur beyond the confines of a controlled classroom setting. The implementation of performance-based assessment strategies can also impact other instructional strategies in the classroom.

3. Portfolio Assessment

Portfolios are a collection of student work gathered over time that is primary used as a summary evaluation method. The most salient characteristic of the portfolio assessment is that rather than being a snap shot of a student's knowledge at one point in time (like a single standardized test), it highlights student effort, development, and achievement over a period of time; portfolios measure a student's ability to apply knowledge rather than simply regurgitate. They are considered both student-centered and authentic assessments of learning.

4. Self-Assessment

Its main purpose is for students to identify their own strengths and weakness and to work to make improvements to meet specific criteria. Self-assessment occurs when students judge their own work to improve performance as they identify discrepancies between current and desired performance. In this way, self-assessment aligns well with standards-based education because it provides clear targets and specific criteria against which students or teachers can measure learning.

Self-assessment is used to promote self-regulation to help students reflect on their progress and to inform revisions and improvements on a project or paper. In order for self-assessment to be truly effective, four conditions must be in place, the self-assessment criteria is negotiated between the teachers and students, students are taught how to apply the criteria, students receive feedback on their self-assessments and teachers help students use assessment data to develop an action plan.

5. Peer Assessment

Peer assessment, much like self-assessment, is a formative assessment strategy that gives students a key role in evaluating learning. Peer assessment approaches can vary greatly but, essentially it is a process for learners to consider and give feedback to other learners about the quality or value of their work. Peer assessments can be used for a variety of products like papers, presentations, projects and or other skills behaviors. Peers assessment is understood as more than only a grading procedure and is also envisioned as teaching strategy since engaging in the process develops both the assessor and the assesses skills and knowledge.

The primary goal for using peer assessment is to provide feedback to the learners. This strategy may be particularly relevant in the classrooms with many students per teacher since student time will be more plentiful than teacher time, although any single student's feedback may not be rich or in-depth as teachers feedback, the research suggests that peer assessment can improve learning.

6. Students Response System

Students response system (SRS), also known as classroom response system (CRS), audience response system (ARS) is general term that refers to a variety of technology-based formative assessment tools that can be used to gather student- level data instantly in the classroom. Through the combination of hardware, (voice recorders, PC, internet connection, projector and screen) and software.

Teachers can ask students a wide range of questions (both closed and open ended), where students can respond quickly and anonymously, and the teacher can display the data immediately and graphically. The use of technology also includes a use of video which examines how a range of strategies can be used to assess students understanding.

The value of SRS comes from the teachers analyzing information quickly and then devising real-time instructional solutions to maximize students learning. This includes a suggested approach to help teachers and trainers assess learning.

Curriculum Integration

An integrated curriculum is described as one that connects different areas of study by cutting across subject-matter lines and emphasizing unifying concepts. Integration focuses on making connections and linkages in content for students, allowing them to see the importance of all subjects in the curriculum. When students are able to see and understand the linkages between different subject matter, they engage in relevant, meaningful activities that can be connected to real life.

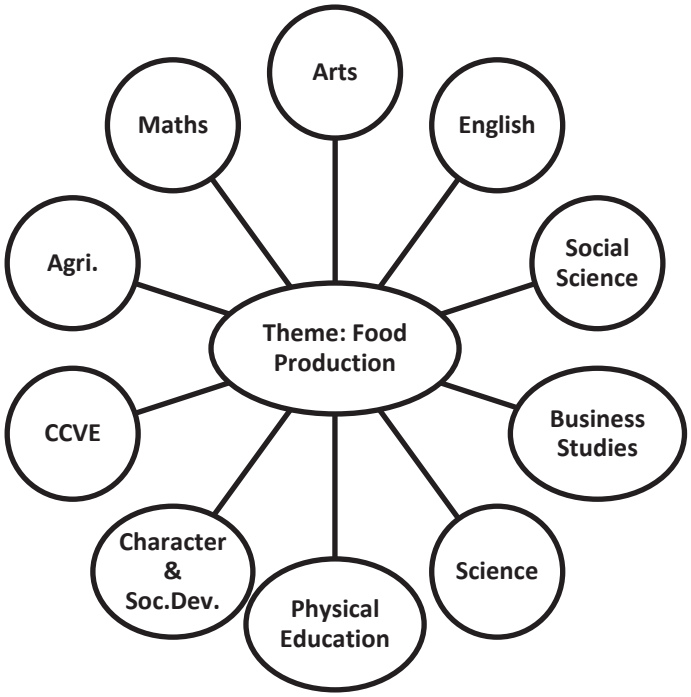
Curriculum integration is a holistic approach to learning thus curriculum integration in SBC will equip students with the essential 21st Century knowledge, skills, values and attitudes. Teachers must develop intriguing curriculum by going beyond the traditional teaching of content based or fragmented teaching to the teacher who is knowledge based and who should be perceived as a 21st Century innovative educator.

There are three approaches that SBC will engage to foster conducive learning for all students whereby they all can demonstrate proficiency at any point of exit. Adapting these approaches will have an immense impact on the lives of these students as they will not only see themselves as catalyst of change for a competitive PNG but also, comparable to the world standards as global citizens.

Engaging these three approaches in our curriculum will surely sharpen the knowledge and ability of each child, allowing them to see themselves as assets through their achievements and as agents of change contributing meaningfully to their country. Integrated learning will bear a generation of knowledge-based populace who can solve problems and make proper decisions based on evidence. Thus, PNG can achieve its goals like the Medium Term Development Goals (MTDG) and aims such as the Vision 2050 for a happy, healthy and wealthy society whereby, all its citizens should have access and fair distribution to income, shelter, health, education and general good and services improving the general standard of living for PNG in the long run.

(i) Multidisciplinary Approach

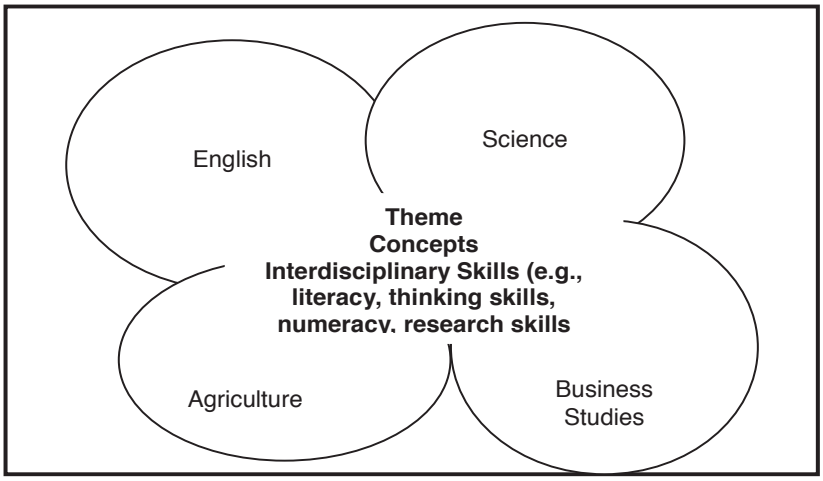
In this approach, learning involves a theme or concept that will be taught right across all subject area of study by students. For instance, if the theme is; “Food Production” all subject areas create lessons or project-based learning and assessment as per their subjects around this theme. The content of the theme, “Food Production” as shown in the diagram will be taught right across all the different subjects through the related concepts identified in the different benchmarks.



(ii) Interdisciplinary Approach

This approach addresses learning similarly to the multidisciplinary approach of integrated learning whereby learning takes place within the subject area. It is termed interdisciplinary as the core curriculum of learning is interwoven into each subject under study by the students. For instance; in a Food technology class, students work on a project on food product development. Apart from learning the process of developing a food product, students are expected to apply literacy skills relating to oral, written, and visual communications on the topic food product through speech delivery in debates, advocacies and awareness campaigns. In the same project, they acquire skills in other related subject disciplines such as; planning, developing and modifying their project including costing, quantities, measurement and time, developing competence in using mathematical and scientific ideas and skills. It is not seen as a single subject skill but a standard essential skill all students must know and do regardless.

Therefore, essential knowledge, skills, values and attitudes comprising the core curriculum are interwoven and provide an essential and holistic framework for preparing all students for careers, higher education and citizenship in this learning.



(iii) Intra-disciplinary Approach

This approach involves teachers integrating sub-disciplines within a subject area. For instance, within the subject Technology and Industrial Arts (TIA), the strands for food, textile, computing, communication and construction will all be captured studying a particular content for TIA. For example, under the strand food technology, students will study food for special needs and occasions, use computational skills to create a food app, use the social media platform to market their food product, draft a pattern and sew an apron to put on during food preparation and in the construction strand under building, students will construct a family dining table. Thus, students are well equipped with life-long skills to sustain themselves.

(iv) Trans-disciplinary Approach

In this approach learning goes beyond the subject area of study. Learning is organized around students' questions and concerns. That is, where there is a need for change to improve lives, students develop their own curriculum to effect these needs. The Trans-disciplinary approach addresses real-life situations thus giving the opportunity to students to attain real life skills. This learning approach is more to do with Project–Based Learning also referred to as problem-based learning or place- based learning.

The three steps to planning project-based curriculum.

1. Teachers and students select a topic of study based on student interests, curriculum standards, and local resources.
2. The teacher finds out what the students already know and helps them generate questions to explore. The teachers will also provide resources for students and opportunities to work in the field.
3. Students share their work with others in a culminating activity. Students display the results of their exploration and review and evaluate the project.

For instance; students may come up with slogans for school programs such as 'Our culture-clean city for a healthier PNG'. The main aim could be to curb betel nut chewing in public areas especially around bus stops and local markets. Here, students draw up their own instructions and criteria for assessment which is they have to clean the nearest bus stop or local market once a week throughout the year. They also design and create posters to educate the general public as their program continues. They can also involve the town council or authority and media to assist them especially to carry out awareness.

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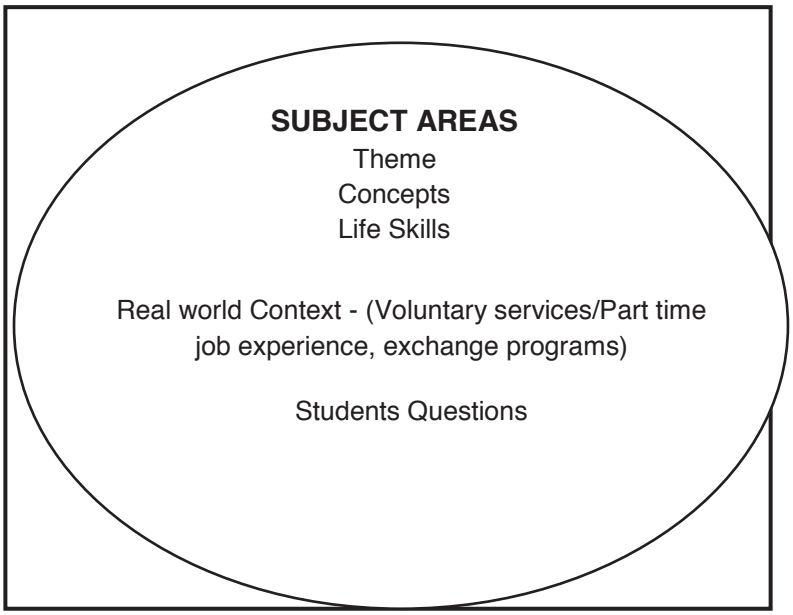
Studies have proven that Project based-programs achievements have led to the following:

- Students go far beyond the minimum effort.
- Make connections among different subject areas to answer open-ended questions.
- Retain what they have learnt.
- Apply learning to real-life problems.
- Have fewer discipline problems.
- Lower absenteeism.



These integrated learning approaches will demand for teaches to be more proactive in order to improve students learning and achievements. In order for SBC to serve its purpose fully, these three approaches must be engaged for better learning for the children of Papua New Guinea now and in the future.

Essential Knowledge, Skills, Values and Attitudes

Students' level of proficiency and progression towards the attainment of content standards for Technology and Industrial Arts subject will depend on their mastery and application of essential knowledge, skills, values, and attitudes in real life or related learning experiences and situations across the secondary curriculum.
These knowledge, skills, values and attitudes have been integrated into the content standards, benchmarks and performance standards developed for Technology and Industrial Arts subject. Teachers are expected to plan and teach these in their lessons, and assess students' performance and proficiency, and progression towards the attainment of content standards.

Technology and Industrial Arts

Technology and Industrial Arts provides and instills in students the confidence to use a range of specific knowledge, skills, values and attitudes in various technologies. These are scoped and embedded within the strands curriculum content in the subject, with the intension to create related career pathways. The content in each strand encourage students to be proactive, competent, creative, responsible and reflective learners, enabling them to pursue career opportunities in respective fields of technology studied in this subject.

Provided herein are recognised knowledge for the subject which are applicable across the strands.

Types of common knowledge for Technology and Industrial Arts

These are specific content knowledge for the subject. They include;	
• Creativity • Branding • Communication skills • Technical expertise • Industry expertise • Critical thinking • Information Technology skills • Innovation	• Building and engineering knowledge • Physical strength and stamina • Mathematical formulas in technology • **Technology and Industrial** language coordination • Technology skills • Problem solving Skills • Prototype

Food Technology Strand

The food technology strand encourages students to "think out of the box or beyond". This simply means to think openly and freely beyond the learning situation to bring about fresh creative ideas into the classroom lessons. This gives opportunity to the students to apply creativity and critical thinking to participate. Teachers must ensure that even students with rudimentary creativity skills end up improvising their products.

Examples of the types of knowledge for Food Technology

These are specific content knowledge for the subject. They include;	
• Nature and properties of food • Classification of food • Food preservation • Food storage and packaging • Menu considerations • Food selections • Food safety • Food Science	• Chemical, physical and sensory properties of n food when subject to product development • Food processing • Food sources and the role of nutrients of food sources in the body. • Food for special needs and occasions • Nutrition

Technology and Industrial Arts is a skills oriented subject, therefore embraces all the commonly recognised skills such as literacy, mathematical literacy, inquiry/research skills, and life skills, are critical to students' success in all subjects of the curriculum and in all areas of their lives.
Listed here for teacher's convenience are commonly recognised skills across the strands.

Types of Skills for Technology and Industrial Arts

These are specific content Skills for the strand. They include;	
• Creativity • Critical thinking • Technical knowledge • Commercial awareness of food industries/catering services • Research and data handling capacity • Critical analysis and interpretation of materials • Management skills • Organizational skills. • Problem solving skills • Mathematical skills • Language literacy skills • Leadership • Innovative skills • Transformational skills	• Food server skills • Focus communication skills (approachability, circumstantial awareness, diligence, efficiency, thoroughness) • Multitasking skills • Attention to detail skills (multitasking, approachability) • Technical skills • Decision making skills • Coding • Information technology soft skills • Logical thinking • Collaboration • Teamwork • Software engineering • Software quality assurance • Customer service • Modeling

Processes in Technology & Industrial Arts

Technology and Industrial Arts expounds on the classroom practices using processes for effective and evidence based lesson deliveries. The commended/suggested processes are for teachers to use as the starting points planning skills or practice based lessons in any of the strands as presented in the subject syllabus.

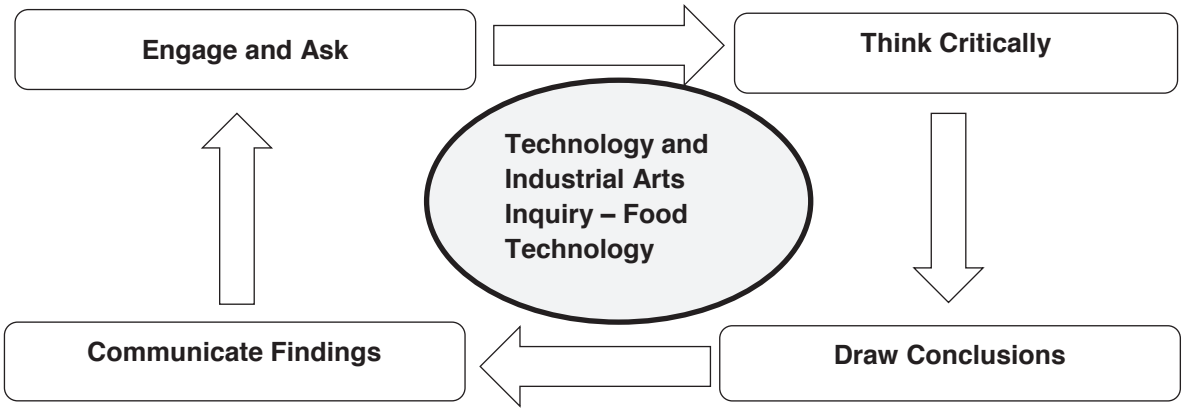
Types of Processes- Inquiry processes for Technology & Industrial Arts subject

Technology & Industrial Arts Inquiry processes include:
• Gathering information • Analysing information • Evaluating information • Making judgements • Taking actions • Instructional technology • Integration process • Project planning process • Organization of learning experiences

Technology & Industrial Arts Inquiry Processes

Engage and Ask	How will I engage my students in the topic and prompt them to ask questions? • Determine the enduring understandings about the topic being studied. • Engage your students with the topic by grabbing their interest with a hook connected to the enduring understandings. • Allow students to generate questions based upon the topic. • Determine what questions will be essential to achieving the enduring understandings. (Student generated or teacher determined) • With students, determine what other information is needed in order to fully answer the questions.
Think Critically	How will students access and analyse information about this topic? • Have students think about where they can find answers to the questions posed about the topic. • Gather and organize multiple primary and secondary sources. • Ensure that sources used expose students to different perspectives and viewpoints about the topic. • Students should use sources to collect, analyse, and interpret data. • Ensure students are analysing sources for credibility, bias, and perspective in order to identify gaps in the research.
Draw Conclusion	How will students synthesize ideas to answer the questions posed based on sources used? • Students should engage in civic discussion to answer the questions posed while respecting diverse opinions. • Engage students in evaluating possible courses of action and their consequences. • Students should make and justify an informed decision or choice and/or design an action plan supported by evidence from sources. • Have students evaluate the consequences of a decision or choice. • Allow students to make revisions based on feedback and further study.
Communicate Findings	How will students demonstrate what they have learned and take action on that learning? • Determine how students will apply what they have learned and share their findings with others. • Explore appropriate audiences for students to present conclusions. • Determine if there is an opportunity for students to take action and influence others to make more informed decisions. • Have students develop strategies to persuade others, including policy makers when applicable. • Prepare students to defend their analysis against alternative.

Below is how the **Technology & Industrial Arts** Inquiry Process will be taught in the classroom. Be specific as you make notes of the activities or prompts you will use to ensure students will have the opportunity to practice these skills as a requirement in the Grade 9 content standards.



Technology & Industrial Arts Enquiry
1. Developing Questions and Planning Inquiries *a. Constructing Essential Questions* - Address essential questions that reflect an enduring issue in the field. *b. Constructing Supporting Questions* - Explain how supporting questions contribute to an enquiry. *c. Determining Helpful Sources* - Develop new supporting and essential questions through investigations, collaboration and using diverse sources.
2. Evaluating Sources and Using Evidence *a. Gathering and Evaluating Sources* - Gather and evaluate information from multiple sources while considering the origin, credibility, point of view, authority, structure, context and corroborative value of the sources. *b. Developing Claims and Using Evidence* Identify evidence that draws information from multiple sources to revise or strengthen claims. - Communicating Conclusions and Taking Informed Action *c. Communicating Conclusions.* - Construct and evaluate explanations and arguments using multiple sources and relevant, verified information. *d. Critiquing Conclusions* - Articulate explanations and arguments to a targeted audience in diverse setting. *e. Taking Informed Action* - Use interdisciplinary lenses to analyse the causes and effects of and identify solutions to local, regional or global concerns. - Use deliberative processes and apply democratic strategies and procedures to address local, regional or concerns and take action in or out of school.

Types of Skills

There are different types of skills. These include:

1. Cognitive (Thinking) Skills
Thinking skills can be categorized into **critical thinking** and **creative thinking** skills.

i. Critical Thinking Skills

A person who thinks critically always evaluates an idea in a systematic manner before accepting or rejecting it. Critical thinking skills include:	
- Attributing - Comparing and contrasting - Grouping and classifying - Sequencing - Prioritising - Analysing	- Detecting bias - Evaluating - Metacognition (Thinking about thinking) - Making informed conclusions

ii. Creative Thinking Skills

A person who thinks creatively has a high level of imagination, able to generate original and innovative ideas, and able to modify ideas and products. Creative thinking skills include:	
- Generating ideas - Deconstructing and reconstructing - Relating - Creating - Making inferences - Predicting - Making generalisations - Visualizing	- Synthesising - Making hypothesis - Making analogies - Inventing - Transformation - Modelling - Simulating

2. Reasoning Skills - Reason is a skill used in making a logical, just, and rational judgement.

3. **Decision-Making Skills -** Decision-making involves selection of the best solution from various alternatives based on specific criteria and evidence to achieve a specific aim.

4. **Problem Solving Skills -** Problem solving skills involve finding solutions to challenges or unfamiliar situations or unanticipated difficulties in a systematic manner.

5. Literacy Skills

A strong emphasis must be placed on various types of literacy, from financial to technological, from media to mathematical, from content to cultural. Literacy may be defined as the ability of an individual to use information to function in society, to achieve goals and to develop her or his knowledge and potential. Teachers emphasize certain aspects of literacy over others, depending on the nature of the content and skills they want students to learn.

The following literacy skills are intended to be exemplary rather than definitive;

Types of Literacy Skills – Skills in basic literacy, digital literacy and financial literacy
• Define and apply discipline-based conceptual vocabulary • Describe people, places, and events, and the connections between and among them • Arrange events in chronological sequence • Differentiate fact from opinion • Determine an author's purpose • Determine and analyse similarities and differences • Analyze cause and effect relationships • Explore complex patterns, interactions and relationships • Differentiate between and among various options • The ability to locate, evaluate and use digital information. • The ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills • The ability to effectively and critically navigate, evaluate and create information using a range of digital technologies. • Making choices about personal finances and having the skills to make decisions that will have positive outcomes. • Effectively use financial skills • Improves personal financial management skills • Improves budgeting and investing skills • Creates a savvy relationship with money application skills • Creates a lifelong journey of learning for education is the key to success when it comes to money

6. Numeracy Skills

Numeracy skills refer to the ability to use, interpret and communicate mathematical information to solve real-world problems. These include the ability to understand basic math like addition, subtraction, division and multiplication. More advanced numeracy skills incorporate the use of graphical, spatial, statistical and algebraic concepts and the ability to interpret that data and apply it to real-world situations.

Types of Numeracy Skills – skills that are driven by the basic mathematical aspects
• Basic knowledge of numbers • Calculation skills • Budgeting • Interpreting mathematical information • Understanding the relationships between numbers • Understanding trends • Measurement and data analysis

7. High Level Thinking Skills

These skills include analysis, synthesis, and evaluation skills.

i. *Analysis Skills* - Analysis skills involve examining in detail and breaking information into parts by identifying motives or causes, underlying assumptions, hidden messages; making inferences and finding evidence to support generalizations, claims, and conclusions.

ii. *Synthesis Skills* - Synthesis skills involve changing or creating something new, compiling information together in a different way by combining elements in a new pattern proposing alternative solutions.

iii. *Evaluation Skills* - Evaluation skills involve justifying and presenting and defending opinions by making judgments about information, validity of ideas or quality of work based on set criteria.

Key Words				
Analyse	Differences	Find	Reproduce	Similar to
Appraise	Discover	Focus	Motivate	Simplify
Arrange	Discriminate	Function	Omit	Take part in
Assumption	Discussion	Group	Order	Test for
Breakdown	Distinction	Highlight	Organize	Theme webbing
Categorize	Distinguish	In-depth	Point out	Create
Cause & effect	Dissect	Inference	Research	Innovate
Choose	Divide	Inspect	See	Design
Classify	Establish	Isolate	Select	Collaborate
Comparing	Examine	Investigate	Separate	Recreate
				Networking

Types of Values

Personal engagement and civic engagement strategies help young people to acquire and apply skills and dispositions that will prepare them to become competent and responsible citizens.

1. Personal Values (importance, worth, usefulness), etc.

Core values	**Sustaining values**
• Sanctity of life • Truth • Aesthetics • Honesty • Human • Dignity • Rationality • Creativity • Courage • Liberty • Affectivity • Individuality	• Self-esteem • Self-reflection • Self-discipline • Self-cultivation • Principal morality • Self-determination • Openness • Independence • Simplicity • Integrity • Enterprise • Sensitivity • Modesty • Perseverance

2. Social Values

Core Values	Sustaining Values
• Equality • Kindness • Benevolence • Love • Freedom • Common good • Mutuality • Justice • Trust • Interdependence • Sustainability • Betterment of human kind • Empowerment	• Plurality • Due process of law • Democracy • Freedom and liberty • Common will • Patriotism • Tolerance • Gender equity and social inclusion • Equal opportunities • Culture and civilization • Heritage • Human rights and responsibilities • Rationality • Sense of belonging • Solidarity • Peace and harmony • Safe and peaceful communities

Types of Attitudes

Attitudes - Ways of thinking and behaving, points of view	
• Optimistic • Participatory • Critical • Creative • Appreciative • Empathetic • Caring and concern • Positive • Confident • Cooperative	• Responsible • Adaptable to change • Open-minded • Diligent • With a desire to learn • With respect for self, life, equality and excellence, evidence, fair play, rule of law, different ways of life, beliefs and opinions, and the environment.

Teaching and Learning Strategies

Food Technology teaching emphasizes and embraces the use of cognitive, reasoning, decision-making, problem solving and higher level thinking skills to teach to enhance students' understanding of inter-disciplinary concepts and issues in relation to environment, geography, history, politics and economic within PNG and globally.

It aims to provide a meaningful pedagogical framework for teaching and learning essential and demand knowledge, skills, values, and attitudes that are required for preparation of students for career, higher education and citizenship in the 21st Century.

Teaching and learning is a two-way interactive interaction between teacher and a student, a student to a student/students and occurs in any learning environment in or outdoors depending on the nature of teaching strategies, learning activities and performance assessments teachers plan to use in the delivering of the lesson.

Students must be prepared to gather and understand information, analyse issues critically, learn independently or collaboratively, organize and communicate information, draw and justify conclusions, create new knowledge, and act ethically.

Technology and Industrial Arts teaching and learning takes on a **blended perception and practices** of its content delivering with envisioning intentions to reinforce evidence based learning. It embraces these in the classrooms whereby each technology strand content are in the form of content standards, benchmarks and performance standards direct or determine the planning of the types of learning situations and activities, assessments throughout the school year.

These standards, including the specific knowledge skills and attitudes, how they are planned for students learning and performance attainment purposes in the respective grade levels are through highly commended teaching, learning and assessing strategies. For example; using blended learning strategies. This is where/when the traditionally recognised strategies (teacher centred) is blended with using e-teaching/learning strategies(online using smart phones) to learn about for instance, food processing, in a Food Technology lesson.

Practical work is integral through studying Food Technology and this includes; cooking, demonstrations, creating and responding to design briefs, dietary analysis, food sampling and taste-testing, sensory analysis, product analysis and scientific experiments.

The Design Process is an important teaching and learning approach in Food Technology.

Teaching Strategies

These are some suggested teaching strategies recommended for TIA subject lesson deliveries. However, teachers can blend these in with the existing or current teaching practices using technology.

- Use of multimedia for content research.
- Utilization of social media for fact finding on particular technology.
- Using variety of resources for meaningful teaching.
- Making most of games in electronic devices for learning.
- Use technology to empower students and reach out.

Learning Strategies

These are suggested learning strategies that can be used across the learning of all the five strands in TIA subject.

1. Use multiple types of instructional materials for learning.
2. Incorporate technology for reinforcement and motivation for learning.
3. Try new learning techniques.
4. Keep traditional methods.
5. Vary assessments.
6. Mix up group work styles.
7. Try a digital curriculum.

TIA Classroom

This classroom will be a learning environment prepared especially for the teaching and learning of TIA subject. As we are moving through the 21st century technology era TIA classrooms must reflect shadow image to encourage the teaching and learning of all the strands in the subject content.

It is suggested that teachers and students could work together to ensure that this technology classroom tips could be accommodated. These are;

- Regularly keep updates on new advancements in technology,
- Ongoing evaluation on daily basis,
- Make technology a treat & not an expectation,
- Monitor closely usage of electronic devices,
- Set ground rules for all students,
- Share knowledge on how to get technical support,
- Communicate with parents,
- Familiarize yourself with the Technology, and
- Safe use of Technology.

These teaching and learning strategies will help teachers to;

- familiarize themselves with different methods of teaching in the classroom, and
- develop an understanding of the role of a teacher for application of various methods in the classroom.

Successful teachers always keep in view that teaching must “be dynamic, challenging and in accordance with the learner’s comprehension. He/she does not depend on any single method for making his/her teaching interesting, inspirational and effective”.

Please find a list of the different teaching and learning strategies in the Appendix.

These strategies;

- make learning more engaging,
- make learning more effective,
- make learning fun,
- encourage higher motivational level,
- improve attention spans,
- develop higher order thinking and reflective skills,
- improve communication skills,
- develop the spirit of teamwork /collaboration,
- develop leadership skills and qualities, and
- encourage discovery learning.

Therefore, teachers are encouraged to utilize the suggested strategies as well as others.

Strands, Units and Topics

This section of the teacher guide contains the Food Technology content to be taught in grade 9. It consists of;

- a brief explanation of how the topics, learning objectives and lesson topics are derived,
- the unit of work containing information on how the content prescribed in the standards are unpacked and organized in a sequential manner, and
- an overview of the content distributed according to the four terms in an academic year. Refer to planning and programming section.

Food Technology is has two units. These units embed the content that students are expected to learn and master at each grade and school level. National content standards are benchmarked at each grade level, which allows for essential KSAVs to be reinforced and expanded throughout the grades.

Benchmarks show grade level expectations of what students are able to do to demonstrate that they are making progress towards attaining the content standard.

These grade-level benchmarks were then unpacked to identify the topics, learning objectives and the lesson topics. Below is a description of how topics were derived from the grade-level benchmarks.

Identifying topics from benchmarks

In order to identify the topic from the benchmark, we need to unpack the benchmark. When we unpack a benchmark, we are identifying what students will know and be able to do when they have mastered the benchmark.

1. Write out the benchmark that you want to unpack.
2. Write the verbs (skills/actions) – Higher order thinking skills.
3. Underline or highlight the big idea (content) in the benchmark. The big idea (content) is the topic derived from the benchmark.
4. Write essential questions that would be engaging for students.
5. Develop sub-topics from the big idea. (topic)
6. Write learning objectives according to the sub-topics.
7. Write lesson Topics from the learning objectives.

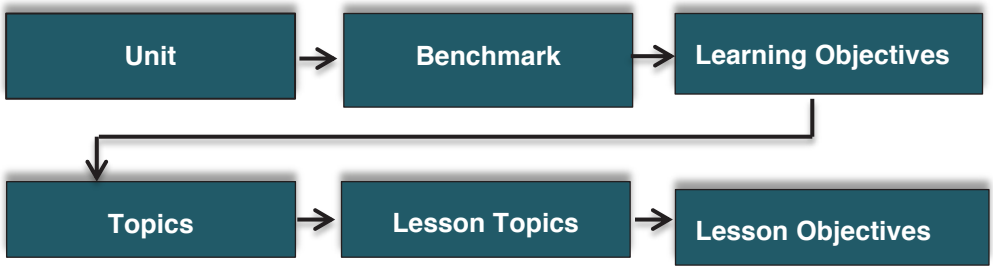


Table of Units, Benchmarks, Topics and suggested Lesson Titles

The table below outlines the contents of Grade 9 Food Technology benchmarks, units, topics and with suggested lesson titles for an academic year. Teachers are provided with what will be taught under in each of the unit in a year. This overview will guide the teachers on how to plan their teaching programs for a school year in each term. Further elaborations on the content for each of the topics and lessons are found in the Units of Work.

Content Standard 2.1: Examine and analyse the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards.			
Units	**Benchmarks**	**Topic**	**Suggested Lesson Titles**
1. Food and Nutrition	**9.2.1.1** Compare and contrast the nature and properties of food	Nature and properties of food	**Lesson 1:** Introduction to food – (Nature and sources of food)
			Lesson 2: Food groups and dietary guidelines
			Lesson 3: Properties of starch, carbohydrates, fats and oil
			Lesson 4: Introduction to food product development
	9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development	**Lesson 1:** Personal hygiene and safety practices
			Lesson 2: Kitchen hygiene
			Lesson 3: Hygiene practices and safety in food development (preparation etc.)
	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition	Food and nutrients	**Lesson 1:** Functions of nutrients and food sources
			Lesson 2: Eating practices
			Lesson 3: Meal planning
	9.2.1.4 Explore nutrition as integral to making food choices	Food metabolism	**Lesson 1:** Digestion and absorption of food
			Lesson 2: Functions of food and nutrients in human body
			Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
	9.2.1.5 Discuss economic, social and technological	Influences on food product development	**Lesson 1:** Food ingredients
			Lesson 2: Principles of cooking methods
			Lesson 3: Food management

	influences of food, food product and food sciences		**Lesson 4:** Economic, Social and technological influences on food product development
	9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism	**Lesson 1:** Food composition **Lesson 2:** Food labelling **Lesson 3:** Energy metabolism **Lesson 4:** Meals for special needs
	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development	**Lesson 1:** Introduction to food product development **Lesson 2:** Design process **Lesson 3:** Design Brief **Lesson 4:** Evaluate the new product
Content Standard 2.2: Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands. (e.g. health, occasions, lifestyle, business)			
2.Food Science	**9.2.2.1** identify and discuss the cultural, physical, chemical and nutritional characteristics of food and impact in product development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	**Lesson 1:** Cooking methods in food product development **Lesson 2:** Physical and biological properties of cereals, vegetables and fruits **Lesson 3:** Physical and biological properties of legumes, fats and oils
	9.2.2.2 Describe the nutritional and sensory characteristics of food selection, meal preparation, product development, storage and preservation	Sensory characteristics of food	**Lesson 1:** Sensory analyses of food **Lesson 2:** Nutritional functions of food **Lesson 3:** Functional foods

2.Food Science	**9.2.2.3** Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management	**Lesson 1:** Food management
			Lesson 2: Trends, fashion and food
			Lesson 3: Seasons and food
	9.2.2.4 Explore safety and hygienic practices relating to food, and changes that occur in the functional properties of food	Food safety and hygienic practices	**Lesson 1:** Food borne diseases
			Lesson 2: Contamination
			Lesson 3: First Aid
	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption	Factors influencing food processing and packaging	**Lesson 1:** Factors that influence food processing
			Lesson 2: The role of food packaging
			Lesson 3: Developments in packaging and distribution
			Lesson 4: Techniques to evaluate products and processes
	9.2.2.6 Apply the design process to create food solutions	The technology design: Design, produce, market and evaluate	**Lesson 1:** Design brief and the technological process
			Lesson 2: Using a design product to create a new product
			Lesson 3: Evaluate the new product

Note: The above are suggested lesson titles for activities in relation to each of the benchmarks for the two units. Teachers are encouraged to develop additional lesson activities to suit their context and students learning needs.

The content background notes for each benchmarks in a unit of work help to reinforce the food technology content and concepts. Teachers can also use computers, internet sources or resource materials to gather more information on the topic.

Grade 9

Food Technology

Teaching Content

Grade 9

Food Technology

Teaching Content

Unit 1: Food and Nutrition

Content Standard: 2.1 Examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards.

Units	Benchmarks	Topic	Suggested Lesson Titles
1. Food and Nutrition	**9.2.1.1** Compare and contrast the nature and properties of food	Nature and properties of food	**Lesson 1:** Introduction to food – (Nature and sources of food)
			Lesson 2: Food groups and dietary guidelines
			Lesson 3: Properties of starch, carbohydrates, fats and oil
			Lesson 4: Introduction to food product development
1. Food and Nutrition	**9.2.1.2** Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development	**Lesson 1:** Personal hygiene and safety practices
			Lesson 2: Kitchen hygiene
			Lesson 3: Hygiene practices and safety in food development (preparation etc.)
1. Food and Nutrition	**9.2.1.3** Examine the nutritional components of food and food development and the impact of food consumption on nutrition	Food and nutrients	**Lesson 1:** Functions of nutrients and food sources
			Lesson 2: Eating practices
			Lesson 3: Meal planning
1. Food and Nutrition	**9.2.1.4** Explore nutrition as integral to making food choices	Digestion and metabolism	**Lesson 1:** Digestion and absorption of food
			Lesson 2: Functions of food and nutrients in human body
			Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
1. Food and Nutrition	**9.2.1.5** Discuss economic, social and technological influences of food, food product and	Influences on food product development	**Lesson 1:** Food ingredients
			Lesson 2: Principles of cooking methods
			Lesson 3: Food management
			Lesson 4: Economic, Social and technological influences on food product development

	food sciences		
1. Food and Nutrition	**9.2.1.6** Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism	**Lesson 1:** Food composition
			Lesson 2: Food labelling
			Lesson 3: Energy metabolism
			Lesson 4: Meals for special needs
1. Food and Nutrition	**9.2.1.7** Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development	**Lesson 1:** Introduction to food product development
			Lesson 2: Design process
			Lesson 3: Design Brief
			Lesson 4: Evaluate the new product

Unit 1: Food and Nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.1 Compare and contrast the nature and properties of food.

Topic: Nature and Properties of Food

Learning Objective(s): By the end of the topic, students will be able to:

- distinguish and differentiate the nature and properties of food,
- classify food into groups and,
- make wise choices with food from selection to consumption.

Essential Questions:

- What is food? What components make up food?
- What is the purpose of a dietary guideline?
- What are the food properties for carbohydrates, fats and oil?

Essential knowledge, skills, values/attitudes:

Knowledge	• Nature and properties/characteristics of food - Carbohydrates - Lipids • Food groups • Nutritional composition • The nutrients • Dietary guidelines
Skills	• Identify and describe the nature and properties of food • Investigate and classify food groups • Research on the nutritional composition of food
Values/Attitudes	• Appreciation of nature and properties of food • Making informed decisions on food selection • Adopt awareness of healthy eating habits

Teaching and Learning Strategies:

Teachers are required to introduce the concept of food and guide students through discussions, activities and exercises to understand and grasp the concept.
Food being the nourishing substance must be understood well. Lack of knowledge indulging human ignorance causes negative implications on the human health.
The teacher therefore has to apply affective methods, techniques and learning approached and guide students to the desired outcome.
Students must be encouraged and assisted to display their knowledge and understanding using various approaches. Students must also be given the opportunity to evaluate the impacts of the political, cultural, technological, chemical, religious and physical influences on food.

Lesson 1: Introduction to food

Lesson Teaching and Learning Strategies

Students to brain storm what food is to their understanding. Allow students to formulate definitions of what food is and to explain why food is so essential to living things (plants, animals, humans).Students should also be encouraged to recall the life of hunters and gatherers and relate to the present so they comprehend with changes and developments with food. Hence they can explain the significance of food that food is for survival.

Students are to discuss on the topic of food. They will define what food is, name types of food they know, explain how food is obtained in the past and present and summarize the importance of food.

Learning Activities
Activity 1: Think and define what food is, explain why food is an essential element for survival. They will also discuss and report ways of obtaining food in the past, present and future.

Activity 2: Arrange and classify foods into groups and state their food nutrients and functions. They may discuss foods as organic and processed foods and differentiate the two.

Activity 3: Analyse and summarize on properties of food. Study the nutritional composition of food and their related deficiency issues. They may discuss and summarize on how nutrient deficiencies can be controlled and prevented.

Lesson 2: Food groups and dietary guidelines

Lesson Teaching and Learning Strategies

Introduce Dietary Guidelines, elaborate on the topic and state clearly that all food has specific functions in the human body. Engage students to work in groups before a display of food items. They arrange foods into groups and state their nutrients and functions of food. Discuss on food nutrients and stress on balanced meals .Stress that a lack of knowledge and ignorance of food aspects have caused people to suffer lifestyle illnesses such as diabetes and therefore appropriate knowledge of food and dietary guidelines is therefore essential. You may create other activities as you see fit.

Discuss and summarise on food sources, nutritional content and nutrient deficiencies and dietary guidelines. Activities can vary from groups to class level however activities must help students understand food groups of food and dietary guidelines.

Learning Activities
Activity 1: Identify and arrange foods into various groups according to their functions and nutrients. Foods that grow and build up our bodies, foods that give energy and keep our bodies warm and foods that protect our bodies and keep us healthy. Sort out the food items into three categories;
(i) eat most,
(ii) eat moderately, and
(iii) eat less.
Encourage students to express their ideas about food. Consider their localities and availability of food. Discuss taboos, habits, practices, ways of obtaining and processing food that negatively hinder good health, nutrient and wellbeing of citizen.

Activity 2
2a. Use a sample dietary guideline of any country (such as Australia) and study its contents.
2b. Brain storm ideas and discuss in groups the relevance and practical application of dietary guidelines. Students can express their own ideas about dietary guidelines. Students could further research and compile the Pacific Dietary Guidelines which Papua New Guinea has adopted.

Activity 3: Students can work in groups and design or plan a menu for a main meal based on the principles of the dietary guidelines for an average Papua New Guinean.

Lesson 3: Functional properties of carbohydrates (starch and sugar)

Lesson Teaching and Learning Strategies

Students will learn the functional properties of Carbohydrate and be able to differentiate between them by performing practical tests**.** Students are to examine various carbohydrate rich foods; examine and analyse the impact of heat on carbohydrates – rich foods. Practical experiments should be conducted to assist students understanding and encourage students to further differentiate between starch and sugar and their underlying relationship.

Learning Activities
Activity 1: Students are to list all carbohydrate-rich (starchy and sugary) foods and discuss their sources, chemistry, Functions and properties)

Activity 2: Students will work in groups to discuss the effect of heat (dry and wet) on carbohydrates-rich foods. Students will conduct practical activities on foods that contain starch and sugar such as breads, sugar and some fruits. Students should further research dextrimization and gelatinization, caramelization and crystallization. All students to melt sugar, boil rice, chop up fruits, observe changes and report findings.

Activity 3: Analyse the classification of Carbohydrates, as simple, double and complex (Sugars) and complete review questions formulated from group discussions.

Lesson 4: Functional properties of fats and oils (lipids)

Lesson Teaching and Learning Strategies

The teacher is required to guide and lead the students into discovery and understanding the properties, functions and the chemistry make–up of fats and oils. Students in practical activities to discover how, fats and oils are affected by heat or temperature in food preparation and their uses in food preparation.

Students are required to learn knowledge and skills in practical session by participating effectively and meaningfully. Teacher is responsible for creating a conducive, learning atmosphere; utilize various discovering approaches for students to fully understand the functional properties of fats and oils.

Learning Activities

Activity 1: Discuss and summarize the types of fats and oils and their food sources.

Activity 2: Analyze and summarize the chemistry components of fats and oils and differentiate between Saturated fats, mono unsaturated fats and polyunsaturated fats, their sources, properties and uses in cooking. Students could research on the concepts of Hydrogenation and Emulsion to understand the purpose of fat in food preparation.

Activity 3: Discuss the effect of heat on fats and oils, the safety aspect in cooking and relative functions in food preparation. Summarize and present information in an appropriate and informative manner.

Content Background

Food: Diet and Health

Food is vital to life. It can be defined as any solid or liquid substance which, when taken by the body, provides it with the necessary materials to enable it to grow, to replace worn - out and damaged parts and to function normally.

The human body is like a complex piece of machinery in that it is prone to faults and weaknesses if it is poorly maintained. This can happen if too little or too much food is eaten, or if the daily food intake is in anyway unbalanced.

One way of ensuring that health and fitness are maintained, when food is plentiful is to have an understanding of food and its effects on the body and to use this knowledge wisely.

What is Nutrition?
Food comes from plants and animals and like other substances, is composed of different chemical elements, arranged in a variety of ways to form molecules. These molecules collectively give individual foods their flavor, color and texture and affect their reaction to heat and their digestion.

Food has different flavors, colors, odors (smells) and textures and contains **nutrients** and water. The body uses some of the molecules in food to function correctly and to stay healthy. There are many different nutrients and each has its own function in the body. Each nutrient is vital to life, and the health of an individual will suffer if any one nutrient is in short supply.

The study of nutrients and their relationship with food and living things is called **nutrition.** Most foods contain more than one nutrient, so are of use to the body in several ways. Some foods such as sugar contain only one nutrient and are of limited use to the body. However, no single foods provide ***all*** the nutrients required by the body in sufficient quantities, so a variety of foods must be eaten in order to get all the nutrients.

What are Nutrients?

Nutrients are chemical substances that are used in the body.
There are five main groups of nutrients: protein, fat, carbohydrate, vitamins and minerals. Each group has several members, which each have their own chemical names.

Macro nutrients are needed by the body in relatively large amounts. They include protein, fat, carbohydrate, and the mineral elements of sodium, calcium, potassium, phosphorus and magnesium.

Micro nutrients are needed by the body in smaller amounts. They include vitamins, essential fatty acids and trace elements (the minerals iron, zinc, copper, iodine, selenium, chromium and cobalt).
Water can also be called a nutrient, as it is vital to life.

Why do we need food?

We need to eat food several times a day every day. This is because we need food to make us ***grow***, keep us ***healthy*** and give us ***energy.***
A mixture of foods will give us all the nutrients we need. Eating food makes us feel good, and eating together with other people is an important social (friendly) activity.

Nutrient	Job in the body	Found mostly in these foods
Protein	• Provides amino acids for new cell growth. • Protein is the secondary source of energy. • Protein makes antibodies, enzymes, haemoglobin and hormones. • Protein is required for the formation of collagen.	Peas, beans, wheat, rice, oats, lentils, meat, fish cheese, eggs, milk, legumes.
Fat	• Gives the body lots of energy • Helps to keep the body warm.	Vegetable oils: olive, sun flower, nuts, fish liver Solids fats: butter, lard , margarine, Hidden fats: pastry, potato chips, sausages, cakes, chocolate, mayonnaise.
Carbohydrate	• Gives the body lots of energy.	All sugary foods, starch in fruits and vegetables, four, pasta, cereals, cakes, biscuits, soft drinks, snack foods.
Vitamins Vitamin A	• Helps the eyes to see in dim light. • Helps to keep the throat, lungs and digestive system moist and healthy. • Helps to keep the skin healthy. • Helps children to grow normally in childhood.	Carrots, green leafy vegetables, tomatoes, mangoes, pumpkin, milk, cheese, oily fish, liver, broccoli, egg yolk.
Vitamin B group	• Helps body get energy from food. • Helps nerves and muscles to work properly. • Helps blood to be made properly. • Helps to keep the digestive system, lungs and mouth moist and healthy.	Whole grain cereals, bread, east, milk, eggs, meat and a mixed diet.
Vitamin C	• Helps to keep the skin, blood vessel, gums and the cells of the body healthy and joined together. • Helps the body to absorb iron from food. • Helps to prevent heart disease.	Oranges, lemons, lime, grapefruit, kiwifruit, strawberries, broccoli, cabbage, peas, potatoes,

Vitamin D	• Makes bones and teeth grow strong and healthy. • Helps body absorb calcium and phosphorus from food.	Liver, oil fish, margarine, milk, butter, eggs.
Vitamin E	• Helps to keep cell membranes strong and helps lower the risk of heart disease.	Lettuce, cereals, peanuts, egg yolk, vegetable oils, milk.
Vitamin K	Necessary for normal blood clotting after an injury.	Green leafy vegetables and a mixed diet usually provide sufficient quantities.

Dietary Guidelines

Governments in all countries have the responsibility for nutrition and health of its population. The government of Papua New Guinea through the Department of Health and the assistance of other non-government organizations carry out health awareness and campaigns to educate the people of Papua New Guinea on health issues, healthy foods and healthy lifestyle.
Papua New Guineans are seeing the rise in health-related illnesses such as diabetes, hypertension heart and liver illnesses. As such, we must encourage adherence to the basic principles of healthy eating. Below are dietary recommendations for a healthy lifestyle:

- Eat less sugar
- Eat less fat
- Eat more fiber and starchy foods
- Eat less salty foods
- Drink less alcohol
- Eat a variety of food and enjoy your food.
- Eat more and a variety of organically grown fruits and vegetables
- Eat the right amount to maintain a healthy weight

The main areas of nutrition that are included in the Guidelines are eating a variety of foods, including vegetables, fruits, whole grain cereals, and nuts. Choose fish, poultry, and meats grown in a sustainable way. Appropriate growth, including avoiding obesity and physical activity are important. Breastfeeding is the basis of infant nutrition and nutrition of mothers is an important public health measure. Negative factors in our Papua New Guinea diet include salt, refined sugar, alcohol and fats. The Guidelines will be useful as a checklist of the issues to be considered in public health programs, addressing both acute and chronic diseases.

Properties of starch, carbohydrates, fats and oil

Carbohydrates - Starch

The carbohydrate present in plants like wheat, maize, barley and rice and in tubers like potato and pulses like peas and beans is stored as **starch.** Starch and its products are used extensively in foods as thickener, stabilizer and found in products such as soups, custard powders, pie fillers sausages, sauces, baby foods and bakery items. Starch is a polysaccharide and is made up of mainly glucose units joined together in a chain.

Carbohydrates - Sugar

There are several types of carbohydrates but they all contain the elements of carbon, hydrogen and oxygen. Carbohydrates are produced mainly by plants during the process of photosynthesis. Carbohydrates can be classified as:

1: Monosaccharides: Some times are called *simple chemical sugars* and the base units from which other carbohydrates are built. They are soluble in water and of varying sweetness.
The main monosaccharides are glucose, fructose and galactose. Glucose and fructose are *simple sugars* and found in fruits, berries, some vegetables and honey. Galactose joins with glucose to form lactose, the milk sugar in breast milk.

2: Disaccharides are double sugars and are composed of two monosaccharide units joined together. They are soluble in water. The main disaccharides are sucrose, lactose and maltose.

3: Polysaccharides are complex sugars and are formed by many monosaccharide units. They are insoluble in cold water and are tasteless. There are 5 main polysaccharides and they are starch, dextrin, cellulose, pectin, glycogen.

Fats and Oils

Fats and oils are obtained from both plants and animals. Fat is present in food either as visible fat (on meat, butter, margarine, lard, dripping) or as invisible fats in biscuits, pastry, cakes (part of food and difficult to detect in foods like lean meat, egg yolk, fish of oily fish, nuts, seeds, fruits)
Fats and oils have the same basic structure but their physical appearances differ at normal room temperature. Fats are solid while oils are liquid at room temperature. Sometimes the word 'lipid' is used to describe fat and if the word lipid appears on a food label, it is referring to fat. Fats are composed of elements: carbon, oxygen and hydrogen in their chemical structure but it is the way they are combined that creates different types of fats and oils.

Foods have a mixture of different types of fats- saturated, monounsaturated and polyunsaturated fatty acids.

Saturated Fats

- Are usually solid at room temperature.
- Are from an animal origin such as butter, meat fat, milk, fat and lard.
- Some fats are hard and crumbly, some are easy to spread.
- Others are liquid at room temperature.
- Two vegetable fats that are high in saturated fats are palm oil and coconut oil.
- The consumption of too many saturated fats has been linked to an increase risk of heart disease, cancers and diabetes.
- Fats that the body needs but cannot make itself are called **Essential Fatty Acids.**

Monounsaturated Fats

They are in large proportions in olives, olive oil, canola oil, peanuts, other nuts and avocado, lean meat, chicken, eggs and fish. These fats tend to reduce harmful levels of cholesterol in the blood and are more stable than polyunsaturated fat.

Polyunsaturated Fats
They are usually liquid at room temperature. They can be extracted from seeds such as sunflower, soya bean, cotton seeds grape seeds and are available to consumers as oils or margarine. These fats are good at reducing cholesterol levels in the body.

They provide essentials fatty acids known as Omega-3 and Omega-6. These have been found to reduce the likelihood of heart disease and blood clots. Good sources of Omega-3 are oily fish, canola and soy oil and good sources of Omega-6 are safflower, sunflower and walnut oils.

Oils
They are fatty substances that are insoluble in water and are usually liquid at room temperature. All oils are high in kilojoules and contain no protein or carbohydrates except fats and vitamins A,D,E and K. Oils from vegetables do not contain cholesterol. Monounsaturated fats are found in olive oils, canola oil and peanut oil and have been found to be useful at keeping down cholesterol levels in the body. Olive oil also contains Vitamin E which is a natural anti-oxidant and effective in fighting off free radicals that damage cells and may cause cancer.

Functional properties of Carbohydrates
Carbohydrate-rich foods include those that contain sugar and starches, such as breads, cereals, sugars and fruits and vegetables. Carbohydrate-rich foods are responsible for two browning reactions in food: Dextrinisation and Caramelisation. They are also responsible for crystallization and gelatinization.

Dextrinisation: When starch is cooked by dry-heat method, dextrinisation occurs where the starch is changed into dextrins which are brown and sweeter in flavor toasting of breads is good example

Caramelisation: Sugar, when heated to a high temperature will melt and become brown liquid. This process is known as caramelisation and occurs when making toffee, caramel sauce and fruit cakes, browning of vegetables such as sweet potato and carrots. Caramelisation occurs in dry heat cooking methods such as baking and grilling

Crystallization: Sugar or sugar-water solution when heated, produces a concentrated solution or syrup to form sweets such as toffees.

Gelatinization: When starch is dissolved and then heated, it will swell and produce a thick paste. This process is known as gelatinization and will occur about 90^{0c}, just below boiling point.

Fats and Oils (lipids)
Lipids are the group name for fats and oils. Fats are solid at room temperature and oils are liquid. There are “good” fats and “bad” fats and they are present in many of the foods we eat.

Hydrogenation
Before oils can be used in the preparation and cooking of food, they are refined to clean in them off impurities. They can be further treated to convert them into solid fat products we know as margarine and solid frying fat. The unsaturated oil is heated and stirred, a catalyst in the form of nukle is added and hydrogen gas is forced into the oil molecule. This process is known as hydrogenation.

Emulsions
An emulsion is formed when two liquids, which do not mix together naturally; such as oil and water are forced together in a colloidal solution. To create a permanent emulsion, in food products an ingredient called an **emulsifier** can be added to oil and water ingredients.

Hints for success with fats and oils

- Always have the oil hot enough before frying so that when the food is added, it sizzles cold oil soaks into the food like a sponge.
- Only use oil for frying once except peanut oil which can be used several times If pieces of food are strained out after cooking.
- Dry food before frying to avoid spitting fat.
- Only fry small portions of food – they cook quickly and evenly.
- Drain fried food well before serving.

Safety when frying
All fats and oils decompose at a particular temperature, when heated and smoky fumes are seen and smelt and fat becomes dark and flecked.

Serving Food
Safe food handling practices when serving food are just as important. To overcome potential problems, a number of food handling practices must be followed:

- Tongs, spoons or scoops must be used to handle food serving. Food must not be picked up by hands.
- Disposal gloves must be used when handling raw food which has the potential to be hazardous.
- Disposal gloves should not be used to prepare food and then touch other surfaces or do other tasks like counting money.
- When serving food, do not let your hands or fingers touch cutlery or crockery surfaces.

Cleanliness of Work Surfaces
Food Contamination can occur through poor cleaning of equipment, utensils or through harmful bacteria left on food preparation surfaces. Equipment used in food preparation should be cleaned at the end of food preparation and it is important to clean as you go.

Safe Food Handling Practices
The best way of ensuring that the opportunity, for food contamination is minimized is to ensure that the seven principles of food handing are followed.

1. Observe the rules for person hygiene.
2. Make sure you don't work with food while you are ill, even if the illness is mild.
3. Make sure food is kept out of the Danger zone for contamination, during all stages of preparation, storage, serving and transportation – that is hot foods hot and cold foods cold.
4. Only purchase food from reputable food supplies.
5. Follow and practice sage food hygiene.
6. Keep equipment and premises in a clean and sanitary condition.
7. Prevent contamination of food supplies, equipment and premises by insects and rodents.

Some tips to remember when purchasing food supplies

- Check the date marking on the product.
- Make sure no sign of contamination. (moulds or smell exist)
- Make sure package no damaged and canned goods are not dented.
- Ensure that frozen foods have no thawing signs.
- When buying at a supermarket, collect frozen goods last. Keep hot foods separate to prevent cross-contamination.
- If food is to be prepared and delivered to you, inspect it before accepting.
- Food must not be left outside as it is open to contamination by domestic animals are open to dust or heat.

Unit 1: Food and nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development.

Topic: Safety and Hygienic Practices in Food Preparation Development

Learning Objective(s): By the end of the topic, students will be able to;

- comprehend, utilize and apply safety and hygienic practices in tool, equipment and food handling in meal preparation and product development and improved personal hygiene.

Essential Questions:

- Why is it necessary to adhere to safety and hygienic practices in food product development?
- What are the consequences and implications of non-compliance as per safety and hygiene guidelines in product development?

Essential knowledge, skills, values and attitudes:

Knowledge	• Hygiene and food safety (Kitchen Hygiene, Food hygiene,) Hygiene & safety practices in; - tool and equipment - food handling in food development - Personal hygiene
Skills	• Demonstrate kitchen hygiene, safety procedures and personal hygiene • Apply safety practices in food handling and development and meal preparation
Values/Attitudes	• Make informed decision on food safety, handling and preparation • Be responsible in handling tools and equipment • Appreciate the development of food • Achieve and maintain improved personal hygiene

Teaching and Learning Strategies:

Safety and Hygiene are matters of paramount concern hence, onus is on the teacher to introduce, teach reinforce and evaluate its effectiveness regularly. The Teacher will employ, develop and execute various methods and approaches to convey the safety and hygiene concept. The teacher will also oversee its implementation and evaluate its effectiveness, Hence there must be an open approach, correction and on-going reinforcement including open participation by both teacher and student.

Students must be introduced to safety and hygiene requirement in the kitchen prior to handling of food and equipment.

It is important that students are fully aware as ignorance lacks effective communication and reinforcement could lead to unwanted results such as food poisoning.

Students must be reminded and encouraged to adhere to hygiene and safety guidelines on all occasions involving food preparation, processing and presentation and storage.

Learning Activities

Lesson 1: Personal Hygiene and Safety Practices.

Activity 1: Discuss in groups and report your discussions on these general points

1a. What is your general impression about the level of hygiene and cleanliness by food handlers in your locality in food outlets such as open markets, kaibars and local restaurants. List some suggestions for improvement if you will have the opportunity.
1b. Conduct a site study on the school, kitchen and dining hall facilities and Home Economics cooking rooms. Observe, assess and report your findings on the state hygiene, cleanliness and safety practices and compile a report.

Lesson 2: Kitchen Hygiene.
Activity 2: A kitchen can be a dangerous place. Food is handled, processed and stored and therefore, a high level of hygiene standard is required.

- Define the terms Micro-organism, yeast, mould, and bacteria.
- Describe the optimum conditions for micro-organism growth.
- What are mycotoxine? Why are they dangerous?
- What is meant by the term anaerobic?
  Explain why anaerobic bacteria are potentially dangerous to the food handler?
- Explain how cross contamination occurs. How can cross contamination be minimized?
- How does food become unsafe? Name some of the contributing causes.

Lesson 3: Hygiene practice and safety in food development (Preparation)
Activity 1
1a. Students can work in groups develop posters on food and kitchen hygiene rules and display on noticeboards as general reminders.

1b. Students can research on micro-organisms that cause poisoning and conduct an health awareness talk. The micro-organisms include:

- ✓ Salmonella
- ✓ Clostridium Botulinum
- ✓ Staphylococcus
- ✓ Clostridium Per fringes
- ✓ Listeria
- ✓ Bacillus Cerus
- ✓ E. Coli

- Investigate how they are spread, the common causes and symptoms.

- Students can copy the thermometer chart, shade in red the **"danger zone"** and explain why the danger zone is important to note.

Content Background

Food safety and hygiene Practices;

- Keep it cool.
- Keep it clean.
- Keep it hot.
- Check the label.

Safe Work Practices

We are surrounded by food every day, and we often overlook how unsafe food can potentially be if it is not stored, handled or prepared correctly. We often forget how important it is to have safe work practices. The main areas to be aware of are:

- Temperature control.
- Cooking food thoroughly.
- Preventing cross contamination of food.
- Personal hygiene.

1. Temperature Control

The Kitchen danger zone is between 60^0C. This is an optimal temperature range in which poisoning bacteria grows. For example, the E. Coli can double in number every 20 minutes in this temperature range. The food contaminated with E. Coli may not look any different but can be unsafe to anyone who consumes it.

The Temperature Danger Zone conveys to us that we should keep food at very high or very low temperature to avoid poisoning.

2. Cooking food thoroughly

Cooking food thoroughly kills bacteria's that may cause food poisoning. Under cooking can be dangerous as foods may contain harmful bacteria.

3. Preventing Cross-contamination

Cross contamination can occur when bacteria spread from raw food such as poultry onto ready – to – eat foods.

Correct storage is therefore essential to help maintain food hygiene. Some storage tips include:

- Glad wrap food before storing in refrigerator or pack in air tight container.
- Fresh meat should be wrapped well and stored
- Label all foods (with date) be placing in the freezer

4. Personal Hygiene

Ensure you have good personal hygiene to prevent bacteria from spreading to food that will make us ill.

Focus on Hand Washing

Wash your hands correctly before you cook or eat is important for safety and hygiene. It is the best way to stop germs from spreading. Wash your hands also after visiting the bathroom, cough or sneeze.

Food Preparation: Avoiding Cross Contamination

One of the most common causes of food contamination is through the cross-contamination of food. Cross-contamination of food involves the transfer of harmful bacteria from- uncooked food to the food. Cooking kills most of the harmful bacteria present however, if raw food comes in contact with cooked food, bacteria can be transferred to the cooked food.

Major risk factors of Cross-Contamination

Chopping board
Cutting raw food on a chopping board and then cutting another food on the same chopping board without washing the board will also contribute to food contamination. Salmonella will be deposited in the cracks or crevices on the board and can be transferred to a high risk food such as meat. Therefore, Health Authorities recommend for coloured boards.

- Red: for raw meat
- Blue: for sea food
- Green: for fruits and vegetables
- Yellow: poultry
- White: for dairy productions
- Brown: for cooked meats

The Sink
The sink can be another major risk area and bacteria can transfer easily between foods. The sink should be thoroughly cleaned in between use.

Spoon
Using a spoon to eat or taste food products and the same spoon to mix or stir other foods allow bacteria to be transferred easily.

Tea towels
Tea towels are to be used to dry dishes only and should not be used to wipe chopping boards, hands or benches.

Safety

Kitchens are potentially dangerous places and every year, thousands of accidents occur. It is therefore very important that we are aware of dangerous situations and take precautions. It is the responsibility of each person working in it to ensure safety in the kitchen. Each worker must be able to use equipment in a manner that will not harm others. Accidents can occur when people disregard safety rules, do not concentrate while working or work too quickly. Our feelings can also affect how you work: anger, fatigue or apathy can all lead to accidents.

Injuries that can occur in a kitchen include broken bones, cuts and abrasions, burns and scalds', falls, electric shocks, muscle, back strain and poisoning. Following are basic rules for a kitchen worker:
1. Never run.
2. If you drop it, pick it up.
3. If you spill it, wipe it up.
4. Concentrate on what you are doing.
5. Always make use of safety features on equipment.

Hygiene

It is the responsibility of all kitchen workers and food handlers to maintain highest level of hygiene. Poisoning, contamination and even death may result when hygiene is neglected.

Kitchen Hygiene

The following are standard hygiene procedures to be practiced:

1. Wipe clean and sanitize work bench before contact with food or equipment.
2. Clean each piece of equipment after use by:
    - loosening and removing any food particles,
    - washing with clean hot water, detergent and scrubbing brush or scourer, or in a dish washer,
    - rinse in clean hot water, ensure there is no soap residue left,
    - dry in a dishwasher or use clean cloth towels, and
    - store equipment in appropriate well ventilated storage areas that are clean, insect and dust free.
3. Clean up (after yourself) as you work.
4. Keep a scrap bin handy and empty it regularly and correctly.
5. Clean up spills and breakages immediately.
6. Wipe down bench tops and shelves after use.
7. Scrub chopping boards regularly, particularly between jobs.
8. Clean stoves and ovens with an abrasive cleaner.
9. Wash and rinse sinks well with hot water and some detergent after each use and dry well.
10. Sweep and mop up kitchen floor at the end of all cooking sessions.
11. If you have a problem with ants, cockroaches or rats, take appropriate action.

Personal Hygiene

When in the kitchen for cooking lessons ensure the following procedures are followed:

1. Wash your hands with soap and warm water. Dry and wear protective gloves, wear fresh and clean aprons and enclose your hair in a hair net, scarf or chef's hat. If hair is long ensure to tie it up firmly.

***Note**: Hands should be rewashed after using the toilet, handling garbage, cleaning your nose or eating.*

2. Do not touch your face, hair or any part of your body while working with food. Finger nails must be trimmed before touching food, have no nail polish and finger rings are not allowed when handling food.
3. Cover all cuts and broken skin with a clean and water proof dressing.
4. Do not handle food if you are unwell.
5. Never lick your fingers during cooking, never smoke, sneeze or cough over food during cooking.
6. Wash your hands when you leave the kitchen.

Food Hygiene Rules

1. Store and hold or keep food in correct temperatures and /or in clean storage containers. Be mindful of the danger zone chart
2. Always use clean equipment
3. Wrap food well before placing in the refrigerator of chiller.
4. Cook foods such as meat thoroughly to destroy harmful bacteria.
5. When reheating foods, heat it thoroughly.
6. Always wash foods clean before use.
7. Frozen foods like meat must be thawed out thoroughly prior to cooking.
8. Always keep foods covered.

Contamination
When these rules are not followed, contamination (physical, biological, chemical) can occur, possibly leading to food poisoning.

Biological contamination arises from disease-causing microorganisms such as bacteria, moulds, yeasts, virus and fungi. The common disease-causing bacteria is found in animal and human excreta, dust and dirt and in raw meats and milk and also on human skin.

Physical contamination occurs when foods contain foreign matter such as plastic, metal, insects, and wood are ingested.

Chemical contamination happens when food is in contact with chemicals such as pesticides, fertilizers or detergents. Symptoms of poisoning include stomach pains, vomiting and diarrhea.

Food Safety
Knowing about temperature gives us a better understanding of how to handle, store and prepare food so that it is safe to eat. Bacteria multiply in food in arm and moist conditions and can make us very sick. Common symptoms of food poisoning are stomach ache, diarrhea and vomiting. The bacteria that commonly cause food poisoning grow rapidly at between 5 degrees Celsius and 60 degrees Celsius. Day time room temperatures in most parts of PNG average between 25 degrees Celsius and 33 degrees Celsius, which mean that there is a 'temperature danger zone' for perishable foods.

The Danger Zone
Most bacteria will grow provided they have enough food and moisture and if the temperature is between 5 degrees Celsius and 60 degrees Celsius. This temperature range is called the *danger zone.* Foods that are high in protein are called high risk foods because bacteria will grow on them more quickly.

Metric Measurements

The secret to a successful product that looks attractive and tastes good is the accurate measurement of all ingredients. If you do not accurately measure the ingredients your food product may not turn out well as you had hoped.

Most recipes follow a metric system. Metric measuring equipment is needed to achieve accurate results. There are four basic types of equipment used to measure ingredients:

- Measuring spoons
- Measuring cups
- Liquid measuring jugs
- Weight scales

1. Measuring Spoons: There are a variety of styles of measuring spoons available to use in food preparation. Measuring spoons are used to measure small amounts of both liquid and solid ingredients such as flour, butter, oil, water, sugar and milk. To accurately measure with spoons, level the top off with the back of a knife. The spoons measure the volume of ingredients in the following amounts.

- 1 tablespoon = 20 ml
- 1 teaspoon = 5 ml
- ½ teaspoon = 2.5 mm
- ¼ teaspoon = 1.25 ml

2. Measuring Cups: The most common is a set of four measuring cups that measure the volume of ingredients such as rice, flour, cocoa, milk or sugar. All ingredients should be level with the top of the cup. The sizes of measuring cups are:

- 1 cup = 250 ml
- ½ cup = 125 ml
- 1/3 cup = 80 ml
- ¼ cup = 60 ml

3. Liquid measuring jugs: Measuring jugs are used to measure the (large) volumes of liquids. To measure liquids, stand the measuring jug on a level surface. Pour the liquid into the jug and read at eye level.

4. Weight Scales: The exact weight of solid foods may be measured using scales in metric amounts of grams and kilograms. Two types of scales are used: (i) the spring mechanical balance (ii) the electronic digital display. Scales are designed to measure very small to very large amounts of food.

Abbreviations: Ingredients in a recipe are often listed using abbreviations. Common abbreviations for weights and measures include:

- tspn - teaspoon
- teasp - teaspoon
- t - teaspoon
- Tab - tablespoon
- Tbspn - tablespoon
- T - tablespoon
- C - cup
- ml - milliitres
- L - litres
- g - grams
- kg - kilograms

Unit 1: Food and nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.

Topic: Food and nutrients

Learning Objective(s): By the end of the topic, students will be able to;

- investigate and analyze food components and examine the impact on nutrition through food processing and consumption.

Essential Questions:

- What are the different food components?
- What impact does food processing have on nutrition?
- What impact does nutrition have on food consumption?
- What impact does food consumption have on nutrition?

Essential knowledge, skills, values and attitudes:

Knowledge	• Nutritional components of food (nutrients) • Food functions and sources • Food product development • Eating habits • Nutritional disorders • Table setting and cultural etiquettes of food • Meal planning
Skills	• Investigate the nutritional components of food • Analyze nutritional disorders in relation to eating habits • Design a plan to create a food product from specific nutritional components • Plan and prepare a nutritious meal for a specific occasion • Demonstrate formal and informal table setting, individual or group table settings for various occasions
Values/Attitudes	• Appreciate the nutritional value of food, food development and consumption • Self-discipline in healthy food eating practices • Be open-minded to food development and consumption • Make wise choices and food planning • Observe and respect different cultural etiquettes in formal and informal occasions

Teaching and Learning Strategies:

Food plays a significant role in the human body. Hence the teacher is required to teach the prescribed knowledge on food effectively. Importantly concepts must be introduced to help students understand the functions of food nutrients. Appropriate activities must be organized and executed to assess students understanding the importance of food.

Students are required to participate fully and gain knowledge and understanding of the content their teacher will organize, reinforcement activities for students by employing various methods and skills. Students must be able to interpret what is taught and be encouraged to apply in their lives appropriate knowledge, skills and values. Students should be encouraged to appreciate food and understand its values in their lives.

Learning Activities

Lesson 1: Functions of Nutrients and Food Sources

Activity 1: Compare and contrast how food was obtained in the past and present. Consider traditional methods and modern methods available today. Summarize findings and convey information.

Activity 2: We have food needs at various stages of life. Investigate and summarize essential nutrients that are vital for these development stages of life.

- Pregnancy and lactation
- Infancy and early childhood
- Childhood
- Adolescence
- Adulthood
- Late adulthood
- Old age

Activity 3: 3a. Compile a list of health issues that are affecting our lives today such as:

- Diabetes
- Coeliac disease
- Anaemia
- Heart disease
- Bowel disorders

3b. Investigate and summarize their possible causes and preventative measures.

Activity 4:

4a. Teacher will provide information on nutrition related illness under two headings

- Under-nutrition, and
- Over nutrition.

4b. Research each one and summarize their causes and preventative measures.
4c. Do a power point presentation or a chart presentation.

Activity 5: Define what food grazing is. What are some nutritional consequences of meal or food grazing?

Activity 6: Discuss and summarize the impact of food in meal planning and food preparations.

- Take away food stores
- Kitchen Technology
- imported foods
- Convenience foods

Content Background

Food

Meals still have to be planned, however individual needs have to be considered. Few people work, and buy food strictly according to the plan. For catering establishments, like canteens, hospitals kitchens, restaurants and hotels, it is vital.

A balanced meal is one that provides all the nutrients and individual needs and should also provide a balance of texture, flavor, colour, and variety of foods.

Our body needs nutrients to live. These nutrients are present in the foods we eat. Each nutrient has a specific function but all work together to keep the body functioning in a healthy way. There is a wide range of food stuff available throughout the world. The foods people eat are governed by (i) geographic factors or what is available in their immediate environments. (ii) Development factors in areas of technology and transport. Most foods require some form of processing before they are ready for eating. Fruits and vegetables can be washed and peeled before they are eaten. Other foods can be processed using both local and modern methods before they are consumed either directly or transported to points of sale for consumers to buy.

Nutritional Components of Food and Impact on Food Consumption on Nutrition

The main reason why people think about eating is to 'satisfy their hunger'. As well as meeting our physiological need to sustain life, the most important function of food is to provide the essential nutrients we need for good health.

Nutrients are chemical substances that are essential to life and to the maintenance of good health. The main nutrients are protein, carbohydrates, fat, vitamins, and minerals and water though not a nutrient is very essential for functioning of body cells.

Food Product Development

New food products are being developed and marketed each year. Why do we need more and are we ever satisfied even when supermarket shelves are stacked to over flowing with food? Companies grow by developing new products and consumers are never completely satisfied. Their needs, demands and wants are ever changing.

Product development: Why do it?

- *Pleasing the Consumer:* Most production today is said to be 'consumer-oriented'. This means it is designed to satisfy some need or want of the consumer. Consumers communicate their approval or disapproval of the products they purchase in many ways. This helps producers to develop products consumers need.
- *Meeting current issues and concerns:* Food producers use market research to investigate consumer's attitudes, values and concerns. Products may be developed to meet specific demands such as nutrition, diet preferences, markets, or consumer beliefs. Producers may modify their products because of concerns about environmental issues or resource sustainability.
- *Staying in business:* Food producers in all sectors have to maintain profitability or close the farm, factory or shop. Food manufacturers develop to maintain the brand names of their products.
- *Keeping ahead with technology:* In times of rapid technological change, producers have to take advantage of technical opportunities for new product development. The opportunities may arise because of new developments or processes. Some examples may include snack foods, take-away, micro-wave technology, or genetically produced fruits and vegetables.

- *Import replacement:* Products are developed to replace ones that were formerly imported for these reasons: a market gap exists, supplier gone out of business.

Balanced Diet and Meal Planning

There are many processes and techniques involved in planning meals. As well, many factors influence when and what we eat. It is easy to plan meals for yourself but planning meals for a family or a group requires you to consider factors such as:

- the number of people to feed,
- each person's health and age,
- the physical activity in which individuals engage,
- individual likes and dislikes,
- available foods,
- nutritional benefit of foods,
- equipment available to prepare, cook and serve food,
- time available for preparation,
- how much money to spend,
- the weather,
- when each person will arrive home,
- how to store, cook and serve the food,
- the variety and colour of the food, and
- any religious requirements or cultural backgrounds.

Eating Practices

Food can be used to bring people together so they can enjoy the companionship and communication. These situations may involve family gatherings or individuals or even large groups.

Attractive food presentation: Enticing family members to eat.

A well prepared meal should not only be appetizing but also well presented. The food and the setting should complement each other for the food to be enjoyed. The domestic table setting allows us to relax and enjoy meals with other family members. Meal times can be real social events for spending time with other people.

Cutlery and Table Setting for formal occasions

- Table linen should be clean and suitable for the occasion. Serviettes may be folded in attractive styles.
- Table decorations or center pieces should be suitable and not too large.
- Seating arrangements should be appropriate for the occasion.
- Cutlery should be clean. Knives and spoons should be placed at the right side of the serving plate in order of use. The soup spoon is placed on the outside next to the dinner knives. Forks are placed on the left of the plate. Dessert spoons and forks generally are placed at the end of the plate. All cutleries is placed 2cm away from the edge of the table.

The presentation of a formal dinner setting is of utmost importance. The presentation of the meal is just as important. Meals should be served at the correct temperatures. Hostesses should arrange the food attractively on serving plates with spills wiped off from the plate edge. The appetizing state of food is the key to the eating occasion.

A. Takeaway and fast food outlets

Take-away and fast food restaurants cater for today's faster lifestyle. They sell fish and chips, chicken, pizza, hamburger and other convenient products.

The type of food outlets in PNG vary both in structure and the foods they sell. Types of services differ from one establishment to another.

B. Formal Catering:

This accord, with conventions or requirements involving certain standards of preparation and behaviors for formal occasions. Examples of formal catering include:

- Formal dinner parties
- Wedding receptions
- Business and conference functions
- Engagement parties
- Balls
- Product launches
- Birthday celebrations at restaurants
- Wedding anniversaries

Informal catering, the menu determines the type and style of service, the setting of the dining area. The Western countries, for the formal catering, the menu consists of courses or the catering event to be served in a set order.

Appetizers: Bite size portions of food, which stimulate the western desire. They can be served hot or cold.
Hors d'oeuvres: An appetizer to be served before a meal.
Entrée': A dish served at dinner before the main course.
Main Course: The large course of the meal.
Dessert: The final course of a meal.
Coffee and Chocolate:

Food Etiquettes on Food around the world

7 most fascinating food etiquettes rules around the world

- Always leave food on your plate in China.
- Don't say "thank you" in India.
- Slurp your noodles in Japan.
- Never salt your food in Egypt.
- Flipping a fish is bad luck in China.
- The oldest person takes the food first bite in South Korea.
- Don't "Cheers" in Hungry.

Cultural Food Customs

- Don't ask for salt and pepper if it isn't on the table.
- Never ask for cheese if it is not offered to you.
- Don't eat your bread as an appetizer before the meal.
- Never stick your chop stick upright in your rice.

Cool food customs around the world

1. Don't ask for salt and pepper if it isn't on the table in Portugal.
   Cooks are proud people and in Portugal when visiting a restaurant, to ask for any kind of seasoning is `to criticize their craft. Beware!

2. Never ask for cheese if it is not offered to you in Italy.
   In Italy, putting parmesan on pizza is frowned upon it is forbidden.

3. Don't eat your bread as an appetizer before the meal in France.
   In France, bread isn't meant to be eaten before the meal. If ever you find yourself amongst the French, make sure to eat the bread in small bites with the rest of your meal.

4. Never stick your chop sticks upright in your rice in Japan.
   Sticking your chopsticks upright is off limits in Japan. To do so at any time will bring bad luck to you or you never discuss money over dinner.

5. Slurp your food in Japan.
   Loudly slurping your food is a sign of respect amongst Japanese chefs. Furthermore, it is thought to improve the flavor of the truth and allow the eater to enjoy hot foods more quickly.

6. Slurp after a meal in the Canada.
   Loudly slurping our food and in a hurried manner is a sign of poor table manners and disrespect to the family and guests.

7. Fart after a meal in Canada.
   In some Inuit (Indian) cultures of Canada, passing gas after eating is a sincere sign of thankfulness.

8. Nobody eats until the oldest person takes a bite in South Korea.
   The elder's eating first is often the norm. You should allow them to set the pace and never eat any faster.

9. Don't put your food in your mouth with a fork in Thailand.
   The fork is used to push food on to the spoon which is then allowed to be eaten.

10. Don't eat with your left hand in the Middle East, India and parts of Africa.
    The right hand is reserved for eating and the left is meant for keeping clean.

11. Don't use your hands at all to eat in Chile.
    It is considered a poor form a knife and fork is expected to be used at every meal.

12. Only drink a Cappuccino before noon in Italy
    In Italy, the only after dinner drink is an expresso. You will be branded a tourist for touching a cappuccino after noon.

13. If an older person offers you a drink in Korea, receive it with both hands.
    Once you've got hold of it, turn your head away and take a sip.

14. Never mix or turn down (refuse) Vodka in Russia.

15. Don't refill your own drink in Japan.
    When drinking, fill the glass of the person next to you instead of your own. Pouring your own will mean you have a problem.

16. Always say "provecho" enjoy in Mexico.
    It's common courteously to wish other eaters well when you catch their eyes.

Eating habits to achieve your health goals

Most of the time, health goals, relate to our eating habits. In life, we have many goals. When it comes to health, we have fitness and food goals such as losing weight, exercising regularly, eating healthier or making better food choices.

Here are some good eating habits which will help us achieve our goals:

1. **Choose Water**

Set a goal to drink water instead of sugar-sweetened drinks.

2. **Stick to one serving**

Challenge yourself to stick to one serving and standard protein sizes.

3. **Eat fruits and Vegetables**

Half fill our plate with vegetables and fruits at every meal as they are low on saturated fats and rich in dietary fiber, vitamins and minerals.

4. **Eat slowly and mindfully**

Eat slowly, take extra time to pay attention to what you are eating and how much.

5. **Swap to whole grains**

Eat whole grain foods (rice, bread) to reduce, the risk of developing heart diseases and diabetes and help with weight management.

These five good eating habits take time to develop. Be patient, no matter how small it makes a big difference to our health.

Meal Planning

What is meal planning? It is the act of thinking ahead about what you will make for meals and snacks and getting prepared. Meal planning gives you the opportunity to think about what you like to eat and how those foods help nourish your body.

What are the benefits of planning meals?

1. Planning your meals allow you to see how much you're actually eating.
2. It helps you eat healthy and to avoid spending at fast foods.
3. It is time saving.
4. It saves your money.
5. It reduces on food wastage.
6. Saves your time.
7. Associates with food variety.
8. Helps you share work load.
9. Helps to improve your cooking skills.
10. Reduces stress.
11. Allow you to learn progressively and experimental with recipes.
12. Reduce the risk of making poor choices.

When you are cooking for the entire family or just for yourself, take time to plan your meals, it's worth the effort

Meal Planning

Food is a vital part of our lives and much of our time spent in its preparation. Everyone has difference needs and requirements for food according to their:

- Age and sex
- Health condition

- Daily activities
- Climate they live in
- Likes and dislikes

Preparation and consumption of food is influenced by:

- Interest and motivation of the one preparing
- Abilities skills and food knowledge of the preparer
- Time and facilities available for preparing
- Availability of food
- Income available to be spent

Appetite and desire to eat food are also affected by:

- Colour, appearance and presentation
- Smell, taste and texture
- Surrounding and atmosphere at where food is to be eaten

Meals are a very time consuming part of family life with long and thorough preparations and the whole family would seat down together to eat in a leisurely manner.

Food habits have changed to fit in with rapidly changing lifestyles.

Eating Practices

Occasions for sharing food

Menus should be designed to meet the needs of the people eating, the food. Whether food is being served at home, in a school canteen, a take-away outlet or at a restaurant, the tastes and the budget of the customer are of primary importance.

When planning a menu, these factors should be considered;

- Flavors – avoid a dominant flavor in each course.
- Texture – Consider a range of textures.
- Appearance – Consider color, shape and variety.
- Aroma- The smell of the food.
- Nutrition – include a range of food with a variety of nutrients.

Styles of Eating

There are many styles of eating practices;

- The el-fresco – barbeque or picnic.
- Formal dinner.
- Casual eating.
- Buffet.

Trends in Eating and Food Service

Food service customers who eat outside meals, snacks and drinks for customers who eat outside their homes no matter the venue or service, customers expect good food and service.

1. **Cafeteria:**
   - A type of restaurant that serves generally ready, cooked food that are positioned behind a food serving counter.
   - Customers may carry a tray to select food.
   - They may order food from the attendants or self-serve.
   - There is no table service and food is paid for to the cashier at the counter.
   - A range of cold and hot foods are available at the counter.
   - The menu is fixed and displayed.
   - Cutlery is handed directly to the customer or collected along the way.

2. **Take Away Restaurant:**
    - Numerous take away or fast food restaurants are available. Some are franchises like Big Rooster and other are family-run services or take – away shops at other outlets that offer fish and chips and in PNG, a range of organic – local food.
    - Such restaurants tend to be informal and noisy, with eating facilities. located both inside and outside the restaurant.
    - The restaurant provides fast service and low-cost food.
    - Menu items are ordered at the counter.
    - The menu is set and rarely charges.
    - Cutlery and cookery is not supplied with the food so customers are expected to eat food directly from disposable containers.

3. **Formal Restaurant:**
    - Described as fine dining to create an overall superior dining experience.
    - Offer degustation menus. (careful and appreciative tasting of various foods designed by chefs to showcase their cuisine and abilities)

4. **Plated Service:**
    - Offered by most restaurants.
    - Customers order their food from the table.
    - Food brought to the table by the waiter.
    - Plated service enables the chef to create and present food beautifully.

5. **Silver Service:**
    - A specialized type of fine dining.
    - The table is set for entrée soup and main course and desert is served in sterling silver ware.
    - All food is presented in silver dishes with elaborate designs.

6. **Gueridon Service:**
    - Foods are partially prepared on dishes and placed on trolley and are wheeled by the waiter and placed near the customers table.
    - The term all guerdon means prepared at your table.
    - The trolley usually has a gas cylinder and burner and water will compete the actual cooking of food near the customer.

7. **Dining out:**
    - A variety of venues that offer a relaxed and informal atmosphere and offer a mix of takeaway and fast food restaurants and formal dining.
    - Prices are generally higher; non-disposal cutlery and cookery are used while food and atmosphere are considered a high quality than those of takeaway restaurants.
    - Eating tends to be relaxed food is moderately priced and wine and beer is often served.

8. **Buffet Service:**
    - Food is placed on table and customers collect their plates, get their meal while mingle and chat.
    - The buffet waiter may assist to serve and customers return to the table to eat.
    - There may be several courses such as soup, main course.
    - Buffet services are often used at wedding and other formal celebrations.

9. **A La Carte Service:** A choice of individually priced dishes for each course.

Table Setting Crockery, Cutlery, Glassware, Linen

The Formal table setting can be quite daunting but some tips to follow include:

- The dinner plate is always placed directly in front of the person.
- The fork is placed on the left-hand side of the plate.
- The knife is placed on the right side of the plate, with the blade facing inwards.
- The bread and butter plate is positioned on the left-hand side or in front. The plate and bread knife are the smallest items on the table. The knife is usually positioned across the top edge of the plated.
- The glass is positioned at the two o'clock position. If there are several glasses, the water glass is usually the largest. The red wine glass is usually mere tout and rounded and globlet in shape. The white wine glass is mere-oval shaped.
- Eating utensils are used from the outside in. So, if you are having an entree course before the main course the entree fork and knife will be placed further away from the plate than those from the main course. That means you use the cutlery further away from you first and work your way in.
- The desert fork and spoon, are generally placed directly above the plate at the twelve o'clock position.
- If you have a serviette, plate it in your lap immediately after the last person has taken his or her seat at the table. If you have to leave the table during your meal, the serviette should be placed to the left-hand side of your plate, or left on your chair. Put it to the right of your plate when you have finished eating.

Presentation and service of food

Presentation of food is very important to the consumer in regards to its;

- visual appeal,
- garnishes, and
- styles of service.

Visual Appeal

- Food presentation is an important aspect of enticing us to eat.
- Garnishes and decorations can be used to make food look more appealing.
- Food when presented is for visual appeal, such as not to over crowd the plate.

Garnishes

- Are used to add appeal to a dish or food.
- They should add colour, contrast, interest or height to a dish to complement the dish.
- Always add a garnish to a dish after it has been plated.

Styles of Service

- Styles of service are discussed.

Unit 1: Food and Nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.4 Explore nutrition as integral to making food choices.

Topic: Digestion and metabolism

Learning Objective(s): By the end of the topic, students will be able to;

- Determine functions of nutrients in the body.
- Discover underlying principles of nutrition in humans.

Essential Questions:

- What are the functions of nutrients and the underlying principles of nutrition on our diet and health?
- What influences food choice?

Essential knowledge, skills, values and attitudes:

Knowledge	• Food choices and decisions/influences on our diet and health • Nutrients (macro and micro nutrients) • Food metabolism • Functions of food and nutrients in human bodies (e.g. body building / repairing, energy giving, making enzymes / hormones / body fluid, maintain homeostasis of body) • Food metabolism-Functions and metabolism of macro and micro nutrients • Nutrition-related illness • Food tests
Skills	• Investigate the role of nutrition in the human body and factors that influence choices of food consumption
Values/Attitudes	• Be responsible for individual health and wellbeing • Be adaptable to change and make informed choices on food

Teaching and Learning Strategies:

This lesson ground the concepts of food, diet, nutrition and health. The teacher is to incorporate appropriate methods to teach the content of food and nutrients, how food, when digested and absorbed the nutritional functions.
Students must be allowed to research to further understand the concepts of macro and micro nutrients and the metabolism aspect of food nutrients and conduct food tests.
The knowledge prescribed must be taught with appropriate activities. Students must be given opportunity to apply their knowledge on a wide range of food, and also be able to identify and suggest constructive ideas towards solving nutritionally-related problems we face today. Relate their knowledge to the health challenges in the communities they live in.

Introduce to the students the concepts of food and the digestive system. Students need to know and have a full understanding on the journey of food from eating to digestion to the absorption and excretion. Give students opportunity to draw diagrams such as the digestive system. Get students to role play, draw posters, research challenging tasks and collect information from different sources. Students are to deploy their understanding of food, when it enters the human body.

Learning Activities

Lesson 1. Digestion and absorption of food

Activity 1: Define food nutrition, metabolism, digestion, absorption and excretion. Cut and paste where possible. Discuss and summarize each concept.

Activity 2: Draw digestive system and label parts. Learn each part by name and understand the metabolic process that occurs.

Activity 3: Discuss and summarize the functions of each part and evaluate its importance in the functioning of the human body. Do a research on homeostasis of food.

Lesson 2: Function of food and nutrients in the body

Activity 1: Discuss nutrient functions, their chemistry make-up and their sources.

Activity 2: Research and report various food tests conducted to confirm the presence of nutrients.
For protein: The Buiret Test
For Fat: The Ethanol Test
For Starch: Iodine solution
For Glucose: Benedicts solution.

Lesson 3: Nutritional issues affecting diet and health
Activity 1:
1a. Student will define the concepts of Malnutrition and over nutrition and the different forms.
1b: Discuss and analyse causes and effects of nutrition related illness and investigate those problems within our local communities.

Activity 2: Teacher will guide a panel of discussion on food. Students will have the opportunity to evaluate and stress on food knowledge as the basis for good health. Give students the opportunity to critically discuss and identify how nutrition related problems can be solved.

Activity 3: Conduct a survey on nutritional illnesses affecting people in the local community. Compare and contrast various forms of nutritional or diet related illness in our local communities and in the world. Suggest positive ways to address our local health problems.

Content Background

Food Metabolism

We consume food for the purpose of fueling and maintaining our bodies. The body has a fascinating system that handles all ingested material where it carefully breaks down the foods into smaller units.

The Digestive System

What happens to food from ingestion to digestion to absorption to metabolism is fascinating account. How food travels through the body and how the body is able to process it or make use of the nutrients and gets rid of waste products is very interesting. The *alimentary canal* is like a tube through the body along which food passes from the mouth to the anus. **Digestion** involves reducing food and nutrients to their simplest form so that they are able to pass through the lining of the small intestine. For example, proteins are reduced to amino acids, carbohydrates are reduced to glucose, fructose and galactose and fats are reduced to fatty acids and glycerol

Absorption is the process by which the products of digestion pass through the walls of the small intestine or digestive tract into the blood stream or the lymphatic system. The lining of the small intestine consists of many finger-like projections called villi which assist b allowing nutrients to be absorbed more efficiently.

The total or sum changes during food breakdown reactions, the process of nutrient absorption and the building of body tissue as a result, is called ***metabolism.*** Energy is required for all metabolic reactions and the body must remain healthy, if it is to be efficient. This is mainly achieved by the intake of nutrients in food. Humans like all living things must have a regular supply.

Function of food and nutrients in the human body

Nutrition

Nutrition is the study of nutrients in food and their relationship with our body. For good health, a person should have a balanced diet that has the right number of nutrients for the body's needs.

Malnutrition is when a person has an *incorrect* or an unbalanced intake of nutrients which can lead to being overweight, underweight or sicknesses. The body systems cannot defend themselves against bacterial, viral and fungal infections which bring additional suffering.

Nutrition levels

People's health is affected not only by the *type* of food they eat but also by the *amount* of food they eat. *Good nutrition* is about ensuring the body receives correct proportions of nutrients their bodies require. *Over nutrition* occurs when the body receives more nutrients (especially fats and oils) than it needs to carry out its functions. Obesity is an example of over nutrition. *Under nutrition* can occur if not enough food is eaten for the body to carry out its basic functions. Anorexia nervosa is an example of under nutrition.

Eating an imbalance or wrong proportion of food nutrients, can cause malnutrition. *Anaemia* results from a lack of iron and is a form of malnutrition. A person suffering from over nutrition or under nutrition can also be malnourished. Overweight and obese people increase their risk of heart disease, high blood pressure and varicose veins. Sensible dieting, exercise and changed eating habits will help people who need to lose weight.

Functions of food and nutrients

Food: Food is any solid or liquid taken into the body that sustains its functions. Food contains the substances that enable the body to grow, replace damaged cells and function normally. The substances in food are called nutrients. There are many different types of nutrients. Our knowledge of foods and their nutrients helps us to have a healthy diet.

Our body needs nutrients to live. The major nutrients needed by the body include protein, carbohydrates, fats (sometimes called lipids) vitamins and minerals. These nutrients are contained in the food we eat.

1. Protein:

Digestion of protein in the body

The word protein is derived from the Greek word meaning to come first. Protein is made up of amino acids, Amino acids are classified as 'essential and non-essential'. Some proteins are supplied by ingested food while others can be synthesized as the need arises. Proteins are classified further as complete, partially complete and incomplete depending on the amount and type of amino acids they are composed of. Protein is supplied by animal and vegetable foods. Animal protein is considered to be the best at providing complete proteins. Plant proteins when combined correctly can supply essential for tissue growth. *Proteins in foods*: When amino acids in foods like milk, meat, fish, eggs, cereals, pulses and nuts combine to form proteins, these proteins are given names. For example in milk, the proteins are caseinogen, lact.albumin, lact.globulin. In meat, the proteins are myosin, fibrin, albumin, collagen. Digestion of protein in the body: Once ingested or taken into the body, protein foods are broken down by the body's digestion process and absorbed into the blood stream where they are used for various functions.

The functions of protein in the body can be grouped into three main areas:

(i) **Body building:** Protein is needed to build new tissues or maintain existing tissues. The building up and breaking down of cells within everyone's body is a continual process. Protein is also used for the making enzymes and hormones such as insulin, oestrogen, thyroxine, progesterone and adrenalin.

(ii) **Regulating body processes:** This includes movement of fluids and control of acid base balance in tissues.

(iii) **Providing energy:** One gram of protein supplies approximately 17 kilojoules if body consumes insufficient carbohydrate and fat.

2. Carbohydrates

Digestion of carbohydrates in the body

Carbohydrates are the most important, most abundant and least expensive source of energy in the human diet. Foods rich in carbohydrates grow easily in most climates and usually form the basis of the staple diet of a place. Nutritionally, carbohydrates can be classified into three groups, sugars, starches and dietary fiber while chemically; carbohydrates are classified into another three groups, monosaccharides, disaccharides and polysaccharides. Monosaccharides are simple sugars. The main monosaccharides are glucose, fructose and galactose. Disaccharides are double but simple sugars, glucose to form lactose, the sugar in milk of mammals.

During digestion, carbohydrates are broken down into glucose which is used by the cells of the body for energy. Carbohydrates when digested in the body are first converted to the basic sugar unit for use as energy in the body.

Carbohydrate performs other functions in the body but primarily it is the most important fuel the human body needs and it provides 55 to 60 per cent of energy.

Functions of carbohydrate

1. Carbohydrate is used as a source of energy in the cells in the body.

2. Glucose not used by the body as a source of energy is converted into glycogen and is stored in the liver and muscle as an energy reserve.

3. Carbohydrate provides the body with 16 kJ of energy per gram.

3. Fats

Fats are more correctly called '*lipids'* and come from both animal and plant sources. Fats and oils have the same basic chemical structure but their physical appearance differs at room temperature. Fat which comes from animal sources generally provide '*saturated fat'* and should be eaten in limited amounts because of the high level of cholesterol it contains. This type of fat is generally solid at room temperature. Fats which come from vegetable sources are normally liquid at room temperature and are commonly called oils. Vegetable fats generally provide the monounsaturated and polyunsaturated fatty acids which are better sources of dietary fat. Examples of food categories that contain fat include: animal sources, dairy produce, fish, plant foods, nuts and pulses, kernels, fruits.

Digestion of fat in the body

Digestion of fat does not begin until they reach the stomach. However chewing disperses fat into smaller particles and the solid fats are warmed by the body and become liquid as they move from the mouth to the stomach. Fatty food is very satisfying and keeps us feeling full for a long time after a meal. Fat maybe solid or liquid. When we refer to fats as a nutrient in food, we are including both solid fats and liquid oils.

Functions of fats

Fats are the most concentrated form of energy providing the body with 37kJ per gram, more than twice the amount of energy provided by protein or carbohydrate. Fats are an important source of fat-soluble vitamins A, D, E and K. Omega 3 fatty acids are necessary for the development of the brain and retina of the eye. Omega 6 fatty acids are required for the formation of all cells in the body. The main function of lipids is to provide fuel for the body. Apart from the main function, fats provide a reserve supply of energy that the body could draw on during in times of emergency and protects internal organs from shock. Lipids work with other nutrients to perform other important functions such as enzyme reactions and hormone activity.

4. Vitamins

Vitamins are organic substances which occur naturally in very small amounts in food. In the body, they assist all the reactions that help sustain normal functioning. There are two main groups of vitamins: fat-soluble vitamins (A, D, E and K) and water- soluble vitamins (the eight B group vitamins and vitamin C. Most vitamins cannot be manufactured by the body and must be found in food. Vitamins are called micro-nutrients because they are only required in very small amount by the body.

Functions of vitamins in the body

Vitamins are involved in a wide range of essential function including normal cell division and growth, the absorption of other key nutrients, the production of hard and soft tissue, the production of energy, healing wounds and burns, and the development of good eyesight.

5. Minerals

A mineral is an element or a compound that occurs naturally. Like vitamins, minerals are only required in minute amounts in the body which the body uses to assist its functioning. It is important to maintain the correct balance of minerals so as to prevent a deficiency from occurring because deficiencies have varying effects on the body's structure and functioning.

Functions of minerals in the body

The main minerals required by the body are calcium, iron, phosphorus, chloride, magnesium, potassium, sodium, sulphur and zinc. Minerals perform a wide range of essential functions. Calcium is essential for the formation of bones and teeth, iron is essential for the formation of hemoglobin in the blood. Chloride acts with potassium and sodium to maintain fluid balance in the body. Iodine keeps the body fluids at the right concentration. Zinc assists with enzyme reactions, protein manufacture, immune reactions, and formation of the part of bone structure, healing of wounds, cell duplication and in sex cell production in men. Magnesium assists in the making of protein in the body, helps relax muscles and conduct nerve impulses. Fluorine is important for bone development and the prevention of osteoporosis.

6. Water

Water is essential to life and the human body and makes up approximately 60% of the human body weight. We can only survive for a few days without water. We need to drink at least 8 glasses of water each day to replace the fluids lost through respiration, sweating and urine.

Movement of water in the body

Water moves in and out of the cell membranes which are semi permeable and the process is called **osmosis**. Dissolved substances in water like sodium, potassium and chloride create the osmotic pressure which regulates this movement in and out of the cells. If we do not drink enough water, our thirst will trigger hormone action that will cause the kidneys to conserve water by making the urine more concentrated. If we consume more water that we need, our kidney will excrete more diluted urine.

Function of water in the body

Water moves in between cells and regulates the volume. If too much water added, the cells swell and we call the condition **oedema**. But if the cells pump out too much water, the human body may dehydrate and collapse. Water is a chief transporter of nutrients and oxygen into the cells and waste materials needed elsewhere out of the cells. Water acts as a lubricant in saliva, mucous membranes, the gastrointestinal tract and as synovial fluids for bone movement. Water acts a cushion and protects delicate organs from striking against the bony cage in which they are held. Water in the uterus also has this cushion effect on the unborn.

7. Dietary fiber

Dietary fiber, roughage or just fiber refers to substances from plant cells which are not digested or absorbed in the human body. In general, fiber is not classed as nutrients but found in plant foods we eat.

Functions of dietary fiber

Fiber does not build or repair body tissue, does not regulate body processes, does not provide energy but it does affect body functions and must be considered when selecting foods. The main function of dietary fiber is to assist in the movement of food and waste products in the digestive tract. Lack of dietary fiber has been blamed for the cause of many lifestyle diseases from constipation to cancer. The more dietary fiber we consume, the softer and bulky are the waste products that are easily expelled from the body.

Eating habits and nutritional disorders

An unbalanced diet and nutritional disorders can result from poor eating:

Health disorders
Heart disease When one or more of the coronary arteries become blocked with fatty deposits (called artheromas), the oxygenated blood cannot reach the heart so easily, causing the heart to be partially starved of oxygen. A severe cramp-like chest develops. This is called **angina.** But where there is complete blockage in the arteries, no blood will flow through and the affected will suffer a 'heart attack' or **coronary thrombosis.** **Causes:** Increasing age, Hereditary, Smoking cigarettes, Choice of food(high intake of saturated fats), Being overweight, Lack of exercise, Stress, High Blood Pressure.
Obesity (excessive weight gain) Can be caused by hormonal disorders but the major cause is eating more food than the body needs. The excess is stored in the body as fat. Obesity is undesirable and unhealthy as obese people are prone to heart disease, chest infections, varicose veins, hernias, hypertension, diabetes, complications during operations and unhappiness.
Eating Disorders *Anorexia Nervosa:* Affects mainly teenage girls and young women and sometimes boys and young men. A person with anorexia nervosa refuses to eat enough to maintain her body weight for their age and height. *Bulimia Nervosa:* Bulimic patients often have powerful urges to eat very large amounts of food and then often make themselves sick or take laxatives to prevent gaining weight. They may not eat anything for extended periods and are often afraid of becoming fat and have a distorted image of what shape or size they are.
Tooth decay and gum disease Tooth decay and gum disease affect man people worldwide, especially in countries where people often eat foods containing added sugar. Dental caries is the name given to tooth decay. Periodontal disease is the name given to gum disease.
Protein deficiency: Kwashiorkor
Carbohydrate deficiency: Marasmus

Vitamin deficiencies include; Vitamin B – Beriberi Vitamin C – Scurvy Vitamin D – Rickets
Mineral deficiencies include; Calcium – Osteoporosis Iron – Anaemia Iodine – Goitre
Severe dehydration can result to death

Unit 1: Food and Nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences.

Topic: Influence on Food Product Development

Learning Objective(s): By the end of the topic, students will be able to;

- Identify and describe the social, economic and technological influences of food products,
- Describe aspects of food science in relation to social, economic and technological influences.

Essential Questions:

- What are the social, economic and technological influences of food and food products?
- What are the social, economic and technological influences on food science?
- What are the sustainable practices on food and food products?

Essential knowledge, skills, values and attitudes:

Knowledge	• Economic influences on food, food product & food science • Social influences on food, food product and food science • Technological influences on food, food product and food science • Sustainable practices on food and food products; - convenience foods (Tech.) - fast food (Social) - principles of cooking (Tech.) - food packaging (Tech.) • Ingredients in food products - herbs - spices - food additives • Primary and secondary Food processing • Resources and food processing • Food processing and developments
Skills	• Discuss economic, social and technological influences of food, food product and food science • Identify ingredients in food products and investigate the effects in food products • Demonstrate and compare methods of cooking and nutritional content and texture of food exposed to the different methods
Values/Attitudes	• Be open minded to the different influences of food, food product and food science • Be appreciative and consider positive and negative influences on issues related to food • Be caring and concern in dealing with situations relating to food, food product and food science

Teaching and Learning Strategies:

The emphasis is on food product development, being subjected to economic, social and technological influences. The teacher is to be familiar with the content aspects to guide and direct student learning. The teacher will utilise a wide range of teaching and learning methods to teach knowledge, skills, attitude and values in this tropic.

Students are required to participate in all organised learning activities.
Teaching and learning approaches must be aimed at developing curiosity and also encourage research skills to be developed. Students must be encouraged to observed and note changes that influence or provide advancement in food product development. Student must be involved in contributing ideas and decisions-making as they are consumers of food products. Allow for students to explore and investigate processing and production of foods locally and be able to assess and evaluate the economic, social and technological influences in food product development in the local community. Teachers should also research other texts to gather and collate learning noted for students.

Learning Activities
Lesson 1: **What is food processing?**

Activity 1: Define food processing and investigate the purpose of food processing.

Activity 2: Explain and summarise the main differences between primary and secondary processing and identity examples for each type.

Activity 3: Investigate how environmental and applied resources have influenced food processing on the local scale. Study and analyse local case studies.

Lesson 2: Processing and Preservation

Activity 1
1a. Discuss and summarize the impact of food processing, which involves removing heat or reducing temperature of the food to stop or slow spoilage caused by enzymes or microbes – chilling, freezing and freeze drying.
1b. List advantages of foods processed in this way.

Practical task: Blanch beans to ice bath to freezing. Observe and describe results.

Activity 2: Discuss and summarize the impact of food process which involves adding heat. They include pasteurization, sterilization, evaporation and dry heat cooking methods (Baking, roasting, drilling, frying micro-waving.

Practical task: Preserving food – Making Jam

Practical task: Sun – dry, Oven-dry, or micro-wave dry fruit, roughly chopped and compare results. Using the format below

	Method	Time taken	Colour	Texture	Flavour
1	Sun-drying				
2	Oven-drying				
3	Micro-wave drying				

Activity 3: Processing foods using chemicals and fermentation, Salting, Smoking, Jam making, chemical additives. Student can discuss each one in groups and conduct a shop survey. Study 5 food products, Summarize information on the table below. Students discuss the role of ingredients in food processing and communicate the findings.

	Food Product	Packaging Materials	Processing Technique	Old / New Technique
1				
2				
3				

Lesson 3: Food Management

Activity 1: Research and communicate ideas on how food is managed in your local area.

Activity 2: Work in groups and devise a practical plan on how to manage food

Lesson 4: Economic, social and technological influences on food product

Activity 1: Research and compile a report on economic, social and technological influences on food product development.

Activity 2: Work in groups and conduct awareness on economic, social and technological influences on food product development.

Content Background

Food additives

Food additives are defined as those substances deliberately added to foods in small quantities to help keep them longer, to improve their nutritive value, or to change their color, flavor or texture so that foods are more appealing to the consumer. They can be natural or artificial substances added to food. The use of food additives is controlled by food laws of any country. This means that nothing can be added to food unless the regulation permits it. There are general and specific regulations for various foods. Before an additive is allowed to be used in a particular food, the manufacturer must be able to show that there is a technological need for its use. It must also be shown that the additive will not be harmful when it is used.

Additives are not a new concept. Phoenicians have used flavorings way back in 1500 BC and salt used as a preservative for centuries. In recent times, the demand for safer and better quality food has meant that we use more additives than previously. With the growth of food science and better nutrition information as well as more consumer interest in foods, we now know more about different chemicals which can be used to improve our food supply.

Each additive has a specific function and there are hundreds in use today. A standard numbering system was adopted to help consumers know more and accurately what goes into their food. The number of a food additive present is actually included on the label of the product.

Types of food additives

Food manufacturers use various types of food additives to improve their products and thus increase their sale ability. Food additives play a vital role in today's food supply as they allow consumers to enjoy a variety of safe, wholesome and tasty foods all the year round.

Types of food additives	Functions
Preservatives	These are chemicals added to food to prevent spoilage or deterioration by microorganisms Traditional preservatives have been used for centuries and common one are salt, sugar and vinegar. Chemical preservatives are sulphur dioxide used in wineries, vegetable storage, onion preservation, sausages and soft drinks.
Anti-caking agents	These keep powdered product flowing without lumps when poured.
Antioxidants	These prevent fats and oils developing rancidity.
Artificial sweetening substances	These impart sweetening with lower kilojoules than sugar
Colouring	This adds or restores color to foods.
Colour retention agents	This retains or intensifies the color of food
Emulsifiers	These prevent oil and water mixtures from separating into layers.
Flavour enhancers	These substances improve the taste and aroma of food.
Flavourings:	These makes foods more palatable by restoring taste lost during processing and also ensure consistency and uniformity of batches.
Flour treatment agents	These are added to flour to improve appearance and quality of baked products.
Glazing agents	These give a shiny appearance or a protective coating to foods.

Humectants	These prevent foods from drying out.
Mineral salts	These improve the texture of foods.
Stabilizers	These maintain the consistent distribution of ingredients in food products.
Thickeners and vegetable gums	These maintain uniform consistency and improved texture in foods.

Herbs and spices

Ingredients used in food preparation

Nearly all herbs and spices have a history in one culture or another dating back thousands of years.
Papua New Guineans have used spices and herbs well before European contact in food, for medicine, for magical practices and sorcery. In the past, herbs and spices appear to have had two major functions- firstly, they provided flavor and interest to diets that were often taste and flavorless-secondly they were used for medicinal purposes and remedies for a wide range of ailments. Although both dried and fresh herbs and spices are good for us today consumers tend to demand fresh herbs and spices.

What gives spices their flavor?

Herbs and spices provide variety of color, texture, aroma, and flavors that add interest and excitement to meals and food products. Some flavors were apparent in the fresh product such as ginger but others on develop the flavors after drying. The flavors in spices are held in the volatile oils that naturally occur in them.

Spices are the buds, bark, roots, berries and aromatic seeds that are harvested to be used to flavor food. Most spices are grown in the tropical parts of the world.

Herbs are the leaves of plants used in cooking; they add flavor and color to all types of meals including desserts. Herbs are delicately flavored and can be added to food at the end of the cooking process to preserve their delicate flavors. As a rule, herbs added at the end of the cooking process will provide a more distinct flavor while those at the beginning will give a more blended flavor.

Popular combinations of herbs and food are listed in the table below:

Herb	Food
Basil	Pesto, tomato dishes, potato dishes, Asian stir-fries
Bay leaf	Casseroles, stocks, soup, stews
Chili	Chicken, meat, tomato dishes
Ginger	Cakes, biscuits, Asian dishes, Indian curries, fruit desserts, fruit juice
Mint	Confectionery, dessert sauces, meat, yoghurt
Lemongrass	Asian dishes, tea, stir-fries
Coriander	Salads, Asian and Indian cuisine
Garlic	Sauces, stir-fries, soup, marinades, curries and casseroles
Oregano	Marinades, sauces, dressings
Sage	Salads and stuffing
Tarragon	Dressings, flavored vinegars, sauces for poultry, fish, game
thyme	In soups, stuffing and casseroles
Cinnamon	Fruit dessert, baked goods,
Cumin	Curries and Middle East dishes
Turmeric	In Indian curries

It is important to store fresh herbs and spices correctly. Before placing fresh herbs in the refrigerator, wrap them in paper towel and place them in plastic bag. The leaves must be covered. Spices should be stored in an airtight container away from light and heat.

Many herbs can be easily grown in gardens, in pot or hanging baskets. Always choose healthy herbs with a strong fragrance. Avoid using discolored leaves, wilted stacks or sprigs with dried ends. Collect or purchase spices in small quantities.

It really depends on individual tastes as to how much or little herbs and spices are used in food. The mortar and pestle is ideal for grinding whole pieces of spices and herbs as the grinding helps to release natural oils that produce wonderful tantalizing flavors.

Principles of cooking methods

The preparation of many foods involves the application of heat in a certain way. Methods of cooking can be classified according to how heat is applied. For *moist methods*, heat is applied through the *medium* of a liquid such as water, steam, stock, milk, fruit juice, wine or beer. For *dry methods*, heat is applied directly to food. Higher temperatures are used in dry cooking and this has different effects on the nutritive value and physical appearance of the food*. Microwave,* heat is generated by electro-magnetic waves.

Heat is necessary for cooking. It can be transferred from the heat source through to a medium and to the food by radiation, convection or conduction. For example, grilling uses radiation, stewing uses convection and frying uses conduction.

Moist Heat Cooking Methods: Effect on the nutrient content of food

- On *starch*: Moist heat causes the grains to absorb the moisture, swell, burst and softens and food is made more digestible.
- On *Protein:* Moist heat coagulates the protein and changes its colour and texture. During the cooking process, the collagen of the connective tissue in fish or meat is changed to gelatin and the food becomes tender.
- On *vitamins* and *minerals*: Moist heat causes nutritive losses to some vitamins and minerals to occur. Mineral salts, Vitamin B and C will diffuse or dissolve into the cooking water. Long cooking of vegetables destroys Vitamin C and causes undesirable changes to colour, flavor and texture.
- Prolonged cooking and keeping food hot encourages heat destruction on Vitamin C and thiamin.
- Preparation for cooking: Slicing, chopping or shredding increases the risk of vitamins leaching out during cooking.
- Oxidation: Vitamin C is destroyed by heat in the presence of oxygen.

Moist heat methods include boiling, steaming, stewing, casseroling, poaching, braising, slow cookers, mumu and pressure cookery.

Dry Heat Cooking Methods:

Dry heat coagulates or sets the surface of food. Whether it is a starchy food like potato, a protein food like chicken, or a fruit like tomato, the outer surface of the food becomes sealed on contact with dry heat. The inside of the food gets cooked in the natural juices or moisture content that is present. It is important with this method of cooking that the food surface is not pierced with a fork or sharp object to let the juices flow out. If this happens, the inner tissues become dry.

Effects on the nutrient content of food:

- *Fat* when heated, it melts to oil and when overheated, it can ignite.
- *Proteins* are very sensitive to heat. When heated to very high temperatures (e.g., in roasting) for prolonged time, some amino acids may be destroyed and toughening of the *protein* may make digestion difficult.
- *Carbohydrates*- The effect of heat on *starch* and *sugar*. *Sugar* will melt, caramelizes, burns and leaves a black residue. *Starch* changes to dextrin.

Dry heat methods include roasting, baking, and grilling, barbecuing, deep-frying, shallow-frying, dry frying, stir frying.

Food management

Food management is a broad process that involves an in-depth insight and knowledge of food *selection, preparation, presentation* and *preservation.* Food handlers or anyone who works with food can be said to engage in the task of food management.
At home, people who are tasked with preparing meals will evaluate the quality of food on hand, discard items that are no longer fresh and indulge in preparing meals that are tasty, nutritious and visually appealing, the same as those in the hospitality establishments.

Selection:

As a consumer, it is very important not only to know how to cook but to have an understanding of selecting foods. The following points do help in your selection:

- read food label to understand a manufactured product.
- when purchasing fresh foods such as meat, fish and seafood, fruits and vegetables, check for signs of freshness.
- know how to correctly store fresh, frozen and packed foods.
- know how to prepare quick and easy healthy foods.

In Papua New Guinea we have an abundance of organically grown foods and other naturally available food like seafood, fruits and vegetables we can make use of apart from imported foods that are available in shops. When selecting foods, we need accurate knowledge of what we are looking for. For example, the bright red gills of a fish indicate its freshness. We also need to know how to store them and how to maintain quality and nutritional value for as long as possible.

All consumers make judgements on the quality of food they select whether it be for preparation in the home or eating straight away. Our selection of food is assisted by our senses. The information below can be a guide:	
Food	**Some selection tips to help you**
Fresh fleshy foods (meat, game, poultry, seafood)	When choosing cuts of meat, poultry or game, the flesh should have no “off” odour. It should be smooth and free from any slime covering, greenish colour or presence of bacteria. Red meat should be bright pink to indicate quality. Fish that are fresh are identified by bright clear and bulging eyes, reddish pink gills, firm-to-touch flesh and no fishy odour.
Fresh fruits and vegetables	Vegetables should look clear and bright, be firm and free from rot and other dead tissue. Color, size, level of ripeness is uniform. Fruits and vegetables are cheapest in price and in quality when in season.
Frozen foods	When purchasing frozen foods, do not buy: - Swollen-chilled food packages. This could indicate bacterial damage on the inside and could activate upon thawing. - dairy products kept outside a refrigerated cabinet. - frozen foods stored above the load line - frozen food packages containing ice crystals.(evidence of

	refreezing) -frozen food with torn packages.
Canned -bottled foods	Over the best- before dates, blown ends, rusted, dented cans are not suitable for consumption.

Preparation: Food is a vital part of our lives and much of our time is spent in its preparation. The preparation and consumption of food is influenced by;

- interest and motivation of the person preparing the food,
- food knowledge, skills and abilities of the person preparing the food,
- time and facilities that are available for preparing food,
- foods that is available,
- income available to be spent on food Appetite and the desire to eat is also affected by; colour, appearance and presentation of food,
- taste, smell and texture of food, and
- surroundings and atmosphere in which the food is eaten.

Meal preparation and planning has always been part of family life with long and thorough preparation and the whole family would sit down together in a cool and leisurely manner. Given the rapidly changing society and changing lifestyles today, food habits have changed. Factors such as demanding careers, farm work, children minding, illness, advances in kitchen technology, snack foods, fast foods, convenience foods, restaurants and food-take-away shops. Food preparers are spending less and less time in this important area,

Presentation: Food that is well prepared, well cooked and attractively presented is more likely to be chosen and enjoyed. In order for the food to be appreciated and enjoyed, the appetite must be stimulated before a meal in order for the digestive juices too be made ready to receive the food when eaten. Appetite stimulation is influenced by the body senses of sight, smell, touch and taste. Food preparation should take account of these senses and food should be attractive, well cooked and well presented. The first visual impression of a meal are important specifically the food in terms of how cooked, how served, colour pattern, food selection, creativity, flavor, texture, decorations, surroundings and serving equipment.

Preservation: Food is preserved to prevent natural and microbial decay. Traditional methods have been used by indigenous groups of people over man years. Today, food is preserved for the following reasons:

- To add variety to the diet by making foods available out of season.
- To make use of food when it is cheap and plentiful and to store it for later use.
- To vary the diet by preserving food in ways that makes a new product out of the food e.g. making jam.

Why preventing decay, preservation also aims to retain as many of the qualities of the fresh food as possible such as colour, texture, flavor, appearance and nutritional value.

Economic, social and technological influences on food product development

Food products are constantly evolving or changing in design and form as food manufacturers consider past and present changes in society to create new food products. Science and technology, migration, lifestyle, communication, trade and environmental factors are some of the important factors that have influenced the development of food products. With increasing consumer demand and many competing products, food manufacturers conduct extensive market research to review their products. Companies grow by developing and supplying new products. Food manufacturers promote their products using targeted marketing campaigns. People nowadays, are more educated about food, health and nutrition and therefore demand nutritionally balanced food products.

Economic Influences

- **Target market:** Food manufacturers maintain their target markets for the products they manufacture.
- **Import replacement:** A product or ingredient may be produced to replace one that as formerly been imported.
- **Making to order:** *Some products are developed for specific purposes than for health benefits or to meet a general consumer concerns or needs.*
- **Increasing profits:** The main reason why food companies develop food products is to increase their market share so that they increase profitability.
- The export industry and meeting consumer demand.

Social Influences

- **Consumer demand:** Consumer demand change over time for a number of reasons like changing tastes, health and dietary needs, lifestyle changes and environmental impact beliefs. Food manufacturers have to meet and satisfy consumer demands to achieve customer satisfaction and this in turn help food manufacturers to stay in the business.
- **Migration:** Migrants take with them their ethnic selection of food items and introduce them in the new host country.
- **Multicultural influences**
- **Consumer satisfaction:** Food companies recognize the importance of consumer satisfaction. Food bureaus have been established to serve as a venue for consumers to seek advice or lay complaints about food products.
- **Changes in law***:* Food manufacturers are forced to adapt a food product because of changes in legislation.
- **Health concerns:** Increased awareness by telling people of the link between food consumption, good health and prevention of diseases.

Technological Influences

- **Keeping ahead with technology:** There is no standing still in business. In times of rapid technological change, producers have to take advantage of technical opportunities for new product development. Technology in society promotes product development to cater for changes.

- Many developments in food processing technology such as pasteurization, refrigeration, freezing, gas and electric stoves and cookers, microwave cookery Improved.
- Trends in marketing are placing greater emphasis on food product development for example, quality of packaging, product presentation and product graphics for awareness and convenience.

Unit 1: Food and Nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues.

Topic: Food Composition and Energy Metabolism

Learning Objective(s): By the end of the topic, students will be able to;

- discover ways and communicate methods of dealing and meeting nutritional requirements to maintain optimum health and wellbeing

Essential Questions:

- How can optimum health and wellbeing be met by nutritional requirements?
- How do people manage nutritional issues?

Essential knowledge, skills, values and attitudes:

Knowledge	• Food composition table • Food labels • Nutritional requirements • Dietary goals and guidelines - meeting nutritional needs of different age groups in the family - weights - liquid measures - oven temperature • Energy metabolism
Skills	• Investigate food composition tables and read and analyze food labels • Prepare and evaluate the nutritional components of a meal for people with special needs • Measure liquids, solids and convert oven temperatures
Values/Attitudes	• Make informed decisions on food choices and participate in physical activities • Be adaptable to change when discovering ideas of healthy eating and living

Teaching and Learning Strategies:

The emphasis is on food composition and energy metabolism, being subjected to food labelling and meals for special needs. The teacher must be well versed on the content to guide and direct student learning.

Students are required to participate in all organised learning activities. Teaching and learning approaches must be aimed at developing curiosity and also encourage research skills to be developed. Students must be encouraged to observed and note nutrition information, personal health and good food practices that meet individual needs. Student must be involved in contributing ideas and decisions-making as they are consumers of food products.

Allow for students to explore and investigate food composition, labelling, energy requirements and special needs of people and foods available locally. They should be able to assess and evaluate consumers' food choices and needs in the local community. Teachers should also research other texts to gather and collate learning noted for students.

Learning Activities

Lesson 1: Food composition

Activity 1: Research and compile a report on the basic composition of food in relation to what is in the foods, nutrition, health promotion, disease prevention and food production.

Activity 2: Work in group and plan and prepare a nutritious recipe for a particular age group.

Lesson 2: Food labeling

Activity 1: Research and communicate ideas on the importance of food labeling.

Activity 2: Work in groups and develop a food product to market. Ensure that the label of the food contains information to help consumers make food choices.

Lesson 3: Energy metabolism

Activity 1: Research and summarize in a report on the process of generating energy from nutrients.

Activity 2: Work in groups and develop awareness tools on the importance of eating healthy food.

Lesson 4: Meals for special needs

Activity 1: Work in groups to plan a meal for special needs.

Activity 2: Work in groups to prepare the meal as planned activity 1.

Content Background

Food Labeling

Labels are part of food packaging. They have information that will help consumers select the products they want to buy. Without labels, we would not know what is inside a package. The label carries important information to the consumer from the manufacturer about a food product such as instructions on how to consume a product, nutritional composition, bar coding, methods of disposal. Food labeling is controlled by food laws as the laws prescribe or dictate words that should or should not appear on labels.

Food labels carry useful information which helps people make choices about their food. By law, all products that are not weighed and packaged in front of you must have the following information:

- Name of the food.
- Name and address of the business.
- Country of origin.
- Weight or measure of contents.
- List of ingredients.
- Food additives.
- The use-by date or best-before date.
- Identification of packaging premises and job lot.

The following information may appear on a label:

- Bar codes.
- Storage suggestion.
- Serving suggestion.

The following information must not appear on a label:

- Anything false, misleading or deceptive.
- Any claim that a particular food is able to cure a specific illness or disease.
- Any statement that the food is a slimming food or has weight reducing properties.

Energy metabolism: the need for energy

The body needs energy to keep normal body processes going, to build body tissues and to carry out physical activities. The amount of energy which the body requires varies and depends on age and sex of person, the climate, body mass or size, occupation of a person and a person's state of health.

Energy is produced in the body in the tissue cells when carbohydrates, fats and proteins are burned or *oxidized* It is possible to measure the amount of energy a certain food will produce when it is eaten.

Note the amount of energy supplied by each of the energy-producing nutrients:1 gram of carbohydrate provides 17 kilojoues,1 gram of fat provides 38 kilojoules and 1 gram of protein provides 17 kilojoules. Energy is produced in the cells, and there are many different types of cells for various functions.

All cells require proteins to grow and energy nutrients to provide energy to carry out their functions, this means that chemical reactions are occurring all the time in the body cells generally referred to as metabolism and consists of:

(i) Breaking down food nutrients or **catabolism** and releasing energy.
(ii) Building up new units in cells or **anabolism** which uses up energy.

The activities we do require different amounts of energy. The more activity you do, the more energy your body will demand. The rate at which this energy is utilized by the body is the **Basal Metabolic Rate (BMR)** and the BMR is the smallest amount of energy required by the body to keep its normal processes going even while at rest or lying down. The BMR of an average man is 300 kJ per hour, an average woman is 250 kJ per hour and average teenager is 230 kJ per hour.

Meals for special needs

Our food needs change at various stages of or lives and factors that influence these changes include age, gender, state of heath, degree of physical activity and our physical being. From conception to old age, our bodies use the nutrients in differing amounts for growth, repair and to keep us healthy.

Each stage in the life span has specific dietary considerations.

Stage in life	Dietary considerations
Pregnancy	The need to increase the intake of protein, Vitamin C, folate, B group vitamins, calcium and iron to build new foetal tissue, growth of the placenta, and breast tissue, for an increased blood supply, bone growth, and formation of tooth buds. Plenty of fluids should be taken except alcohol.
Lactating women	Nutrient needs, especially for carbohydrates, vitamins and minerals increase to provide milk for the baby. A wide range of nutritious foods should be provided.
Infants: Babies	They grow so rapidly and so require a diet high in energy, protein and calcium, to sustain the growth of bones and soft tissue. Infants double their weight in the first six months and triple it by their first birthday. Sweet and salty foods should be avoided. A variety of foods with different tastes and textures should be introduced after 3-6 months as well as milk.
Infants: Toddlers	Aged 2 and 4 years: Growth rate slows slightly and more active. A good supply of protein, vitamins, and minerals is needed, smaller amount of fats and carbohydrates for energy. A variety of foods should be introduced.
Children:	Aged between 5 and 11: quantity of food needed depends on the child's size and activity. Diet structure is very similar. Their intellectual and social growth is quiet fast in comparison. Children need a diet that provides sustained energy to prevent fatigue and allow them to maintain concentration at school as well as keeping them energetic and healthy. Healthy eating habits should be encouraged.
Adolescents and Teenagers	From 12 to 18 years: more growth into young people and a period of high physical activity. High intake of nutrients for energy, protein, vitamins minerals and high calcium diet and to exercise regularly. Care should be taken that adolescents do not over eat or diet unwisely.
Adults	Well balanced diets is needed to provide adequate nutrients (protein, vitamins, minerals, fiber, energy, calcium) for maintenance and repair of all body tissues and energy for physical activity. Women should ensure that their iron and calcium needs are met.

Late adulthood (elderly)	Adults to maintain an active lifestyle in leisure activities like swimming and gardening, maintain good health and nutrition and communication. Sometimes, people don't eat well because of tooth problem or lose interest due to loneliness. Diet considerations for the elderly: cut down on sweets, meals to be high in protein, vitamins, minerals, energy, and fiber. Overall, a variety of foods should be eaten.

Unit 1: Food and nutrition

Content Standard: 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark: 9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment.

Topic: Food Product Development

Learning Objective(s): By the end of the topic, students will be able to;

- produce and evaluate food items applying food product development processes.

Essential Questions:

- What are the different design processes to create food items?
- How is a food product developed?
- How do we evaluate food product processes?

Essential knowledge, skills, values and attitudes:

Knowledge	• The types of product development • The process of product development • The design process • Market research • The design brief • Analysis of a new food product • Sensory analysis
Skills	• Plan and design types of product using the design process and product development process • Evaluate and analyze food products
Values/Attitudes	• Be confident in using the design process to create food items using various techniques and food preparation equipment • Handle equipment and tools with care

Teaching and Learning Strategies:

The emphasis is on food product development, being subjected to project based learning using the design process. The teacher is to be familiar with the content aspects to guide and direct student learning using the design process.
The teacher will utilise a range of teaching and learning methods to teach knowledge, skills, attitude and values in this tropic.
Students are required to participate in all organised learning activities. Teaching and learning approaches must be aimed at developing curiosity and also encourage research skills to be developed. Students must be encouraged to observe, make decisions, think critically and practice the processes of designing or making a product using the design process. Student must be involved in contributing ideas and decisions-making as they are consumers.

Allow for students to explore and investigate food development processes, market needs, special needs of people, nutritional value of food and the types of foods available locally. They should be able to assess and evaluate consumers' food choices and needs in the local community. Teachers should also research other texts to gather and collate learning noted for students.

Learning Activities

Lesson 1: Introduction to food product development

Activity 1: Students participate in a group discussion and share their thoughts and ideas on potential problems, gaps and opportunities in their local community, related to food product development that they might like to solve.

Activity 2: Students spend time together in pairs or groups thinking up as many ideas as possible for food product development project that solve the problem they're working on. Decide amongst their group which ideas are your strongest to create a shortlist.

Activity 3: Brainstorm different food products. How do we create a new innovative product for our community?

Lesson 2: Design process

Design Thinking is a 5-step process of designing a product to solve a problem or meet a need. The process starts with the customer's wants, needs or problems and works backwards to design a product that solves that problem or meets that need.

Look at the 5 stages of the design process. Identify who we are creating a product for;

1. Empathise - earn about your target customers and speak to them to find out what their wants, needs and preferences are.
2. Define - choose a specific problem to solve with your business / product idea.
3. Ideate - brainstorm a range of possible product design solutions to solve this problem.
4. Prototype - make a sample (also called a mock-up) of your strongest product design so you can test whether it works and people are willing to use it.
5. Test - share your prototype with target customers for their feedback.

Students learn what Market Research is and why it is important to the success of product design.

Market Research - Is asking your customer what they think of your product and studying your competitors to see whether you can make your product better than theirs.

Share the following terms and definitions on the display board:

- Empathise - observe and engage with your target customers and put yourself in their shoes, to understand them better.
- Insights - Unique and meaningful pieces of information or unexpected details about target customers that help you understand them better, so you can design products to specifically meet their wants and needs better than competitors.
- Validation - Collecting evidence from target customers that they're interested in your product and likely to buy it.

Share through discussion with student the purpose of market research:

- Identify potential new customers.
- Learn more about existing customers.
- Inform their decisions regarding existing and new products or services.
- Better understand their competitors.
- Test new markets.
- Identify performance, pricing or promotion opportunities.

Target Customer Survey Example

Teaching Note: Students will be focusing their market research on target customers to clarify their wants and needs, collect insights and validate their business ideas.

- Direct students to go to page 16 of their workbook.
- To prepare them for producing a survey to conduct their own market research

Encourage students to ask questions to clarify.

Before they create their own survey and do market research in the next lesson, it is a good idea if students practice talking to people about their product ideas and ask for feedback.

If there is time, ask them to interview 3 people (ideally target customers if possible) – family, friends, teachers, neighbours, peers from other teams in the class etc.:

- Explain their business idea
- Ask for feedback – positive and negative

Note: Only conduct the survey with people they know and they should have adult permission to do research with other people.

Lesson 3: Design brief

Scenario or context: Preparing a nutritious drink for a breastfeeding woman

Using a design brief to create a new product `

Activity 1: Read the design brief, understand the scope of content, knowledge, skills, attitudes and values involved. Delegate responsibilities.

Activity 2: Implement/ carry out all tasks as required.

Activity 3: Do ongoing evaluation throughout the process of developing the product. Keep notes about problems and how they were managed so that choices and decisions can be justified.

Lesson 4: Evaluate the new product

Write honest comments about the product you prepared:

- Does our product meet the specifications of the design brief?
- Was the drink suitable in terms of taste and flavor for a nursing mother and why?
- Was the product prepared hygienically?
- Were the equipment and technique used appropriate?
- Was the drink tasty and well presented?
- How could your product have been improved?

Activity 1:

1a. Conduct a general presentation session based on all comments. Consider suggestions and compile for further improvements.

1b. Write an evaluation and take further steps where necessary.

Activity 2: Brain storm ideas and compile recipe books based on local foods for children, pregnant women, lactating women and the sick and invalids. Use the design process to prepare nutritious meals for people with special needs.

Activity 3:

3a. Conduct food and nutrition and health talks in our neighboring community.

3b. Demonstrate cooking methods and nutrition messages to the near-by communities.

Content Background

Introduction to food product development

Product development is the lifeblood of the **food** industry, from refining an existing product or by developing a completely new **product**. Every year new products are developed even when supermarket shelves are stacked to overflowing, and food shelves are stocked to the rafters with more and new food products. Are we never satisfied? Companies grow by developing new food products and to capture a share of the market, and increase income. Consumer's needs, demands and wants are changing within a society and the push for product development is more than a desire to keep up with the 'new'**.** **Product development** takes place in stages where creativity and the principles of **food** science are applied-the physical, chemical, and microbiological composition of **food**, **food** quality, **food** safety, and **food** processing. Companies devote large quantities budgets to **developing** new **products** in order to stay competitive, and satisfy consumer demand. Changes in the law can force **food** companies to alter their **products**.

Reasons for new food product development

1. Consumers often become bored with products and are quickly distracted by new products. For a company that continues to market 'the same old thing' this distraction could mean the loss of profits as consumers spend their money elsewhere.
2. Companies devote large quantities budgets to **developing** new **products** in order to stay competitive, and satisfy consumer demand.
3. Changes in the law can force food companies to alter their products. Sometimes the changes required may be relatively minor, such as a labeling requirement (for example declarations that the product may contain traces of nuts), but sometimes food companies can be required to alter the content of a product, for example to remove certain additives from certain foods.
4. New and efficient technology in the food processing industry can boost the development of new food products.
5. Environmental concerns can influence the processes involved in the making of food products.

In Papua New Guinea, new food products are flooding our supermarkets and food outlets. The challenge is on us also to design and develop new food products and expand the food processing industry in our country. New products can be developed b imitating ideas from overseas and producing them local in PNG. This has happened with the local production of varieties of tinned fish, tinned meat, bakery items, noodles, soft drinks, ice cream products, soft drinks and laundry soaps and powders. Alternately we can design and produce *brand new food products* or *novel foods'* that are uniquely ours.

The production of food products can be manual or automated. Papua New Guinea over the years has embraced the concept of having to manually produce new food items like rice, honey, noodles, jam, herbs and spices and fruit juice. Other food products in Papua New Guinea are manufactured from our local food industries and are available on the supermarket shelves.

Design brief

Based on the results of an investigation or research, a design brief will be prepared and will outline the aim or intent of a food development project The design brief will specify what is to be achieved, clarifies specific materials to be used in the product, the method of processing and the market to which the product is to be promoted. Some examples of food development projects showing the aim of a new product development:

- To design a sweet snack pack that would appeal to teenagers to be sold in the school canteen.
- To design a healthy drink for an elderly women in hospital who has problems eating solid food, to be sold in the hospital canteen.
- To design nutritious thick soups that would appeal to male adults, to be sold in the village trade stores.
- To design a savoury, vegetarian snack food that would appeal to children, to be sold at the local market.

Analyze the design brief

When analyzing a design brief, it is important to pick out the key words such as sweet, snack, sold in school canteen. These key words will be referred to when doing product assessment to see if it meets the needs of the design brief.

Gather research information and investigate ideas:

Design process

Steps in developing a new product

- Establish a design brief for a new product, outlining the aim of the project. Keep the design brief simple in order to fulfill the original product aim.
- Ideas stage: Gather research information and investigate, screen and evaluate ideas.
- Produce specification for the development of the new product.
- Plan and make products.
- Check on quality of product.
- Evaluate.

Sensory analysis*:* A very important part of food product development is sensory analysis. This is used to produce, measure, examine and explain people's reaction to a food through the senses of smell, sight, taste, hearing and touch. Both trained and untrained assessors examine and eat various food samples. The samples may differ from each other by having more or less salt, darker or lighter color or more or less fat. The assessors record their observations in two ways:

- Hedonic descriptions: by describing their likes and dislikes. For example food might taste horrible, delicious, tasty, and unpleasant or looks appetizing.
- Sensory descriptions: by describing food texture, mouth feel, taste, appearance and smell For example food is crisp, crunchy, fruity, smooth, greasy, sweet, watery or sour.

All test and research results are carefully analyzed and the future of a product is decided on whether to be improved or withdrawn from retail outlets as a sale item.

Unit 2: Food Science

Content Standard: 2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands. (e.g., health, occasions, lifestyle, business)

Units	Benchmarks	Topics	Lesson Titles
2.Food Science	**9.2.2.1** identify and discuss the cultural, physical, chemical and nutritional characteristics of food and impact in product development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	**Lesson 1:** Cooking methods in food product development
			Lesson 2: Physical and biological properties of cereals, vegetables and fruits
			Lesson 3: Physical and biological properties of legumes, fats and oils
2.Food Science	**9.2.2.2** Describe the nutritional and sensory characteristics of food selection, meal preparation, product development, storage and preservation	Sensory characteristics of food	**Lesson 1:** Sensory analyses of food
			Lesson 2: Nutritional functions of food
			Lesson 3: Functional foods
2.Food Science	**9.2.2.3** Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management	**Lesson 1:** Food management
			Lesson 2: Trends, fashion and food
			Lesson 3: Seasons and food
2.Food Science	**9.2.2.4** Explore safety and hygienic practices relating to food, and changes that occur in the functional properties of food	Food safety and hygienic practices	**Lesson 1:** Food borne diseases
			Lesson 2: Contamination
			Lesson 3: First Aid
2.Food Science	**9.2.2.5** Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption	Factors influencing food processing and packaging	**Lesson 1:** Factors that influence food processing
			Lesson 2: The role of food packaging
			Lesson 3: Developments in packaging and distribution
			Lesson 4: Techniques to evaluate products and processes

2.Food Science	**9.2.2.6** Apply the design process to create food solutions	The technology design: Design, produce, market and evaluate	**Lesson 1:** Design brief and the technological process
			Lesson 2: Using a design product to create a new product
			Lesson 3: Evaluate the new product

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.1 Identify and describe the cultural, physical and biological nutritional characteristics' of food that influence food development.

Topic: Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils

Learning Objective(s): By the end of the topic, students will be able to;

- Investigate and evaluate the cultural, physical and biological characteristics that influence food development.

Essential Questions:

- What are the characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils?
- How are foods affected in cooking or in food processing?

Essential Knowledge, Skills, Values and Attitudes:

Knowledge	• Physical, chemical and biological properties of food - cereals and vegetables - fruits and legumes - fats and oils • Cooking methods and effects on how these foods are affected in cooking or in food processing - dextrinization - gelatinization - caramelization - crystallization
Skills	• Research on the physical, chemical and biological properties of food • Analyse and evaluate cooking methods and effects of food product development • Create food products and communicate their properties and characteristics
Values/Attitudes	• Make informed decisions on food product development • Appreciate the physical, chemical and biological properties of food • Being responsible of the different cooking methods and the effects of food product development

Teaching and Learning Strategies:

The teacher is encouraged to introduce the topic and divide it up into lessons identifying which lessons will be theory lessons and which of them will be practical lessons. The lessons should promote the design process and problem solving approaches. The students are encouraged to apply what they learn in real life situations. The lesson activities are hands on activities and the teacher is required to guide and closely supervise students. The learning strategy is enquiry and project based approach.

Learning Activities

Lesson 1: Cooking methods in food product development

Activity 1: Toast a piece of bread. Note and describe the colour before and after toasting. Describe the taste of untoasted and toasted bread. Give a verbal report to our class.

Activity 2: Add a little water to half cup of sugar and sliced onions and heat until it turns brown. You have made caramelized onions. Explain what had happened to the sugar and water and onions. Research on ways to serve caramelized onions and report to class.

Activity 3: Practical Activity suitable for Assessment or group work in cooking lesson.
Investigation: Starch gels
You will need: - 4 saucepans
- 2 cups of water
- 1tablespoon of the following thickening agents: (plain flour, corn flour, arrow root, custard powder)
- 4 large plates (labelled with each of the thickening agents used)
- Stove hot plates

What you do?

i) Blend each of the thickening agents with half (½) cup of water in a saucepan. Stir over heat until the mixture thickens and boils. Pour onto the plate.
ii) Record your observations in the table below.

Observation	Plain flour	Corn flour	Arrowroot	Custard powder
Colour (e.g. clear, greyish, white, opaque, transparent)				
Consistency of gel while still warm (e.g. sticky, soft, firm, runny, very firm)				
Consistency of gel after chilling. (e.g.) runny Sticky, soft, firm, very firm				

What did you find out?

i) Which agents produced the finest gels?
ii) List some recipes require a firm gel?
iii) What dishes need a starch gel that is thin enough to pour?

Lesson 2: Physical and biological properties of cereals, vegetables and fruits

Activity 1: Research and summarize the biological importance of cereals.

Activity 2: Discuss about the physical properties of vegetables and fruits.

Lesson 3: Physical and biological properties of legumes, fats and oils

Activity 1: Research and summarize the biological importance of legumes.

Activity 2: Research and work in groups to characterize the physical properties of fats and oil.

Content Background

Technological change in food processing

Most of the foods we eat today have been processed in some ways. Processed food is raw food which has been subjected to one or more processing techniques from where food is obtained to the consumer's table. In earlier days and in rural areas in PNG, people do their own processing such as drying, smoking, milling and packaging based on simple ideas and low level technology. Today much of the food processing is done in factories, although modern processes are yet based on traditional principles, the technology and machinery used and methods of distribution and storage are quite different.

Purposes of food processing

Generally foods are processed to increase their storage life and to prepare them for serving. Some foods are minimally processed while others are very highly processed. The purposes of processing are:

- To preserve foods to be kept for a longer time.
- To allow foods to be transported without damage.
- To give variety to the diet.
- To increase choices for consumers.
- To make foods safer for consumption.
- To save time and energy for home food preparation.
- To enable seasonal foods to be enjoyed all year round.
- To improve the nutritional value of some foods.
- To meet the special needs of large organizations.

Preparation methods in food product development

Food actions and reaction

Food actions and reactions refer to the functional properties of specific foods. As well as having a nutritional role, the macro-nutrients have functional roles in food. The cause foods to react and perform in certain ways: a property that is very important when cooking food and combining with other substances. It is because certain foods react in certain ways, it has been possible to create many and varied food products, both in the home and in the factory.

How does processing affect the properties of food?

Food processing in factories or homes causes changes to take place in foods. During processing, the properties of foods are altered and in some instances, new products have been developed to balance these changes.

The functional properties of food include a number of *physical* and *chemical changes* that occur during storage, preparation and presentation. Functional properties must be well understood as they affect greatly the way foods are selected, stored, prepared and presented. The functional properties include such reactions as;

- browning reactions (caramelization, dextrinization, enzymatic)
- crystallisation
- emulsification
- gelatinization
- denaturation and coagulation
- aeration

Gelatinzation: Gelatinization occurs when dissolved starch cells in the presence of heat, producing a thick paste. Recipes based on the use of starch foods, such as sauces, cakes ad gravies depend on the gelatinization of starch for their consistency. The starchy substance in the recipe is known as the thickening agent, flour, rice, cornflour, sago or arrowroot. The starch is blended with a separating agent, either a solid (e.g., sugar, powdered milk) or a liquid (e.g. water, milk or melted fat) to keep the starch grains apart so they don't stick or clump together. The blended starch is then added to the liquid to be thickened and the mixture is heated. The liquid must be stirred while heating to avoid clumping of the starch grains. During heating, the liquid softens the cell wall of the starch grain, the cell wall bursts and the starch inside starch to absorb the liquid. This causes the starch to become bigger so that the liquid becomes a gel. This will happen just below boiling point at about 90 degrees Celsius.

Dextrinization: Dextrinization is a browning reaction that uses moist heat methods of cooking. When starch is cooked by dry heat methods, such as in toasting bread, it undergoes a process known as 'dextrinization'. The starch is changed to 'dextrin' which is sweeter and brown in colour.

Caramelization: Is a browning reaction on sucrose when sugar is heated on its own when heated to about 160 degrees Celcius, it melts, giving off water and the liquid browns. This is called 'caramelization' and it is useful in many recipes including toffee, caramel sauce, caramel and fruit cakes and caramel onions.

Enzymatic browning: When certain fruits or vegetables are cut or bruised, the tissue exposed to air quickly darkens

Denaturing and Coagulation:

The processes involved in food preparation causes a permanent change to take place in the nature of protein. It is because these changes cannot be reversed. The protein is said to be 'denatured'. This change in chemical structure occurs when the protein, is heated, agitated, or combined with acid or alcohol. When foods containing protein are cooked, the heat causes the protein to turn from a liquid to a solid through a process called 'coagulation'. For example, when an egg is fried or poached, the white and yolk both set firm and change colour. It is because of coagulation that eggs are often used to thicken sauces, custards and desserts, and to bind ingredients together in rissoles or meat loaves.

Aeration: Agitation, such as beating or whipping an egg white, traps air and as the protein is denatured, a foam is formed. The aeration property of egg protein is important in meringues, soufflés and sponge cakes. Fats are also able to tap air within their structure but are not referred to as foam. Fat is usually beaten with sugar as an aerating agent. The aeration property of fat is useful when making butter cakes, butter cream and icings.

Shortening: Fats are used in pastries and other baked products to make them tender. In such recipes, the fat is referred to as 'shortening', because it surrounds the gluten strands in the mixture and prevents them reacting with liquids which could cause the gluten to toughen. Unsaturated fats are the best forms of shortening for food preparation.

Emulsification: Emulsions are prepared by mixing oil and water. To allow these two substances to remain mixed, a third substance must be added. Such a substance is called an '*emulsifier or emulsifying agent'.* Egg yolk is an excellent emulsifying agent.

"Oil and water do not mix" goes the saying but emulsions are an exception. An emulsifying agent 'lecithin' in egg yolks can hold water together to form an emulsion. Commercial food suppliers have developed a range of emulsifiers for the food industry Emulsions form the basis of products like mayonnaise, salad dressing and other sauces.

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.2 Describe the nutritional and sensory characteristics' of food to meet the needs, health and occasions.

Topic: Sensory Characteristics of Food

Learning Objective(s):

By the end of the topic, students will be able to;

- Examine and communicate the importance of sensory assessment of food to a consumer or a food manufacturer and identify factors such as meeting their needs, health and occasions.

Essential Questions:

- Why is the sensory assessment of food important to a consumer or a food manufacturer?
- What are the senses involved in the evaluation of food for consumption?
- Why are sensory assessment tests important to the food industry?
- Why are nutritional and sensory characteristics of food important to meeting different needs, health reasons and occasions?

Essential Knowledge, Skills, Values and Attitudes:

Knowledge	• Sensory descriptors (taste, smell, touch, sight, sound) • Sensory assessment of food (flavour, appearance, aroma, taste, texture) • Food sensory analyses test and ranking • Nutritional functions of food to meet the needs, health and occasions • Functional food
Skills	• Investigate types of sensory descriptors and the nutritional and sensory assessment of food • Analyse food sensory test and ranking • Create, communicate and evaluate nutritional functions of food to meet the needs, health and occasions
Values/Attitudes	• Appreciate the importance of nutritional sensory assessment tests in the food industry • Being responsible of food choices to meet the needs, health and occasions • Make informed decisions on food sensory analyses test and ranking

Teaching and Learning Strategies:

The teacher is encouraged to introduce the topic and divide it up into lessons identifying which lessons will be theory lessons and which of them will be practical lessons. The lessons should promote the design process and problem solving approaches. The students are encouraged to apply what they learn in real life situations.

The lesson activities are hands on activities and the teacher is required to guide and closely supervise students. The learning strategy is enquiry and project based approach.

Learning Activities
Lesson 1: Sensory analyses of food

Activity 1: Write in your own words a description of sensory assessment of food.

Activity 2: Why is the sensory assessment of food important to a consumer or a food manufacturer?

Activity 3: Name the senses involved in the evaluation of food for consumption.

Activity 4: Why are sensory assessment tests important to the food industry?

Lesson 2: Nutritional functions of food

Activity1: Research and tabulate all principle mineral elements and trace elements according to functions, food sources and deficiency diseases.

Activity 2: Describe the chemical composition of proteins, differentiate between essential amino acids and non-essential amino acids and define the concept “biological value of protein”.

Activity 3: Differentiate between fats and carbohydrates; illustrate in diagram form the chemical structures of saturated fats, mono unsaturated fats and poly-unsaturated fats.

Lesson 3: Functional Foods

Activity 1: Define concepts: Designer foods, Probiotics, Pharma foods, Food aceuticals, Nutraceuticals, Medical foods.

Activity 2: Define ‘**oligosaccharides**’ and describe its characteristics. Name the country this concept originated from.

Activity 3: Conduct a survey in food stores and other retail outlets, record and analyze functional foods and prepare a presentation report to educate others in your school.

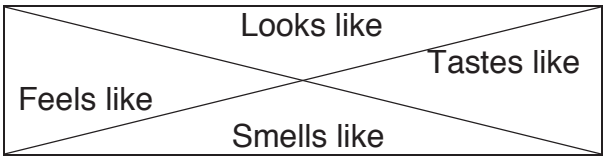
Content Background

Sensory analyses of food

Food designers may evaluate their products by having a panel of people to taste-test the food. One evaluation tool is a sensory evaluation test that judges the quality of food products. This means that a tester uses four of their senses- sight, taste touch and smell - to evaluate the success of a product. The table lists some words that might be used in a sensory evaluation.

Looks	Taste	Feels	Smells
colorful	bitter	greasy	fruity
golden	bland	hard	sweet
well shaped	burnt	crisp	spicy
well risen	creamy	doughy	yeasty
uneven	tangy	sticky	mild
undercooked	sweet	lumpy	strong
glossy	sour	grainy	milky
dull	strong	smooth	sour
cloudy	sharp	runny	rancid
clear	spicy	creamy	garlicky
curdled	salty	crunchy	pungent
dark	oily	soft	unpleasant
fresh	tart	coarse	acid

A useful way to record information from a sensor evaluation is to use an X- chart. The four 'arms' of the X are divided into four senses: looks, tastes, feels and smells. Around each of these arms, you can record the results of our sensory evaluation.



Sensory Assessment of Food

Every time food is eaten, a judgment is made either consciously or unconsciously using our sensory organs. These organs of the body detect appearance, odour, taste and texture of food. Most judgments of food quality are described below;

Flavour: Flavour is considered to be the total sum of taste and odour together with appearance and even the sound of food. Flavour is the total sensory impression formed when food is eaten and is probably the most important factor motivating food choices. The flavour of food is often important in determining the price of food.

Appearance:The initial appeal of food is mainly attributed to appearance as food manufacturers and chefs spend so much time and energy crafting of foods that look appealing. Before we smell or taste the food, it is the look that entices us to eat it. Our eyes perceive the size, shape and colour of food and other such characteristics as transparency, dullness, opaqueness and gloss. These attributes all contribute to the overall appeal of the food.

Colour plays a major role in our perception of food. The colour of any food serves as a guide for judging its quality and indicating any deterioration or spoilage. For example, fruits are judged by their colour to indicate state of quality whether fresh or bruised. Colour is also used to judge the level of cooking of foods like meat and its level of doness.

Aroma: Aroma is a sensation closely related to taste. The sense of smell is far more acute than the sense of taste. Aroma is detected through tiny, sensitive receivers in the upper part of the nose. People differ in their sensitivity and detection of odours. For example people suffering from cold often complain about losing their taste for food because they cannot smell it. Food odours must first exist as gas in order to be smelled and food odours can be influenced by temperature, hot foods therefore have stronger odour than cold foods.

Taste: Taste sensations originate when taste receptors or taste buds which are distributed in the mouth are stimulated. Taste buds are specialized; each group detects a specific taste sensation. There are four fundamental taste sensations: sour, salty, bitter and sweet. The taste buds detecting sour are distributed along the sides of the tongue those reacting to salt are on the sides of the mouth and tip of tongue, those reacting to sweet at the tip of the tongue and those responding to bitter are at the back of the tongue. To have taste, a substance must be dissolved in liquid or saliva to stimulate the nerve endings in the taste buds. It is believed that taste buds never tire but taste sensations get lowered as one continues to eat a particular food. Common experience verifies the impression that the first bite of food is usually the best. Different taste also compliments or counteracts each other for example sugar can decrease saltiness and salt can decrease sweetness. Bitterness is the least pleasurable, caffeine is often said to smell better than it tastes. Sugar reduces the sourness of acids and makes hot curries mild to the taste.

Texture: Texture in food is defined in many ways however it is the 'mouth feel'. Generally, texture is the physical structure of the food, the surface appearance and the way food feels as it is handled in the mouth. These elements influences the way food is seen by the eye and when put into the mouth for chewing. People often refer to positive qualities of food such as being 'moist or creamy'. Even though the colour, taste and odour of food is acceptable, a food can be rejected on 'mouth feel'. Food texture and consistency are very important. Strawberry for example, once frozen and thawed, the structure of the fruit is broken and a 'mushy' texture becomes obvious and can be rejected even when strawberry natural has good colour, aroma and taste.

We need food for body growth and repair, energy, warmth, protection from disease and to regulate the body processes. Without food, the body cannot carry out these functions. It is not the quantity of food that matters but what the food contains.

The food we eat passes into the digestive system which acts like a processing plant breaking the food down into its component parts so that the processes of warmth and energy provision, body defense and regulation and building block mechanisms can be continued daily.

These component parts of food are complex substances called **nutrients.** The six nutrients contained within foods are:

- Proteins
- Fats
- Carbohydrates
- Vitamins
- Minerals
- Water

Each nutrient performs a variety of functions within the body and many nutrients depend on each other to work properly. Each type of body cell requires specific nutrients to build, repair and reproduce itself, for example protein is required in the maintenance of body cells, carbohydrates and fats are required to provide energy for the physical and chemical changes which take place within the cells, calcium is needed for bone cells, iron is needed for blood cells, and so on.

Some facts about nutrients

- Each nutrient is made up of molecules which in turn are made up of a complex arrangement of chemical elements, for example carbohydrates are made up of carbon, hydrogen and oxygen.
- Organic nutrients are those that contain carbon and they are protein, carbohydrates, fats and vitamins.
- Inorganic nutrients consist of *mineral elements* for example iron, calcium and iodine. Many foods contain inorganic elements. Since most elements are only needed in small amounts, it is not likely that a deficiency would occur when a balanced diet is consumed. However, care must be taken calcium and iron in particular is in adequate supply.
- Each nutrient has one or more functions in the body.
- Nutrients are needed by the body in small amounts which vary according to a person's age, activity level, sex and state of health. The estimated intake of nutrients required for good health is referred to as the Recommended Dietary Intake (RDI).
- The term mineral is used in nutrition to mean any element required by the body other than carbon, hydrogen, oxygen and nitrogen.
- Nutrients which are required in large amounts are called **macronutrients**. Their RDIs are measured in grams (g). Those needed in much smaller amounts, for example vitamins and minerals are called **micronutrients** and are measured in milligrams (mg) or micrograms (ug). (Note: 1 gram =1000 milligrams, and 1 milligram = 1000 micrograms).Most foods including milk and eggs, contain several different nutrients however, some foods for example sugar contain just one nutrient.
- The lack of essential nutrients in the diet causes **deficiency symptoms or deficiency diseases.**
- Cooking and processing of foods often affects the nutrient content; for example, deep frying foods increase their fat content while boiling vegetables reduces their vitamin C content. Other foods for example breakfast cereals or rice are sometimes enriched to compensate the loss of nutrients during processing.

Functional foods

A functional food or special-purpose food is a food which has been modified to serve a role other than satisfying nutrient requirements. Functional foods have been designed for therapeutic (treating or curing disease) or prophylactic (protecting from or preventing disease) effects to raise the health standard of a population.

Each food has been designed to have a specific biological reaction in the body providing a health benefit beyond the nutritional content of the food. They may claim to strengthen the body's immune system, prevent or control disease (like cancer), improve metabolism, control obesity or modulate moods.

Functional foods are not the same as medical foods. They are similar in appearance to normal foods and are intended to be consumed as part of a normal diet. Functional foods have been modified by physical, microbiological or genetic techniques to regulate physiological processes and ingredients have been adjusted (by type and quantity) to have a beneficial effect in the body.

Other terms that have been applied to functional foods include:

- Designer foods
- Probiotics
- Pharma foods
- Foodaceuticals
- Nutraceuticals

These terms show the relationship between food and medicine (pharmaceuticals) These specific-purpose foods have provided health benefits in countries like Australia and functional foods focus on giving positive benefits. Functional foods in developed countries like Australia are seen as opportunities for export potential as well as research and development.

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation.

Topic: Food Management

Learning Objective(s): By the end of the topic, students will be able to;

- Investigate and communicate ideas about food management, food trends and fashion and, seasons and food.
- Evaluate strategies in food selection, meal preparation, product development, storage and preservation.

Essential Questions:

- What is food management?
- What are food trends and fashion? How do they influence food product development?
- How do seasons affect food selection, preparation, product development, storage and preservation and its development?

Essential Knowledge, Skills, Values and Attitudes:

Knowledge	• Food management - Purchasing food supply - Considerations in meal planning - Planning a Food budget • Trends, fashion and food • Managing time and food • Seasons and food • Food production
Skills	• Research on food management and the factors such as food trends, fashion, season and time management • Analyse food management processes and practices • Create, communicate and evaluate food management strategies
Values/Attitudes	• Making healthy food choices • Appreciating food and seasons, trends and fashion • Being responsible in food management processes and consequences • Evaluate and develop responses/solutions to food management issues

Teaching and Learning Strategies:

Engage students into discussion on food and various influencing factors that affect choices and decision making in selection, preparation, product development, storage and presentation. The teacher will develop activities and encourage students to participate meaningfully by using the inquiry process. Data and facts will be collated and compiled for presentation.

Learning Activities

Lesson 1: Food management

Activity 1: In groups discuss the following issues and compile a report for presentation;
1a. the cultural significance of food,
1b. chemical, nutritional and biological characteristics of food,
1c. the five senses and food,
1d. food and fashion ideas,
1e. systems and practices in managing such as;
- Selection,
- Production,
- Development, and
- Presentation.

1f. the role of food in a changing society, and
1g. food and lifestyle,

Activity 2: Copy and paste a standard Food Composition Table (chart) into your activity book. Study them carefully and generate discussions in small groups as assisted by your teacher.

Lesson 2: Trends, Fashion and Food

Activity1: Discuss in small groups how traditional customs, taboos and food beliefs may have an impact on food choices in areas you come from today. Identify and list them to generate discussion in your groups.

Activity 2: List and discuss some food fads and fallacies people in your village still hold on to today. How does that affect nutritional status of the people?

Lesson 3: Seasons and Food

Activity 1: Different cuts of meat attract different prices. Why is this and is nutritional quality reflected in the price of meat? Why or why not?

Activity 2: Define what seasonal eating is? How does seasonal eating affect our lifestyles, activities, food choices and meal planning in Papua New Guinea?

Activity 3:

3a. Students will apply their art skills to draw a Healthy Eating Pyramid.

3b. Students will distribute on the chart commonly eaten foods in PNG, slot them in their correct sections to complete the requirements of;

- Eat most
- Eat moderately
- Eat least

3c. Students will write short statements to justify the grouping of food.

3d. Students will use a sample of a Food Composition table provided by the teacher to generate discussions and create awareness of the need for good food.

Activity 4: Explain why seafood is the most perishable of all animal flesh.

Content Background

What is food management?

Food management is a broad process that involves the proper oversight of food selection, preparation, presentation and preservation.

Food production

Ninety-eight per cent of all food is produced on land and 2 per cent comes from aquatic or water sources. Cereals, root crops, and vegetables are the world food products. In developing countries, 60% of the population work in agriculture while only 5 -15 per cent in developed countries work in agriculture.12 per cent of the world's cultivated land is irrigated and this produces 20 per cent of the world's food harvest. It is expected that improvement and innovations in farm technology will increase the amount of food produced in developing countries. Today new food products are being invented and produced all the time.

Foods can be classified into five food groups. We should try to eat a variety of foods from each group ever day Nutritional problems may result if we miss out on one or more food group. The food groupings recommended for a balanced diet as shown on the **healthy eating pyramid** requires;

- Bread and cereals. (4 servings per day)
- Fruits and vegetables. (4 servings per day)
- Meat and meat alternatives. (2 servings per day)
- Dairy products. (children and adolescents 600mL per day)
  (adults 300mL per day)
- Butter, margarine and oil. (2 tablespoons per day)

The Healthy Diet Pyramid

The Healthy Diet Pyramid is beneficial in teaching nutritious food choices and people are guided as to the frequency or section of the pyramid which foods belong to. The ***Eat Most*** foods include vegetables, beans and peas, lentils and fruits, wholemeal breads and cereals, rice and pasta. The ***Eat Moderately*** foods include milk, yoghurt, lean meat, eggs, cheese (include the reduced fat and low fat dairy products), fish, chicken (without skin).The ***Eat Small Amounts*** of food include butter, margarine (polyunsaturated, mono-unsaturated), salt, sugar, reduced fat spreads (canola, olive, poly-unsaturated).

Meal Planning

There are many techniques and processes involved in planning meals. As well, many factors influence when and what you eat. It is easier to plan meals for yourself however planning meals for a family or a group, requires you to consider factors such as:

- the number of people to feed
- each person's health and age
- the physical activity which individuals engage
- individual likes and dislikes
- available foods
- the nutritional benefit of foods
- the equipment available for cooking and serving
- the time available for preparation
- how much money to spend
- the weather
- when each person will arrive home

- how to store, cook and serve food
- the variety and colour of food
- any religious requirements and cultural backgrounds

Food and fashion

Food trends are those patterns which reflect our food choices, preparation techniques and presentation. Food trends can be of the past, present and future. Influences on food trends include;

Lifestyle

A person's type of employment can influence the food choices he or she makes. People with a very active lifestyle have moved away from traditional family eating patterns, preferring fast, convenient foods such as frozen meals, take-away.

Availability

We have many available foods from which to choose and new food products are developed constantly for purchase by the consumer. The local environment may affect the availability of food because of soil, climate, proximity to the sea and transportation.

Technological developments also affect food availability. New techniques in food processing, harvesting, storage and distribution mean more food can be produced and distributed over a large area.

Economics is another important factor in the types of food available. A consumer's available income can significantly affect his or her choice of food.

Food properties

Foods differ in whether they are palatable and delectable according to their characteristic taste, odor and texture.

Marketing practices

Modern marketing techniques have an important influence on an individual's choice of food such as attractive presentations, eye-catching labels and packaging, favorable displays.

Consumer concerns

Eating guidelines (refer to Food Pyramid and Food Composition Table) today are health related and consumers are becoming more conscious of buying products which satisfy these the dietary guideline requirements. Consumers are more aware of environmental issues involved in our food industry such as plastic bags campaigns. Consumer concerns are affecting developments in the packaging industry.

Impact of food fads and fallacies

A food fad is an idea about food which has no factual basis and which interests people for only a short time. A food fallacy is a mistaken or false idea as it arises from the ignorance of nutrition or from incorrectly applying the science of nutrition to the daily diet.

Historical and cultural food taboos and beliefs

Food beliefs are often based in a community's religious or cultural background. Such beliefs often relate to the type of food eaten and the way food s prepared or eaten. Some religious groups include the Jewish community, Muslims or Seventh Day Adventist or Mormon. The Mormons for example restrict the use of meat, tea, coffee, and alcohol in the diet.

Factors affecting food choice

The foods available to most people throughout the world are not radically different. The all fit into the same categories: fish, meat, poultry, cereals, fruits, vegetables, seeds and nuts. Before the influx of technology, and improved transport and communication, a culture's diet was ruled first of all by geographic factors. People ate what food was available. Today food choices and food production are influenced by a variety of factors which can be grouped into three aspects:

Physiological aspects are to do with physical needs and reactions of the body. Food is a biological need and our bodies require fuel and foods that individuals select or required intake depends on factors like age, gender, body size and activity level, state of health and body reactions to food.

Psychological factors relate to the mind. A meal is one of the social venues in which many psychological ideas, beliefs, values, experiences, attitudes, self-concepts and emotions are expressed. All of these affect our habits regarding food choice.

Social aspects are of our lives and lifestyle involving interaction with other people. Food is a form of expression and a means by which relations are developed and maintained through culture, traditions, religion, lifestyle, technological resources, economics and social interactions.

Food selection

All consumers make judgements on the quality of food they select whether it be for preparation in the home or eating straight away. Making judgements is based on skills and knowledge of various foods. We should also have knowledge on food storage to maintain freshness, quality and nutritional value for as long as possible.

What to look for?

Foods	Characteristics	What to look for?
Meat	Common types of imported meats are from beef, lamb, pork, veal, mutton, Game are meats that are locally hunted or raised such as wallabies, bandicoots, cuscus and poultry, ducks and birds.	Hygienically prepared and packed to meet health standards, have no foul or 'off' odour, no slime covering, no odd colour, have a right meaty colouring
Seafood	Flesh of edible aquatic animals: fish, molluscs, crustaceans and marine animals.	Fish must have a fresh look, feel and smell: bright clear and bulging eyes, reddish pink gills, flesh is form-to-touch and no odour.
Fresh fruits and vegetables	Vegetables and fruits are valued in the diet for their texture, flavour, colour and nutritional value. Fruits and vegetables are best and cheapest when in season.	They should have the right colour, be firm and free from rot and other dead tissue and be uniform in size, colour and degree of ripeness.
Frozen foods	Several advantages in using frozen food: picked at peak condition and frozen soon after picking therefore tenderer and flavoursome with minimum loss of nutrients. Freezing does not significantly affect the nutritional value of food and enzyme activity is delayed through blanching. Enzyme activity in fresh fruits and vegetables can cause foods to develop poor colour, texture and flavour.	When purchasing, do not buy swollen-chilled food packages, dairy goods that are kept outside the refrigerated cabinet, those stored above the load line, food in torn packages and broken seals,

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food.

Topic: Food Hygiene, Safety and Lifestyle

Learning Objective(s): By the end of the topic, students will be able to;

- examine and communicate safety and hygienic practices in food handling to consumption.
- explore and analyse food trends and practices in usage and consumption to achieving food needs and demands.
- investigate the physical, biological and chemical contamination of food and apply safe ways of preparing and handling food.

Essential Questions:

- What are safe and hygienic practices in handling food?
- Why are safety and hygienic measures important in the kitchen?
- What is food borne diseases?
- How are food contaminated?
- What are the changes that occur in the functional properties of food?

Essential, knowledge, skills, values and attitudes:

Knowledge	• Safety practices in food • Hygienic practices in food • Food borne illnesses • Food Hygiene • Contamination - biological contamination - chemical contamination - physical contamination • Safe use of equipment • Response to emergency situations
Skills	• Practise and apply safe and hygienic ways of food handling food • Practise and apply safe ways to prevent food borne diseases • Evaluate the changes that occur in the functional properties of food • Research and communicate issues on food contamination
Values/Attitudes	• Being responsible in applying safe and hygienic ways in handling food • Making informed decisions in food product development • Making healthy food choices

Teaching and Learning Strategies:
In this topic, the emphasis is on 'food' and how it is influenced by different factors and with the impact it has on food production, inclusive of safety and hygiene. The teacher will apply creative ways and utilize a range of teaching methods to help students grasp the concepts. Students are encouraged to employ creativity skills and problem solving approaches to food issues and apply what they have learnt in real life situations.

Learning Activities

Lesson 1: Food Borne Illnesses

Activity 1: Use references to investigate on the common food-borne infections, identify their names, how they spread, places of common source and related symptoms. Present all their findings in a logical manner.

Activity 2a: Answer these questions or complete these activities:

- How can foods in storage contaminate each other?
- List three types of micro-organisms.
- Some organisms have a resting form which is resistant to temperature change and quite dangerous in food processing context. What is this called?
- Micro-organisms cause food poisoning. Name two other was food can be contaminated.
- List the conditions for optimum micro-organic growth.
- All micro-organisms can growth in dark and light conditions. True or false?

Activity 2b: Match the behaviors to the organisms:

A. salmonella bacteria	1. produce a downy coating on food.
B. yeast cells	2. cause infective food poisoning.
C. non-pathogenic bacteria	3. ferment sugars.
D. moulds	4. produce toxins in food.
E. staphylococcus bacteria	5. cause illness or disease.
F. pathogenic bacteria	6. breakdown organic material.
G. clostridium botulinum bacteria	7. produce a deadly toxin.

Lesson 2: Contamination

Activity 1a. Test our understanding on food spoilage agents by copying and completing the following statements. Word list is provided:

Word list: *enzyme, spores, autolysis, contact, micro-organisms, pathogenic (or pathogens), quality, microbial, yeast, plants, moulds, insects, bacteria, rodents, birds.*

1) Food may be spoiled by_____-activated chemical reactions in the food cells.
2) This process of _____ softens the food and prepares it for decay by _____.
3) Physical damage to food can spoil the _____and speed up other spoilage such as _____ and _____.
4) Food loss from pests affect mostly _____foods. Some of the worst pests are _____, _____ and _____.
5) Three types of microbial spoilage agents are _____ , _____ and _____.

6) Food spoilage micro-organisms that cause illness are called _____.
7) Micro-organisms get into food from _____ in the air, or from _____ with infected surfaces.

Activity 1b: Research on adulteration of food and write a summary.

Activity 3: Below are some important safe foods handling procedures that should be followed to avoid cross contamination. Try to add to the list and display the chart at viewing range in your home or classroom. Encourage all to read;

- Never keep perishable foods such as meat, poultry and seafood at room temperature for longer than two hours, including time to prepare, serve and eat.
- Keep raw foods separate from cooked foods to avoid spreading bacteria.
- Frozen foods should be thawed in the refrigerator, not at room temperature which can cause excessive bacteria to form on the outside of the product while the inside is thawing.
- Cook meat, poultry and seafood thoroughly. High temperatures reached in boiling, baking, frying and roasting (70 degrees or higher for a minimum of two minutes) kill most food poisoning bacteria.

Lesson 3: First Aid

Activity 1: Define 'scalds and burns'. Describe precautionary measures to prevent this. Explain the first aid steps involved when attending to the case above.

Activity 2: Describe the task of an Occupational Health and Safety officer employed in a commercial kitchen.

Content Background

Hygiene and safety

Hygiene is the science that deals with the preservation of health. Food especially safe for human consumption, must be free from dangerous micro-organisms such as bacteria. For this reason, hygiene standards must be met by food handlers. Food must be stored and transported in a clean environment at correct temperatures. Waste products must be disposed of appropriately and pests must be controlled. Food handlers need to keep their hands, hair and clothing clean. They should tie back long hair and wear covered shoes. Utensils and preparation areas should be washed with suitable detergents and kept clean at all times. Specific equipment should be used only for its intended purpose, and cross-contamination should be avoided between cooked and raw food. To help maintain hygiene, preparation areas (such as kitchens) should be designed properly, so they are easy to keep clean and wash rooms and toilets should be kept free from disease.

Safety refers to a person's freedom from harm, injury, danger or risk. In terms of safety of food, consumers must be made safe from for poisoning and other health- related. In a workplace environment, the employer is responsible for ensuring safe premises such as;

- using correct equipment,
- maintaining equipment in good working order,
- keeping equipment out of the way to prevent accidents,
- cleaning equipment,
- carrying things properly,
- wearing correct clothing,
- cover and bundle up hair to avoid catching on fire,
- enough space and room to move about in preparation and cooking area,
- keeping handy fire blankets and hydrants, and
- apply and use pest control measures appropriately.

Taking care is to be safe or being free from injury or danger. Individuals should follow certain rules to avoid physical accidents. In the kitchen, consider these safety hints below:

- to avoid accidents, think before you act,
- wash our hands before preparing food,
- know how to operate the fire extinguisher,
- dress appropriately: (wear an apron, wear protective shoes, tie back long hair)
- store foods and utensils appropriately,
- treat utensils with care e.g. carry sharp knives with point downwards,
- take care when using equipment,
- manage a clean work area,
- follow instructions carefully,
- mop up spills immediately,
- keep pets out of the kitchen, and
- lock away poisons.

What spoils food?

Microbial activity, chemical activity, physical damage and chemical contaminants are seen as factors that cause foods to spoil.

Micro-organisms occur naturally in our environment and in some cases are used for beneficial purpose such as the manufacture of beer, wine, yoghurt and antibiotics. There are those that which have the most damaging effect when given the correct conditions and allowed to reproduce, cause toxic by-products like protozoa, algae, viruses, mould, yeasts, and bacteria. Bacteria, yeasts and mould have relevance to food handling and food poisoning.

Microorganisms that cause food poisoning include salmonella*, Clostridium Botulinum, Staphylococcus, Clostridium Perfringens, Listeria, Bacillus Cerus and Escherichia coli (E.coli)*

Name	Spread by	Common source	Symptoms
Salmonella (Heat will kill tis bacteria at 60 degrees and above)	Faecal contamination, unwashed hands, flies, contaminated work surface and utensils, surface of raw meat. Cross contamination is common	Raw meats, pork, chicken Frequently found in outlets where cross contamination will occur. Foods not proper thawed.	6 -72 hours vomiting, high fever, diarrhoea, severe listlessness
Clostridium Botulinum (spore forming bacteria)	Found in soil, marine mud, some fish and vegetables and grows on canned and bottled foods.	Can resist boiling for up to 6 hours. Canned foods heated under pressure to kill such microorganisms.	In 18 -36 hours, toxins affect the central nervous system, earl symptoms include double vision, speech and swallowing difficulty. Death may result after 1-8 days, respiratory system is paralyzed. Fatality rate is 80%.Early anti toxin given will save life.

Contamination

What causes foods to spoil?

From the time a food is harvested, slaughtered or picked it begins to deteriorate in quality. This deterioration is due to several factors as discussed below:

(i) Environmental Conditions

The environmental factors which can cause foods to spoil are shown below.

Environmental food spoilers	
Temperature	Heat melts butter
Moisture	Biscuits become soft when exposed to air
Insects	Moths produce "cobwebs". Weevils lay eggs in flour.
Light	Milk loses Vitamin B under light.
Oxygen	Butter goes rancid through **oxidation.**
Rodents	Mice eats cereals (corn, rice etc.)
Mishandling	Fruits bruise when dropped, Vegetables bruise when over handled. Broken packets let spoilers into food.

(ii) Enzymes: Enzymes are proteins produced in all living cells. The act as organic catalysts and each enzyme is responsible for a specific chemical reaction. Cell enzymes accelerate chemical reactions leading to changes in food colour, texture, flavor and odour. Some reactions are increased by exposure to light and air. Enzyme -activated chemical activity is responsible for the ripening and softening of fruits and vegetables, and will continue past the stage where the food is at its peak quality for eating. It is easy to observe some of the effects on fruits that ripen quickly such as bananas, mangoes and pawpaw. *Autolysis* is a process of self-destruction (or cellular breakdown) in both plant and animal foods. In this process, chemical reactions, cause softening and breakdown of the cell walls to allow the entry and aid the action of microbial agents of decomposition.

Chemical contamination

Chemical contaminants can spoil the flavor with no risk to health, or may pose a serious health problem. The effects may be immediate or may show up in the long term. Foods that absorb odours and flavours readily such as milk, butter, margarine and eggs are said to be contaminated if contact with (or storage area) anything that has strong odour, results in spoilage For example, fish-flavoured butter or kerosene - flavoured eggs. This kind of contamination spoils the *quality* but doesn't necessarily make the food unsafe.

Chemical contamination that can cause food poisoning, resulting in serious illness such as paralysis or cancer, in many cases can be fatal. Chemical contamination comes from exposure of food to pesticides, fertilizers, herbicides, or industrial wastes, deliberate **adulteration** of food with poisonous substances, or use of food **additives** in illegal quantities, or in foods where they have not been permitted.

Naturally occurring food toxins can also cause food poisoning. Certain types of mushrooms, fish and shellfish produce toxins that cause illness and sometimes death. For example, solanine in potatoes that turns green when eaten in large amounts can cause quite serious illness. So don't eat green potatoes.

Food poisoning is any condition caused by eating substances contaminated with harmful pathogenic bacteria. Although food poisoning can be caused in a variety of ways, it is generally an acute condition and symptoms will become apparent upon entry into the gastro-intestinal tract within two to three hours or sometimes can arise even two days after the contaminated food has been eaten. Symptoms include stomach pains, vomiting, diarrhea and general fatigue and serious cases result in death. Food poisoning can be classified in three ways:

- *Chemical* - caused by the presence of toxic chemicals in food for example pesticides and heavy metals (lead and mercury)
- *Biological* - caused by eating dangerous foods for example wild mushrooms, green potatoes or certain sea foods.
- *Bacterial* - caused through microbiological contamination

The prevention of food poisoning is dependent on food handlers **maintaining strict standards of hygiene** at home or in the work place and the home kitchen. The main goals of food hygiene are to stop:

- food from becoming contaminated with dangerous substances.
- the growth and reproduction of food - poisoning micro-organisms that end up finding their way to the food sources.

First Aid issues can be prevented or minimized given the following situations:

(1) The food handler: Each person who prepares food should have a basic knowledge of food hygiene principles which include personal hygiene, clean work surroundings, personal presentation and hygiene.

(2) Equipment and Environment: All work surfaces must be cleaned and sanitized regularly. Danger is inherent in any workplace. Accidents are caused by:

- equipment not used for its intended purpose,
- lack of attention to health and safety practices,
- failure to use health and safety equipment such as gloves or boots,
- Inadequate attention to maintenance and housekeeping will cause injury or accident for example, a wet or poorly cleaned floor,
- failure to provide adequate safeguards such as fire extinguisher and First Aid Kit, and
- when a person does work with a lack of concentration.

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption.

Topic: Factors affecting food processing and packaging

Learning Objective(s):
By the end of the topic, students will be able to;

- examine the social, economic and environmental impacts of food processing technology.
- evaluate the developments, roles or functions of food packaging and distribution.

Essential Questions:

- What are the social, economic and environmental impacts of food processing technology?
- What are the factors that influence food processing?
- What is the role of food packaging and distribution of food from production to consumption?
- What are the developments in food packaging and distribution?

Essential Knowledge, Skills, Values and Attitudes:

Knowledge	• Social impact of food processing technology • Economic impact of food processing technology • Environmental impact of food processing technology • Role of packaging • Packaging and distribution of food • Packaging and distribution of food from production to consumption
Skills	• Research on the social, economic and environmental impacts of food processing technology • Investigate the role of food packaging • Create food packaging products and communicate its impact on food processing
Values/Attitudes	• Appreciate and the developments of food packaging and distribution • Make informed decisions on the impacts of food processing technology • Being aware of food issues and consumption

Teaching and Learning Strategies
The teacher is encouraged to introduce the topic and divide it up into lessons identifying which lessons will be theory lessons and which of them will be practical lessons. The lessons should promote the design process and problem solving approaches. The students are encouraged to apply what they learn in real life situations.

The lesson activities are hands on activities and the teacher is required to guide and closely supervise students. The learning strategy is enquiry and project based approach.

Learning Activities

Lesson 1: Factors that influence food processing

Activity 1: (a) What is food processing?

(b) What are some reasons for processing food?

Activity 2: Raw materials such as food, equipment and processing systems are important factors that affect food processing. Identify, plan and improve these factors to process food on a small scale basis.

Activity 3:

3a. Why is food additives included when processing food?

3b. Define HCCP and explain its significance in food processing.

Lesson 2: The role of food packaging

Activity 1: Using a food product from your pantry at home, list all the information conveyed by the packaging.

Activity 2: Topic discussion and presentation. Discuss in two groups on the question: Do you think environmentalists would agree with the argument that "packaging prevents more waste than it creates?" Consider both positive and negative aspects. Report a summary of your discussion to the rest of the class.

Activity 3: Interview an elderly person from any part of PNG on traditional packaging of food in the early part of PNG history. Describe the effectiveness of traditional food packaging techniques used in PNG both past and present.

Lesson 3: Developments in packaging and distribution

Activity 1: Answer these questions:

1a. What is packaging?

1b. What are the advantages and disadvantages of packaging?

1c. Describe the functions of packaging

1d. List the requirements for labels which appear on food packages. Why are these requirements important?

Activity 2: Identify as many food products as you can which highlight ways in which packages can be recycled.

Lesson 4: Types of food packaging

Activity 1:

1a: Describe the four techniques of modified atmosphere packaging;

- barrier specific packaging
- vacuum packaging
- gas packaging
- active packaging

1b: Collect samples of each type and display for viewing.

Activity 2: Co-extrusions and Laminations are two current developments in packaging materials. Research and compile an account for each one. Find sample of each type and display for class viewing.

Activity 3: What is a 'bar code' and what is its purpose as it appears on a product package?

Content Background

Food processing extends from what it is to quality assurance of the final product. It is about machinery and processes, involved in modern food production.

Food processing is the changing of food from its raw-unprocessed state and changing it in some way to make food product weather packaged or unpackaged. In food manufacture, processing intervenes in the food chain between the producer and the consumer. Some processes:

- change the texture of food
- change the moisture content of the food
- may combine raw food materials to make a different product

Not all of the processes are related to food preservation.

Two major aspects for food processing are *first* processes that have little or no effect on the nature of food itself and *two* processes that use food as raw material. Processed foods generally have a longer storage life than the raw materials because one or more of the principles of food preservation have been applied in the food processing methods.

Factors that influence food processing:

Raw materials*:* Raw materials for processing are required to be of good quality, reliable standard and specified type. The assessment of raw materials is part of quality management in food manufacturing. Raw materials going into large processing plants first go through sensory assessment before other tastings are carried out.

Processing applications: There is a range of processing techniques that are used to process food. Processes that involve *removing heat* or *reducing temperatures* of the food to slow or stop spoilage caused by enzymes or microbes - ***chilling, freezing and freeze-drying.***
Processes that involve *adding heat* are- ***pasteurization, sterilization, evaporation and cooking methods (****baking, roasting, grilling, frying, stir-frying, and micro-waving),* ***dehydration****.* Heat is used to make food more desirable to eat because it develops the colour and flavor of man foods. Heat also destroys enzymes and microbe activity as well as insects. In this way, it makes food safer to eat.

Processes which involve *adding chemicals* are ***fermentation, salting or curing, smoking, jam making and chemical preservatives.***

Processing equipment: Equipment for food processing must meet all criteria. Factors influencing the selection of equipment include suitability for the processing system. Some criteria are:

- able to handle a large volume of food efficiently and rapidly to give a quick turn over of quality products.
- hygiene- not easily contaminated.
- durability and reliable working life of equipment
- high standard of operational safety
- low noise and vibration levels
- quick servicing
- conformity to environmental guidelines.

Production systems: are the ways in which the process of production are organized and applied. They include *automated* and *computerized systems* which are generally found in large-scale operations.

Food additives: An additive is not a contaminant (undesirable chemical substances that enter food accidently and are not permitted by law), but chemicals that are deliberately added to food by the manufacturer to improve some aspect of the finished product. Some functions of additives include;

- maintain or improves the quality of the finished product
- improves the storage life of food
- serves as preservative when necessary
- improves the food to make it more appealing

There are different types of additives:

- Additives that maintain or improve the keeping quality of food are those that - destroy or inhibit micro-organisms
  - inhibit chemical reactions.
- Additives that make food more attractive and acceptable. They are
  - colours, flavours ,artificial sweeteners, free flowing agents, modifying agents and other additives like flavor enhancers and dough improvers.
- Additives that improve the nutritive value of food. Some examples of nutritive additives are iron, iodine, Vitamin A, B,C and D

Quality assurance: It is vitally important for food manufacturers to apply strict policies about quality specifications of their raw materials, hygiene of food handling and standards of processing that aim to gain approval of consumers and an assured place in the market. In addition, most food companies have a quality-management policy that requires constant testing programs to be applied at various stages of processing and again for the finished product. The Microbial Testing for example, is done during manufacture and of the final product and in compliance with HACCP guidelines, Food Laws and Act and Quality standards.

A **package** can be defined as one unit of a product which is wrapped or sealed in a sheath or packed in a container. The prime function of food packaging is protection, preservation and allowing for the food to be handled easily. The other prime functions of packaging are to contain and identify the product.

Functions of packaging:

(i) **Containment**: Think about the last time you purchased a food product. Its package helped to prevent the food from spoilage, keeping the food ready for consumption. Containment is the foremost function of packaging to meet the needs of transport and storage of food products in convenient units. Packaging contributes to food preservation, safety and availability. It has been estimated that 30 - 40 per cent of total spoilage could be prevented by improvements in food handling, preservation, processing, and storage and distribution facilities in combination with effective and adequate packaging.

(ii) **Food preservation**: Packaging must have characteristics which allow it to block out or permit the passage of moisture vapour and carbon dioxide and oxygen gases. For example packaging prevents dry foods such as breakfast cereals from becoming moist, and prevents fat products such as margarine from absorbing oxygen and becoming **rancid.** Packaging also protects the foods against the effects of climatic changes.

(iii) **Physical Protection**: All food products can suffer physical damage during transportation, storage and distribution therefore, physical protection is necessary to prevent food products from breakages, cracks, denting and corrosion.

(iv) **Safety**: Safe packaging of food products ensures they are fit for human consumption. The hygienic processing and packaging of foods results in fewer outbreaks of food poisoning.

(v) **Communication**: Packaging conveys information about the product to help consumers make purchasing decisions. It is required that all products information that is clear and precise.

(vi) **Convenience:** Packaging offers time-saving convenience for handle and use such as appropriate opening and closing features. Examples are the snap lock plastics and can rip-offs.

Packaging must enable a food product to reach the consumer in the same condition as when it was produced and different food products require different types of packaging to keep them in their ideal condition. There are three types of packaging:

Types of packaging

(i) **rigid** packages: These packages include cans and plastic and glass bottles

(ii) **semi-rigid** packages: These packages include cardboard boxes and cartons and polystyrene foam.

(iii) **flexible packages**: These packages include plastic film wrap, foil, foil pouches and paper bags.

Packaging material

The main types of packaging materials include:

- metal (aluminum and iron)
- paper and board
- plastics (flexible or rigid)
- plastic films (of varied thickness)
- glass

Characteristics of Packaging materials

Packaging material	Properties	Functions
Metal (aluminium and iron)	strength, lightweight, non-corrosive, excellent barrier qualities, withstands extreme heat and cold	-widely used for drink cans as it is easily opened -allows food and drink to retain their flavor and odour because t imparts no smell or taste.
Paper and paper board	strength, lightweight, can be treated to improve its package functions such as coating, waxing, moisture resistance and impenetrable to liquids.	-forms a range of packages from flexible bags to rigid cartons. -provides a printable surface to communicate information. -used in more rigid forms to prevent physical damage. -it is economical and recyclable
Plastics (flexible or rigid)	excellent clarity(transparent), protective quality, light-weight, strength, moisture-barrier, potential air-tight quality preventing rancidity and flavor changes on food.	-prevents physical damage -acts as cushioning for fragile products -used to package products which need protection from oxygen. -used as stretch wrap for pallet loads and in crates for bottles
Glass	Strength, moisture and oxygen barrier, transparency, lack of reaction to contents, ability to withstand high and low temperatures, fragility, recyclability	-prevents physical damage and flavor changes, -popularly served for beverages because inexpensive Made into product packaging which is to be reused or broken down and reprocessed into new bottles.

Packaging developments

Lifestyle changes and advances in industrial and home technology create markets for new products. Packaging design and manufacture has changed to meet specific food industry needs. It has led to the development of new processing and packaging techniques and machinery and product innovation in the market. Packaging is a dynamic and competitive aspect of food manufacturing.

Packaging systems

The consumer trends towards more fresh food and high quality in food products have been largely satisfied by developments in food packaging. This packaging system has accompanied the production of new packaging materials. The new packaging systems are:

Aseptic packaging: A system wherein the food product and the container are sterilized separately and the containers are filled and sealed in a sterile environment. This technique has developed rapidly since 1981 when hydrogen peroxide was permitted as sterilizing agent for packages.

Aseptic packaging gives shelf stability at room temperature for several months without the use of preservatives, with better colour, flavor, colour and nutrient retention than canning.

Modified Atmosphere Packaging (MAP)

Atmosphere modification in packaging aims to change the composition of the air inside a container to extend product shelf life or maintain the quality of food product

(i) Normal atmospheric conditions in the package would contribute to spoilage.

(ii) Atmospheric gases would slowly penetrate the packaging barrier to spoil the food.

(iii) Gases produced by the food itself would cause deterioration.

MAP, in the form of barrier-specific packaging, gas packaging, active packaging and vacuum packaging reduces or exclude oxygen contact with the packaged food hence reduces microbial activity and enzymatic reactions.

Food labeling laws

The Food Act requires packaged food to show:

- The name of the food
- The name and address of the manufacturer, the packer, the vendor or the importer.
- The country of origin
- The batch or bar code
- The list of ingredients
- The date marking

Unit 2: Food Science

Content Standard: 9.2.2 Investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands.

Benchmark: 9.2.2.6 Apply the design process to create food solutions.

Topic: The technology design: design, produce, market and evaluate
Learning Objective (s):
By the end of the topic, students will be able to;

- Plan, create and evaluate a food product.
- Apply and evaluate the design process to create food solutions.

Essential Questions:

- What is a design brief?
- How do we create food solutions?
- How do we make a food product for market?
- How do we evaluate a food product?
- What are the processes involved in food technology design?
- What are the factors to consider in the food product development process?

Essential Knowledge, Skills, Values and Attitudes:

Knowledge	• Food design process • Food solutions
Skills	• Designing process in food • Creation of food solutions • Evaluating food product
Values/Attitudes	• Appreciate the designing process of food • Being mindful of nutritional value of food for different age groups and needs

Teaching and Learning Strategies
The teacher is encouraged to introduce the topic and divide it up into lessons identifying which lessons will be theory lessons and which of them will be practical lessons. The lessons should promote the design process and problem solving approaches. The students are encouraged to apply what they learn in real life situations.

Learning Activities

Lesson 1: Design brief and the technological process

Activity 1: What is a design process and list all its functions.

Activity 2: Explain the importance of good planning for a design brief.

Activity 3: A design brief state the scope of a situation. How is useful during planning?

Lesson 2: Using a design brief to create a new product

Scenario or context: Preparing a nutritious drink for a breastfeeding woman.

Activity 1: Read the design brief, understand the scope of content, knowledge, skills, attitudes and values involved. Delegate responsibilities.

Activity 2: Implement/ carry out all tasks as required.

Activity 3: Do ongoing evaluation throughout the process of developing the product. Keep notes about and problems and how they were managed so that choices and decisions can be justified.

Lesson 3: Evaluate the new product

Write honest comments about the product you prepared:

- Does our product meet the specifications of the design brief?
- Was the drink suitable in terms of taste and flavor for a nursing mother and why?
- Was the product prepared hygienically?
- Were the equipment and technique used appropriate?
- Was the drink tasty and well presented?
- How could your product have been improved?

Activity1:

1a. Conduct a general presentation session based on all comments. Consider suggestions and compile for further improvements.

1b. Write an evaluation and take further steps where necessary.

Activity 2: Brain storm ideas and compile recipe books based on local foods for children, pregnant women, lactating women and the sick and invalids. Use the design process to prepare nutritious meals for people with special needs.

Activity 3:

3a. Conduct food and nutrition, and health talk/campaign in your neighboring community.

3b. Demonstrate cooking methods and nutrition messages to the near-by communities.

Content Background

The design and technology process

The design and technology process, is the knowledge and way of managing situations and the ability to come up with solutions to meet our needs and wants. It incorporates the principles of management and, is an approach that was devised to guide individual through the task of solving problems. The design process is not just for use in schools but also used in industry to ensure that all products are properly designed and thoroughly tested to fit the purpose for which they were intended. The important functions for a design process are:

- It identifies needs.
- It enables decision making to be based on relevant data and information.
- It provides a method of finding solutions to problems.
- It encourages individuals to apply a general problem – strategy.
- It encourages individuals to identify a wide variety of alternative solutions to any problem.
- It anticipates that individuals will accept responsibilities for their decisions.

There are key stages of the design and technology process involves *planning, making*, *evaluating* and sometimes *marketing*. Each of these stages can be broken down into a number of steps. Applying the technology process involves understanding the components of the task, coming up with ways to solve it, choosing the best idea, developing a plan of action and then, making it happen. At each stage, the decisions made influence the management and success of the final solution.

Planning: Take time to plan well. Aspects involved in planning the design of a product involve identifying, exploring, developing, applying, communicating and evaluating ideas. Sharing ideas with others, helps you to decide whether our design is practical or whether it needs to be modified. At the planning stage, you consider cost and availability of resources. You could make a model to trial. At the end of the planning stage, you are ready to make the product.

Making: Making is about carrying out the plan. It involves the producing or constructing products using appropriate materials and tools, the best management of time, resources and making eco-friendly decisions in the making process, demonstrating and applying a range of skills, work accuracy and capability to produce a quality product that has market value and ready to sell out.

Evaluating: This is about making judgments, reflecting on ideas and their implementation. Evaluating is questioning, assessing and reviewing the processes involved in the making of the product. Key question is: Does the product meet the needs of the design brief?

Marketing: This is about advertising, selling and profit which you are required to calculate production costs and determine a reasonable selling rate. You will explore effective marketing techniques to market your product effectively and to make some profit.

What is a Design Brief

This is a written statement which outlines a problem, gives specifications which must be adhered to, states the parameters within which to work in order to reach a solution.

Design	**Problem***: Describes a* scenario or context of the problem from which the brief arises. **Brief:** A statement that presents the task and gives clear instructions for the task to be done. **Specifications**: Identify key considerations or constraints for the design solution. **Investigations:** Gather information, images, concepts or ideas from a variety of sources to eventually decide upon the design to be made. Develop and record a range of ideas that may be able to solve the brief.
Produce	**Making:** Engages you in making, constructing and producing the product or solution by using appropriate materials, tools, equipment and the steps of production.
Evaluate	**Evaluating/Testing:** Encourages you to think and evaluate the effectiveness of the plan. Reflect on the design process. Determine the success of the final design solution. Evaluate what worked well, and why, and where improvements could be made. Seek expert or client feedback.

Problem:

Coconuts and fruits are in abundance and the nearest town market can only be reached by dingy to sell produce. Naturally coconuts mature and fall and village people have given up on making copra due to low copra price and lack of reliable transport. Apart from cooking, the young coconuts can be made use of for a nutritious drink both for young children, lactating women, and for the menfolk as well.

Design Brief:

Prepare a refreshing and nutritious drink for a breastfeeding woman. Use the coconut water as the base for the drink, add scrapped coconut flesh, other locally found fruits like passion fruit, pineapple, mango and some sugar to sweeten (if need be).This refreshing drink is ideally served for lunch for women who breast feed.

Specifications:

- This drink must contain coconut water as the base for the drink.
- The flesh of young coconuts must be scrapped and added to the coconut water.
- Other local fruits such as passion fruit, mango, or pineapple can also be grated and added to the drink mixture.
- These fruits when combined should contain essential vitamins and other nutrients to help stimulate milk production for the baby and also for mother and baby's health.
- The drink does not cost at all as all the fruits can be locally obtained.
- This drink is also suitable to be served for family meals.

Investigation:

- Investigate the nutritional content of all the fruits.
- Study other fruit drink recipes you can make using local fruits that are suitable for nursing mothers.
- Research the availability of fruits, utensils, equipment you need to make the drink.
- Research various ways or serving ideas for the drink.
- Investigate if other village women would like to learn from our demonstration and give general nutritional advice on diet requirements.

Making:

- Collect all the ingredients.
- Make the product and serve attractively using creative ideas such as a coconut shell dressed with sliced lemon.
- Present the product in an attractive manner.

Evaluating/Testing:

- Does your product meet the specifications of the design brief?

Planning and Programming

The 8 steps in Planning and Programming Process

1. Identify the number of Strands and Units in the subject Syllabus.
2. Identify the total number of Content Standards, Benchmarks and Number of Topics. (Syllabus and Teacher Guide)
3. Consider the Facts and Considerations in the Planning and Programming Process. (subject related)
4. Distribute the Content evenly across the 4 school terms in a Matrix. (Proposed Template)
5. Expand and plot the distributed content into the complete Yearly Content Overview for the subject for the grade. (Proposed Template)
6. Develop the Termly Programs. (Proposed Template)
7. Develop the Weekly Teaching Program, and (Proposed Template) Daily Lesson Plan. (SBC Template)
8. Review, Evaluate and Re-plan the yearly, termly, weekly Programs.

Planning and Programming Process

The Planning and Programming Process used by the Business and Technology Subjects is an 8 step process. This process begins from Unpacking the Content Standards and Benchmarks and ends with planning a daily lesson plan.

Step 1: Identify the number of Strands and Units in the subject Syllabus.
Step 2: Identify the total number of Content Standards, Benchmarks and Number of Topics. (Syllabus and Teacher Guide)
Step 3: Consider the Facts and Considerations in the Planning and Programming Process (subject related)
Step 4: Distribute the Content evenly across the 4 school terms in a Matrix. (Proposed Template)
Step 5: Expand and plot the distributed content into the complete Yearly Content Overview for the subject for the grade. (Proposed Template)
Step 6: Develop the Termly Programs (Proposed Template-3 part programme)
Step 7: Develop the Weekly Teaching Program and (Proposed Template) Daily Lesson. Plan. (SBC Template)
Step 8: Review, Evaluate and Re-plan the yearly, termly, weekly Programs.

Technology and Industrial Arts Planning and Programming Process

Planning and Programming Process involves 8 steps. The steps are outlined and described with samples provided to assist and guide you.

Step 1: Identify the number of Strands and Units in the subject Syllabus
It is important to first identify the strand and unit names for familiarization and also the number of strands and units in the Grade 9 Technology and Industrial Arts subject.

Technology and Industrial Arts has 5 strands and 13 Units.

Table of Strands and Units

The table below outlines the strands and units for grade 9 Technology and Industrial Arts subject. This helps teachers understand how to deal with units per strand when they are expanded into evidence outcomes and benchmarks at each grade.

The strands and units of content standards explain the progression from Grade 9 to Grade 10, linking to senior high school Technology and Industrial Arts content. The order and linkage of units signifies what the students will achieve from one grade to the next.

Technology and Industrial Arts is organised around five strands – Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology. These strands are comparable with the strands used internationally. The Content Standard of each Strand is based on units. The Strands, Units and Content Standards are outlined in the table below:

Step 1: Identify the number of Strands and Units in the subject Syllabus (Grade 9&10 TIA Syllabus Page 30)

Strands	Units
Textile Technology	Fibres and Fabrics
	Textiles and Clothing
Food Technology	Food and Nutrition
	Food Science
Construction Technology	Building Technology
	Electrical Technology
	Plumbing Technology
	Welding Technology
	Engineering Technology
Communication Technology	Data Communication and Network
	Computer Security and Safety
Computer Technology	Computer Architecture
	Computer Software

Step 2: Identify the total number of Content Standards

Benchmarks and Number of Topics (Syllabus and Teacher Guide)

- Use the Syllabus to derive the total number of Content Standards and total number of Benchmarks.
- Use the unpacking tool to derive your topics and the total number of topics.
- Place or slot them in a matrix as in the sample shown below so you are knowledgeable and made aware of the total number of content standards, benchmarks and topics that you will be working with in the planning and programming of teaching and learning for the subject in a school year for that grade.

Grade 9 Technology and Industrial Arts Content Matrix

Consult the Grade 9 Technology and Industrial Arts Content Matrix showing the total number of strands, units, content standards, Benchmarks and topics to be covered in Grade 9.

Total Number Of Strands	Total Number Of Units	Total Number of Content Standards	Total Number Of Benchmarks	Total Number Of Topics
1	2	2	11	11
2	2	2	13	13
3	5	5	29	29
4	2	2	12	12
5	2	2	11	11
Totals	**13**	**13**	**77**	**77**

Step 3: Consider the Facts and Considerations in the Planning and Programming Process (subject related)

It is important to consider and analyse facts that are worth considering if these facts will help or if these facts will pose a challenge to the planning and programming process.

Facts and Considerations about the Grade 9 Technology and Industrial Arts

1. As per the Matrix, there are a total of 77 Benchmarks and Topics which must be programmed and taught in a school year.
2. TIA is now a subject which requires all students to take all 5 strands in the subject unlike the OBE practice.
3. There are no specialist teachers who are trained to teach all the specialist content in the TIA subject.
4. Current practice has one teacher who can teach Food and Textile (Currently Home Economics), one teacher who can teach Construction Technology (currently Practical Skills) and one teacher who can teach Communication and computer Technology (currently Computer Studies and ICT).
5. With consideration #4, there are 3 personnel who will be required to teach TIA together to deliver the subject. ***Thus, this fact is considered to propose the Planning and Programming Process for TIA subject into a 3-part Teaching and Learning Planning and Programming Process.*** Which means TIA Subject Program is made up of 3 sub-programs.

1. Time Allocation for Grade 9 Technology and Industrial Arts is 240 minutes per week which means it has 6 periods/6 lessons a week: 1 block of 80 minutes (2periods) periods and 1 x 160 minutes (4 periods blocked).
2. There is a total of 40 teaching weeks in a school year. (4 Terms x 10 Weeks each)
3. In a term, there are about 8 weeks of actual teaching weeks which gives us 48 periods/48 lessons of actual teaching in a term (6 periods a week x 8 actual teaching weeks in a term).
4. Using these facts and considerations, we can Plan and Program the TIA according to this understanding.

Understanding 1:
There are 3 x Teachers who are required to teach the TIA subjects in 40 weeks. Therefore teaching and learning must be programmed using the 3 parts (40 /3 = 13.3 weeks per part).

Understanding 2:
There are 77 Benchmarks for TIA that must be planned and programed for 40 weeks but distributed equally according to the 3-parts: Textile & Food =34 BMs; Construction = 33 BMs; Communication &Computer = 33. (use the strand with the highest BMS to determine the number of BMS per week = 34 /16 = 2.1 BMS week).

Understanding 3:
The 3-factor plan and program for TIA becomes the Yearly plan and Program (meaning to say, the plan and program will be utilized by the teacher for 3 lots of students taking TIA in a rotation approach for a year. The TIA Content distribution will be determined by the 3 parts (3 available personnel) and therefore the content will be distributed.

Understanding 4:

In the instance where the school decides to deliver the Food Technology, Textile Technology, Communication Technology and Computer Technology from term 1-3, then the Construction Technology gets to be taught in Term 4. This allows for the school to acquired or make available the necessary requirements for the construction technology strand. Otherwise, it becomes school-based and students are awarded an attainment certificate- for the strands they have learnt and NOT TIA. TIA is externally examined and certified.

Step 4: Distribute the Content evenly across the 3-Parts (Proposed Template)

The teaching content outweighs the teaching weeks and therefore considerations must be made on teaching and learning approaches for example; integration, project-based learning, etc. we have provided some information to help you distribute the Technology and Industrial Arts subject content to be programmed fairly across the 3-parts. The tables include:

Grade 9 Technology and Industrial Arts Content distribution for the Teaching Year

The Grade 9 TIA has been distributed according to the 3-parts in a 13 week rotation program. *The content standards and Benchmarks according to the Distribution are also written and provided for you in a table.*

Week	Textile Technology and Food Technology	Construction Technology	Communication and Computer Technology
1	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.1 and 9.1.1.2	Building Technology CS: 9.3.1 BMS: 9.3.1.1. 9.3.1.2, 9.3.1.3,	Communication Technology Data Communication and Network CS: 9.4.2 BMs: 9.4.1.1, 9.4.1.2, ,
2	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.3, .1.1.4,	Building Technology CS: 9.3.1 BMs: 9.3.1.4, 9.3.1.5, 9.3.1.6,	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.1.4.3, 9.1.4.4, 9.1.4 .5
3	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs:9.1.2.1, 9.1.2.2,	Electrical Technology CS: 9.3.1 BMs: 9.3.2.1, 9.3.2.2, 9.3.2.3,	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.1, 9.4.2.2,
	Assessment	**Assessment**	**Assessment**
4	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.3, 9.1.2.4,	Electrical Technology CS: 9.3.2 BMs: 9.3.2.4, 9.3.2.5,	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.3, 9.4.2.4
5	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.5, 9.1.2.6,	Electrical Technology CS: 9.3.2 BMs: 9.3.2.6, 9.3.2.7	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.5,
6	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.1. 9.2.1.2	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.1, 9.3.3.2	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.6,
	Assessment	**Assessment**	**Assessment**
7	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.3, 9.2.1.4	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.3, 9.3.3.4,	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.1, 9.5.1.2
8	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.5, 9.2.1.6,	Welding Technology CS: 9.3.4 BMs: 9.3.4.1, 9.3.4.2,	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.1.5.3, 9.1.5.4
9	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.7	Welding Technology CS: 9.3.4 BMs: 9.3.4.3, 9.3.4.4, 9.3.4.	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.1.5.5
	Assessment	**Assessment**	**Assessment**

10	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.1, 9.2.2.2	Engineering Technology CS: 9.3.5 BMs: 9.3.5.1, 9.3.5.2,	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.1, 9.5.2.2
11	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.3, 9.2.2.4,	Engineering Technology CS: 9.3.5 BMs: 9.3.5.3, 9.3.5.4,	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.3, 9.5.2.4
12	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.5	Engineering Technology CS: 9.3.5 BMs: 9.3.5.5, 9.3.5.6, 9.3.5.7	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.5,
13	**Summative Assessment**		

Grade 9 Technology and Industrial Arts Content Standards and Benchmarks Overview as per Strands and Units

The five strands – Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology are unpacked into units to Benchmarks as outlined in the table below:

Strand 1:Textile Technology	
Unit 1: Fibres and Fabrics	
Content Standard	**Benchmarks**
CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.1 – 9.1.1.6
	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing
	9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics
	9.1.1.3 Explore the elements of design and the design and construction of fashion ideas
	9.1.1.4 Describe the functions of tools and equipment and their safe usage
	9.1.1.5 Explore the range of textile construction techniques
	9.1.1.6 Apply appropriate safety practices in fashion design and construction
Strand 1:Textile Technology	
Unit 2:Textile and Clothing	
CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.1 – 9.1.2.6
	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design
	9.1.2.2. Demonstrate an awareness of the fundamentals of the design process through various artistic versions
	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects
	9.1.2.4 Describe how the properties of textile fibres affect textile wear and care
	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects
	9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work
Strand 2:Food Technology	
Unit 1: Food and Nutrition	
CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.1 – 9.2.1.7
	9.2.1.1 Compare and contrast the nature and properties of food
	9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development
	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.
	9.2.1.4 Explore nutrition as integral to making food choices
	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences
	9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues
	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment

Strand 2:Food Technology	
Unit 2:Food Science	
CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions, lifestyle, business)	9.2.2.1 – 9.2.2.6
	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development
	9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.
	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation
	9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food.
	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption
	9.2.2.6 Apply the design process to create food solutions.
Strand 3: Construction Technology	
Unit 1: Building Technology	
CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.1 – 9.3.1.6
	9.3.1.1 Investigate the history and theory of buildings
	9.3.1.2 Identify and describe a variety of construction materials, components, and processes
	9.3.1.3 Describe the elements of drawings, and their application in technical drawings.
	9.3.1.4 Identify and describe the elements of safety
	9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects
	9.3.1.6 Apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects
Strand 3: Construction Technology	
Unit 2: Electrical Technology	
CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 – 9.3.2.7
	9.3.2.1 Describe the historical development of electricity
	9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety
	9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.
	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors
	9.3.2.5 Identify symbols used and explain the functions of components and devices in electrical circuit diagrams
	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.
	9.3.2.7 Investigate the concepts, principles and practices related to electrical
Strand 3:Construction Technology	
Unit 3: Plumbing Technology	
CS 3.3 Investigate and analyse fundamental concepts of plumbing and	9.3.3.1 – 9.3.3.4
	9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade

theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.
	9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math.
	9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing.
Strand 3:Construction Technology	
Unit 4:Welding Technology	
CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.1 – 9.3.4.5
	9.3.4.1 Investigate safe workshop setup and safety procedures in welding
	9.3.4.2 Explore and interpret welding principles, codes and standards
	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fi t-up techniques
	9.3.4.4 Investigate and analyse the properties of metals
	9.3.4.5 Investigate the various welding techniques and cutting processes
Strand 3: Construction Technology	
Unit 5: Engineering Technology	
CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.1 – 9.3.5.7
	9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.
	9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations
	9.3.5.3 Explore and distinguish the different types of the Engineering fields.
	9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.
	9.3.5.5 Explore and analyse the general safety practices in engineering.
	9.3.5.6 Outline management and problem solving skills using the engineering design process.
	9.3.5.7. Explore and utilise communication practices appropriate to engineering.
Strand 4: Communication Technology	
Unit 1: Data Communication and Network	
CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.1 – 9.4.1.7
	9.4.1.1 Define the elements of data communication system.
	9.4.1.2 Describe the functions of the different components of a computer network.
	9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.
	9.4.1.4 Explore the use of technical terminology, basic scientific concepts and mathematical concepts used in communications technology and apply them to the creation of media products.
	9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a range of communications media products or services.

	9.4.1.6 Research and apply the design brief to design, configure and manage simple network.
	9.4.1.7 Explore the Authoring Software or Multimedia associate software
Strand 4: Communication Technology	
Unit 2:Computer Security and Safety	
CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.	9.4.2.1 – 9.4.2.5
	9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment
	9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices
	9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society
	9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments.
	9.4.2.5 Demonstrate an understanding of and apply safe work practices in communications technology activities
Strand 5:Computer Technology	
Unit 1:Computer Architecture	
CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.1 – 9.5.1.6
	9.5.1.1 Comprehend and explain the Computer System and types of computer.
	9.5.1.2 Explore generations of computer
	9.5.1.3 Investigate and describe the design brief of solving problems.
	9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;
	9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic
	9.5.1.6 Explore and describe hardware and software troubleshooting principles
Strand 5: Computer Technology	
Unit 2: Computer Software	
CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.1 – 9.5.2.5
	9.5.2.1 Explore programming software and applications
	9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management
	9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)
	9.5.2.4 Create documents using Microsoft Office
	9.5.2.5 Explore the Authoring Software or Multimedia associate software

Grade 9 Technology and Industrial Arts Content Standards, Benchmarks and Topics Overview as per the Strands and Units

Strand 1: Food Technology **Unit 1: Fibres and Fabrics**		
Content Standard	**Benchmark**	**Topic**
CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles, fashion and clothing	Impact of changes on textiles, fashion and clothing
	9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics	Introduction to fibres and fabrics
	9.1.1.3 Explore the elements of design and the design and construction of fashion ideas	Designing and Construction
	9.1.1.4 Describe the functions of tools and equipment and their safe usage	Functions and safe usage of tools and equipment
	9.1.1.5 Explore the range of textile construction techniques	Techniques in textile construction
	9.1.1.6 Apply appropriate safety practices in fashion design and construction	Safety practices in fashion designing and construction
Strand 1:Textile Technology **Unit 2: Textile and Clothing**		
Content Standard	**Benchmark**	**Topic**
CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design	Sources of Design
	9.1.2.2. Demonstrate an awareness of the fundamentals of the design process through various artistic versions	Fundamentals of design process
	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects	Tools and techniques in project designs
	9.1.2.4 Describe how the properties of textile fibres affect textile wear and care	Textiles wear and care
	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects	Designing a textile project
	9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work	Documenting a project portfolio
Strand 2:Food Technology **Unit 1: Food and Nutrition**		
Content Standard	**Benchmark**	**Topic**
CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural	9.2.1.1 Compare and contrast the nature and properties of food	Nature and properties of food
	9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development

and technological influences on the production and compliance with ethical principles and standards	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.	Food and nutrients
	9.2.1.4 Explore nutrition as integral to making food choices	Food metabolism
	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences	Influences on food product development
	9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism
	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development
Strand 2:Food Technology **Unit 2:Food Science**		
Content Standard	**Benchmark**	**Topic**
CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions, lifestyle, business)	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils
	9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.	Sensory characteristics of food
	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management
	9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food.	Food safety and hygienic practices
	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption	Factors influencing food processing and packaging
	9.2.2.6 Apply the design process to create food solutions	The technology design
Strand 3:Construction Technology **Unit 1:Building Technology**		
Content Standard	**Benchmark**	**Topic**
CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the	9.3.1.1 Investigate the history and theory of buildings	The history and theory of buildings
	9.3.1.2 Identify and describe a variety of construction materials, components, and processes	Building construction materials
	9.3.1.3 Describe the elements of drawings, and their application in technical drawings.	Trade drawing

processes in which those materials and equipment are used according to industry standards.	9.3.1.4 Identify and describe the elements of safety	The Elements Occupational Health and Safety
	9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects	Building Codes, Standards and regulations
	9.3.1.6 Apply mathematical skills and scientific concepts in the planning and building of a variety of construction projects	Trade Maths
Strand 3:Construction Technology **Unit 2: Electrical Technology**		
Content Standard	**Benchmark**	**Topic**
CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship, sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 Describe the historical development of electricity	History of Electricity
	9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety	Workplace and Electrical safety
	9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.	Electrical or Electronic processes and products
	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors	Fundamentals of electricity
	9.3.2.5 Identify symbols used and explain the functions of components and devices in electrical circuit diagrams	Components and devices used on circuit diagrams
	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.	Circuits
	9.3.2.7 Investigate the concepts, principles and practices related to electrical	Electrical Fundamentals
Strand 3:Construction Technology **Unit 3: Plumbing Technology**		
Content Standard	**Benchmark**	**Topic**
CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade	Fundamental concept and relevance of plumbing trade
	9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places	Topic 2: Occupational Health and Safety regulations and standard
	9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math	Plumbing tool and equipment
	9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing	Trade Drawing

Strand 3: Construction Technology **Unit 4: Welding Technology**		
Content Standard	**Benchmark**	**Topic**
CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.1 Investigate safe workshop setup and safety procedures in welding	Workshop Organisation
	9.3.4.2 Explore and interpret welding principles, codes and standards	Welding Standards
	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fi t-up techniques	Measurement Techniques
	9.3.4.4 Investigate and analyse the properties of metals.	Metals
	9.3.4.5 Investigate the various welding techniques and cutting processes.	Cutting and Welding
Strand 3: Construction Technology **Unit 5: Engineering Technology**		
Content Standard	**Benchmark**	**Topic**
CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.	Historical aspects of Engineering Design Process
	9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations.	Introduction to Engineering
	9.3.5.3 Explore and distinguish the different types of the Engineering fields.	Engineering Fields
	9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.	Engineering Principles and practices
	9.3.5.5 Explore and analyse the general safety practices in engineering.	Occupational Health & safety
	9.3.5.6 Outline management and problem solving skills using the engineering design process.	Engineering Design Process
	9.3.5.7. Explore and utilise communication practices appropriate to engineering.	Engineering Communication
Strand 4: Communication Technology **Unit 1: Data Communication and Network**		
Content Standard	**Benchmark**	**Topic**
CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.1 Define the elements of data communication system.	Data Communication Systems
	9.4.1.2 Describe the functions of the different components of a computer network.	Computer Networks
	9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.	OSI Model
	9.4.1.4 Explore the use of technical terminology, basic scientific concepts, and mathematical concepts used in communications technology and apply them to the creation of media products.	Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products

	9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a range of communications media products or services.	Media Communication
	9.4.1.6 Research and apply the design brief to design, configure and manage simple network.	Design Brief-Simple Network
	9.4.1.7 Explore the Authoring Software or Multimedia associate software	Authoring Software Multimedia
Strand 4:Communication Technology **Unit 2:Computer Security and Safety**		
Content Standard	**Benchmark**	**Topic**
CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.	9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment	Postures in Computer Equipment Usage
	9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices	Health and Safety in ICT
	9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society	Effects of Computer Usage
	9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments.	Emerging Technological Impact
	9.4.2.5 Demonstrate an understanding of and apply safe work practices in communications technology activities	Safe Working Practices/Habits
Strand 5: Computer Technology **Unit 1: Computer Architecture**		
Content Standard	**Benchmark**	**Topic**
CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.1 Comprehend and explain the Computer System and types of computer.	Computer System
	9.5.1.2 Explore generations of computer	History of Computers
	9.5.1.3 Investigate and describe the design brief of solving problems.	Design Brief
	9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;	Computer Electronics
	9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic	Binary
	9.5.1.6 Explore and describe hardware and software troubleshooting principles	Troubleshooting

Strand 5:Computer Technology **Unit 2: Computer Software**		
Content Standard	**Benchmark**	**Topic**
CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.1 Explore programming software and applications	Software Programming
	9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management	Operating System
	9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)	Keyboarding
	9.5.2.4 Create documents using Microsoft Office	Microsoft Office
	9.5.2.5 Explore the Authoring Software or Multimedia associate software	Authoring Software/ Multimedia

Grade 9 Technology and Industrial Arts Topics and Lesson Titles as per Strands and Units

The strand, Units and Benchmarks are further unpacked into Topics and Lesson Titles in the Teacher Guides. These are outlined in the table below:

Strand 1:Textile Technology **Unit 1:Fibres and Fabrics**	
Topics	**Lesson Titles**
Benchmarks	**9.1.1.1 – 9.1.1.6**
Topic 1: Impact of changes on textiles, fashion and clothing	Lesson 1: Exploring Textiles? Lesson 2: Origins of textiles, fashion and clothing Lesson3: Factors affecting changes in textile, fashions and clothing
Topic2: Introduction to fibres and fabrics	Lesson 1: What are fibres and fabrics? Lesson 2: Characteristics and properties of fibres and fabrics Lesson 3: From fibres to fabrics.
Topic 3: Designing and Construction	Lesson 1: Elements of design and design types. Lesson 2: Sources of fashion ideas. Lesson 3: Basic construction processes.
Topic 4: Functions and safe usage of tools and equipment	Lesson 1: Textile Construction methods tools and their functions. Lesson 2: Safety when using textile tools and equipment. Lesson 3: Care and maintenance of textile products.
Topic 5: Techniques in textile construction	Lesson 1: Textile construction methods Lesson 2: Colouring and decorating methods Lesson 3: Fabric finishes
Topic 6: Safety practices in fashion designing and construction	Lesson 1: Differentiating between textile designing and construction processes Lesson 2: Safety practices in textile.
Strand 1:Textile Technology **Unit 2:Textile and Clothing**	
Benchmarks	**9.1.2.1 – 9.1.2.6**
Topic 1: Sources of Design	Lesson 1: Sources of design Lesson 2: Technological progression Lesson 3: Emerging trends
Topic 2: Fundamentals of design process	Lesson 1: Importance of design process Lesson 2: Skills in the design process Lesson 3: Various artistic version
Topic 3: Tools and techniques in project designs	Lesson 1: Fashion and types of garments Lesson 2: Transferring patterns from garment to garment Lesson 3: Patterning techniques
Topic 4: Textiles wear and care	Lesson Types of tools for textile projects Lesson Safe uses of special tools Lesson Care for tools
Topic 5: Designing a textile project	Lesson What is design process Lesson Phases in Textile Project development Lesson Textile Projects
Topic Documenting a project portfolio	Lesson People and textile industry Lesson Textile technology equipment Lesson Textile Project exhibit
Strand 2:Food Technology **Unit 1: Food and Nutrition**	
Benchmarks	**9.2.1.1 – 9.2.1.7**

Topic 1: Nature and properties of food	Lesson 1: Introduction to food –(Nature and sources of food) Lesson 2: Food groups and dietary guidelines Lesson 3: Properties of starch, carbohydrates, fats and oil Lesson 4: Introduction to food product development
Topic 2: Safety and hygienic practices in food product development	Lesson 1: Personal hygiene and safety practices Lesson 2: Kitchen hygiene Lesson 3: Hygiene practices and safety in food development (preparation etc.)
Topic 3: Food and nutrients	Lesson 1: Functions of nutrients and food sources Lesson 2: Eating practices Lesson 3: Meal planning
Topic 4: Food metabolism	Lesson 1: Digestion and absorption of food Lesson 2: Functions of food and nutrients in human body Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
Topic 5: Influences on food product development	Lesson 1: Food ingredients Lesson 2: Principles of cooking methods Lesson 3: Food management Lesson 4: Economic, Social and technological influences on food product development
Topic 6: Food composition and energy metabolism	Lesson 1: Food composition Lesson 2: Food labelling Lesson 3: Energy metabolism Lesson 4: Meals for special needs
Topic 7: Food product development	Lesson 1: Introduction to food product development Lesson 2: Design process Lesson 3: Design Brief Lesson 4: Sensory analysis
Strand 2: Food Technology **Unit 2: Food Science**	
Benchmarks	**9.2.2.1 – 9.2.2.6**
Topic 1: Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	Lesson 1 Cooking methods in food product development Lesson 2 Physical and biological properties of cereals, vegetables and fruits Lesson 3 Physical and biological properties of fruits, legumes, fats and oils
Topic 2: Sensory characteristics of food	Lesson 1 Sensory analyses of food Lesson 2 Nutritional functions of food Lesson 3 Functional foods
Topic 3: Food management	Lesson 1 Food management Lesson 2 Trends, fashion and food Lesson 3 Seasons and food
Topic 4: Food safety and hygienic practices	Lesson 1 Food borne diseases Lesson 2 Contamination Lesson 3 First Aid
Topic 5: Factors influencing food processing and packaging	Lesson 1 Factors that influence food processing Lesson 2 The role of food packaging Lesson 3 Developments in packaging and distribution Lesson 4 Techniques to evaluate products and processes
Topic 6: The technology design	Lesson 1 Design brief and the technological process Lesson 3 Evaluate the new product Lesson 2 Using a design product to create a new product
Strand 3: Construction Technology **Unit 1: Building Technology**	
Benchmarks	**9.3.1.1 – 9.3.1.6**

Topic 1: The history and theory of buildings	Lesson 1: Introduction to Building Lesson 2: Definition of Building Lesson 3: Different Types of Building Lesson 4: Types of material used Lesson 5: Importance of building and career paths.
Topic 2: Building construction materials	Lesson 1: Define Building materials Lesson 2: Timber Building Materials Lesson 3: Bricks and Concrete materials Lesson 4: Metal and steel materials
Topic 3: Trade drawing	Lesson 1: Define trade drawing Lesson 2: Types of trade drawing Lesson 3: Isometric drawing Lesson 4: Pictorial drawing Lesson 5: Orthographic drawing Lesson 6: Types of lines use
Topic 4: The Elements Occupational Health and Safety	Lesson 1: Define occupational Health and safety Lesson 2: The regulations of OHS Lesson 3: The standards of OHS
Topic 5: Building Codes, Standards and regulations	Lesson 1: Define Building legislations and regulations Lesson 2: Types of building codes Lesson 3: Types of building regulations
Topic 6: Trade Maths	Lesson 1: Define Applied maths Lesson 2: Formulae to calculate substructure Lesson 3: Define sub- structure member (footings, post, bearers) Lesson 4: Define super -structure members (Floor joist, studs, roofing frame) Lesson 5: Types of building defect
Strand 3: Construction Technology **Unit 2:Electrical Technology**	
Benchmarks	**9.3.2.1 – 9.3.2.7**
Topic 1: History of Electricity	Lesson 1: Electrical Energy Production & Supply Lesson 2: Modern Power Generation methods Lesson 3: Renewable and sustainable energy practices.
Topic 2: Workplace and Electrical safety	Lesson 1: Electrical Energy Production & Supply Lesson 2: Renewable and sustainable energy practices. Lesson 3: Career Pathway in Electrical Technology
Topic 3: Electrical or Electronic processes and products	Lesson 1: OHS legislation & Regulation Lesson 2: Personal Safety Lesson 3: Emergency procedures.
Topic 4: Fundamentals of electricity	Lesson 1: Electrical or Electronic processes Lesson 2: Electrical or Electronic products
Topic 5: Components and devices used on circuit diagrams	Lesson 1: Electricity Lesson 2: Conductivity Lesson 3: Conductors and Insulators
Topic 6: Circuits	Lesson 1: Electrical components & devices Lesson 2: Electrical symbols used in circuit diagrams
Topic 7: Electrical Fundamentals	Lesson 1: OHMs LAW Lesson 2: Kirchhoff's Law Lesson 3: Circuit Calculations
Strand 3:Construction Technology **Unit 3:Plumbing Technology**	
Benchmarks	**9.3.3.1 – 9.3.3.4**
Topic 1: Fundamental concept and relevance of plumbing trade	Lesson 1: Introduction to plumbing trade. Lesson 2: Importance of plumbing trade. Lesson 3: Career pathways of plumbing trade.

Topic 2: Occupational Health and Safety regulations and standard	Lesson 1: Define Occupational Health Safety regulations and standards. Lesson 2: Types of regulations and standards.
Topic 3: Plumbing tool and equipment	Lesson 1: Define plumbing tools and equipment. Lesson 2: Types of manual tools and equipment. Lesson 3: Types of plumbing materials and specifications.
Topic 4: Trade Drawing	Lesson 1: Define trade drawing. Lesson 2: Methods of Isometric drawing. Lesson 3: Methods of Pictorial drawing. Lesson4: Types of lines used.
Strand 3:Construction Technology **Unit 4:Welding Technology**	
Benchmarks	**9.3.4.1 – 9.3.4.5**
Topic 1: Workshop Organisation	Lesson 1: Workshop Set-up Lesson 2: Workshop safety procedures
Topic 2: Welding Standards	Lesson 1: Welding Principles Lesson 2: Welding Codes Lesson 3: Welding Standards
Topic 3: Measurement Techniques	Lesson 1: Measurement Lesson 2: Print reading Lesson 3: Layout/ fit-up Techniques
Topic 4: Metals	Lesson 1: Types of metals Lesson 2: Metal Properties
Topic 5: Cutting and Welding	Lesson 1: Types of Welding Lesson 2: Thermal cutting, heating and gouging Lesson 3: Brazing Lesson 4: Welding processes
Strand 3: Construction Technology **Unit 5: Engineering Technology**	
Benchmarks	**9.3.5.1 – 9.3.5.7**
Topic 1: Historical aspects of Engineering Design Process	Lesson 1: Engineering, past, present & Future Lesson 2: Engineering Innovations Lesson 3: Influence of Engineering in the society.
Topic 2: Introduction to Engineering	Lesson 1: Introduction to Engineering Lesson 2: Scope of Engineering Lesson 3: Roles and responsibilities of Engineers
Topic 3: Engineering Fields	Lesson 1: Types of engineering fields Lesson 2: Specific terminologies for the different types of engineering. Lesson 3: Processes of manufacturing materials in various engineering discipline
Topic 4: Engineering Principles and practices	Lesson 1: Engineering principles Lesson 2: Engineering practices Lesson 3: Engineering materials
Topic 5: Occupational Health & safety	Lesson 1: OHS legislations and regulations for Engineers Lesson 2: Hazards & Risk Control Measures Lesson 3: Risk Assessment & Management Lesson 4: Basic First –Aid and CPR
Topic 6: Engineering Design Process	Lesson 1: Steps of Engineering Design Lesson 2: Management skills Lesson 3: Problem-solving skills
Topic 7: Engineering Communication	Lesson 1: Effective communication Lesson 2: Interpersonal and intrapersonal communication skills Lesson 3: Telephones, emails, directories Lesson 4: Report writing, Lesson 5: Memorandums Lesson 6: Incident reports

Strand 4: Communication Technology **Unit 1:Data Communication and Network**	
Benchmarks	**9.4.1.1 – 9.4.1.7**
Topic 1: Data Communication Systems	Lesson 1: Introduction to Data Communication Systems Lesson 2: Elements of Data Communication systems
Topic 2: Computer Networks	Lesson 1: Introduction to Computer Networks Lesson 2: Functions of Computer Network Components
Topic 3: OSI Model	Lesson 1: Introduction OSI Model Lesson 2: Functions of the OSI Model
Topic 4: Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products	Lesson 1: Communication Technology Terminologies Lesson 2: Application of Terminologies Lesson 3: Media Products.
Topic 5: Media Communication	Lesson 1: Introduction to Media Communication Lesson 2: Techniques and Skills for application purposes
Topic 6: Design Brief-Simple Network	Lesson 1: Introduction to Design Brief Lesson 2: Research and apply Design Lesson 3: Brief in simple Networking
Topic 7: Authoring Software Multimedia	Lesson 1: Introduction to Multimedia, Authoring Software Lesson 2: Categories of Authoring Software Lesson 3: Features of Multimedia, Authoring Software
Strand 4:Communication Technology **Unit 2:Computer Security and Safety**	
Benchmarks	**9.4.2.1 – 9.4.2.6**
Topic 1: Postures in Computer Equipment Usage	Lesson 1: Introduction to Ergonomics Lesson 2: Correct Posture or Positions Lesson 3: Case Study - Posture
Topic 2: Health and Safety in ICT	Lesson 1: Types Health Hazards associated with use of ICT Lesson 2: Good ergonomics practices to minimise Health hazards associated in ICT usage
Topic 3: Effects of Computer Usage	Lesson 1: Introduction to computer technology Lesson 2: Effects of Computer Technology Usage on society
Topic 4: Emerging Technological Impact	Lesson 1: The evolution of emerging technologies Lesson 2: Impact of emerging technologies on society and environment Lesson 3: Case-Study (Music)
Topic 5: Safe Working Practices/ Habits	Lesson 1: Introduction to Work Place Safety Lesson 2: Safe Work Practices
Strand 5: Computer Technology **Unit 1:Computer Architecture**	
Benchmarks	**9.5.1.1 – 9.5.1.5**
Topic 1: Computer System	Lesson 1: Information-Processing- Cycle Lesson 2: Computer Hardware and Software Lesson 3: Types of Computer
Topic 2: History of Computers	Lesson 1: History of Computers Lesson 2: Generation of Computers Lesson 3: Classification of Computers
Topic 3: Design Brief	Lesson 1: Introduction to Design Brief Lesson 2: Stage Design Brief Lesson 3: Case Study of Design Brief
Topic 4: Computer Electronics	Lesson 1: Fundamentals of Computer Electronics Lesson 2: Functions of computer electronic components
Topic 5: Binary	Lesson 1: Introduction to Binary Numbers Lesson 2: Binary Numbers Lesson 3: Digital Logic Circuitry

Topic 6: Troubleshooting	Lesson 1: Introduction to Computer Troubleshooting Lesson Lesson 2: Troubleshooting Lesson 3: Case Study of Troubleshooting
Strand 5: Computer Technology **Unit 2: Computer Software**	
Benchmarks	**9.5.2.1 – 9.5.2.5**
Topic 1: Software Programming	Lesson 1: Introduction to Programming. Lesson 2: Types of Programming software and applications Lesson 3: Example of Software Programs and associated programming languages
Topic 2: Operating System	Lesson 1: Introduction to Operating System Lesson 2: Categories of Operating Systems Software Lesson 3: File Management
Topic 3: Keyboarding	Lesson 1: Introduction to Keyboard Lesson 2: Keyboard Techniques Lesson 3: Hands on Typing
Topic 4: Microsoft Office	Lesson 1: Introduction to Microsoft Word Lesson 2: Introduction to Microsoft Excel Lesson 3: Introduction to Microsoft PowerPoint/Publisher
Topic 5: Authoring Software/ Multimedia	See Strand 4, Benchmark 9.4.1.7

Step 5: Expand and plot the distributed content into the complete 16 Week 3-Part Yearly Content Overview for the grade

The strand, Units and Benchmarks are further unpacked into Topics and Lesson Titles in the Teacher Guides.

The Yearly Content Overview for the Technology and Industrial Arts is a 16 week 3-part Content Overview which is Yearly Content Overview for the Technology and Industrial Arts Subject.

It outlines the Strands, Units, Content Standards, Benchmarks, Topics and Lessons to be taught in 16 weeks for each part. Teachers have the option of outlining the their Yearly Content Overview in a template that can be easily read and understood by all who will be using the Yearly Overview to derive their Termly teaching programs.
(A sample template is provided.)

In the sample below, the Strands, Units, Content Standards, Benchmarks, Topics and Lesson Titles are distributed evenly across the 16 weeks for each part that must be programmed.

A sample is given below for your convenience to help you plan for your termly program.

Grade 9 Textile and Food Technology Yearly Content Overview

Wk	Textile Technology and Food Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Textile Technology: Fibres and Fabrics: CS: 9.11	CS1.1 Investigate the evolution, characteristics, designs and	9.1.1.1 Compare and contrast social, economic, cultural and technological changes to textiles,	Impact of changes on textiles, fashion and clothing	Lesson 1: Exploring Textiles? Lesson 2: Origins of textiles, fashion and clothing

	BMs: 9.1.1.1 and 9.1.1.2, 9.1.1.3,	trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	fashion and clothing		Lesson3: Factors affecting changes in textile, fashions and clothing
			9.1.1.2 Distinguish the properties and characteristics of fibres and fabrics	Introduction to fibres and fabrics	Lesson 1: What are fibres and fabrics? Lesson 2: Characteristics and properties of fibres and fabrics Lesson 3: From fibres to fabrics.
			9.1.1.3 Explore the elements of design and the design and construction of fashion ideas	Designing and Construction	Lesson 1: Elements of design and design types. Lesson 2: Sources of fashion ideas. Lesson 3: Basic construction processes
2	Textile Technology: Fibres and Fabrics: CS: 9.11 BMs: 9.1.1.4, 9.1.1.5, 9.1.1.6	CS1.1 Investigate the evolution, characteristics, designs and trends of fabrics and fabric designs, their construction, production, representation, regulation and marketing.	9.1.1.4 Describe the functions of tools and equipment and their safe usage	Functions and safe usage of tools and equipment	Lesson 1: Textile Construction methods tools and their functions. Lesson 2: Safety when using textile tools and equipment. Lesson 3: Care and maintenance of textile products.
			9.1.1.5 Explore the range of textile construction techniques	Techniques in textile construction	Lesson 1: Textile construction methods Lesson 2: Colouring and decorating methods Lesson 3: Fabric finishes
			9.1.1.6 Apply appropriate safety practices in fashion design and construction	Safety practices in fashion designing and construction	Lesson 1: Differentiating between textile designing and construction processes Lesson 2: Safety practices in textile.
3	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs:9.1.2.1, 9.1.2.2,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for	9.1.2.1 Describe historical influences, technological progression and emerging trends as inspirational sources of design	Sources of Design	Lesson 1: Sources of design Lesson 2: Technological progression Lesson 3: Emerging trends
			9.1.2.2. Demonstrate an	Fundamentals of design	Lesson 1: Importance of

		a variety of needs and occasions	awareness of the fundamentals of the design process through various artistic versions	process	design process Lesson 2: Skills in the design process Lesson 3: Various artistic version
4	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.3, 9.1.2.4,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.3 Apply a broad range of contemporary and appropriate tools and techniques with competence and in the development of design projects	Tools and techniques in project designs	Lesson 1: Fashion and types of garments Lesson 2: Transferring patterns from garment to garment Lesson 3: Patterning techniques
			9.1.2.4 Describe how the properties of textile fibres affect textile wear and care	Textiles wear and care	Lesson Types of tools for textile projects Lesson Safe uses of special tools Lesson Care for tools
5	Textile Technology: Textile and Clothing: CS: 9.1.2 BMs: 9.1.2.5, 9.1.2.6,	CS1.2 Integrate and apply principles and techniques in presenting fashion ideas and illustrations in pattern making and garment construction for a variety of needs and occasions	9.1.2.5 Apply the design process to respond to needs and opportunities in textile design projects	Designing a textile project	Lesson What is design process Lesson Phases in Textile Project development Lesson Textile Projects
			9.1.2.6 Select and use appropriate technology to creatively document, communicate and present design and project work	Documenting a project portfolio	Lesson People and textile industry Lesson Textile technology equipment Lesson Textile Project exhibit
6	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.1. 9.2.1.2	CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.1 Compare and contrast the nature and properties of food	Nature and properties of food	Lesson 1: Introduction to food –(Nature and sources of food) Lesson 2: Food groups and dietary guidelines Lesson 3: Properties of starch, carbohydrates, fats and oil Lesson 4: Introduction to food product development
			9.2.1.2 Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development	Safety and hygienic practices in food product development	Lesson 1: Personal hygiene and safety practices Lesson 2: Kitchen hygiene Lesson 3: Hygiene practices and safety

					in food development (preparation etc.)
7	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.3, 9.2.1.4	CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.3 Examine the nutritional components of food and food development and the impact of food consumption on nutrition.	Food and nutrients	Lesson 1: Functions of nutrients and food sources Lesson 2: Eating practices Lesson 3: Meal planning
			9.2.1.4 Explore nutrition as integral to making food choices	Food metabolism	Lesson 1: Digestion and absorption of food Lesson 2: Functions of food and nutrients in human body Lesson 3: Over nutrition and malnutrition (anorexia, bulimia, obesity, hypertension etc.)
8	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.5, 9.2.1.6,	CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with ethical principles and standards	9.2.1.5 Discuss economic, social and technological influences of food, food product and food sciences	Influences on food product development	Lesson 1: Food ingredients Lesson 2: Principles of cooking methods Lesson 3: Food management Lesson 4: Economic, Social and technological influences on food product development
			9.2.1.6 Explore ways of meeting nutritional requirements to maintain optimum nutrition or manage nutritional issues	Food composition and energy metabolism	Lesson 1: Food composition Lesson 2: Food labelling Lesson 3: Energy metabolism Lesson 4: Meals for special needs
9	Food Technology: Food and Nutrition: CS: 9.2.1 BMs: 9.2.1.7	CS 2.1 Students will be able to examine and analyze the characteristics and properties of difference types of food and the social, economic, political, cultural and technological influences on the production and compliance with	9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment	Food product development	Lesson 1: Introduction to food product development Lesson 2: Design process Lesson 3: Design Brief Lesson 4: Sensory analysis

		ethical principles and standards			
10	Food Technology: Food Science: CS: 9.2.2 BMs: 9.2.2.1, 9.2.2.2	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions,	9.2.2.1 Identify and describe the cultural, physical, biological and nutritional characteristics of food that influence food development	Characteristics and properties of cereals, vegetables, fruits, legumes, fats and oils	Lesson 1 Cooking methods in food product development Lesson 2 Physical and biological properties of cereals, vegetables and fruits Lesson 3 Physical and biological properties of fruits, legumes, fats and oils
			9.2.2.2 Describe the nutritional and sensory characteristics of food to meet the needs, health and occasions.	Sensory characteristics of food	Lesson 1 Sensory analyses of food Lesson 2 Nutritional functions of food Lesson 3 Functional foods
11	Food Technology: Food Science: CS: 9.2.2 BMs: 9.2.2.3, 9.2.2.4,	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence the development and production of food to meet different demands (e.g., health, occasions)	9.2.2.3 Apply management strategies in food selection, meal preparation, product development, storage and preservation	Food management	Lesson 1 Food management Lesson 2 Trends, fashion and food Lesson 3 Seasons and food
			9.2.2.4 Explore safety and hygiene practices relating to food, and changes that occur in the functional properties of food	Food safety and hygienic practices	Lesson 1 Food borne diseases Lesson 2 Contamination Lesson 3 First Aid
12	Food Technology: Food Science: CS: 9.2.1 BMs: 9.2.2.5 9.2.2.6	CS 2.2 Students will be able to investigate and analyse the cultural, physical, chemical, nutritional, biological and sensory characteristics of food and how they influence	9.2.2.5 Examine the social, economic and environmental impact of food processing technology, and the role packaging plays in the distribution of food from the point of production to consumption	Factors influencing food processing and packaging	Lesson 1 Factors that influence food processing Lesson 2 The role of food packaging Lesson 3 Developments in packaging and distribution Lesson 4 Techniques to evaluate products and processes

		the development and production of food to meet different demands (e.g., health, occasions,	9.2.2.6 Apply the design process to create food solutions.	The technology design	Lesson 1 Design brief and the technological process Lesson 3 Evaluate the new product Lesson 2 Using a design product to create a new product
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Grade 9 Construction Technology Yearly Content Overview

Wk	Construction Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Building Technology CS: 9.3.1 BMS: 9.3.1.1. 9.3.1.2, 9.3.1.3,	CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and equipment are used according to industry standards.	9.3.1.1 Investigate the history and theory of buildings	The history and theory of buildings	Lesson 1: Introduction to Building Lesson 2: Definition of Building Lesson 3: Different Types of Building Lesson 4: Types of material used Lesson 5: Importance of building and career paths.
			9.3.1.2 Identify and describe a variety of construction materials, components, and processes	Building construction materials	Lesson 1: Define Building materials Lesson 2: Timber Building Materials Lesson 3: Bricks and Concrete materials Lesson 4: Metal and steel materials
			9.3.1.3 Describe the elements of drawings, and their application in technical drawings.	Trade drawing	Lesson 1: Define trade drawing Lesson 2: Types of trade drawing Lesson 3: Isometric drawing Lesson 4: Pictorial drawing Lesson 5: Orthographic drawing Lesson 6: Types of lines use
2	Building Technology CS: 9.3.1 BMs: 9.3.1.4, 9.3.1.5, 9.3.1.6,	CS 3.1 Investigate the history and theory of buildings and analyse the components and systems of buildings, occupational health and safety procedures, the properties of building materials and the processes in which those materials and	9.3.1.4 Identify and describe the elements of safety	The Elements Occupational Health and Safety	Lesson 1: Define occupational Health and safety Lesson 2: The regulations of OHS Lesson 3: The standards of OHS
			9.3.1.5 Describe the scope and purpose of building codes, and identify other regulations and standards that apply to construction projects	Building Codes, Standards and regulations	Lesson 1: Define Building legislations and regulations Lesson 2: Types of building codes Lesson 3: Types of building regulations
			9.3.1.6 Apply mathematical skills and scientific	Trade Maths	Lesson 1: Define Applied maths Lesson 2: Formulae

		equipment are used according to industry standards.	concepts in the planning and building of a variety of construction projects		to calculate substructure Lesson 3: Define sub- structure member (footings, post, bearers) Lesson 4: Define super -structure members (Floor joist, studs, roofing frame) Lesson 5: Types of building defect
3	Electrical Technology CS: 9.3.2 BMs: 9.3.2.1, 9.3.2.2, 9.3.2.3,	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship , sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.1 Describe the historical development of electricity	History of Electricity	Lesson 1: Electrical Energy Production & Supply Lesson 2: Modern Power Generation methods Lesson 3: Renewable and sustainable energy practices.
			9.3.2.2 Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety	Workplace and Electrical safety	Lesson 1: Electrical Energy Production & Supply Lesson 2: Renewable and sustainable energy practices. Lesson 3: Career Pathway in Electrical Technology
			9.3.2.3 Identify, design, develop and evaluate processes and products related to electrical technology and communicate the findings through the use of appropriate electrical and electronic terminology.	Electrical or Electronic processes and products	Lesson 1: OHS legislation & Regulation Lesson 2: Personal Safety Lesson 3: Emergency procedures.
4	Electrical Technology CS: 9.3.2 BMs: 9.3.2.4, 9.3.2.5,	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to	9.3.2.4 Define electricity and conductivity and differentiate insulators from conductors	Fundamentals of electricity	Lesson 1: Electrical or Electronic processes Lesson 2: Electrical or Electronic products
			9.3.2.5 Identify symbols used and explain the functions of components and	Components and devices used on circuit diagrams	Lesson 1: Electricity Lesson 2: Conductivity Lesson 3: Conductors and

		economic growth, entrepreneurship , sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	devices in electrical circuit diagrams		Insulators
5	Electrical Technology CS: 9.3.2 BMs: 9.3.2.6, 9.3.2.7	CS 3.2 Analyse and apply the technological processes, concepts, principles and practices related to Electrical Technology and its social contribution with regard to economic growth, entrepreneurship , sustainability and as a tool for change, improving the quality of life responsive to individual, community and industrial needs.	9.3.2.6 Identify the different types of circuits and explain the parts and operation of a simple practical circuit.	Circuits	Lesson 1: Electrical components & devices Lesson 2: Electrical symbols used in circuit diagrams
			9.3.2.7 Investigate the concepts, principles and practices related to electrical	Electrical Fundamentals	Lesson 1: OHMs LAW Lesson 2: Kirchhoff's Law Lesson 3: Circuit Calculations
6	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.1, 9.3.3.2	CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent	9.3.3.1 Describe and explain the fundamentals, concepts, and their relevance in the plumbing trade	Fundamental concept and relevance of plumbing trade	Lesson 1: Introduction to plumbing trade. Lesson 2: Importance of plumbing trade. Lesson 3: Career pathways of plumbing trade.
			9.3.3.2 Analyse and describe OHS Regulations and standards in the plumbing trade and work places.	Topic 2: Occupational Health and Safety regulations and standard	Lesson 1: Define Occupational Health Safety regulations and standards. Lesson 2: Types of regulations and standards.

		system, and water distribution system.			
7	Plumbing Technology CS: 9.3.3 BMs: 9.3.3.3, 9.3.3.4,	CS 3.3 Investigate and analyse fundamental concepts of plumbing and theories, OHS, Occupational Health and safety Regulations and standards ,trade drawing, demonstrations and applications of tools and materials specifications, installation of plumbing fittings and accessories in (DWV) Drain, waste, vent system, and water distribution system.	9.3.3.3 Demonstrate and apply basic plumbing tools and equipment and their specifications and practice in trade math.	Plumbing tool and equipment	Lesson 1: Define plumbing tools and equipment. Lesson 2: Types of manual tools and equipment. Lesson 3: Types of plumbing materials and specifications.
			9.3.3.4 Explore and apply basic concepts of trade drawings in plumbing.	Trade Drawing	Lesson 1: Define trade drawing. Lesson 2: Methods of Isometric drawing. Lesson 3: Methods of Pictorial drawing. Lesson4: Types of lines used.
8	Welding Technology CS: 9.3.4 BMs: 9.3.4.1, 9.3.4.2,	CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	9.3.4.1 Investigate safe workshop setup and safety procedures in welding	Workshop Organisation	Lesson 1: Workshop Set-up Lesson 2: Workshop safety procedures
			9.3.4.2 Explore and interpret welding principles, codes and standards	Welding Standards	Lesson 1: Welding Principles Lesson 2: Welding Codes Lesson 3: Welding Standards
9	Welding Technology CS: 9.3.4 BMs: 9.3.4.3, 9.3.4.4, 9.3.4.5	CS 3.4 Investigate and analyse safety procedures, print reading, measurement and layout, identify properties of	9.3.4.3 Demonstrate knowledge in fundamental print reading, measurement and layout or fi t-up technique	Measurement Techniques	Lesson 1: Measurement Lesson 2: Print reading Lesson 3: Layout/ fit-up Techniques
			9.3.4.4 Investigate	Metals	Lesson 1: Types of

		metals, the welding techniques, cutting processes according to welding codes, inspections, testing principles and apply fundamentals of fabrication.	and analyse the properties of metals		metals Lesson 2: Metal Properties
			9.3.4.5 Investigate the various welding techniques and cutting processes	Cutting and Welding	Lesson 1: Types of Welding Lesson 2: Thermal cutting, heating and gouging Lesson 3: Brazing Lesson 4: Welding processes
10	Engineering Technology CS: 9.3.5 BMs: 9.3.5.1, 9.3.5.2,	CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.1 Describe how history and society has influenced the engineering field and critically analyse innovations.	Historical aspects of Engineering Design Process	Lesson 1: Engineering, past, present & Future Lesson 2: Engineering Innovations Lesson 3: Influence of Engineering in the society.
			9.3.5.2 Investigate the scope of engineering, roles and responsibilities of an engineer and recognise current innovations	Introduction to Engineering	Lesson 1: Introduction to Engineering Lesson 2: Scope of Engineering Lesson 3: Roles and responsibilities of Engineers
11	Engineering Technology CS: 9.3.5 BMs: 9.3.5.3, 9.3.5.4,	CS 3.5 Investigate and analyse the historical and societal influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.	9.3.5.3 Explore and distinguish the different types of the Engineering fields.	Engineering Fields	Lesson 1: Types of engineering fields Lesson 2: Specific terminologies for the different types of engineering. Lesson 3: Processes of manufacturing materials in various engineering discipline
			9.3.5.4 Explore and discuss engineering principles and practices and the appropriate materials in engineering.	Engineering Principles and practices	Lesson 1: Engineering principles Lesson 2: Engineering practices Lesson 3: Engineering materials
12	Engineering Technology CS: 9.3.5 BMs: 9.3.5.5, 9.3.5.6, 9.3.5.7	CS 3.5 Investigate and analyse the historical and societal	9.3.5.5 Explore and analyse the general safety practices in engineering.	Occupational Health & safety	Lesson 1: OHS legislations and regulations for Engineers Lesson 2: Hazards

		influences in Engineering by understanding the engineering principles, practices, the design process, the management, problem-solving and communication skills appropriate to any engineering field.			& Risk Control Measures Lesson 3: Risk Assessment & Management Lesson 4: Basic First –Aid and CPR
			9.3.5.6 Outline management and problem solving skills using the engineering design process.	Engineering Design Process	Lesson 1: Steps of Engineering Design Lesson 2: Management skills Lesson 3: Problem-solving skills
			9.3.5.7. Explore and utilise communication practices appropriate to engineering.	Engineering Communicatio n	Lesson 1: Effective communication Lesson 2: Interpersonal and intrapersonal communication skills Lesson 3: Telephones, emails, directories Lesson 4: Report writing, Lesson 5: Memorandums Lesson 6: Incident reports
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Grade 9 Communication and Computer Technology Yearly Content Overview

Wk	Communication and Computer Technology	Content Standard	Benchmark	Topic	Lesson Title
1	Communication Technology Data Communication and Network CS: 9.4.2 BMs: 9.4.1.1, 9.4.1.2, ,	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.1 Define the elements of data communication system.	Data Communication Systems	Lesson 1: Introduction to Data Communication Systems Lesson 2: Elements of Data Communication systems
			9.4.1.2 Describe the functions of the different components of a computer network.	Computer Networks	Lesson 1: Introduction to Computer Networks Lesson 2: Functions of Computer Network Components
2	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.4.1.3, 9.4.1.4,	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.3 Define the OSI (Open Systems Interconnect) model and how it functions.	OSI Model	Lesson 1: Introduction OSI Model Lesson 2: Functions of the OSI Model
			9.4.1.4 Explore the use of technical terminology, basic scientific concepts,and mathematical concepts used in communications technology and apply them to the creation of media products.	Communication Technology Terminologies Basic Scientific and Mathematical Concepts in creating media products	Lesson 1: Communication Technology Terminologies Lesson 2: Application of Terminologies Lesson 3: Media Products.
3	Communication Technology Data Communication and Network CS: 9.4.1 BMs: 9.1.4 .5, 9.1.4 .6, 9.1.4 .7	CS 4.1 Investigate and analyse communication technology utilising multimedia and the practices and systems in designing, installing, configuring and managing networks.	9.4.1.5 Explore and articulate the core concepts, techniques, and skills required to produce a range of communications media products or services.	Media Communication	Lesson 1: Introduction to Media Communication Lesson 2: Techniques and Skills for application purposes

			9.4.1.6 Research and apply the design brief to design, configure and manage simple network.	Design Brief- Simple Network	Lesson 1: Introduction to Design Brief Lesson 2: Research and apply Design Lesson 3: Brief in simple Networking
			9.4.1.7 Explore the Authoring Software or Multimedia associate software	Authoring Software Multimedia	Lesson 1: Introduction to Multimedia, Authoring Software Lesson 2: Categories of Authoring Software Lesson 3: Features of Multimedia, Authoring Software
4	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.1, 9.4.2.2,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society.	9.4.2.1 Investigate and demonstrate appropriate posture in using computer equipment	Postures in Computer Equipment Usage	Lesson 1: Introduction to Ergonomics Lesson 2: Correct Posture or Positions Lesson 3: Case Study - Posture
			9.4.2.2 Identify health hazards associated with the use of ICT and propose good ergonomic practices	Health and Safety in ICT	Lesson 1: Types Health Hazards associated with use of ICT Lesson 2: Good ergonomics practices to minimise Health hazards associated in ICT usage
5	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.3, 9.4.2.4,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society	9.4.2.3 Identify effects of the widespread use of computers and associated technologies on society	Effects of Computer Usage	Lesson 1: Introduction to computer technology Lesson 2: Effects of Computer Technology Usage on society
			9.4.2.4 Evaluate the impact of past, current and emerging technologies on the Individual, society and environments .	Emerging Technological Impact	Lesson 1: The evolution of emerging technologies Lesson 2: Impact of emerging technologies on society and environment Lesson 3: Case-Study (Music)

6	Communication Technology Computer Security and Safety CS: 9.4.2 BMs: 9.4.2.5,	CS 4.2 Investigate and analyse the ergonomics, social and ethical issues and the development of a monitoring and control system for both hardware, software and information security in society	9.4.2.5 Demonstrate an understanding of and apply safe work practices in communications technology activities	Safe Working Practices/Habits	Lesson 1: Introduction to Work Place Safety Lesson 2: Safe Work Practices
7	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.1, 9.5.1.2	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.1 Comprehend and explain the Computer System and types of computer.	Computer System	Lesson 1: Information-Processing- Cycle Lesson 2: Computer Hardware and Software Lesson 3: Types of Computer
			9.5.1.2 Explore generations of computer	History of Computers	Lesson 1: History of Computers Lesson 2: Generation of Computers Lesson 3: Classification of Computers
8	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.3, 9.5.1.4	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and	9.5.1.3 Investigate and describe the design brief of solving problems.	Design Brief	Lesson 1: Introduction to Design Brief Lesson 2: Stage Design Brief Lesson 3: Case Study of Design Brief
			9.5.1.4 Identify and describe the functions of, as well as important advances related to, electronic and computer components;	Computer Electronics	Lesson 1: Fundamentals of Computer Electronics Lesson 2: Functions of computer electronic components

		robotics and be aware of related environmental and societal issues.			
9	Computer Technology Computer Architecture CS: 9.5.1 BMs: 9.5.1.5, 9.5.1.6	CS 5.1 Explore and analyse computer fundamentals, the skills to manage and maintain; diagnose, troubleshoot and solve issues that encompass computer systems, networking, interfacing and programming as well as electronics and robotics and be aware of related environmental and societal issues.	9.5.1.5 Demonstrate a basic understanding of binary numbers and digital logic	Binary	Lesson 1: Introduction to Binary Numbers Lesson 2: Binary Numbers Lesson 3: Digital Logic Circuitry
			9.5.1.6 Explore and describe hardware and software troubleshooting principles	Troubleshooting	Lesson 1: Introduction to Computer Troubleshooting Lesson Lesson 2: Troubleshooting Lesson 3: Case Study of Troubleshooting
10	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.1, 9.5.2.2	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.1 Explore programming software and applications	Software Programming	Lesson 1: Introduction to Programming. Lesson 2: Types of Programming software and applications Lesson 3: Example of Software Programs and associated programming languages
			9.5.2.2 Demonstrate the understanding of Operating Systems/ Software and File Management	Operating System	Lesson 1: Introduction to Operating System Lesson 2: Categories of Operating Systems Software Lesson 3: File Management
11	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.3, 9.5.2.4	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and	9.5.2.3 Apply typing skills with speed (20wpm) and accuracy (80%)	Keyboarding	
			9.5.2.4 Create documents	Microsoft Office	Lesson 1: Introduction to Keyboard Lesson 2: Keyboard

		databases, and develop and apply the skills and knowledge in the various software.	using Microsoft Office		Techniques Lesson 3: Hands on Typing
12	Computer Technology Computer Software CS: 9.5.2 BMs: 9.5.2.5,	CS 5.2 Investigate and analyse computer system and application software, programming, algorithm, web design and databases, and develop and apply the skills and knowledge in the various software.	9.5.2.5 Explore the Authoring Software or Multimedia associate software	Authoring Software/ Multimedia	Lesson 1: Introduction to Microsoft Word Lesson 2: Introduction to Microsoft Excel Lesson 3: Introduction to Microsoft PowerPoint/Publisher
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Step 6: Develop the Termly Programs

Extract the terms content from the Yearly Overview to expand the content into the termly teaching program.

Note that the TIA program is developed in 3-parts and 1 of the 3 parts is the program to be used all year around for the different lots of students rotating to take all 5 strand s of TIA. Below is a proposed Template to develop a Teaching Program for a Term. (13 weeks)

Subject: _____Grade _____Term:____ Year: _____

Wk	CS	BM	Unit	Topic	Learning Obj.	K	S	A/V	P.S
Write the week number	Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledg e to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	By the end of this Topic, students will be able to; Write the Performa nce Standarc (if the Benchma rk carries one)

Note: A Performance Standard will only be included if the Benchmark has been nominated to carry a Performance Standard (Assessment). Otherwise, it is not very necessary for all Benchmarks to have a Performance Standard.

Step 7: **Develop the Weekly Teaching Program (Proposed Template) and Daily Lesson Plan. (SBC Template)**

Template 1: Using Topics to develop Weekly Teaching Program.
You can use the Topics to develop the weekly teaching program.
Below is a proposed Template to develop a Teaching Program for a week.
Subject: _____ Grade: ____ Term:_____ Week: ____ Date: _____Year: _____

CS	BM	Unit	Topic	Learning Objective	Knowledge	Skill	Attitude/ Values	Suggested Learning Activities	Performance Standard
Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledge to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	List down the learning activities that will be done in this topic	By the end of this Topic, students will be able to; Write the Performance Standard (only if the Benchmark carries a performance standard)

Template 2: Using Lesson Titles to develop Weekly Teaching Program

Use the unpacking process to derive lesson titles and lesson objectives to be able to expand your weekly teaching program.

Below is a proposed Template to develop a Teaching Program for a week.

Subject: _____ Grade: ____ Term:_____ Week: ____ Date: _____Year: _____

CS	BM	Unit	Topic	LO	K	S	A/V	PS	Lns N: & Titles	Lsn. Obj.	Sugg.L .Act
Write the Coding only	Write the Coding only	Write the Unit number and Name	Write the Topic number and Name	By the end of this Topic, Students will be able to: Write the learning Objectives for the Topic	Write the essential knowledge to be learnt in this topic	Write the essential skill to be learnt in this topic	Write the essential attitude and values to be learnt in this topic	By the end of this Topic, students will be able to; Write the Performance Standard (if the Benchmark carries one)	Lesson 1:	L1 Objectives	
									Lesson 2:	L2 Objectives	
									Lesson 3: Etc.	L3 Objectives	

Timetabling of Technology and Industrial Arts

The teaching and learning of TIA can be organized in the manner of class rotational basis. There are three teachers who will be teaching the subject TIA.

1: The Home Economics Teacher,

2: The Practical Skills Teacher, and

3. The Maths /Science/Computing Teacher.

These three teachers will be timetabled to teach TIA during the term. Then the planning and programming will be organized in this same manner only each strand teacher will extract the strand program for teaching as these are subject specific content. This is to ensure that teachers are on contact throughout the terms and to maintain their teaching loads.

Sample 1st Rotational Program for the First 13 Weeks (Term1 Week 1-10 and Term 2 Week 1-2)

Class	Strand	Content Teacher	
Class 1 and 2	Food and Textile Technology	Home Economics Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 3 and 4	Construction Technology	Practical Skills Teacher	
Class 5 and 6	Communication and Computer Technology	Computing ICT Teacher	

Sample 2nd Rotational Program for the Next 13 Weeks (Term 2 Week 4 – Term 3 Week 6)

Class	Strand	Content Teacher	
Class 1 and 2	Construction Technology	Practical Skills Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 3 and 4	Communication and Computer Technology	Computing ICT Teacher	
Class 5 and 6	Food and Textile Technology	Home Economics Teacher	

Sample 3rd Rotational Program for the Next 13 Weeks (Term 3 Week 7 – Term 4 Week 9)

Class	Strand	Content Teacher	
Class 1 and 2	Communication and Computer Technology Food and Textile Technology	Home Economics Teacher	These classes can be rotated so they all cover all the strands of TIA
Class 3 and 4	Food and Textile Technology	Home Economics Teacher	
Class 5 and 6	Construction Technology	Practical Skills	

Step 8: Review, Evaluate and Re-plan the yearly, termly, weekly Programs.

This process must be done collaboratively by all teachers who teach the subject.

Standards-Based Lesson Planning

What are Standards-Based Lessons?

In a Standards-Based Lesson, the most important or key distinction is that, a student is expected to meet a defined standard for proficiency. When planning a lesson, the teacher ensures that the content and the methods of teaching the content enable students to learn both the skills and the concepts defined in the standard for that grade level and to demonstrate evidence of their learning.

Planning lessons that are built on standards and creating aligned assessments that measure student progress towards standards is the first step teacher must take to help their students reach success. A lesson plan is a step-by-step guide that provides a structure for an essential learning.

When panning a standards-based lesson, teacher instructions are very crucial for your lessons. How teachers instruct the students is what really points out an innovative teacher to an ordinary teacher. Teacher must engage and prepare motivating instructional activities that will provide the students with opportunities to demonstrate the benchmarks. For instance, teacher should at least identify 3-5 teaching strategies in a lesson; teacher lectures, ask questions, put students into groups for discussion and role play what was discussed.

Why is Standards-Based Lesson Planning Important?

There are many important benefits of having a clear and organized set of lesson plans. Good planning allows for more effective teaching and learning. The lesson plan is a guide and map for organizing the materials and the teacher for the purpose of helping the students achieve the standards. Lesson plans also provide a record that allows good, reflective teachers to go back, analyze their own teaching (what went well, what didn't), and then improve on it in the future.

Standards-based lesson planning is vital because the content standards and benchmarks must be comparable, rigorous, and measurable and of course evidence based and be applicable in real life that we expect students to achieve. Therefore, teachers must plan effective lessons to teach students to meet these standards. As schools implement new standards, there will be much more evidence that teachers will use to support student learning to help them reach the highest levels of cognitive complexity. That is, students will be developing high-level cognitive skills.

Components of a Standards-Based Lesson Plan

An effective lesson plan has three basic components;

- aims and objectives of the course,
- teaching and learning activities, and
- assessments to check student understanding of the topic.

Effective teaching demonstrates deep subject knowledge, including key concepts, current and relevant research, methodologies, tools and techniques, and meaningful applications.

Planning for Under-Achievers

Who are underachieving students?

Under achievers are students who fail or do not perform as expected. Underachievement may be caused by emotions (low self-esteem) and the environment (cultural influences, unsupportive family).

How can we help underachievement?

Underachievement varies between students. Not all students are in the same category of underachievement.

Given below is a suggested strategies teachers may adopt to assist underachievers in the classroom.

- Examine the Problem Individually

It is important that underachieving students are addressed individually by focusing on the student's strengths.

- Create a Teacher-Parent Collaboration

Teachers and parents need to work together and pool their information and experience regarding the child. Teachers and parents begin by asking questions such as;

  - In what areas has the child shown exceptional ability?
  - What is the child's preferred learning styles?
  - What insights do parents and teachers have about the child's strengths and problem areas?

- Help student to plan every activity in the classroom.
- Help students set realistic expectations.
- Encourage and promote the student's interests and passions.
- Help children set short and long-term academic goals.
- Talk with them about possible goals.
- Ensure that all students are challenged (but not frustrated) by classroom activities.
- Always reinforce students.

Sample of Standards-Based Lesson Planning

The following sample lesson can help teachers to plan effective lessons. Teachers are encouraged to study the layout of the different components of these lessons and follow this design in their preparation and teaching of each lesson. Planning a good lesson helps the teacher in maintaining a standard teaching pattern which should not deviate students' learning of the concept from the topic.

Unit 1: Food and Nutrition

Content Standard 9.2.1 Students will be able to examine and analyze the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmark 9.2.1.1 Compare and contrast the nature and properties of food.

Topic: Nature and Properties of Food

Lesson Title: Introduction to food – (Nature and sources of food)

Lesson Objective (s): By the end of the lesson, students will be able to;

- distinguish and differentiate the nature and properties of food,
- classify food into groups, and
- make wise choices from food selection to consumption.

Essential Questions:

- What is food?
- What are functions of food nutrients?
- What is the purpose of a dietary guideline?

Materials: pictures, handouts, reference books, charts or posters

Knowledge:	• Nature and properties/characteristics of food • Food nutrients • Dietary guidelines
Skills:	• Identify and describe the nature and properties of food • Investigate and classify food groups • Research on the nutritional composition of food
Values/Attitudes:	• Appreciation of nature and properties of food • Making informed decisions on food selection • Adopt awareness of healthy eating habits

Teaching and Learning Strategies

Teacher Activities	Student Activities
Introduction (time in minutes)	
Introduce the lesson by engaging students in groups to discuss the importance of food and ways of obtaining food in the past.	Do the following in groups or in pairs; • Discuss and define what food is. • Explain why food is an essential element for survival.
Body (time in minutes)	
Modeling	
Display a food chart. Ask students to research and analyse food in various groups as per their functions. • How are food classified? • What are their food properties?	• They may discuss foods as organic and processed foods etc. • Arrange and classify foods into groups accordingly.
Guided Practice	
Engage and guide students to investigate and summarize the following; • Ways of obtaining food in the present and future, • Functional properties of food.	In groups research, analyse and summarize; • Ways of obtaining food in the present and future, • Functional properties of food.
Independent Practice	
Give students the opportunity to gather their findings and report on; • The nutritional composition of food and their related deficiency issues. • The importance of the dietary guidelines. • Compare and contrast ways of obtaining food past, present and future.	Study and report on; • The nutritional composition of food and their related deficiency issues. • The importance of the dietary guidelines. • Comparing and contrasting ways of obtaining food past, present and future.
Conclusion (time in minutes)	
Summarize important points by asking students questions related to their reports – What did the students learn in this lesson? Self-evaluation – Points to consider such as content, teaching and learning strategies for lesson improvement.	• Present their findings/report to the rest of the class. • Make corrections where necessary to their reports

Assessment/lesson evaluation

Students can:

- distinguish and differentiate the nature and properties of food,
- classify food into groups and,
- make wise choices from food selection to consumption.

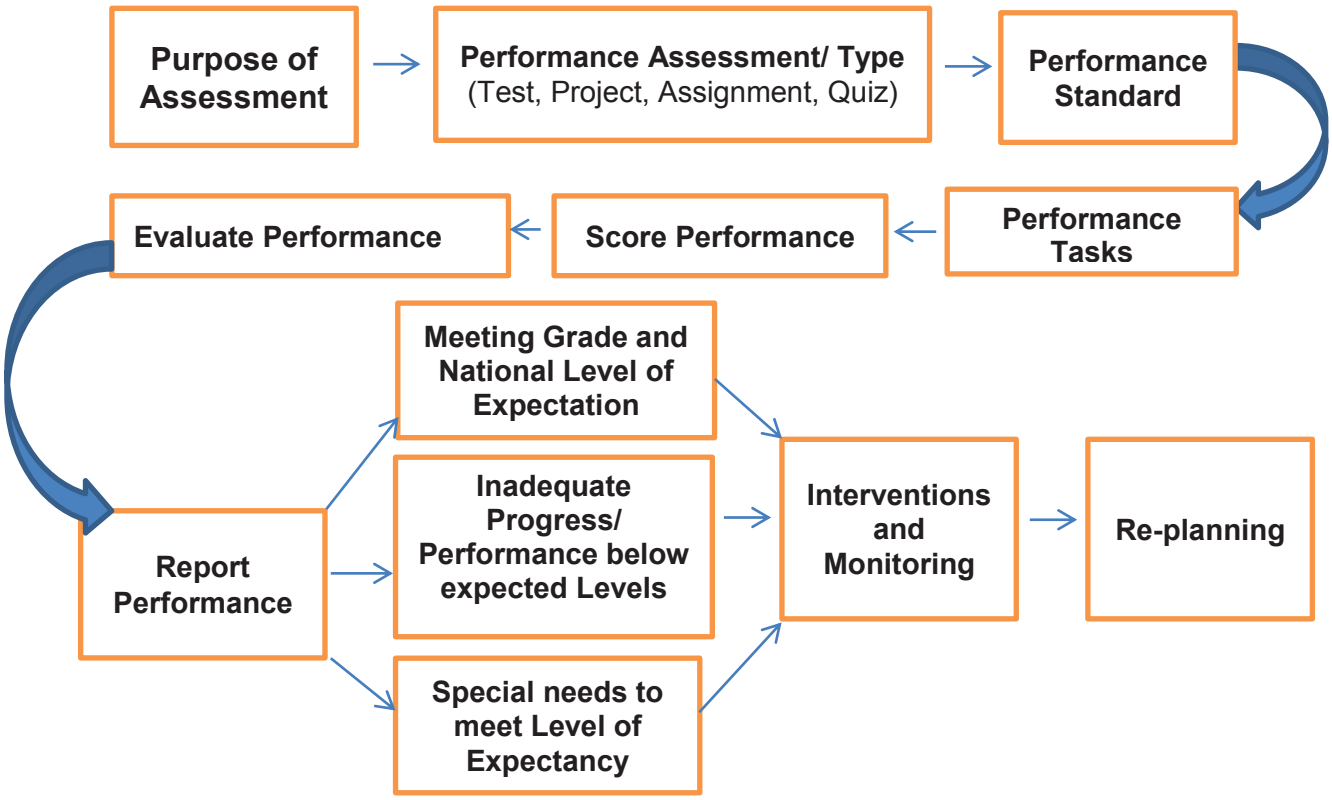
Assessment, Monitoring and Reporting

What is Standards-Based Assessment (SBA)?

Standards-Based Assessment is an on-going and a systematic process of **assessing**, **evaluating, reporting** and **monitoring** students' performance and progression towards meeting grade and national level expectations. It is the measurement of students' proficiency on a learning objective of a content standard and progression towards the attainment of that content standard and benchmark.

Standards-Based Assessment Cycle

The Standards-Based Assessment Cycle begins with the purpose to assess learning. Teachers must always clearly define the purpose and expectations of the assessment tasks or activities before starting the assessment. The cycle consist the delivery of the assessment, scoring of performance, monitoring or learning, evaluating learning and performance, reporting of achievement and underachievement, developing interventions for underachievers and advance learners and replanning assessment as demonstrated below;



Purpose of Standards-Based Assessment

Standards-Based Assessment (SBA) serves different purposes. These include instruction and learning purposes. The primary purpose of SBA is to improve student learning so that all students can attain the expected level of proficiency or quality of learning.

Enabling purposes of SBA is to;

- measure students' proficiency on well-defined content standards, benchmarks and learning objectives,
- ascertain students' attainment or progress towards the attainment of specific component of a content standard,
- ascertain what each student knows and can do and what each student needs to learn to reach the expected level of proficiency,
- enable teachers to make informed decisions and plans about how and what they would do to assist weak students to make adequate progress towards meeting the expected level of proficiency,
- enable students to know what they can do and help them to develop and implement strategies to improve their learning and proficiency level,
- communicate to parents, guardians, and relevant stakeholders the performance and progress towards the attainment of content standards or its components, and
- compare students' performances and the performances of other students.

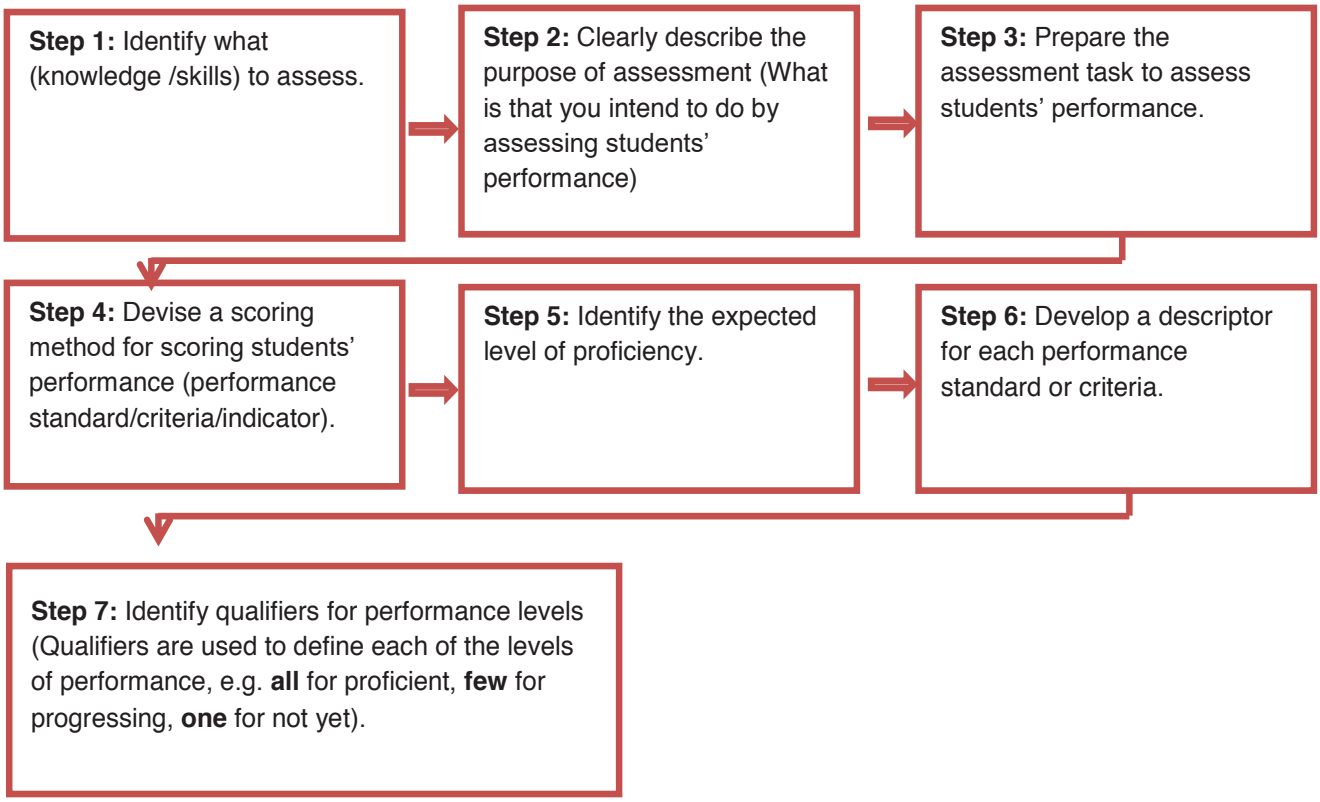
Principles of Standards-Based Assessment

The principle of SBA is for assessment to be;

- emphasing on tasks that should encourage deeper learning,
- be an integral component of a course, unit or topic and not something to add on afterwards,
- a good assessment requires clarity of purpose, goals, standards and criteria,
- of practices that should use a range of measures allowing students to demonstrate what they know and can do,
- based on an understanding of how students learn,
- of practices that promote deeper understanding of learning processes by developing students' capacity for self-assessment,
- improving performance that involves feedback and reflection,
- on-going rather than episodic,
- given the required attention to outcomes and processes, and
- be closely aligned and linked to learning objectives, benchmarks and content standards.

Standards-Based Assessment Process

Teachers are required to use the steps outlined below when planning assessment. These steps will guide you to develop effective assessments to improve student's learning as well as evaluating their progress towards meeting national and grade-level expectations.



Authentic Assessment

Authentic Assessments in Standards-based Assessment directly measure student's performance through "real life tasks" or "situations" that resemble "real life situations." Authentic assessment;

- Is performed in a real life context that approximates as much as possible, the use of a skill or concept in the real world.
- Is based on the development of a meaningful *product, performance or process.*
- Students develop and demonstrate the application of their knowledge, skills, values and attitudes in real life situations which promote and support the development of deeper levels of understanding.
- Is mostly associated with assessment as or while learning and assessment for learning but occasionally or contextually in summative learning.
- Includes assessment activities such as demonstrations, debates, field work, simulations, problem solving, project-based learning, poster presentations, research, laboratory work, reflections, problem-based activities, role play, report/essay, field experience, field report, recounts etc.

Advantages of Authentic Activities

- Empower students to take ownership in their learning.
- Appreciates Learning experience.
- Enables and encourages the Learning experiences to be used as a basis of learning.
- Meaningful, relevant and practical.
- Assess the actual learning experience which means; you do not need to "teach" and then assess, rather you assess actual learning experience while it is actually happening.

Authentic Assessment Criteria

In standards-based Assessment, teachers are encouraged to step out of their traditional assessment and explore authentic assessment. The criteria in authentic assessment;

- Looks at students actively engaged in completing a task that represents the achievement of a learning objective or standard.
- Takes place in real life situations.
- Asks students to apply their knowledge, skills, values and attitudes in real life situations.
- Students are given the criteria against which they are being assessed.

A Comparison of Authentic and Traditional Assessment

Authentic Assessments	Traditional Assessments
• Portfolios, demonstrations, field work, case studies, assignments, lab reports • Students take an active role in process • Qualitative • Interpretive • Focuses on performance, process and product • High level thinking • Use of rubric • Use of criterion levels evaluation • Part of teaching and learning Process • Shows mastery and learning performance • Generally extends over time	• Multiple choice tests, true-false, fill in the blanks, sentence completion, matching, diagram completions • External-(teacher driven-assessing performance of teacher rather than the student) • Teacher-centered (what is appropriate and convenient for the teacher and what teacher thinks is good for students and decides what should be and should not be learnt) • Quantitative (driven to collect marks) • Objective • End product (only looking for the end product and not concerned about the performance and process) • Standardised or norm referenced • Isolated facts • Low level content • Generally occurs in “one setting”

Standards-Based Assessment Types

In standards-Based Assessment, there are three broad assessments types.

1. Formative Assessment

Formative assessment includes 'assessment *for* and *as'* and is conducted during the teaching and learning of activities of a topic.

Purposes of assessment for Learning

- On-going assessment that allows teachers to monitor students on a day-to-day basis.
- Provide continuous feedback and evidence to the teachers that should enable them to identify gaps and issues with their teaching, and improve their classroom teaching practice.
- Helps students to continuously evaluate, reflect on, and improve their learning.

Purposes of assessment as Learning

- Occurs when students reflect on and monitor their progress to inform their future learning goals.
- Helps students to continuously evaluate, reflect, and improve their own learning.
- Helps students to understand the purpose of their learning and clarify learning goals.

2. Summative Assessment

Summative assessment focuses on '*assessment of learning'* and is conducted after or at the conclusion of teaching and learning of activities or a topic.

Purposes of assessment of Learning

- Help teachers to determine what each student has achieved and how much progress he/she has made towards meeting national and grade-level expectations.
- Help teachers to determine what each student has achieved at the end of a learning sequence or a unit.
- Enable teachers to ascertain each student's development against the unit or topic objectives and to set future directions for learning.
- Help students to evaluate, reflect on, and prepare for next stage of learning.

Performance Assessment

Performance assessment is a form of testing that requires students to perform a task rather than select an answer from a ready-made list. For example, a student may be asked to explain historical events, generate scientific hypotheses, solve math problems, converse in a foreign language, or conduct research on an assigned topic. Teachers, then judge the quality of the student's work based on an agreed-upon set of criteria. It is an assessment which requires students to demonstrate that they have mastered specific skills and competencies by performing or producing something.

Types of performance assessment;

I. *Products-Oriented*

This refers to concrete tangible items that students create through either the visual, written or auditory media such as;

- Creating a health/physical activity poster.
- Video a class game or performance and write a broadcast commentary.
- Write a speech to be given at a school council meeting advocating for increased time for health and physical education in the curriculum.
- Write the skill cues for a series of skill photo's.
- Create a brochure to be handed out to parents during education week.
- Develop an interview for a favourite sportsperson.
- Write a review of a dance performance.
- Essays.
- Projects.

II. *Process-Oriented Tasks*

It shows the thinking processes and learning strategies students use as they work such as;

- Survival scenarios.
- Problem solving initiative/adventure/ activities.
- Decision making such as scenario's related to health issues.
- Event tasks such as creating a game, choreographing a dance/gymnastics routine, creating an obstacle course.
- Game play analysis.
- Peer assessment of skills or performances.
- Self-assessment activities.
- Goal setting, deciding a strategy and monitoring progress towards achievement.

III. *Performances-Oriented*

It deals with observable affective or psycho-motor behaviours put into action such as;

- Skills check during game play.
- Role plays.
- Officiating a game.
- Debates.
- Performing dance/gymnastics routines.
- Teaching a skill/game/dance to peers.

Performance Standards

Performance standards are measurement standards that are observed through evidence outcomes and performance indicators. Evidence outcomes and Performance Indicators are used to measure students' performances, proficiency, competency, progression and achievement of the desired grade or level of expectation.

Performance Standards are concrete statements of how well students must learn what is set out in the content standards and benchmarks, often called the "be able to do" of "what students should know and be able to do." Performance standards indicate the quality that specifies how competent a students' demonstration or performance must be. They include explanations of how well students must demonstrate the content, explaining "how good is good enough."

Performance standards;

- measure students' performance and proficiency (using performance indicators) in the use of a specific knowledge, skill, value, or attitude in real life or related situations,
- provide the basis (performance indicators) for evaluating, reporting and monitoring students' level of proficiency in use of a specific knowledge, skills, value, or attitude,
- are used to plan for individual instruction to help students not yet meeting expectations (desired level of mastery and proficiency) to make adequate progress towards the full attainment of benchmarks and content standards,
- are used as the basis for measuring students' progress towards meeting grade-level benchmarks and content standards,
- a stem statement for Performance Standards will begin with…"Students will be able to…" , and
- a stem statement for Performance Indicator will begin with …"Students can be able to…".

Assessment Strategies

It is important for teachers to know that, assessment is administered in different ways. Assessment does not mean a test only. There are many different ways to find out about student's strengths and weaknesses. Relying on only one method of assessing will not reflect student's achievement.

The table shows a range of action verbs that are used in the different levels of learning and where applicable for the type of assessment strategies.

Action Verbs to Assessment Strategies		
Cognitive Learning	**Action Verbs**	**Assessment Strategies**
Knowledge - to recall or remember facts without necessarily understanding them	Arrange, define, duplicate, label, memorize, name, order, recognize, relate, recall, reproduce, list, tell, describe, identify, show, label, collect, examine, tabulate, quote	• Prior knowledge inventory, misconception/preconception check • Focused listing, empty outlines • Pre-post test, quiz, quick poll
Comprehension- to understand and interpret learned information	Classify, describe, discuss, explain, express, interpret, contrast, predict, associate, distinguish, estimate, differentiate, discuss, extend, translate, review, restate, locate, recognize, report	• Minute paper, muddiest (or clearest) point • Observe and evaluate a student artifact or performance task using a rubric • Directed paraphrasing • Pre-post test, quiz • Interviews
Application – to put ideas and concepts to work in solving problems	Apply, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, calculate, complete, show, examine, modify, relate, change, experiment, discover	• Observe and evaluate a student artifact, performance, or task using a rubric • Directed paraphrasing, real-world application (apply learning in a new context) • Test, quiz • Job/internship evaluation, skill ratings
Analysis – to break information into its components to see interrelationships and ideas	Analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, test, separate, order, connect, classify, arrange, divide, infer	• Pro and con grid, categorizing grid, compare and contrast, concept maps • Observe and evaluate a student artifact, performance, or task using a rubric • Journaling • Job/internship evaluation, skill ratings
Evaluation – to judge the value of information based on established criteria	Appraise, argue, assess, attach, defend, judge, predict, rate, support, evaluate,	• Reflection component of a portfolio or experience • Journaling

	recommend, convince, judge, conclude, compare, summarize	• Peer evaluation
Affective Learning	appreciate, accept, attempt, challenge, defend, dispute, join, judge, praise, question, share, support	• Reflection component of a portfolio or experience • Journaling • Observe and evaluate group work • Surveys, interviews, focus groups

The table shows different strategies that are applicable in the standards-based assessment types.

Strategy	Description
Analogies	Students create an analogy between something they are familiar with and the new information they have learned. When asking students to explain the analogy, it will show the depth of their understanding of a topic.
Classroom Presentations	A classroom presentation is an assessment strategy that requires students to verbalize their knowledge, select and present samples of finished work, and organize their thoughts about a topic in order to present a summary of their learning. It may provide the basis for assessment upon completion of a student's project or essay.
Conferences	A conference is a formal or informal meeting between the teacher and a student for the purpose of exchanging information or sharing ideas. A conference might be held to explore the student's thinking and suggest next steps; assess the student's level of understanding of a particular concept or procedure; and review, clarify, and extend what the student has already complete.
Discussions	Having a class discussion on a unit of study provides teachers with valuable information about what the students know about the subject. Focus the discussions on higher level thinking skills and allow students to reflect their learning before the discussion commences.
Essays	An essay is a writing sample in which a student constructs a response to a question, topic, or brief statement, and supplies supporting details or arguments. The essay allows the teacher to assess the student's understanding and/or ability to analyse and synthesise information.
Exhibitions/ Demonstrations	An exhibition/demonstration is a performance in a public setting, during which a student explains and applies a process, procedure, etc., in concrete ways to show individual achievement of specific skills and knowledge.
Interviews	An interview is a face-to-face conversation in which teacher and student use inquiry to share their knowledge and understanding of a topic or problem, and can be used by the teacher to explore the student's thinking; assess the student's level of understanding of a concept or procedure and gather information, obtain clarification, determine positions, and probe for motivations.
Learning Logs	A learning log is an ongoing, visible record kept by a student and recording what he or she is doing or thinking while working on a particular task or assignment. It can be used to assess student progress and growth over time.
Observation	Observation is a process of systematically viewing and recording students while they work, for the purpose of making programming and instruction decisions. Observation can take place at any time and in any setting. It provides information on students' strengths and weaknesses, learning styles, interests, and attitudes.
Peer Assessment	Assessment by peers is a powerful way to gather information about students and their understanding. Students can use set criteria to assess the work of their classmates.

Performance Tasks	During a performance task, students create, produce, perform, or present works on "real world" issues. The performance task may be used to assess a skill or proficiency, and provides useful information on the process as well as the product.
Portfolios	A portfolio is a collection of samples of a student's work, and is focused, selective, reflective, and collaborative. It offers a visual demonstration of a student's achievement, capabilities, strengths, weaknesses, knowledge, and specific skills, over time and in a variety of contexts.
Questions And Answers (Oral)	In the question–and-answer strategy, the teacher poses a question and the student answers verbally, rather than in writing. This strategy helps the teacher to determine whether students understand what is being, or has been, presented, and helps students to extend their thinking, generate ideas, or solve problems.
Quizzes, Tests, Examinations	A quiz, test, or examination requires students to respond to prompts in order to demonstrate their knowledge (orally or in writing) or their skills (e.g., through performance). Quizzes are usually short; examinations are usually longer. Quizzes, tests, or examinations can be adapted for exceptional students and for re-teaching and retesting.
Questionnaires	Questionnaires can be used for a variety of purposes. When used as a formative assessment strategy, they provide teachers with information on student learning that they can use to plan further instruction.
Response Journals	A response journal is a student's personal record containing written, reflective responses to material he or she is reading, viewing, listening to, or discussing. The response journal can be used as an assessment tool in all subject areas.
Selected Responses	Strictly speaking a part of quizzes, tests, and examinations, selected responses require students to identify the one correct answer. The strategy can take the form of multiple-choice or true/false formats. Selected response is a commonly used formal procedure for gathering objective evidence about student learning, specifically in memory, recall, and comprehension.
Student Self-Assessments	Self-assessment is a process by which the student gathers information about, and reflects on, his or her own learning. It is the student's own assessment of personal progress in terms of knowledge, skills, processes, or attitudes. Self-assessment leads students to a greater awareness and understanding of themselves as learners.
Case study	This strategy is used to extend students' understanding of real life issues The teacher provide students with case studies related to the topic of the lesson and allow them to analyse and evaluate. Students study the case study and identify the problem addressed. They analyse the problem and suggest solutions supported by conceptual justifications and make presentations. This enriches the students' existing knowledge of the topic.
Debate	This strategy is used to increase students' interest, involvement and participation. Teacher provides the topic or question of debate on current issues affecting a bigger population, clearly outlining the expectations of the debate. Explain the steps involved in debating and set a criteria/standard to be achieved. Students conduct researches to gather supporting evidence about the selected topic and summarising the points. They are engaged in collaborative learning by delegating and sharing tasks to group members.
Games and	This strategy encourages motivation and creates a spirit of competition and challenge to enhance learning. The teacher being creative, select

simulations	appropriate games for the topic of the lesson. Give clear instructions and guidelines. The game selected must be fun and build a competitive spirit to score more than their peers to win small prices. Students go into groups and organise. Follow the instructions and play to win.
Peer Teaching and Learning *(power point presentations, pair learning)*	Students teach each other using different ways to learn from each other. It encourages; team work, develops confidence, feel free to ask questions, improves communication skills and most importantly develop the skills of inquiry. Teacher distributes topics to groups to research and teach others in the classroom. Go through the basics of how to present their peer teaching. Students go into their established working groups. Develop a plan for the topic. Each group member is allocated a task to work on. Research and collect information about the topic allocated to the group. Outline the important points from the research and present their findings in class.
Project (individual/group)	Projects help students complete tasks individually or collectively. Teacher outline the steps and procedures of how to do the project and the criteria. Students are involved in investigations and finding solutions to problems to real life experiences. They carry out researches to analyse the causes and effects of problems to provide achievable solutions. Students carefully utilise the problem-solving approach to complete projects.
Use media and technology	Teacher is encouraged to use media & technology to teach and generate engagement depending on the age of the students. Show a full movie, an animated one, a few episodes form documentaries, you tube movies and others depending on the lesson. Provide questions for students to answer before viewing. Viewing can provoke questions, debates, critical thinking, emotion and reaction. Students after viewing, students engage in critical thinking and debate.

Scoring Methods for Performance Assessment

Assessment can be scored during or after the students have completed the assessment task. However, it is best done during a lesson- using a checklist, rating scales & rubrics.

A rubric is a coherent set of criteria for students' work that includes descriptions of levels of performance quality on the criteria. Rubrics have two major aspects: coherent sets of criteria and descriptions of levels of performance.

Rubrics include;

(1) descriptions of the of task,
(2) the scales to be used,
(3) the dimensions of the task, and
(4) the description of each dimension on the scale.

A Rubric

- Is a scoring guide that helps teachers evaluate student performance, based on a range of criteria.
- Lists the criteria, or characteristics, that student work should exhibit and describes specific quality levels for those criteria.
- Is a great way to improve communication, learning, and grading fairness.
- Is descriptive and not evaluative.
- Can be used to evaluate, but the operating principle is to match the performance to the description rather than "judge" it.
- Is as good or bad as the criteria selected and the descriptions of the levels of performance under each.

Knowing how to create and use rubrics gives the teacher a better understanding of assessment and another option for assessing student performance. Effective rubrics have appropriate criteria and well-written descriptions of performance.

Purpose of Rubrics

Like any other evaluation tool, rubrics are useful for certain purposes and not for others. *The main purpose of rubrics is to assess performances*. For some performances, you observe the student in the process of doing something, like using an electric drill or discussing an issue. For other performances, you observe the product that is the result of the student's work, like a finished bookshelf or a written report.

1. Support Authentic Assessment

While traditional tests measure how well students recall content, rubrics measure how well students can apply knowledge to authentic contexts or real-world tasks.

2. Clearly Communicate Expectations

Because rubrics define student "quality" in terms of objective criteria and standards, they clearly communicate how instructors will evaluate student performance.

3. Improve Performance

Rubrics lead to better student performance. When students understand assignments and expectations before they begin, they are more likely to fulfil them. They know what specific criteria and standards of excellence will be used to rate their performance.

4. To Inspire Fairness

Because rubrics have detailed assessment information, students don't feel that grades are assigned subjectively or arbitrarily. Also, when you have more than one grader, a rubric allows all graders to apply the same criteria in the same way.

Although rubrics have many benefits and make grading faster and easier, a good rubric takes time, effort and patience to construct. You'll probably need to change (change, not add to) your grading and assessment methods, based on what you believe about learning assessment. Rubrics are best for critical assessments, major projects, and other assignments that require a multi-dimensional performance evaluation. The trick is to know what type of rubric to create for your situation.

Reasons for Creating Rubrics/Marking Schemes

Rubrics or marking schemes are created for;

1. Categories to assess-different components or elements that will assess;
    - Factual information
    - Application
    - Analysis
    - Writing Skills

2. Criterion for assessment;
    - Accuracy
    - Completeness
    - Length or number of examples
    - Supported with research
    - Range of answer
    - Description and support

3. Levels or points 3-5 levels;
    - Exemplary, Proficient, acceptable, not acceptable
    - Excellent, good, fair, poor
    - 10 points, 5 points, 1 point

Parts of a Rubric

- A rubric is a matrix of criteria and their descriptors.
- The left side of a rubric matrix lists the **criteria (performance standards)** for the expected product or performance.
- Across the top of the rubric matrix is the **rating scale** that provides a set of values for rating the quality of performance for each criterion.
- **Descriptors** under the rating scale provide examples or concrete indicators for each level of performance.
- The dimensions of the task that **qualifies** the achievement.

Below is a sample showing parts of a rubric

Performance Standard/Criteria	Advanced	Proficient	Progressing	Not Yet
Identify reasons for developing caring relationships	Identify and explain all the reasons for developing caring relationships	Identify all the reasons for developing caring relationships	Identify only a few of the reasons for developing caring relationships	Identify only one reason for developing caring relationships
Explain the reasons for developing caring relationships	Explain all the reasons for developing caring relationships and provide an in-depth justification for some of the reasons	Explain all the reasons for developing caring relationships	Explain only a few reasons for developing caring relationships	Explain only one reason for developing caring relationships

Types of Rubrics

1. Analytic Rubric

Analytic rubrics describe work on each criterion separately. For most classroom purposes, analytic rubrics are best. Focusing on the criteria one at a time is better for instruction and better for formative assessment because students can see what aspects of their work need what kind of attention. Focusing on the criteria one at a time is good for any summative assessment (grading) that will also be used to make decisions about the future, for example, decisions about how to follow up on a unit or decisions about how to teach something next year.

Template for Analytic Rubrics

Criteria	Beginning	Developing	Accomplished	Exemplary	Score
Criteria 1	Description reflecting beginning	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 2	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 3	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	
Criteria 4	Description reflecting beginning level performance	Description reflecting movement toward mastery level of performance	Description reflecting achievement of mastery level of performance	Description reflecting of highest level of performance	

2. Holistic Rubrics

Holistic rubrics describe the work by applying all the criteria at the same time and enabling an overall judgment about the quality of the work. Holistic rubrics are based on criteria for good work and on observation of how the work meets those criteria.

One classroom purpose for which holistic rubrics are better than analytic rubrics is the situation in which students will not see the results of a final summative assessment and you will not really use the information for anything except a grade. Some high school final examinations fall into this category. Grading with rubrics is faster when there is only one decision to make, rather than a separate decision for each criterion.

Holistic Rubric						
Score	**5**	**4**	**3**	**2**	**1**	**0**
Description	Demonstrate **complete** understanding of the problem. **All** requirements of task are **included in response**.	Demonstrate **considerate** understanding of the problem. **All** requirements of task are **included**.	Demonstrate **partial** understanding of the problem. **Most** requirements of task are **included**.	Demonstrate **little** understanding of the problem. **Many** requirements of task are **missing**.	Demonstrate **no** understanding of the problem.	**No** response/ **not** attempted task

Decide on type of rubric to be used (Holistic or Analytic)

1. **When to use Holistic Rubric**

- There is no single correct answer/response to a task
- The focus has nor the overall quality, proficiency, or understanding of a specific content or skills.
- You are assessing large numbers (e.g. 150 portfolios)

2. **When to use Analytic Rubric**

- Several subjects are assessing the student work.
- Description promotes consistent scoring.
- Stakeholders will be examining the rubric scores.
- Substantial feedback to students or the subjects is desired.
- Outlines of specific strengths/weaknesses are anticipated.

General Rubric Matrix

This is a sample of a general rubric matrix that can be used for projects or other assessment. The table presents information that you can use or choose from to develop your own rubrics. You can adjust to suit the subject.

Criteria	Performance Standards (Descriptors)
Beyond	**Beyond Standard (s) - *Advanced in Performance and Understanding***
	Consistently demonstrates advanced conceptual problem-solving understandings Consistently generates tasks that make connections between and among problem-solving ideas Consistently applies strategies to unique situations Consistently demonstrated confidence to approach tasks beyond the proficiency level for grade Consistently initiates problem-solving investigations
Consistent	**Meet Standard (s) - *Proficient in Performance and Understanding***
	Consistently demonstrates understanding of problem-solving standards and cluster at the grade level Consistently demonstrated conceptual understanding Consistently applies multiple strategies flexibly in various situations Understands and fluently applies procedures with understanding Consistently demonstrates perseverance and precision Constructs logical problem solving arguments of thinking and reasoning Uses problem-solving language correctly and appropriately
Inconsistent	**Progressing - *Not Yet Proficient in Performance and Understanding***
	Inconsistently uses tools appropriately and strategically Demonstrates inconsistent understanding of key problem-solving ideas at grade level Demonstrates inconsistent conceptual understanding of key problem solving ideas at grade level Inconsistent in understanding and application of grade level appropriate strategies Depends upon assistance of teacher and/or peers to understand and complete tasks Needs additional time to complete tasks Applies models of problem-solving ideas inconsistently
Seldom	**Not Yet - *Limited Performance and Understanding***
	Exhibits minimal understanding of key problem -solving ideas at grade level Rarely demonstrates conceptual understanding Seldom provides precise response Seldom use appropriate strategies Consistently requires assistance and alternative instruction Use tools inappropriately to model problem-solving ideas

Steps to use the general matrix to develop rubrics

Here is a description of the process on how to use the above table and develop the rubric for an assessment.

1. Organise the criteria and qualifier in a four (4) pointer scale as shown below.

Criteria	Beyond	Consistent	Inconsistent	Seldom

Note: *The qualifiers Beyond, Consistent, Inconsistent and Seldom are taken from the general matrix*.

2. Refer to the general matrix and select an appropriate descriptor under each of the qualifiers to suit your assessment and place it in the table as shown below.

Criteria	Beyond	Consistent	Inconsistent	Seldom
1	Consistently demonstrates advanced conceptual problem-solving understandings	Consistently demonstrates understanding of problem-solving standards and cluster at the grade level	Inconsistently uses tools appropriately and strategically	Exhibits minimal understanding of key problem-solving ideas at grade level

Note: *The descriptors are taken from the general matrix. The descriptors do not have to be in the order as they appear in the general matrix.*

3. If the assessment tasks consist more than one criteria (performance tasks) the appropriate descriptors from the general matrix can be used in the rubrics.

Criteria	Beyond	Consistent	Inconsistent	Seldom
1	Consistently demonstrates advanced conceptual problem-solving understandings	Consistently demonstrates understanding of problem-solving standards and cluster at the grade level	Inconsistently uses tools appropriately and strategically	Exhibits minimal understanding of key problem-solving ideas at grade level
2	Consistently generates tasks that make connections between and among problem-solving ideas	Consistently demonstrated conceptual understanding	Demonstrates inconsistent conceptual understanding of key problem-solving ideas at grade level	Rarely demonstrates conceptual understanding
3	Constructs logical problem-solving arguments of thinking and reasoning	Constructs logical problem-solving arguments of thinking and reasoning	Depends upon assistance of teacher and/or peers to understand and complete tasks	Consistently requires assistance and alternative instruction

Note*: Ensure that the descriptors must not be repeated.*

4. The general matrix can be used for three (3) pointer scale as shown below:

Criteria	Consistent	Inconsistent	Seldom
1	Consistently demonstrates understanding of problem-solving standards and cluster at the grade level	Inconsistently uses tools appropriately and strategically	Exhibits minimal understanding of key problem-solving ideas at grade level

Note: *The steps two and three can be used also for the three (3) pointer scale.*

Scoring of Performance for Formative Assessment

1. Scoring Assessment using Rating Scale

Rating Scales are a type of checklists that judge the degree to which a criteria is met. They generally have a scale of between 1-6 options.

Types of Rating Scales

There are three (3) commonly used types, these are as follow:

A. Frequency Rating Scales

B. Grade Rating Scales

C. Number Rating Scales

A. Frequency Rating Scales

A frequency rating scale scores how often a task is done to meet criteria.

Here is an example of a frequency rating scale used to assess the skill “Collaboration”. This frequency rating scale can be used for assessing students during group activity. The collaboration focuses on students’ ability to be part of a group and work together displaying qualities such as leadership, patience, tolerance, consideration and guidance.

Criteria	**Frequency**			
	Always = 4	**Sometimes = 3**	**Rarely = 2**	**Never - 1**
1. Embraces abilities and encourages participation	Always embraces everyone’s abilities and encourages participation	Sometimes embraces everyone’s abilities and encourages participation	Rarely embraces everyone’s abilities and encourages participation	Never embraces everyone’s abilities and encourages participation
2. Ensures everyone is tasked to an activity	Always ensures everyone is tasked to an activity	Sometimes ensures everyone is tasked to an activity	Rarely ensures everyone is tasked to an activity	Never ensures everyone is tasked to an activity
3. Encourages everyone to achieve together	Always encourages everyone to achieve together	Sometimes encourages everyone to achieve together	Rarely encourages everyone to achieve together	Never encourages everyone to achieve together

B. Grade Rating Scales

A grade rating scales can be use letters to grade and indicate the students' level of performance or achievement for example A, B, C, D, etc.

Here is an example of a rubric showing Grade Rating Scale. It is a summative assessment, that has been accumulated and the scoring is given in percentage and grade.

Performance Standards/ Criteria	**A 90 - 100**	**B 70 - 89**	**C 50 - 69**	**D 0 - 49**
Identify reasons for developing collaborative skills	Identify and explain the reasons for developing collaborative skills	Identify all the reasons for developing collaborative skills	Identify only a few of the reasons for developing collaborative skills	Identify only one reason for developing collaborative skills
Explain the reasons for developing collaborative skills	Explain all the reasons for developing collaborative skills and provide an in-depth justification for some of the reasons	Explain all the reasons for developing collaborative skills	Explain only a few of the reasons for developing collaborative skills	Explain only one reason for developing collaborative skills
Identify reasons for fostering collaborative skills	Identify and explain all the reasons for fostering collaborative skills	Identify all the reasons for fostering collaborative skills	Identify only a few of the reasons for fostering collaborative skills	Identify only one reason for fostering collaborative skills
Explain the reasons for fostering collaborative skills	Explain all the reasons for fostering collaborative skills and provide and in-depth justification for some of the reasons	Explain all the reasons for fostering collaborative skills	Explain only a few of the reasons for fostering collaborative skills	Explain only one reason for fostering collaborative skills

Grade rating scale

Score Range/Percentage Rating (%)	**Grade**
80 – 100%	A
70 – 79%	B
60 – 69%	C
50 – 59%	D
0 – 49%	E

C. Number/Numerical Rating Scale

A number rating scale measures students' preferences, feelings, perceptions and interest on a provided numerical scale.
Here is an example of a number rating scale used to assess the skill "Collaboration".

Number scales	1	2	3	4	5
Rating	Not all true	Some truth	Unsure	true	Very true

Sample 1
Here is an example of a rubric showing Number Rating Scale, has a rate of 1 indicating *Not all true* to a rate of 5 *Very true*.

Criteria	***Number Rating Scale***				
1. Collaboration is a 21st century skill that is required in achieving a team's goals and aims	***1***	***2***	***3***	***4***	***5***
2. Collaboration involves skills such as leadership, patience, tolerance, consideration and guidance.	***1***	***2***	***3***	***4***	***5***

Descriptive Terms to use for Rating Scale

The following tables show descriptive words to use when planning and constructing rubrics to assess students' performances or achievements.

The table shows terms that describe the skill of ***selecting 'the right' information*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
pertinent	relevant	suitable	trivial
insightful	meaningful	appropriate	superficial
significant	relevant	predictable	vague
perceptive	thoughtful	basic	questionable
precise	logical	partially correct	confusing
purposeful	focused	appropriate	irrelevant

The table shows terms that describe the skill of ***selecting 'enough' information*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
comprehensive	thorough	cursory	superficial
in-depth	sufficient	partial	incomplete
rich & detailed	specific	simplistic	undeveloped
extensive	substantial	partial	sketchy

The table shows terms that describe the skill of ***evaluating product or connecting insights to personal experience*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
insightful	thoughtful	predictable	trivial
astute	relevant	appropriate	unfocused
perceptive	thoughtful	routine	trivial
intuitive	logical	rudimentary	unsubstantiated
innovative	credible	predictable	trite
compelling	meaningful	obvious	tenuous

The table shows terms that describe the skill of ***designing or constructing*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
efficient	practical	viable	unworkable
innovative	effective	workable	ineffective

The table shows terms that describe the skill of ***organizing or formatting information*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
skillful	systematic	simplistic	haphazard
purposeful	logical	methodical	disorganised

The table shows terms that describe the skill of ***analyzing information or data*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
accurate	logical	partially accurate	flawed
insightful	logical	simplistic	unsupported
astute	credible	plausible	inaccurate
precise	relevant	basic	irrelevant

The table shows terms that describe the skill of ***presenting or communicating information or selecting appropriate visuals*** at varying levels of quality.

Excellent	Proficient	Adequate	Limited
vivid	interesting	simplistic	lacks appeal
compelling	effective	predictable	does little to sustain interest
enhances	supports	partially supports	interferes with
engaging	interesting	straightforward	ineffective
skillful	effective	appropriate	inappropriate
intriguing	interesting	predictable	ineffective

Scoring Assessment using a Checklist

Check lists are one of the easiest methods of scoring assessment tasks. The criteria i.e. skills, cues or tasks are considered separately according to whether they have been accomplished.
Types of Checklists include;

- Yes/No
- Tick/Cross
- Circling
- Narrow scale, e.g. Sometimes, rarely, never
- Colouring
- Symbols (signifiers), e.g. pictures, facials, artifacts, signs, drawings, concept maps)

Sample Scoring using Yes/No Checklist Scale to assess "Collaboration"

No	Criteria	Write Yes (score 2) or No (score 1)
1	Embraces everyone's' abilities and encourages participation	
2	Ensures everyone is tasked to an activity	
3	Encourages everyone to achieve together	

Sample Scoring using Tick/Cross Checklist Scale to assess "Collaboration"

No	Criteria	Place a tick (score 2) or an x (score 1)
1	Embraces everyone's' abilities and encourages participation	
2	Ensures everyone is tasked to an activity	
3	Encourages everyone to achieve together	

Scoring of Performance for Summative Assessment

Grade rating scales are better scoring tools for summative assessment of students' performance. They indicate students' level of performance using such as; A, B, C, D etc.

A Grade is given after the accumulated total for a number of assessments has been completed either at the end of an assessment period, a topic, a term, a grade or year.

The subject assessment components, tasks and weightings should be able to guide the grading of achievements as demonstrated in a rubric designed for this purpose.

Sample Scenario to score Summative Assessment

For instance; If Technology and Industrial Arts Subject has an assessment plan for a 100 marks per term, then the grading shall be scored at the end of each term. As per the Assessment weighting, the subject can plan to score assessment of students per term according to this components:

- 1 x Project = maximum of 50 marks
- 1 x Moderation = maximum of 50 marks
- 2 x tests = maximum of 30 marks
- 1 x portfolio = maximum of 5 marks
- 1 x participation = maximum of 5 marks

Assessment Components and Task Weighting

The Assessment components and Task Weighting is intended for a Termly Assessment Schedule. It anticipated that the assessment components with their weightings may be changed by the teachers' Termly Teaching Programs accordingly but the total scores allocated for the **Theory Assessment Components (TAC)** of 40 Marks and **Practical Assessment Components (PAC)** 60 Marks should remain as it is the determined as the required 40/60 Moderation Components (i.e. 100 marks) for TIA assessments per Assessment Period.

Theory Assessment Components (TAC) (40 marks)	**Total Score/100**	**Practical Assessment Components (PAC) (60 marks)**	**Total Score/100**
		Project Portfolio No. 1	10
		STEAM Project Portfolio No. 1	10
Test No. 1	15	Project No. 1	25
		STEAM Project No. 1	25
Assignment No. 1	10		
Test No. 2	15		
Total Theory Score	**____/40**	**Total Practical Score**	**____/60**
Total Scores of TAC + PAC = Total Scores out of 100	**_____/100**		

Sample Subject Assessment Structure

The internal assessment for the Technology and Industrial Arts/ Business Studies subject is based on the Grade 9 & 10 and Grade 11 & 12 Technology and Industrial Arts Syllabus. The final assessment should be based on a range and balance of assessment strategies and instruments. Assessment must be both normative and criterion.

Component	Weighting	Tasks	Assessment Referencing
Practical Work in response to design brief (Moderation and Projects included here)	**60 %** (of mandatory total)	Development and application of design ideas, safe and skillful use of materials, tools and equipment to make a product and the identified processes	Criterion referencing rubrics
Design folio with outcomes of research, investigations and planning	**20 %** (of mandatory total)	Folio showing results of investigation in response to design brief, rough notes or sketches of design ideas, timelines, final drawings or plans, processes used to make the product and evaluation reports	Criterion referencing rubrics
Tests	**20 %** (of mandatory total)	Theory and also applications in theory	Normative
Marks	**100 %**	**A combination of design folios, practical applications, moderations and tests.**	

Sample Assessment Outline

SBC embraces standards and as such, standards must also drive the administration of assessments to students. It is important that every student must be given the outline of the Assessment that has been planned for the term. Each Term will include 6 different parts of assessment. The teacher can decide to have any number from 4-6. Assessment is weighted accordingly as shown in the table below.

Assessment Type	Description	Weighting
Topic Tests x 2	Students will be given two topic tests based on the content learnt in the term. 1 will be given mid-term and 1 at end-term. The test will be comprised of 10 multiple choice questions and 5 short written answers.	1 = 15 marks 1=10 marks
Portfolio	Individual Students will be assessed	10 marks
Moderation	In groups of four - five, students work to critically engage with one another in the required design process. Students will address criteria provided in class and prepare and deliver a 5-10 minute presentation addressing the criteria.	30 marks
Project (Application)	In groups of three to four, students work to critically engage with one another in the assigned project. Students will address criteria provided in class and prepare and deliver a 5-10 minute presentation addressing the criteria.	20 marks
Participation	2 marks will be allocated each day for attendance. Another 3 marks will be awarded for active participation.	5 marks

STEAM Assessment

Steps in Developing a STEAM Activity

1. Identify the Real/Authentic Situations that can be solved through the STEAM activity.
2. Select a well-defined Benchmark in your subject area that will carry the STEAM activity.
3. Identify related subject areas with their concepts to be used solve the Authentic Situation. Note down the KSAVs of the Unit of Work for the STEAM activity.
4. Write a Description of the Authentic Situation for the STEAM activity based on the identified Authentic Situation.
5. Write down the Task Descriptions for the STEAM Activity in order to approach the Authentic Situation.
6. Develop the Rubric to assess the STEAM Activity. Find below the steps 1-13.

Steps in developing the Rubrics

1. Decide on type of rubric to be used. (Holistic or Analytic)
2. Decide what point scale rubric to use (always use 3, 4 or 5 point-scale) and rating scales to use. (descriptive words or numerals)
3. Plan the layout to develop the rubric.
4. Decide what to assess from the Category of Tasks Description.
5. Identify and List the Category of Tasks Description for the Criteria.
6. Reword the Tasks Descriptions to create Criteria.
7. List the criteria against the Task Descriptions in a table.
8. Unpack the Task Descriptions and Identify the essential KSAV that can be assessed.
9. Reword the Task Descriptions with the inclusion of KSAVs into a Descriptor statement for each criteria and distribute into each Competency Level/Level of achievement.
10. Determine appropriate variance of Qualifiers for each Descriptors of each achievement level.
11. Determine the appropriate Descriptive Words or Number for Point Scales of the intended rubric.
12. Completed Rubric For the STEAM Assessment.
13. Consider the Applications of the Steam Rubric.

Grade 9 Sample STEAM Activity for Assessment
The teacher can use this sample as a guide to develop STEAM assessment.
Refer to the Appendix Section for the STEAM Activity Assessment Template.

Subject: Technology and Industrial Arts

Strand 2: Food Technology

Unit 1: Food and Nutrition

Content Standard 2.1 Students will be able to examine and analyse the characteristics and properties of different types of food and the social, economic, political, cultural and technological influences on their production and compliance with ethical principles and standards.

Benchmarks: 9.2.1.7 Apply the design process to create food items using combinations of basic ingredients with variations using a selection of techniques and food preparation equipment.

Related Concept Links to Food Technology Benchmark with other Subject Areas

Subjects	Reference Benchmark Codes	Essential KSAV (Knowledge, Skills, Attitudes and Values)
1. Science	9.3.3.1	**K:** Physical and chemical properties of Food, pH Value of Food **S:** Investigate **A/V:** Being responsible
2. Character Social Development (CSD)	9.2.2.3 , 9.2.2.4, 9.1.5.2	**K:** Nutrition, Eating Disorders, Quality of Life **S:** Decision Making skills, **A/V:** Show respect and appreciation, goal setting, team work
3. English	9.2.3.1, 9.2.4.1, 9.2.8.1, 9.5.4.1	**K:** Descriptive writing, Ideas of writing, Clear and coherent ideas of writing, Information sources **S:** Research skills Interrogation skills, Comprehension skills, Presentation skills Report writing skills **A/V:** Being critical and considerate
4. Social Science (Geography)	9.1.3.4	**K:** Impact of migrations on places, resources, services, environments and cultures **S:** Analyze situations **A/V:** Being tolerant
5. Technology Industrial Arts (Communication Technology)	9.4.1.5	**K:** Range of communication and media products or services **S:** Problem solving **A/V:** Appreciate the development and benefits of communication products
6. Business Studies	9.1.1.3, 9.1.2,4, 9.2.2.8, 9.3.1.3, 9.5.2.5,	**K:** Types of journals used in accounting process, Customer service strategies, Importance of marketing mix, Marketing on social media, 5 P's of Marketing Mix

		S: Financial skills, ICT Skills, **A/V:** Transparent and accountable, making business decisions,
7. Agriculture	9.1.5.4, 9.1.3.1, 9.2.2.1	**K:** Food Crops, Animal Food products, Consumption needs of people, Food Demand and Supply, Food Security **S:** Research and Analyze data **A/V:** Making informed decisions, show respect and consideration
8. Maths	9.1.1.4	**K:** Calculation methods, Money is measured using numbers **S:** Estimate a reasonable solution to a problem using rounding and estimation, mathematical Thinking Skills, Problem Solving **A/V:** Being trustworthy
9. Arts	9.3.3.2, 9.3.3.5	**K:** Food presentation **S:** Creativity, artistic thinking **A/V:** Care and consideration,

The anchor subject in this sample STEAM assessment is Technology Food Technology

Topic: The Technology Design: Design, produce, market and evaluate

Learning Objectives: By the end of the topic, students will be able apply the design process to create food solutions to address nutritional issues affecting individual health and wellbeing.

Purpose of Assessing the Topic

The main purpose of this assessment task is to give students the opportunity to develop knowledge and skills to confront a problem like situation. They will use problem solving skills, design process and enquiry approach to gather information, plan, create market and evaluate a food product. Hence, they will use practical strategies or approaches as a platform to solve real life problems.

How the Performance Task will be done: Group Project Presentation

Performance Standard

By the end of the project, students will be able to;

- use enquiry approach to investigate and gather and analyze information to establish practical solutions to problems,
- use the design process to develop food product considering nutritional quality of food,
- advertise and market their food products, and, account daily earnings,
- conduct nutrition campaigns in their school community,
- make recommendations and compile a folio of the project.

Authentic Situation

Teachers in the school have noticed a general decline in students' participation and performance. Many students are from the local electorate, and they are experiencing social, political, physical and economical changes as a result of land grabbing, migration and infrastructure development. Many students have been seen at school with unhealthy lunches. The school canteen is not well stocked to provide for students lunch needs.

The Business and Technology department has identified the situation and will take a practical approach to find solutions. To achieve this, the grade 9 food technology students, as an assessment task will conduct a survey to gather information, analyze and communicate the results. Students will engage in cooking activities. They will design food menus, develop and sell food products to students and teachers. Proceeds will be entered on cash books for the department hence, the students will organize in groups and conduct outdoor health awareness campaigns to promote and stress the concept of healthy eating.

Task Description

- Develop questionnaires to conduct a survey to investigate the nutritional status of students.
- The questions must aim to investigate and establish the type of foods students eat at school lunches and at home.
- Decide on the logistics of the survey and conduct the survey as wildly as possible.
- Analyze the results of the survey and list recommendations.
- The results of the survey should set the stage/scene for further practical tasks.
- Plan and design food menus and formulate recipes to cook, simple but nutritious lunches.
- Create a food application or use smart phones either watsapp or Facebook to upload and advertise food menus and take food orders.
- Calculate food costing and present budget
- Prepare, process and package food products.
- Organize in groups to do outdoor nutrition campaigns and sell food products.
- Prepare and record proceeds from food sales for the Home Economic Department.
- Identify strengths and weakness, discuss, document and submit as project evaluation report.
- Compile a folio with attachments of survey instruments, tabulated findings and recommendations, food menus and recipes, food costings and budget samples, cash book entry, photographs and illustrations and submit for assessment.

Materials

- Survey questions
- Recipes sheets
- Cooking ingredients
- Cooking tools and equipment
- Food packaging materials
- Smart phone/laptop
- Charts/posters/pamphlets/fliers
- Markers and charts
- Audio-visual equipment
- Cash Entry Book

1. Categorizing Tasks for the Rubrics (Holistic Rubric)

Research

- The questions must aim to investigate and establish the types of foods eaten at school lunches and at home. ***(Content/information)***
- Analyse the results of the survey and list recommendations to set the stage/pace for further practical tasks. ***(Survey results and recommendations)***

Project Planning

- Plan and design food menus, formulate recipes. ***(Planning and designing of food product development)***
- Create a food application. Use smartphones to upload lunch menus, advertise and take food orders. ***(Technology application)***
- Calculate food costing and present a budget. ***(Budget + costing)***

Production – Product Development & Marketing

- Prepare, process and package food products. ***(Food product development)***
- Organize in groups to conduct outdoor nutrition campaigns and to sell food products. ***(Outdoor awareness and advocacy)***
- Prepare cash book entry and record proceeds from food sales for Home-eco Department. ***(Cash Book Entry)***

Project Evaluation and Folio Submission

- Identify strengths and weakness, discuss, document and submit as project evaluation report. ***(Project Evaluation)***
- Compile a folio with attachments of survey instruments, tabulated findings and recommendations, food menus and recipes, food costing and budget samples, cash book entry, photographs and illustrations and submit for assessment. ***(Folio product compilation and submission)***

2. List the Criteria against the Tasks Descriptions in the Table

Category/Criteria	**Task Description**
Content information	Participants to adhere to survey guidelines. Provide accurate information on the questionnaire sheets
Survey Results and Recommendation	Compile a survey report, list recommendations and finalize for further action
Planning on Food Product Development	Plan and design nutritious food menus. Formulate recipes
Technology Application	Create a food application or use watsapp or Facebook (social media) to advertise food menus and take food orders
Costing and Budget	Calculate food costs, draft a Budget and food purchase
Food Product development	Prepare, process and package foods as per order
Outdoor Presentations	Group presentations of nutrition awareness and food sales
Cash Book Entry	Record proceeds from food sales for HE Department
Project Evaluation	Identify strengths and weaknesses. Discuss, document and submit the project evaluation report
Product: Folio completion and submission	Compile all aspects of the survey, planning and development of food production, nutrition awareness campaign, records of food sale and project evaluation report

3. Unpack the Task Descriptions and Identify the essential KSAV that can be assessed

Category/Criteria	Task Description	Essential		
		Knowledge	Skills	Attitudes/ Values
Gathering Information	Participants to adhere to survey guidelines. Provide accurate information on the questionnaire sheets	• Ethical issues • Nutritional value of food • Dietary needs for different groups	• Public relation, • Questioning techniques, • Entering information Organize content logically	• Appreciation • Being responsible • Respect views of others
Survey Results and Recommendation	Compile a survey report, list recommendations and finalize for further action	• Food Nutritional values • Health issues	• Analyze survey information • Compiling findings	• Making informed decisions
Food Product Development Planning	Plan and design nutritious food menus and recipes	• Food properties • Nutritious value of food • Dietary guidelines • Cooking methods • Food safety and handling	• Design process – Investigating, analyzing, • Problem solving, • Classifying, • Communicating ideas	• Taking responsible actions, • Making informed decisions, • Being creative and innovative
Technology Application	Create a food application, utilize Watsapp or Facebook platforms (social media) to advertise and market food products	• Use of technology, • Online platforms for sales and marketing, • e-commerce	• Operate technology devices, • Create market venues on electronic devices, • Create food app	• Making informed decisions, • Online citizenship
Costing and Budget	Planning Budget and food costing	• Budget, • Food costing	• Accuracy, • Mathematical calculations, • Accounting skills	• Consumer knowledge of food and purchasing food
Food Product development	Prepare, process and package foods as per order	• Cooking methods • Food ingredients • Packaging	• Safety and care • Design process	• Making informed decisions • Problem solving

Outdoor Presentations	Outdoor awareness presentation and food sale	• Food and nutrition • Health and wellbeing	• Communication, • Advocacy and awareness, • Sales and marketing skills	• Commitment & perseverance
Cash Book Entry	Record revenue and expenditure	• Money transactions • Profit • Revenue • Expenses	• Keep records of money • Math calculations (addition& subtraction)	• Wise consumer • Transparency and accountability
Project Evaluation	Identify: Evaluate successes and failures of the project. Make recommendations	• Report Writing	• Judgmental skills	• Making informed recommendations, • Mental, physical and social preparedness
Product: Folio completion and submission	Compile a folio attach project details, submit for assessment	• Report Writing	• Folio & write up • Research skills	• Transparency and accountability

4. Completed Rubric Sample: School Lunch Assessment Rubric

Criteria	Advance	Achieved	Progressing	Novice	Marks
Gathering information	Participants were well versed of the information and provided **accurate** results on time	Participants were knowledgeable and provided **satisfactory** results on time	Participants completed **some** tasks with care. Others were incomplete and needed help	Participants attempted to complete **few** tasks, and not all were attempted. Lack of motivation	/4
Survey Results and Recommendations	Questionnaires provided **precise** answers, **well-structured** information compiled, analyzed and logically presented	Questionnaires provided answers and information **satisfactorily** compiled, analyzed and presented	Questionnaires provided **partial** answers and some were irrelevant to topic and purpose	Questionnaires provided very **few** answers, information **incomplete,** not presented in a logical manner	/4
Food Product Development Planning	Menus and recipes are **well-structured** and contain precise instructions with nutritional considerations	Menus and recipes are of the **correct layout** with nutritional considerations	Menus and recipes are correctly structured, but **some had information gaps**	Menus and recipes are poorly structured but noted for **incomplete information**	/4
Technology Application	Successful uploading of information on social media accommodating **smart marketing strategies** and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ **some marketing strategies** to convince customers to buy food product or place food orders	Successful attempts to connect on social media. **Lack marketing skills** but attracted customers	Struggled with social media. Encountered problems getting started but convinced **only a few** customers and shows less team work	/4
Costing and Budget	Have an **in-depth** understanding on calculating food costs and develop realistic and reliable budget	Have **basic** understanding on calculating food costs and skills of budgeting	Have **partial** understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered **difficulty** in calculating food costs per portion and struggled to plan a budget	/4
Food Product Development	Food product/lunch **well** prepared, processed and package as per	Food product/lunch prepared, processed and package as per	Food product/lunch was **not well** prepared, processed and	Food product/lunch **lacked** the process of development,	/4

	order with consideration of food safety	order with **little** consideration of food safety	package as per order with little consideration of food safety	poor order done and no consideration of food safety	
Outdoor Presentation – Nutrition Awareness and Lunch sale	Awareness was **well organized** and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. **Exceptional** selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was **satisfactorily** organized and presented with tasks delegated. Awareness messages were delivered with sound knowledge and confidence. Good selling skills/techniques displayed, food sold and sales techniques evident	Awareness was **partially** presented, some tasks not fairly delegated. Food was sold, errors occurred during money handling. Needed supervision and guidance at some stages. Organization was evident but team work was lacking	Awareness was **difficult to organize.** Students' roles were not specified correctly. Disorganization was evident, Food sales was slow and showed lacked of coordination and team work	/4
Cash Book Entry	Figures entered **correctly**, checked and all balanced well. No outstanding/ uncollected money	Figures entered **correctly with minor errors** identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, **food was sold on credit** resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some **money was not accounted for,** made losses and outstanding money was not accounted for	/4
Evaluation	All aspects of the project was **well** discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was **fairly** discussed and evaluated, a general report finalized and presented on time	The project report was **partially** finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was **incomplete** and lack information and was not satisfactory compiled	/4
Folio Compilation and Submission	The folio contained **all** the requirements of the project in a logical order, was **well documented** and submitted on time	The folio contained **most** of the requirements of the project, was documented and submitted on time	The folio was adequately complied, some sections lacked details of the project and submitted after the due date	Folio lack sufficient information due to lack of teamwork, and, was submitted very late	/4

1. How to Score using the rubric

Scoring Rubrics

Criteria	Advance 4	Achieved 3	Progressing 2	Novice 1	Marks
Gathering information	Participants were well versed of the information and provided **accurate** results on time	Participants were knowledgeable and provided **satisfactory** results on time	Participants completed **some** tasks with care. Others were incomplete and needed help	Participants attempted to complete **few** tasks, and not all were attempted. Lack of motivation	3/4
Survey Results and Recommendations	Questionnaires provided **precise** answers, **well-structured** information compiled, analyzed and logically presented	Questionnaires provided answers and information **satisfactorily** compiled, analyzed and presented	Questionnaires provided **partial** answers and some were irrelevant to topic and purpose	Questionnaires provided very **few** answers, information **incomplete,** not presented in a logical manner	4/4
Food Product Development Planning	Menus and recipes are **well-structured** and contain precise instructions with nutritional considerations	Menus and recipes are of the **correct layout** with nutritional considerations	Menus and recipes are correctly structured, but **some had information gaps**	Menus and recipes are poorly structured but noted for **incomplete information**	2/4
Technology Application	Successful uploading of information on social media accommodating **smart marketing strategies** and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ **some marketing strategies** to convince customers to buy food product or place food orders	Successful attempts to connect on social media. **Lack marketing skills** but attracted customers	Struggled with social media. Encountered problems getting started but convinced **only a few** customers and shows less team work	3/4
Costing and Budget	Have an **in-depth** understanding on calculating food costs and develop realistic and reliable budget	Have **basic** understanding on calculating food costs and skills of budgeting	Have **partial** understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered **difficulty** in calculating food costs per portion and struggled to plan a budget	3/4
Food Product Development	Food product/lunch **well** prepared, processed and package as per order with consideration of	Food product/lunch prepared, processed and package as per order with **little** consideration of	Food product/lunch was **not well** prepared, processed and package as per order with little	Food product/lunch **lacked** the process of development, poor order done and no	2/4

	food safety	food safety	consideration of food safety	consideration of food safety	
Outdoor Presentation – Nutrition Awareness and Lunch sale	Awareness was **well organized** and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. **Exceptional** selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was **satisfactorily** organized and presented with tasks delegated. Awareness messages were delivered with sound knowledge and confidence. Good selling skills/techniques displayed, food sold and sales techniques evident	Awareness was **partially** presented, some tasks not fairly delegated. Food was sold, errors occurred during money handling. Needed supervision and guidance at some stages. Organization was evident but team work was lacking	Awareness was **difficult to organize.** Students' roles were not specified correctly. Disorganization was evident, Food sales was slow and showed lacked of coordination and team work	3/4
Cash Book Entry	Figures entered **correctly**, checked and all balanced well. No outstanding/ uncollected money	Figures entered **correctly with minor errors** identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, **food was sold on credit** resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some **money was not accounted for,** made losses and outstanding money was not accounted for	3/4
Evaluation	All aspects of the project was **well** discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was **fairly** discussed and evaluated, a general report finalized and presented on time	The project report was **partially** finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was **incomplete** and lack information and was not satisfactory compiled	4/4
Folio Compilation and Submission	The folio contained **all** the requirements of the project in a logical order, was **well documented** and submitted on time	The folio contained **most** of the requirements of the project, was documented and submitted on time	The folio was adequately complied, some sections lacked details of the project and submitted after the due date	Folio lack sufficient information due to lack of teamwork, and, was submitted very late	3/4
Total Mark					**30/40**

2. How to Grade using the rubric
Grading Rubrics

Score Range	Grade	Qualifier (Proficiency)	Descriptor	Percentage
30 – 40	A	Advanced	Description reflecting **highest** level of performance.	76% - 100%
20 - 29	B	Achieved	Description reflecting **mastery** level of performance.	46% - 75%
10 – 19	C	Progressing	Description reflecting **movement towards** mastery level of performance.	26% - 45%
0 - 9	D	Novice	Description reflecting **beginning** level of performance	0% - 25%

3. How to Report using the rubric

Reporting an individual student's performance on the task

Assessment Task Report					
Assessment Task:	**School Lunch Project**				
Name:		**Grade:**	**Class:**	**Marks and Grade:**	**/40**
Criteria	**Advance** **76% - 100%** **30 – 40** **A**	**Achieved** **46% - 75%** **20-29** **B**	**Progressing** **26% - 45%** **10 – 19** **C**	**Novice** **0% - 25%** **0 – 9** **D**	**Scoring**
Gathering information	Participants were well versed of the information and provided **accurate** results on time	Participants were knowledgeable and provided **satisfactory** results on time	Participants completed **some** tasks with care. Others were incomplete and needed help	Participants attempted to complete **few** tasks, and not all were attempted. Lack of motivation	3/4
Survey Results and Recommendations	Questionnaires provided **precise** answers, **well-structured** information compiled, analyzed and logically presented	Questionnaires provided answers and information **satisfactorily** compiled, analyzed and presented	Questionnaires provided **partial** answers and some were irrelevant to topic and purpose	Questionnaires provided very **few** answers, information **incomplete,** not presented in a logical manner	4/4
Food Product Development Planning	Menus and recipes are **well-structured** and contain precise instructions with nutritional considerations	Menus and recipes are of the **correct layout** with nutritional considerations	Menus and recipes are correctly structured, but **some had information gaps**	Menus and recipes are poorly structured but noted for **incomplete information**	2/4
Technology Application	Successful uploading of information on social media accommodating **smart marketing strategies** and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ **some marketing strategies** to convince customers to buy food product or place food orders	Successful attempts to connect on social media. **Lack marketing skills** but attracted customers	Struggled with social media. Encountered problems getting started but convinced **only a few** customers and shows less team work	3/4
Costing and Budget	Have an **in-depth** understanding on calculating food costs and develop realistic and reliable budget	Have **basic** understanding on calculating food costs and skills of budgeting	Have **partial** understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered **difficulty** in calculating food costs per portion and struggled to plan a budget	3/4

Food Product Development	Food product/lunch **well** prepared, processed and package as per order with consideration of food safety	Food product/lunch prepared, processed and package as per order with **little** consideration of food safety	Food product/lunch was **not well** prepared, processed and package as per order with little consideration of food safety	Food product/lunch **lacked** the process of development, poor order done and no consideration of food safety	2/4
Outdoor Presentation – Nutrition Awareness and Lunch sale	Awareness was **well organized** and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. **Exceptional** selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was **satisfactorily** organized and presented with tasks delegated. Awareness messages were delivered with sound knowledge and confidence. Good selling skills/techniques displayed, food sold and sales techniques evident	Awareness was **partially** presented, some tasks not fairly delegated. Food was sold, errors occurred during money handling. Needed supervision and guidance at some stages. Organization was evident but team work was lacking	Awareness was **difficult to organize.** Students' roles were not specified correctly. Disorganization was evident, Food sales was slow and showed lacked of coordination and team work	3/4
Cash Book Entry	Figures entered **correctly**, checked and all balanced well. No outstanding/ uncollected money	Figures entered **correctly with minor errors** identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, **food was sold on credit** resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some **money was not accounted for,** made losses and outstanding money was not accounted for	3/4
Evaluation	All aspects of the project was **well** discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was **fairly** discussed and evaluated, a general report finalized and presented on time	The project report was **partially** finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was **incomplete** and lack information and was not satisfactory compiled	4/4
Folio Compilation and Submission	The folio contained **all** the requirements of the project in a logical order, was	The folio contained **most** of the requirements of the project, was documented and	The folio was adequately complied, some sections lacked details of the	Folio lack sufficient information due to lack of teamwork, and,	3/4
	well documented and submitted on time	submitted on time	project and submitted after the due date	was submitted very late	
Total Mark					**30/40**

Note: The shaded is the student's proficiency score for each task.

Moderation Assessment in Technology and Industrial Arts

What is Moderation as Assessment?

Moderation is the process of teachers sharing, working through and agreeing to expected standards of student achievement and progress. It supports teachers to compare their own judgments to either confirm or adjust them. The process involves teacher collaboration to establish a shared understanding of what achievement of standards looks like and whether or not the student has demonstrated achievement of the standard through the evidences of performance tasks. Teachers work towards making judgments of assessments of standards that are consistent and comparable.

Moderation Purposes

"Moderation is concerned with the consistency, comparability and fairness of professional judgments about the levels demonstrated by students." *(Maxwell,2002).*

Comparable judgments result from teachers understanding of the curriculum, and agreeing on benchmark assessed. The essence is that, there is common understanding of how to assess progress and achievement within and across schools.
Moderation helps teachers to make dependable, evidence-based decisions and leads to consistency.
There is a need for consistency of teacher judgments:

- Over time-same evidence viewed at different times or different contexts leading to same judgment by same teacher.
- Against standards-equivalent application across different types of evidence.
- By a teacher-between his/her students.
- Between teachers-within the same school and different schools.
- Between teaching years and levels.

Making consistent, reliable and valid decisions across different points in time is important when schools report on student progress, make decisions on school targets and resourcing, or compare different grades data with past information.

All schools experience variables that challenge the consistency of practice such as staff changes, changes in student numbers or changing education demands. Consistent moderation overtime can prevent this in a number of ways.

- Always applying the same standardized criteria ensures consistency over time.
- Where nationally standards criteria or exemplars are available, these become the same external reference used each year or each time.
- Moderators will change over time but the same criteria and associated references will remain and continue to guide decisions.

The Benefits of Moderation

The Benefits of involving students in Moderation

- When students are actively involved they can participate in selecting evidence (e.g. samples of their work) that best demonstrate the intended learning outcomes.
- The process of assessment develops students' understanding of the desired outcomes and success criteria or expected rubrics developed.
- Making judgments is closely linked to developing the skills of self and peer-assessment.
- This can lead to shared expectations of learning and understandings of standards between teachers and students.
- Greater student confidence in teacher judgments.
- Provides greater transparency of the assessment process.

The Benefits of Moderation for Teachers

- Brings together collective wisdom, resulting in greater consistency of judgment, and focused teaching.
- Provides greater confidence in teacher judgments and assurance that judgments are consistent with other professionals.
- Leads to shared expectations of learning and understandings of levels and progression of learning.
- Develops deeper understandings about content and progressions of learning.
- Improves quality of assessment.
- Alignment of expectations and judgments with curriculum expectations or progressions, and hence improved teaching and learning.
- Assurance to parents and others that interpretations of students' progress and achievement are in line with other professionals.

Process of Moderation

Purpose, learning area and context of the moderation:
It could be moderation of a proficiency based project or design portfolios or the understanding of how to take a running record or of judgments of student achievement and progress for reporting.

Who is involved?

Who needs to be involved? Who will be the co-coordinator?
It is preferable that the leader/co-coordinator has the authority to make decisions for the timing, duration and frequency of Moderation meetings.
Will they be extra meetings, or part of staff or team meetings, or non-contact days?
What is the attainment requirement for the moderation? School based certification?

The Evidence of Student Learning that will be Moderated

- For a piece of writing, student writing samples will be used.
- For moderating a design portfolio, the task, text and questions the student responded to may be used, along with notes of student questions, samples of work done and annotated tasks in line with the assessment task and criteria.
- For supervision of an assessment tool: this could be a student's running record and the teacher.
- For judgments of student achievement and progress for reporting to parents, a range will be required, covering both formal and informal collection of evidence.
- Developed rubrics written against national exemplar may be used as assessment tools of moderation which can be maintained and improved every year.

When to use Moderation in TIA

Moderation assessment for TIA will be project based and or evidence based assessment. This can be carried out in a year from grades 9-12. This could mean one project in one of the strands or an incorporation of all the strands of the subject TIA in grade 12 where each school makes the decision to undertake moderation as assessment. This could be the final moderation project that will incorporate all the strands in TIA. For grades 9, 10, and 11, the moderated projects can be strand based.

Moderation – Using the Design Process

The design process will be assessed as it is the driver of the design portfolio evolving into the food product development in the case of food technology. Each stage of the food product development process will be assessed with their specific rubrics developed.

These are some guidelines given for the designing process;
1. Set the task descriptions, step by step on what is expected to be done by the students to complete the task.
2. Create and develop a design brief out of the tasks that indicates the design product or solution.
3. Ensure that the activities of the project are guided by the design brief.
4. Nominate essential knowledge, skills, attitudes and values to be taught and or assessed. Assessment can be in stages or on the entire project or product

Develop Criteria for Assessing Learning

These criteria would normally be communicated to students with the activity.

Example: Students will be assessed on their ability to:

- Prepare a nutritious dish with consideration to dietary or health needs, constraints in food preparation, proficiency in manufacture and time management.
- Select and use appropriate kitchen equipment, techniques and materials to prepare a meal or dish.
- Document project work and show evidence of:
  - inspiration and evaluation,
  - presentation of final dish,
  - collection and justification of resources,
  - appropriate food safety standards, and
  - experimentation with and justification of techniques and equipment.

Assessment Rubrics

The development of assessment rubrics will cover the three focus areas.

1. Design Portfolio
2. Food Product Development
3. The Design Process

1. The Design Portfolio

As this is an ongoing or running file of student work the assessment criteria is developed formatively. This portfolio will show all evidence of work done in the designing, planning, making and evaluating the project.

2. **Food Product Development**

List the essential phases of the project. Example, develop the product or preparing the dish.

1. The method and techniques used to develop the dish
2. The rationale behind developing the food recipe
3. Produce or prepare the nutritious dish
4. Select and use appropriate kitchen equipment, techniques and materials to prepare the dish
5. Evaluate the project

The different phases of the project will guide the teacher to develop an analytic as well as a holistic rubric. Refer to the assessment sections on the steps to develop a rubric.

Reporting, Monitoring and Evaluation

Recording, reporting, monitoring and evaluation are integral part of assessment for students from grades 9 to 12. Therefore, it is commended that recording, reporting, monitoring and evaluation of students achievements for Business and Technology Subjects must be done by grade levels in school based assessment or also referred to as internal school assessment.

The marks awarded to students in their internal assessment will be a combination of the internal assessment mark and the examination mark.

Internal assessment provides a measure of student's achievements based on a wider range of syllabus content and benchmarks than maybe covered by the external examination. Business and Technology subjects provide a summation of each student's achievement in Grades 9-12. The internal assessment mark must comply with the types of tasks and assessment rubrics specified in the holistic or analytic rubrics. The external examination provides a measure of student achievement of those aspects of the content standards that can be reliably measured in an examination setting.

Recording

Standards based recording and reporting is about student understanding and mastering a learning standard and less about grades. A standards based report card can list the most important skills students should learn in each subject at a particular grade level. Instead of letter grades, students receive marks or a code that show how well they have mastered the skills. The marks or codes that schools use to represent student progress are;

A - Advanced
B - Proficient
C - Progressing
D - Novice

The standards are basically the learning standards and expectations for each grade level. SBC requires an effective way of recording and reporting to measure progress of student's performance such as in Project Based Learning. Reporting progress is based on the teaching and learning strategies for performance based learning which are accurately assessing the performance towards mastery. The teaching model is changing therefore the performance measurements of Standards-Based Reporting will be more reflective of learning in the classroom. Hence, SBA allows students to be able to know against which criteria they will judge their work, and the standards attached to each of the criteria. It tells students what is required and allows teachers to gain a sense of how students are doing overall based on their achievement of the standards and promotes mastery learning.

Schools must maintain and submit student assessment records according to the school based assessment policy. Teachers can record the evidence of students'. demonstrations' of achieving the content standards and benchmarks using assessment instruments that are manageable.

Here are some recommended recording methods;

- Individual or class checklists or class grid to record observations,
- Comments on students work indicating what they have done well and where they need to improve,
- Work samples being added to a portfolio,
- Test marks,
- Students assessments of their own performances using rubrics or assessment criteria, and
- Students assessment of their peers using the assessment criteria.

Students are given constructive feedback by the teacher on what they can do well and what they need to improve on. Likewise, teachers are focused on the content they are assessing and are able to apply fair, precise and consistent judgment.

Reporting

Teachers are obliged to report on what students have done or how well they have performed and how they improve further. Formal reporting through written reports and interviews are done to inform parents and guardians of the students learning progress and other related areas such as behavior. Teachers must ensure that the student has demonstrated and achieved the standards independently on a number of occasions. These can be done formally or informally. The achievements are reported to respected stakeholders in relation to;

- Weaknesses in the learner
- Strengths in the learner
- Parent and guardian support and
- Evaluation

Purpose of Reporting

- **Students are provided with appropriate feedback that will improve their skills**

In a standards-based learning approach, teachers are expected to provide their students with quality feedback that will improve student learning. As opposed to the traditional grading system that only provides students with a single numerical or letter grade, the standards-based grading system requires teachers to provide their students with meaningful and appropriate feedback that will accelerate mastery of learning standards. It is believed that standards-based grading allowed students to identify their areas of growth and to improve on their own competencies.
Teachers need to communicate with their students what each proficiency score means and should be explained to the students' parents what each score means and how they can help their children demonstrate mastery of learning standards expected of them for the subject.

- **Students can track their progress**

In a standards-based grading approach, students understand the meaning of each score that they receive. Because there are rubrics that explain the meaning of each proficiency score, students can easily monitor which standards need to be improved further and which learning standards have already been met. As such, students begin to monitor their progress and become accountable for their learning goals.

Interventions and Monitoring

Underachievement is poorer than expected performance. Students who consistently display performance demonstrative of underachievement are identified and interventions for regress are planned to promote learning. Such interventions should be planned not as a general aspect but should address individual students' limitations in learning and should encourage learning.

- **Monitoring of students learning**

Monitoring of students learning is done through strategies that teacher devise to track their teaching and students achievement. This is through the assessment program, classroom teaching, and performance in performance-based learning and students self-assessment in achieving the learning standards.

- **Re-planning**

Re-planning of teaching programs and lesson planning are addressed apart from the planning and programming for all other students. This is specifically addressing underachievers. Re-planning includes teaching and learning strategies, resources, remedial activities which can be planned into the normal teaching times instead of creating extra times after classes.

Certification

Certifying of students must be done through an awarding system which will determine the level of achievement. This will be in a form of achievement statements suggested below;

Levels of achievement

1. Very high achievement
2. High achievement
3. Satisfactory achievement
4. Low achievement
5. Below requirement level

All teachers responsible for grades 9 -12 must consider school based assessment levels of achievements to be effected across all Business and Technology Subjects, recognized Certification of Attainment.

Glossary

Terms	Definitions
Acetic acid	A compound found in vinegar, amongst other foods, that gives a sour and pungent smell
Acid	A substance with pH below 7 that can break down to release hydrogen ions
Acrylamide	A by-product made when foods high in starch are fried, roasted or baked at a high temperature
Additive	Ingredients added to foodstuffs to alter them in order to preserve or enhance specific qualities e.g. taste, colour
Additives	Substances added to food to preserve or enhance appearance or flavours
Aftertaste	The after-effect of flavour leaving a coating in the mouth after chewing food
Allergy	A negative response triggered by the immune system from a range of causes such as consuming certain common food ingredients
Amino acids	Simple organic compounds containing an amino group and a carboxyl group: the building blocks of proteins
Antioxidant	A substance that inhibits oxidation, particularly important in the preservation of stored food products
Aroma	The smell given off by food (e.g. baked bread) and drink which is detected by receptors in the nose
Ascorbic acid	The scientific name for vitamin C; essential for growth and defense against infection
B vitamins	Water-soluble vitamins which help the body release energy from food. There are many B vitamins, all of which are required in a healthy diet
Bacteria	Group of single-celled organisms with a cell wall but no organelles (structure in a cell with a specific function)
Base	When added to an acid, will form a salt. Accepts hydrogen ions from an acid
Biotechnology	Controlled manipulation of biological systems for a desired outcome
Bitterness	A strong flavour, generally lacking in sweetness and usually quite sharp e.g. in coffee and citrus fruit
Blanching	A process where foods, such as vegetables, are boiled for a very short time, then plunged into cold water to stop the cooking process

Brewing	Producing beer by soaking starch in water, then fermenting the sweet liquid with yeast, producing ethanol and carbon dioxide bubbles
Browning	When the surface of food becomes darker and browner in colour as a result of cooking
Bulking agent	A food additive that increases the weight and/or volume of food without altering its nutritional value
Butyric acid	A carboxylic acid which can be found in, for example, milk and parmesan cheese
Canning	Process used to preserve foods where food is heated in a can to kill microorganisms
Caramelisation	A process by which monosaccharides and disaccharides are browned by the application of heat; a form of non-enzymatic browning
Carbohydrase	An enzyme that breaks down carbohydrate into simpler sugars
Carbohydrate	One of the key macro nutrients made up of carbon, hydrogen and oxygen; main source of energy in the diet
Carbonation	A process when carbon dioxide dissolves in a liquid and produces gas bubbles, producing a fizzy sensation
Carotenoid	A pigment in plants causing bright red, orange and yellow colours like those found in tomatoes, carrots and bananas
Carrageenan	A polysaccharide found in seaweed, used as a food additive e.g. for thickening, gelling, stabilizing
Casein	A protein found in milk
Cholesterol	A type of lipid, found in most body tissues; an essential part of cell membranes, vital for healthy body function. Made by the body and also found in dietary sources
Clouding agent	A food additive that makes beverages look more cloudy by creating an oil-droplets emulsion; used in fruit juices
Collagen	A protein found in connective tissue, acting as a structural component and often aiding elasticity
Colloid	A mixture in which one substances (solid, liquid or gas) is evenly dispersed in another (solid, liquid or gas) e.g. milk
Critical temperature zone	The temperature range of 5-63°C in which harmful microorganisms can grow and which must be avoided as much as possible during food-storage
Crystallisation	A process where molecules come together in a highly ordered arrangement forming a solid with a high melting point

Curing	A method of preserving meat (e.g. pork) and fish (e.g. salmon), usually using salt or compounds such as nitrites
Deficiency	The lack of essential nutrients leading to malnutrition and disease
Deformation	A process where the shape of an object is altered
Denaturation	A change in protein structure where the proteins bond together, usually by heat, acid or shear; solubility is lost and the helix structure breaks apart
Density	A physical property; relationship between mass and how much space (volume) it takes up. An indication of how open the internal structure is
Deterioration	The process of food decaying or losing freshness
Dextrin	What is produced when starch or glycogen is broken down with water (hydrolysis), forming short-carbohydrates of a few glucose molecules joined together
Diet	The total overview of foods eaten by an individual. Often based on personal taste or culture, some dietary choices can be healthier than others
Disaccharide	The molecule formed when two sugar molecules (monosaccharides) bond together and lose water e.g. sucrose, lactose, maltose
Emulsifier	An additive used in processing to stabilise a solution to prevent separation of components, typically fat/oil and water
Emulsion	A mixture of liquids which do not naturally combine: oil-in-water emulsions e.g. milk, or water-in-oil emulsions e.g. butter
Enrobing	The process of coating a food product with another ingredient
Essential nutrient	A nutrient required for normal function which cannot be synthesised by the body, so these nutrients must come from a dietary source
Esterification	A chemical reaction between alcohol and carboxylic acid forming an ester
Extrinsic sugar	'Free' sugars (e.g. table sugar) or added sugar. When fruits are juiced, they release these sugars
Extrusion	A cooking method where mixture of ingredients usually containing starch is forced through small openings at high pressure to form shapes e.g. breakfast cereal
Fatty acid	A molecule made up of carbon and hydrogen, which can be unsaturated or saturated; basic building block of oils and fats
Fermentation	A process carried out by bacteria and yeasts to convert simple sugars to acids or alcohols, altering food properties

Fibre	A material that cannot be broken down by enzymes and resistant to digestion. Provides bulk to many foods
Flavour	The experience involving taste and smell
Foam	When gas bubbles are trapped within a liquid or solid, providing an aerated structure e.g. whipped cream
Food Science	The study of scientific and technical disciplines to help ensure the safety, availability & consistency of food globally
Fortification	The process of adding nutrients to food
Gel	A network formation of long-chain molecules which trap water to form a semi-solid material
Gelatine	A protein derived from collagen, which dissolves in water and forms a gel on cooling, then melts at body temperature. Alternative spelling is gelatin
Gellan	A vegan gelling agent (gelatine substitute) produced by the bacterium Sphingomonas elodea; used in milk
Genetic modification	The alteration of genetic material to artificially produce a desired characteristic, outcome, resistance or novel trait
Glucose	A simple sugar; main source of energy in the body, and the preferred fuel in the brain
Gluten	A protein found in wheat, responsible for elastic qualities in dough and chewy texture in bread
Insulin	The hormone which controls blood glucose levels; insufficient insulin production can cause diabetes
Iodine value	The amount of grams of iodine absorbed by 100g of substance; often used to calculate the level of unsaturated fatty acids
Irradiation	The process of preserving food by exposure to radioactive sources to kill pathogens, with limited impact on appearance and quality
Keratin	A fibrous, structural protein present in animal (including human) skin and hair
Lactase	An enzyme with only one function: breaking down lactose into smaller sugars. Lactase deficiency is the most common cause of lactose intolerance
Lactic acid	Produced from lactose in milk by bacteria involved in the production of cheese and yoghurt. Also produced in anaerobic exercise

Lactose	A small sugar present in milk, which provides energy and adds body and sweet flavour to the milk
Leavening agents	Substances that promote volume increase by aeration e.g. yeast, baking soda. Also called raising agents.
Lecithin	A substance commonly used as an emulsifier, found in egg yolk for example
Legumes	Plants in the pea family, often nutrient-rich. Many help to fertilise the soil around them (e.g. peas, peanuts, navy beans)
Lipid	A group of compounds insoluble in water; includes fats and oils with various functions e.g. energy yielding and structural components
Liposoluble	A substance that can dissolve in fats and oils
Macronutrient	Required in large amounts in the diet; the main types are proteins, carbohydrates and lipids
Maillard reaction	A chemical reaction between amino acids and reducing sugar, which creates colour and flavour compounds
Malnutrition	The condition of having excessive nutrients, a lack of nutrients, or wrong proportion of nutrients
Malting	The process of soaking grain in water and heating, to allow germination and enzymes to develop
Maltose	A small sugar produced when starch breaks down; found in beer and malted products such as milkshakes
Melting point	The temperature at which a compound transitions from a solid to a liquid
Micronutrient	Required in small amounts in the diet; includes certain vitamins and minerals
Minerals	A group of essential nutrients e.g. calcium and potassium
Mollusc	Invertebrate with a soft body, often covered with a shell (e.g. mussels, squid)
Monosaccharide	A single sugar unit (e.g. glucose, galactose, fructose), formed by condensation of disaccharides with water added
Monosodium glutamate	White, odourless, crystalline powder with good water solubility. Functions as a flavour enhancer with an umami taste which can intensify the meaty, savoury flavour of food
Mouth feel	The way food and drink are felt in the mouth other than taste
Myoglobin	Protein that binds to oxygen, usually found in the muscle of vertebrae

Non-reducing sugar	A sugar which cannot act as a reducing agent, donate electrons to other molecules or participate in redox reactions e.g. sucrose
Nutrient	A nourishing substance required for maintaining growth and good health in living things
Oil	A blend of various triacylglyceride (TAG) molecules, typically liquid at room temperature
Panning	The process of building thin layers of sugar, sweetener or other coating onto food (e.g. nuts, fruits)
Pasteurisation	Using temperature and time to reduce microorganisms to a safe level without major alteration to the properties of the product e.g. milk (72°C for 15 sec.)
Pathogen	Microorganisms (e.g. bacteria, virus) that can cause disease
Pectin	A structural component found in plant cell walls which can be used for thickening and gelling
Polysaccharide	A complex carbohydrate formed by long chains of monosaccharide units, joined together by glycosidic bonds
Prebiotic	Indigestible plant component whose consumption promotes the growth of beneficial bacteria in the large intestine
Preservative	Extends the shelf life of a food product by inhibiting microbial growth
Protein	One of the main types of macronutrient; made up of chains of amino acids
Retrogradation	Realigning of amylose and amylopectin chains during cooling of a gelatinised starch mixture to a crystalline structure
Rheology	The study of the food behaviour when force is applied; deformation of solid or flow of liquid. Impacts food texture, equipment and packaging
Riboflavin	Vitamin B2; found in eggs, vegetables and meats
Salmonella	A genus of bacteria that can cause food poisoning. Poor hygiene practices can lead to salmonella infections
Saturated fat	A fatty acid molecule with no double bonds between carbon atoms; it is solid at room temperature
Sensory	Relating to the five basic senses: hearing, touch, taste, sight and smell
Stabiliser	A food additive that helps with structure stability, typically seen in salad dressing to stop oil and water from separating

Starch	A polysaccharide made up of many glucose molecules, joined via glycosidic bonds; contains amylose and amylopectin
Sterilisation	The process for eliminating microbes from foods e.g. bacteria, moulds, viruses
Sucrose	A table sugar derived from cane or beet crops
Sugar	A small chain carbohydrate, soluble in solution, that adds a sweet taste to foods
Sweetener	An additive that replaces sugar to provide sweetness, usually with lower energy content. Can be found in nature or produced synthetically
Taste	One of the basic senses. Food is detected in the mouth by receptors in the tongue. The five tastes are sweet, bitter, sour, salty and umami
Taste panel	A group of people having a joint duty to taste and/or evaluate a food or beverage product
Tempering	A process used to give chocolate a glossy appearance, 'melt in the mouth' sensation and prevent chocolate bloom
Thickener	A substance that increases the viscosity of a liquid
Trans fat	A type of unsaturated fat, found in margarine and spreads, not commonly occurring in nature
Unsaturated fat	A fatty acid chain with one or more double bonds between carbon atoms and is liquid at room temperature
Vegetable	Edible plant parts such as roots, leaves and stems e.g. spinach, carrots, celery
Viscosity	The measurement of a fluid's internal friction and resistance to flow. Typically used to measure the thickness of a liquid
Vitamins	A group of essential nutrients e.g. B vitamins important for normal growth and nutrition
Volatile	Evaporates easily at room temperature
Wheat	An important cereal crop, ground into flour to produce bread and pasta
Yeast	A single celled organism capable of fermenting sugar into alcohol and carbon dioxide
Zinc	A mineral which helps to process foods in the body. Good sources include dairy, bread and meat

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Appendices

Appendix 1: 21ST Century Skills

Ways of thinking	**Creativity and innovation** • Think creatively • Work creatively with others • Implement innovations **Critical thinking, problem solving and decision making** • Reason effectively and evaluate evidence • Solve problems • Articulate findings **Learning to learn and meta-cognition** • Self-motivation • Positive appreciation of learning • Adaptability and flexibility
Ways of working	**Communication** • Competency in written and oral language • Open minded and preparedness to listen • Sensitivity to cultural differences **Collaboration and teamwork** • Interact effectively with others • Work effectively in diverse teams • Prioritise, plan and manage projects
Tools for working	**Information literacy** • Access and evaluate information • Use and manage information • Apply technology effectively **ICT literacy** • Open to new ideas, information, tools and ways of thinking • Use ICT accurately, creatively, ethically and legally • Be aware of cultural and social differences • Apply technology appropriately and effectively
Living in the world	**Citizenship – global and local** • Awareness and understanding of rights and responsibilities as a global citizen • Preparedness to participate in community activities • Respect the values and privacy of others **Personal and social responsibility** • Communicate constructively in different social situations • Understand different viewpoints and perspectives **Life and career** • Adapt to change • Manage goals and time • Be a self-directed learner • Interact effectively with others

Appendix 2: Teaching and Learning Strategies

Strategy	Teacher	Students
Case study Used to extend students' understanding of real life issues	Provide students with case studies related to the topic of the lesson and allow them to analyse and evaluate.	Study the case study and identify the problem addressed. They analyse the problem and suggest solutions supported by conceptual justifications and make presentations. This enriches the students' existing knowledge of the topic.
Debate A method used to increase students' interest, involvement and participation	Provide the topic or question of debate on current issues affecting a bigger population, clearly outlining the expectations of the debate. Explain the steps involved in debating and set a criteria/standard to be achieved.	Conduct researches to gather supporting evidence about the selected topic and summarising the points. They are engaged in collaborative learning by delegating and sharing tasks to group members. When debating, they improve their communication skills.
Discussion The purpose of discussion is to educate students about the process of group thinking and collective decision.	The teacher opens a discussion on certain topic by asking essential questions. During the discussion, the teacher reinforces and emphasises on important points from students responses. Teacher guide the direction to motivate students to explore the topic in greater depth and the topic in more detail. Use how and why follow-up questions to guide the discussion toward the objective of helping students understand the subject and summarise main ideas.	Students ponder over the question and answer by providing ideas, experiences and examples. Students participate in the discussion by exchanging ideas with others.
Games and simulations Encourages motivation and creates a spirit of competition and challenge to enhance learning	Being creative and select appropriate games for the topic of the lesson. Give clear instructions and guidelines. The game selected must be fun and build a competitive spirit to score more than their peers to win small prices.	Go into groups and organize. Follow the instructions and play to win
Observation Method used to allow students to work independently to discover why and how things happen as the way they are. It builds curiosity.	Give instructions and monitor every activity students do	Students possess instinct of curiosity and are curious to see the things for themselves and particularly those things which exist around them. A thing observed and a fact discovered by the child for himself becomes a part of mental life of the child. It is certainly more valuable to him than the same fact or facts learnt from the teacher or a book. Students • Observe and ask essential questions • Record

		• Interpret
Peer teaching & learning *(power point presentations, pair learning)* Students teach each other using different ways to learn from each other. It encourages; team work, develops confidence, feel free to ask questions, improves communication skills and most importantly develop the spirit of inquiry.	Distribute topics to groups to research and teach others in the classroom. Go through the basics of how to present their peer teaching.	Go into their established working groups. Develop a plan for the topic. Each group member is allocated a task to work on. Research and collect information about the topic allocated to the group. Outline the important points from the research and present their findings in class.
Performance-related tasks *(dramatization, song/lyrics, wall magazines)* Encourages creativity and take on the overarching ideas of the topic and are able to recall them at a later date	Students are given the opportunity to perform the using the main ideas of a topic. Provide the guidelines, expectations and the set criteria.	Go into their established working groups. Being creative and create dramas, songs/lyrics or wall magazines in line with the topic.
Project (individual/group) Helps students complete tasks individually or collectively	Teacher outlines the steps and procedures of how to do and the criteria.	Students are involved in investigations and finding solutions to problems to real life experiences. They carry out researches to analyse the causes and effects of problems to provide achievable solutions. Students carefully utilise the problem-solving approach to complete projects.
Use media & technology to teach and generate engagement <u>depending on the age of the students</u>	Show a full movie, an animated one, a few episodes form documentaries, you tube movies and others depending on the lesson. Provide questions for students to answer before viewing.	Viewing can provoke questions, debates, critical thinking, emotion and reaction. After viewing, students engage in critical thinking and debate

Appendix 3: A Sample Portfolio

This refers to a collection of student work and additional information gathered over a period of time that demonstrates learning progress from a subject or/ integrated subjects project. **Certain sections of the portfolio such as the safety and uses of equipment /or tools have to be adjusted /or altered accordingly to suit the subject specifics.**

Sample Student Portfolio Template

Name: _____ **Class:** _____ **Term:** _____ **Date:** ___/___/___

Subject: _____

Strand: _____

Unit: _____

Content Standard: _____

Benchmark: _____

Name of Project: _____

Purpose of the Project: _____

1. Idea Generation

a. Inform the students that most of the projects for example; sewing shirt, making a bowl, preparing food or making a furniture) are based on existing ideas to solve a problem. Ask the students to choose from these list words/phrase (**substitute, combine, adapt, modify, put to another use, eliminate, reverse/rearrange**) one word/phrase that provokes your thoughts about their project idea to solve an existing problem. The word/phrase selected by students will direct the approach the students take towards the ideas of the students' projects.

Write this word/phrase in the space provided below.

_____

b. Guide the students to explain how this word/phrase is in line with their ideas of a project.

_____

_____

c. Assist students to develop an inquiry question based on their project idea.

_____

1. Research

Inform the students that their project idea needs to be validated to ensure that the product get the people who will pay for it and that they won't waste time, money, and effort on an idea that won't sell.

a. Students to validate the product ideas by conducting a survey to get feedbacks from the potential buyers. The students will have to prepare a survey questionnaire with a number of essential questions on their product ideas like the one below.

***Survey on Project Idea**: (Name of the project idea)*

1) Explain how useful is the furniture/garment to you?

_____

2) Explain how often do you have this dish?

_____

3) How much would you like to spend on this garment/furniture if you intend to buy it?

_____

b. At this stage, students should consider the **Safety precautions** to be taken in the stages of **Planning, Prototyping, Production and Marketing**. They can do this by responding to related questions as show in the examples below.

1) What is the First Aid symbol?

2) Explain what is safety?

Students draw the FIRST AID SYMBOL here

_____

3) How can safety be enforced in working practices to minimize the risks associated in the working environment?

_____

4) In the following stages (**Planning, Prototyping, Production and Marketing**), the students will draw 2 items/tools and describe the type of injury that may occur through the incorrect use of each of the items/tools.

1. Planning Stage	
Item/Equipment/Tool	***Injury that may occur***
Name: _____ *(Drawing of the item/equipment/tool)*	*1.*
	2.
	3.
Name: _____ *(Drawing of the item/equipment/tool)*	*1.*
	2.
	3.

2. Prototyping Stage	
Name: _____ *(Drawing of the item/equipment/tool)*	*1.*
	2.
	3.
Name: _____ *(Drawing of the item/equipment/tool)*	*1.*
	2.
	3.

5) The students will have state what action they should take to assist the teacher next to each of the injuries described below.

Injury	***Action taken by student***
A student using knife a cuts his/her finger.	*1.*
	2.
A student cooking burns his/her hand on a hot pot	*1.*
	2.

3. Planning

Explain to the students that it is important to take the time to plan carefully before they begin to build your prototype. They need to decide on a number thing when building their prototype. Inform the students characteristics of materials/food to be used texture, design, hardness, durability and colour) etc. All of these is determine by the purpose and the function of the project.

a. Tasting

1) In terms food, students need to actually taste ingredients separately first and after the different ingredients are combined. They will also identify the various ways to cook them. Students will have find out ways to improve the taste for their intended project dish.

b. Sketching

1) In terms of fabric garments and construction technology projects, students have to sketches of the various prototypes needs to prepared and evaluated for their practicality and usefulness. They also need to consider the purpose and function of their project for they will determine the materials to be used, the characteristics for the materials to be used. Students have to determine ways to improve the design of their fabric garment and construction technology projects.

4. Prototyping

a. For Fabrics and construction technology, the students will have to select projects sketches that will be made into prototypes, be sampled and do detailed working diagrams/patterns/templates to ergonomics standards. Students evaluate their prototype and make appropriate changes on the detailed working diagrams/patterns/templates to meet the ergonomics standards.

b. As for food, students written up a recipe and cook sample dishes various ways. Students will make appropriate taste evaluation of each dish to select the one to use as the project.

5. Production

a. Students need to be selective gathering the required materials and food ingredients as per their materials/recipe list to for the project based on their prototypes and the ergonomics standards. This is because of the conditions of the raw materials to be used for their project. The materials have to be evaluated for defects or damages acquired by the materials to select the appropriate materials. Students should select the materials according to the descriptions of materials needed for their project.

b. For Food, students have to use the confirmed recipe from the prototype to prepare and create the dish.

c. Students will use the confirmed outlined garment patterns/templates to measure and cut out the material list for their project. For technology construction, students utilise the confirmed cutting list and the detailed working diagram to cut out the materials for their project like the one below.

Project Name	
Total Unit (No of Project)	

Material List				
Quantity	**Name of Material(s)**	**Description(s)**	**Unit Cost**	**Total Cost**

d. While working on the projects, the students will have to fill in and complete the table of the Procedures in the Production of their project

Procedure (How to make my Project)

No	Operations	Tools/Equipment Needed
1		
2		
3		
4		
5		
6		
7		

6. Costing

a. The students are required to calculate the cost of their project. To calculate their project, they have to calculate the cost of all the materials used in their project, the labour cost (based on their rate per hour) and these adds up to the selling/marketing cost. Students have to add 30% markup of the selling/marketing cost to determine the selling price.

b. Students should also evaluate the responses from product research survey as they could influence the cost the project.

c. The cost for making the project are:

1) Material costs: K____
2) Labor costs (No: of Hours Spent x Your Rate): 10 hrs x K ___ = K____
3) Selling/Marketing cost: K____

d. Students will use the simple formula below to calculate a good markup percentage for their project:

Markup Percentage = (Selling price – Unit cost) / Unit cost x 100%

a. They simply take the sales price minus the unit cost, and divide that number by the unit cost. Then, multiply by 100 to determine the markup percentage.

For example, if the project costs K50 to make and the selling price is K75, then the markup percentage would be 50%: (K75 – K50) / K50 = 0.50 x 100 = 50%.

7. Marketing

a. Students need to review the responses/feedback from the Surveys done on the project idea and inform the interested people of the completed project.

b. Students could put out flyers, brochures and posters to promote the completed project to the public.

c. Students could create promotional webpages on social media to market the product.

A Sample Student Self-Assessment

Student Self-Assessment/Teacher Assessment						**Date: / /**			
Project Name:						**Term:**			
Student Name:		**Grade:**		**Class:**		**Total Score:**			
		Give yourself a score of 3, or 2, or 1, or 0 for performances				Teacher scores of students' performances			
	Criteria	**Students' scores**				**Teacher's scores**			
		3	**2**	**1**	**0**	**3**	**2**	**1**	**0**
1	**Idea Generation** a. Selection of word/phrase in line with project idea								
	b. Explanation of the word/phrase in-line with project and development of main issue question								
2	**Research** a. Development of a survey questionnaire with a number of essential questions on their project ideas								
	b. Safety for stages of **Planning, Prototyping, Production and Marketing**. i. Draw safety precaution sign								
	ii. Tool/items and injuries that may occur								
	iii. Injuries and actions taken by students								
3	**Planning** a. Identify the various ways to cook them and find out ways to improve the taste for their intended project dish								
4	**Prototyping** a. Select projects sketches that will be made into prototypes, be sampled and do detailed working diagrams/patterns/templates to ergonomics standards								
5	**Production** a. Select the materials according to the descriptions of materials needed for their project.								
6	**Costing** a. Calculate their project, they have to calculate the cost of all the materials used in their project, the labour cost (based								

	on their rate per hour) and these adds up to the selling/marketing cost.								
7	**Marketing** a. Review the responses/feedback from the Surveys done on the project idea and inform the interested people of the completed project. b. Create promotional webpages on social media to market the product								

A Sample Peer Student Assessment

Student Self-Assessment/Teacher Assessment										**Date: / /**			
Project Name:										**Term:**			
Student Name:						**Grade:**				**Total Score: /**			
Peer's Name:						**Class:**							
		Give yourself a score of 3, or 2, or 1, or 0 for performances				Give your peer a score of 3, or 2, or 1, or 0 for performances				Teacher scores of students' performances			
	Criteria	**Students' scores**				**Peer's scores**				**Teacher's scores**			
		3	**2**	**1**	**0**	**3**	**2**	**1**	**0**	**3**	**2**	**1**	**0**
1	**Idea Generation** a. Selection of word/phrase in line with project idea												
	b. Explanation of the word/phrase in-line with project and development of main issue question												
2	**Research** a. Development of a survey questionnaire with a number of essential questions on their project ideas												
	b. Safety for stages of **Planning, Prototyping, Production and Marketing**. i. Draw safety precaution sign												
	ii. Tool/items and injuries that may occur												
	iii. Injuries and actions taken by students												
3	**Planning** a. Identify the various ways to cook them and find out ways to improve the taste for their intended project dish												
4	**Prototyping** a. Select projects sketches that will be made into prototypes, be sampled and do detailed working diagrams/patterns/templates to ergonomics standards												
5	**Production** a. Select the materials according to the descriptions of materials needed for their project.												
6	**Costing** a. Calculate their project, they have to calculate the cost of all the materials used in their project, the labour cost (based on their rate per hour) and these adds up to the selling/marketing cost.												

7	**Marketing** a. Review the responses/feedback from the Surveys done on the project idea and inform the interested people of the completed project. b. Create promotional webpages on social media to market the product												

Samples of Student Response System Applications

These are web based apps that work with a multitude of devices and operating systems. Here are the 4 best student response systems that interface with multiple devices.

1. Kahoot

Kahoot is a utility that allows teachers to create quizzes and surveys, and then send them to students. Teachers may allow students an unlimited amount of time to respond to questions, or they may set a time limit on each questions. Points are awarded to students both for correct answers and for responding quickly with those correct responses. Teachers can track students as they make progress.

2. Socrative

Socrative works excellently both for students working on their own or for students who are collaborating with one another. Socrative offers several different ways for instructors to engage their students. There are space races in which students can compete in teams or as individuals to answer questions as quickly and accurately as possible. Polls allow instructors to receive student feedback.

3. Infuse Learning

Infuse learning is (was!) an excellent student response system for teachers who must support students with a variety of learning styles. With infusion a teacher can create questions, quizzes and writing prompts and send them to students who are participating in virtual classrooms or in an online learning program. What makes Infuse Learning unique is that it allows the teacher to give the student multiple response options.

4. Verso

This is a free utility that teachers can use to create virtual classrooms. Verso works with the teacher's Google Drive account. This means that links, files, videos, images, and documents from the instructor's Google Drive can be added to the Verso classroom for students to access. Students who enter the classroom will be shown new items that have been added to the classroom since their last visit.

Source:*https://www.emergingedtech.com/2015/09/top-5-multi-platform-student-response-systems/*

Appendix 4: Steam Assessment Template

The template is divided into four (4) parts to help the teacher better understand the general connections of each part in developing a STEAM Assessment Project/Activity.

1. Information from Syllabus and Teacher Guide – Subject Concept Connections

Subject: (*Name of the Subject)* ……

Strand: (*Identify and write the nominated Strand)* ……...

Unit: (*Write the name of Unit under the Strand)* ……

Content Standard: *(Write the Content Standard for the Strand)* ……...

Benchmark: (*Write the nominated Benchmark for the STEAM Project/Activity)*

……

Benchmarks from Related Subject Areas:

Identify related subject areas with linking concepts or skills to be used to solve the problem (Authentic Situation). Organize them in a table as shown below.

Subjects *(List of related Subjects)*	**Benchmarks** *(List the nominated Benchmarks Codes)*	**Essential KSAVs** *(Unpack and list the specific KASVs for each of the Subject Benchmarks)*

2. Unpacking Standards for the STEAM Assessment Project/Activity

Topic: (*Unpack the nominated Benchmark to come up with the topic)*

……

Learning Objective(s): (*Unpack Standards to write broad learning objective in relation to the Topic)*

……

Purpose of Assessing the Topic: *(Describe the intentions of teaching and learning through conducting the STEAM Assessment Project/Activity)*

……

How the Performance Task will be done: (*List down the assessment strategy to use to execute the task or project, for example; group work, peer, etc.)*

……..

Performance Standard: *(Unpack standards and write a statement to describe students' attainment of standards)*

……

3. STEAM Assessment Problem, Task Descriptions and Materials

Authentic Situation: *(Describe the problem and possible solutions with its benefits. Use the guide for paragraphs 1-3 to help develop Authentic Situations).*

Paragraph 1: *Describes the problem/situation.*

……

Paragraph 2: *Describes the solution to the problem/situation and who will be responsible to take up the task.*

……

Paragraph 3: *You would mention any rewards/awards for an adequate solution to the problem/situation as a booster to create a competitive competition and a promoter of critical thinking amongst the students so that they can come out with the best products.*

……

Task Descriptions: (*List the Task Descriptions or Requirements in order to approach the Authentic Situation or Problem).*

- ……
- ……
- ……..

Materials: (*List the type of teaching and learning materials needed for the activity or project)*

- ……..
- ……
- ……

4. Developing Rubrics to Assess the STEAM Project/Activity

1. Decide on the Type of Rubric to be used (Holistic or Analytic)

Categorizing Task Descriptions

2. Decide what to assess from the Task Description.

3. Reword the Tasks descriptions to create Criteria.

4. Identify and list down categories/criteria of tasks for the Rubric and organize them in a table as shown below.

Table 1

Category *(List the main assessment task components in logical order (steps) to come up with the end product)*	**Task Description** *(Copy paste the task descriptions)*

Essential KSAVs to assess the STEAM Project/Activity

5. Unpack the task descriptions and identify the essential KSAV that can be assessed and organize them in a table as shown below.

Table 2

Category *(Copy and paste Table 1 – Column 1)*	**Task Description** *(Copy and paste Table 1 –Column 2)*	**Essential KSAVs** *(Unpacked Task Description KSAVs)*

Completed Table of Rubric

6. Reword the task descriptors with the inclusion of KSAVs into a descriptor statement for each criterion and distribute into each competency level/level of achievement.

7. Identify appropriate descriptive words or numerals (Choose to use 3, 4 or 5 point-scale) for the intended rubric. The table below shows examples of descriptive terms used as rating scales to show level of competency or achievement.

8. Upon the completion of the above steps in developing rubrics, the information is tabulated as shown below.

Table 3

Criteria	**Advance**	**Achieved**	**Progressing**	**Novice**	**Mark**
Copy and paste Table 2 – Column 1	*Description reflecting of highest level of performance*	*Description reflecting achievement of mastery level of performance*	*Description reflecting movement toward mastery level of performance*	*Description reflecting beginning*	*/4*

9. Consider the Application of the STEAM Rubric

Note: *Refer to the STEAM assessment section and on the next page for a Sample STEAM Assessment Project/Activity and further deliberations on how to Score, Grade and Report using the rubric.*

Sample STEAM Activity Assessment

Subject: Business Studies

Strand: 2 Business Management

Unit 5: Information Technology

Content Standard 2.5 Students will be able to explain the information technology concepts and examine the systems and tools needed to gather, access, analyse, synthesize, evaluate, manage, and disseminate information.

Benchmarks: 9.2.5.1 Analyse the impact of information technology on society.

Topic: Impact of information technology on society

Learning Objective: By the end of this topic, students will be able to demonstrate a positive impact of information technology on society.

Purpose of Assessing the Topic:
To assess whether students can be able to use mobile technology to positively Impact their society and analyse this impacts.

How the Performance Task will be done: Group Project Presentation

Performance Standard: By the end of the project**,** students will be able to use mobile technology to positively impact their community/society.

Situation (Authentic)
A school has been faced with the challenge of behavioral issues for some time now and the public has lost its confidence in the school to be a good or genuine school. Most parents fear sending their children to his school and always opt to transfer their children in very first instances. The Board of Governors of the school has decided to raise the Behavior Standards or Benchmarks to a certain degree to improve its image and standards of learning.

To meet the expectations of the BOG, the principal and teachers intend to market the school to the public of NCD to lure students to have the interest to enroll at the school. With such a PAST bad reputation, the school will really need to convince the public that they have raised their standards and that their school is worth enrolling in it. The Principal and the teachers now have a task on hand to convince the public to enroll their children there and they have to try every means to do so.

To achieve this, the school is now requesting the Business and Technology Department to design an assessment Task for a certain Grade to assist with the situation. The Business & Technology Department has opted to design the task for Grade 9 students as one of their projects towards their assessments. The school principal also announces that the best video assessed by the Business & Technology Department will be rewarded as it is also a competition.

Task Descriptions:

- Plan and write a short write-up for your video-clip.
- Use the notes to make a 2-minute video clip to advertise and market your school to the public.
- The short video clip must embrace the school rules, motto, and mission and vision statements.
- It must also contain messages of new and competent management.
- This video clip has to have the potential to positively change the image of the school
- This 2-miunte video clip must be captivating and totally convincing to attract students to want to enrol at your school.
- This clip must not be more than 2 minutes (maximum time limit)
- Submit both your write-up (on a chart) together with your video clip
- Teacher will present your video clips for the whole class to observe and use the rubric below to assess the video clip.

Materials: Smartphone, butcher papers, markers

1. Developing Rubrics to Assess Video Clips

i. Decide on type of rubrics to be used (Holistic or Analytic)
ii. After you decide, plan the rubrics
iii. Planning to develop the rubric
iv. Categorise the Tasks Description into Criteria

Sample of categorizing tasks for the rubric

- Plan and write a short write-up for your video-clip. ***(The write up of the video)***
- Use the notes to make a 2-minute video clip to advertise and market your school to the public. ***(The development of the video)***
- The short video clip must embrace the school rules, motto, and mission and vision statements. ***(The content of the video)***
- It must also contain messages of new and competent management. ***(The content of the video)***
- This video clip has to have the potential to positively change the image of the school. ***(The content of the video)***
- This 2-miunte video clip must be captivating and totally convincing to attract students to want to enrol at your school. ***(The content of the video)***
- This clip must not be more than 2 minutes. (maximum time limit) ***(The presentation of the video)***
- Present your video clip to be assessed. ***(The presentation of the video)***
- Submit both your write-up (on a chart) together with your video clip. ***(The product)***

2. Identify and List down Categories of Tasks

Category	Task Description
The write up of the video	Plan and write a short write-up for your video-clip.
The development of the video	Use the notes to Make a 2-minute video clip to advertise and market your school to the public.
The content of the video	• The short video clip must embrace the school rules, motto, and mission and vision statements. • It must also contain messages of new and competent management. • This video clip has to have the potential to positively change the image of the school • This 2-minute video clip must be captivating and totally convincing to attract students to want to enrol at your school.
The Presentation of the video	• This clip must not be more than 2 minutes (maximum time limit) • Present your video clip to be assessed
The product	Submit both your write-up (on a chart) together with your video clip.

3. Unpack the Task Descriptions and Identify the essential KSAV that can be assessed

Category	Task Description	Essential KSAVs
The write up of the video script	Plan and write a short write-up for your video-clip.	Skill: Procedural Writing
The development of the video	Use the notes to Make a 2-minute video clip to advertise and market your school to the public.	Values and attitudes: - Teamwork and cooperation - Creativity Knowledge: Know about the school
The content of the video	• The short video clip must embrace the school rules, motto, and mission and vision statements. • It must also contain messages of new and competent management. • This video clip has to have the potential to positively change the image of the school • This 2-minute video clip must be captivating and totally convincing to attract students to want to enrol at your school.	Knowledge: Adequate content about the school Skill: Convincing and persuasive Values and attitude: Encouraging and luring
The Presentation of the video	• This clip must not be more than 2 minutes (maximum time limit) • Present your video clip to be assessed	Skill: - Time management - delivery skills (posture, language) and - communication skills - social skills (relativity and connectivity) Values and attitude: confidence
The product	Submit both your write-up (on a chart) together with your video clip.	EKSAVs in the Write up and Presentation

4. Reword the Task Descriptions with the inclusion of KSAVs into a Descriptor statement for each criterion and distribute into each Competency Level/Level of Achievement.

5. Determine the appropriate Descriptive Words or Number for Point Scales of the intended rubric.

Helvetica	Advanced	Progressing	Novice	Mark
The write up of the video script	**Skill:** Procedural Writing **Organised paper of video script writing procedures**	**Organised paper of video script writing procedures**	**Organized paper of video script writing procedures**	/3
The development of the video	Values and attitudes: - Teamwork and cooperation - Creativity **Knowledge:** Know about the school **The video corresponds to the 2-minutes script and illustrates teamwork**	**The video corresponds to the 2-minutes script and illustrates teamwork**	**The video corresponds to the 2-minutes script and illustrates teamwork**	/ 3
Content of the video	**Knowledge:** Adequate content about the school Skill: convincing and persuasive Values and attitude: Encouraging and luring **The short video clip embraces the core ideas of school rules, motto, and mission and vision statements**	**The short video clip embraces the core ideas of school rules, motto, and mission and vision statements**	**The short video clip embraces the core ideas of school rules, motto, and mission and vision statements**	/3
Presentation of the video	**Skill:** - Time management - delivery skills (posture, language) and - communication skills - social skills (relativity and connectivity) **Values and attitude:** confidence **The video clip captures essence of vital messages of the new and competent management with potentials to**	**The video clip captures essence of vital messages of the new and competent management with potentials to positively change the image of the school and captivating and convincing to attract students to want to enroll at the school**	**The video clip captures essence of vital messages of the new and competent management with potentials to positively change the image of the school and captivating and convincing to attract students to want to enroll at the school**	/3

	positively change the image of the school and captivating and convincing to attract students to want to enroll at the school			
The product	**EKSAVs** in the Write up and Presentation: **Video clip submitted at the assessment deadline for presentations**	**Video clip submitted at the assessment deadline for presentations**	**Video clip submitted at the assessment deadline for presentations**	/3

6. **Completed rubric sample: Video clip Assessment Rubric**

Criteria	Achieved	Progressing	Novice	Marks
Video Script Write up	**Innovative** and **well** organised paper with **clarity** of video script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script writing procedures	/3
Video Development	**Appropriately considered details** for the video are **well** corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	**Considered details** for the video are **mostly** corresponded to the 2-minutes script and illustrates a coordinated teamwork	**Some details** considered for the video are **partially** corresponded to the 2-minutes script and illustrates a less coordinated teamwork	/3
Video Clip Content	• The short video clip **fully** embraces the core ideas of school rules, motto, and mission and vision statements.	• The short video clip **mostly** embraces the core ideas of school rules, motto, and mission and vision statements.	• The short video clip **somewhat** embraces the core ideas of school rules, motto, and mission and vision statements.	/3
Video Presentation	• The video clip **fully** captures essence of vital messages of the new and competent management with **necessary** potentials to positively change the image of the school and **really** captivating and **totally** convincing to attract students to want to enroll at the school.	• The video clip **mostly** captures the essence of vital messages of the new and competent management with **most** potentials to positively change the image of the school and **mostly** captivating and **partially** convincing to attract students to want to enroll at the school.	• The video clip **somewhat** captures the essence of vital messages of the new and competent management with **some** potentials to positively change the image of the school and **almost** captivating and **less** convincing to attract students to want to enroll at the school.	/3
Video Clip Submission Time	- Video clip submitted **well before** the assessment deadline for presentations	• Video clip submitted **just before** the assessment deadline for presentations	• Video clip submitted **within** the assessment time for presentations	/3

1. How to Score using the rubric

Scoring Rubrics

Criteria	Achieved	Progressing	Novice	Scoring
Video Script Write up	**Innovative** and **well** organised paper with **clarity** of video script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script writing procedures	2/3
Video Development	**Appropriately considered details** for the video are **well** corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	**Considered details** for the video are **mostly** corresponded to the 2-minutes script and illustrates a coordinated teamwork	**Some details** considered for the video are **partially** corresponded to the 2-minutes script and illustrates a less coordinated teamwork	1/3
Video Clip Content	• The short video clip **fully** embraces the core ideas of school rules, motto, and mission and vision statements.	• The short video clip **mostly** embraces the core ideas of school rules, motto, and mission and vision statements.	• The short video clip **somewhat** embraces the core ideas of school rules, motto, and mission and vision statements.	3/3
Video Presentation	• The video clip **fully** captures essence of vital messages of the new and competent management with **necessary** potentials to positively change the image of the school and **really** captivating and **totally** convincing to attract students to want to enrol at the school.	• The video clip **mostly** captures the essence of vital messages of the new and competent management with **most** potentials to positively change the image of the school and **mostly** captivating and **partially** convincing to attract students to want to enrol at the school.	• The video clip **somewhat** captures the essence of vital messages of the new and competent management with **some** potentials to positively change the image of the school and **almost** captivating and **less** convincing to attract students to want to enrol at the school.	3/3
Video Clip Submission Time	- Video clip submitted **well before** the assessment deadline for presentations	• Video clip submitted **just before** the assessment deadline for presentations	• Video clip submitted **within** the assessment time for presentations	2/3
11/15				

2. How to Grade using the rubric

Grading Rubrics

Score Range	Grade	Qualifier (Proficiency)	Descriptor	Percentage
13 – 15	A	Advanced	Description reflecting **highest** level of performance.	76 - 100%
9 - 12	B	Achieved	Description reflecting **mastery** level of performance.	46 - 75%
5 – 8	C	Progressing	Description reflecting **movement towards** mastery level of performance.	26 - 45%
0 - 4	D	Novice	Description reflecting **beginning** level of performance	0 - 25%

3. How to Report using the rubric

Reporting an individual student's performance on the task

Assessment Task Report							
Assessment Task:			Video Development Project				
Name:		Grade:		Class:		Score and Grade:	/15

Criteria	Achieved A	Progressing B	Novice C
Video Script Write up	**Innovative** and **well** organised paper with **clarity** of video script writing procedures	**Well** organised paper with **clarity** of video script writing procedures	Organised paper with some **clarity** of video script writing procedures
Video Development	**Appropriately considered details** for the video are **well** corresponded to the 2-minutes script and illustrates a well-coordinated teamwork	**Considered details** for the video are **mostly** corresponded to the 2-minutes script and illustrates a coordinated teamwork	**Some details** considered for the video are **partially** corresponded to the 2-minutes script and illustrates a less coordinated teamwork
Video Clip Content	• The short video clip **fully** embraces the core ideas of school rules, motto, and mission and vision statements.	• The short video clip **mostly** embraces the core ideas of school rules, motto, and mission and vision statements	• The short video clip **somewhat** embraces the core ideas of school rules, motto, and mission and vision statements
Video Presentation	• The video clip **fully** captures essence of vital messages of the new and competent management with **necessary** potentials to positively change the image of the school and **really** captivating and **totally** convincing to attract students to want to enrol at the school.	• The video clip **mostly** captures the essence of vital messages of the new and competent management with **most** potentials to positively change the image of the school and **mostly** captivating and **partially** convincing to attract students to want to enroll at the school	• The video clip **somewhat** captures the essence of vital messages of the new and competent management with **some** potentials to positively change the image of the school and **almost** captivating and **less** convincing to attract students to want to enroll at the school
Video Clip Submission Time	- Video clip submitted **well before** the assessment deadline for presentations	• Video clip submitted **just before** the assessment deadline for presentations	• Video clip submitted **within** the assessment time for presentations

Note: The shaded is the student's proficiency score for each task.

Related concept links to Business Studies Benchmark with other subject areas:

Subjects	Reference Benchmark Codes
1. Arts (Theatre Arts)	9.2.2.2
2. Christian Civic Value Education (CCVE)	9.3.1.3
3. Character Social Development (CSD)	9.1.5.1, 9.1.5.2, 9.1.5.3, 9.1.5.4, 9.1.5.5
4. English	9.2.2.1
5. Social Science (History)	9.2.2.3, 9.2.2.4
6. Social Science (Political Science)	9.3.3.1, 9.3.3.2
7. Technology Industrial Arts (TIA)	9.4.1.4, 9.4.1.5, 9.4.1.6

The anchor subject in this sample STEAM assessment is Technology and Industrial Arts.

Appendix: 5 Planning and Programming Options

1. Sequential Planning and Programming

This process must be done collaboratively by all teachers who teach the subject.

Sequential planning and programming in TIA is planning a teaching program in the order of strands that are organized in the TIA Syllabus. This approach of programing is recommended for schools that have limited teaching personnel to teach the subject TIA and cannot teach using the rotational teaching plan. All the TIA classes will be learning the same strand at the same time.

3- Step in sequential planning and programming.

Step 1: Calculate the total number of benchmarks for each of the 5 strands in TIA.

Step 2: Divide the total number of benchmarks by the number of weeks in a term.

Step 3: Distribute the number of benchmarks throughout the weeks.

A sample is done to show you how all the strands are programmed in sequence in a term. The same is repeated for the rest of the three terms. Ensure that all the benchmarks are covered in all the units across the grade level. The teacher is encouraged to conduct assessment as per their school assessment schedules.

Terms	Weeks	Strands	Units	Benchmarks
One (1)	1	Textiles Technology	1. Fibres and Fabrics	9.1.1.1
	2	Food Technology	1.Food and Nutrition	9.2.1.1
	3	Construction Technology	1. Building Technology	9.3.1.1
	4	Communication technology	1. Data Communication and Network	9.4.1.1
	5	Computing Technology	1. Computer Architecture	9.5.1.1
	6	Textiles Technology	1. Fibres and Fabrics	9.1.1.2
	7	Food Technology	1.Food and Nutrition	9.2.1.2
	8	Construction Technology	1. Building Technology	9.3.1.2
	9	Communication technology	1. Data Communication and Network	9.4.1.2
	10	Computing Technology	1. Computer Architecture	9.5.1.2

Note that, there are 5 periods that are programmed for the subject. The single period is used to teach the theory aspect of the topic and the 4 block periods for practical lessons. In the event where a practical lesson may not be possible for reasons being that there are no materials or facilities then the 4 block periods can be used for theory lessons.

2. Integration approach in planning and programming

Integration is another option given to plan a teaching program. Integration focuses on making connections and linkages in content or unifying concepts across subjects, within a subject or across strands. Integration of subject based processes and skills such as the design process can be also considered in planning and programming. The section 'Curriculum Integration' in this Teacher Guide further explains the different approaches of integration that the teacher can use in programing for teaching and learning.

The sample given shows integration within the TIA subject strands. This is done by identifying unifying concept in the benchmarks of the 4 strands. In this case, the unifying concept in the benchmarks is **safety**. The teacher can decide to program and teach safety covering four (4) strands in a period of 1 or 2 weeks. The teacher can decide on sequencing the concepts depending on your students learning needs or availability of resources. However, the benchmarks that do not have linking concepts with other benchmarks can be taught as stand-alone benchmarks.

Sample Integration Programming
Term 1: Grade 9

Week	Linking Concepts	Strand	Units	Benchmarks
1 - 2	Safety	Textiles Technology	1.Fibers and Fabrics	**9.1.1.4** Describe the functions of tools and equipment and their safe usage
		Food Technology	1.Food and Nutrition	**9.2.1.2;** Practice safety and hygiene procedures in tool and equipment, food handling, meal preparation and food development
		Construction Technology	1.Building Technology	**9.3.1.4** Identify and describe the elements of safety
		Construction Technology	2. Electrical Technology	**9.3.2.2** Investigate and communicate OHS legislation and regulation and assess and employ emergency procedures whilst observing safety
		Construction Technology	4.Welding Technology	**9.3.4.1** Investigate safe workshop setup and safety procedures in welding
		Construction Technology	5.Engineering Technology	**9.3.5.5** Explore and analyse the general safety practices in engineering.
		Communication technology	2.Computer Safety and Security	**9.4.2.2** Identify health hazards associated with the use of ICT and propose good ergonomic practices
3 ↓	*Design Process*	*Write the Strand names*	*Write the Unit names*	*Identify and write the benchmarks of the strands that have the linking concepts, skills, principles and processes that follow the design process*