

**Technology and Industrial Arts**

# **Food Technology**

**Junior High  
Grade 10**

**Teacher Guide**

**Standards-Based**



Papua New Guinea

Department of Education

**'FREE ISSUE  
NOT FOR SALE'**



---

**Technology and Industrial Arts**

**Food**

**Technology**

**Junior High**  
**Grade 10**

**Teacher Guide**

**Standards-Based**



Papua New Guinea  
**Department of Education**

---

**Issued free to schools by the Department of Education**

Published in 2022 by the Department of Education, Papua New Guinea.

© Copyright 2022 Department of Education, Papua New Guinea.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted by any form or by any means electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the publisher.

Graphic Design and Layout by Rupuna Kepsy Pikita

**ISBN:** 978- 9980-921-44-4

# Content

Acknowledgements.....	IV
Acronyms.....	V
Secretary’s Message.....	VI
Introduction.....	1
Structure of Teacher Guide.....	2
Purpose of the Teacher Guide.....	3
How to use the Teacher Guide.....	5
Syllabus and Teacher Guide Alignment .....	9
Learning and Performance Standards.....	11
Core Curriculum.....	15
Science, Technology, Engineering, Arts and Mathematics.....	16
Curriculum Integration.....	25
Essential Knowledge, Skills, Values and Attitudes.....	29
Teaching and Learning Strategies.....	37
Strands, Units and Topics.....	39
Units 1: Food and Nutrition .....	44
Units 2: Food Science .....	105
Planning and Programming .....	135
Standards-Based Lesson Planning .....	151
Standards-Based Assessment, Monitoring and Reporting.....	155
Glossary .....	209
References .....	216
Appendices .....	218

# Acknowledgements

The Food Technology Teacher Guide for Grade 10 was developed by the Curriculum Development Division of the Department of Education and was coordinated by Essa Leva Godua and assisted by Clemencia Pue Dimain and the Technology & Industrial Arts Curriculum Subject Group (SCG).

Writers from schools, tertiary institutions and non-government organisations have contributed to the writing of this Teacher Guide through specialist writing workshops and consultations. Quality assurance groups and Technology and Industrial Arts Subject Curriculum Group have also contributed to the development of this Teacher Guide. They are all acknowledged for their support and contributions.

Dr. Arnold Kukari (Late) is also acknowledged for his consultancy and advice to the development of the Junior & Senior High School Curriculum.

Subject Advisory Committee (SAC) and Board of Studies (BOS) are acknowledged for their recommendations and endorsements respectively of this Teacher Guide.

# Acronyms

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

# Secretary's Message

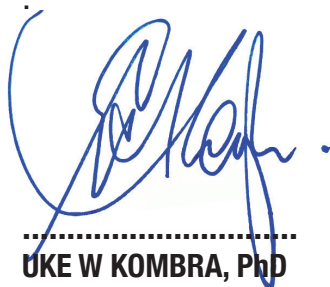
The ultimate aim of Standards-Based Education in Papua New Guinea (PNG) is to prepare students for careers, higher education, and citizenship. This means that education should focus on developing and equipping students with essential knowledge, skills, values, and attitudes that they can use in all aspects 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 10 Technology and Industrial Arts: Food Technology Teacher Guide to be used in all High Schools throughout Papua New Guinea.



.....  
**UKE W KOMBRA, PhD**  
Secretary for Education

# Introduction

Technology and Industrial Arts aims to equip students with the 21<sup>st</sup> 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 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 10 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 10 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 10 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, 21<sup>st</sup> 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 TIA: Food Technology is inclusive and fosters the learning needs of all students.

# Syllabus and Teacher Guide Alignment

The Grade 10 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.

<b>Syllabus and Teacher Guide Alignment</b>	
<b>Syllabus</b>	<b>Teacher Guide</b>
<p>Outlines the ultimate aim and goals, and what to teach and why teach it.</p> <ul style="list-style-type: none"> <li>• Overarching and SBC principles</li> <li>• Content overview</li> <li>• Core curriculum</li> <li>• Essential knowledge, skills, values and attitudes</li> <li>• Strands and units</li> <li>• Evidence outcomes</li> <li>• Content standards and grade-level benchmarks</li> <li>• Overview of assessment, evaluation, and reporting</li> </ul>	<p>Describes how to plan, teach, and assess students' performance.</p> <ul style="list-style-type: none"> <li>• Determine topics for lesson planning instruction and assessment</li> <li>• Formulate learning objectives</li> <li>• Plan SBC lesson plans</li> <li>• Select teaching and learning strategies</li> <li>• Implement SBC assessment and evaluation</li> <li>• Implement SBC reporting and monitoring</li> </ul>

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 10 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
<ul style="list-style-type: none"> <li>• SBC Aims and Goals</li> <li>• Content Standard</li> <li>• Benchmarks</li> <li>• Evidence Outcomes</li> </ul>	<ul style="list-style-type: none"> <li>• Learning Objectives</li> <li>• Lesson Objectives</li> <li>• Essential Knowledge, Skills, Values and Attitude</li> <li>• Performance Standard</li> </ul>

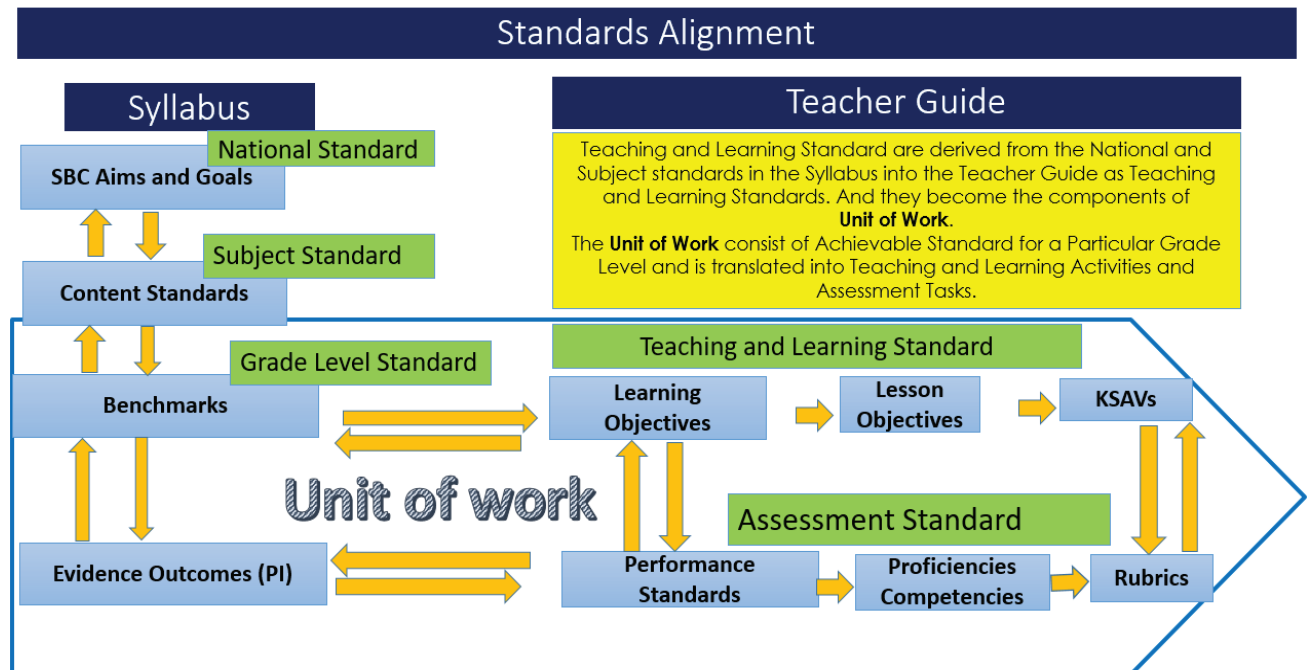
**Standard Alignment**

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.

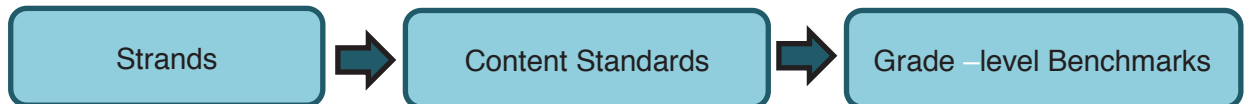
## Benchmarks

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.

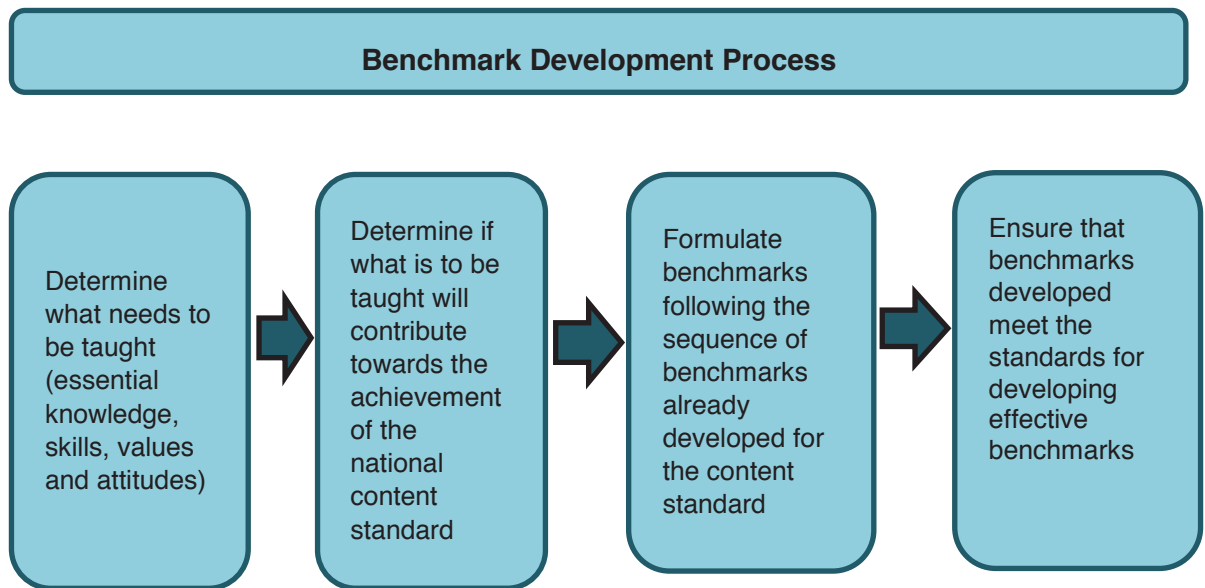
### Approach for Setting National Content Standards and Grade-Level Benchmarks



### 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),
- 21<sup>st</sup> 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.

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.

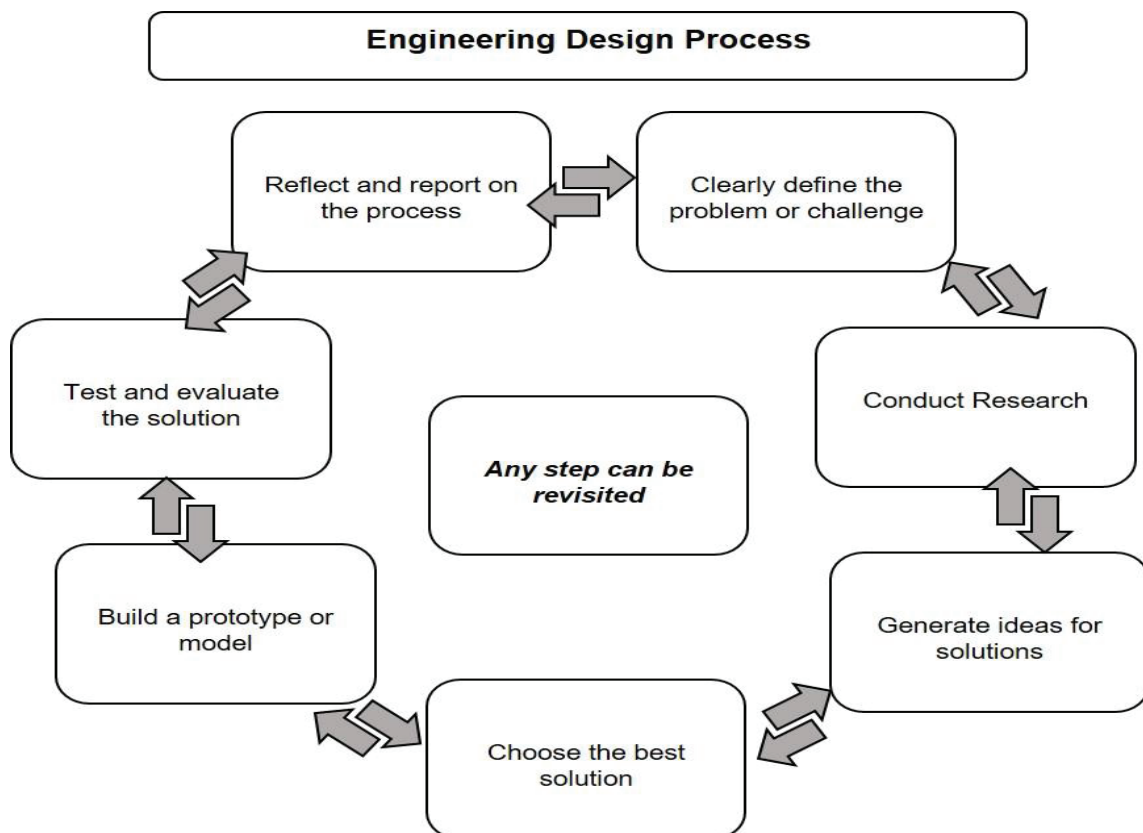
### Engineering Design Process

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.

**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.

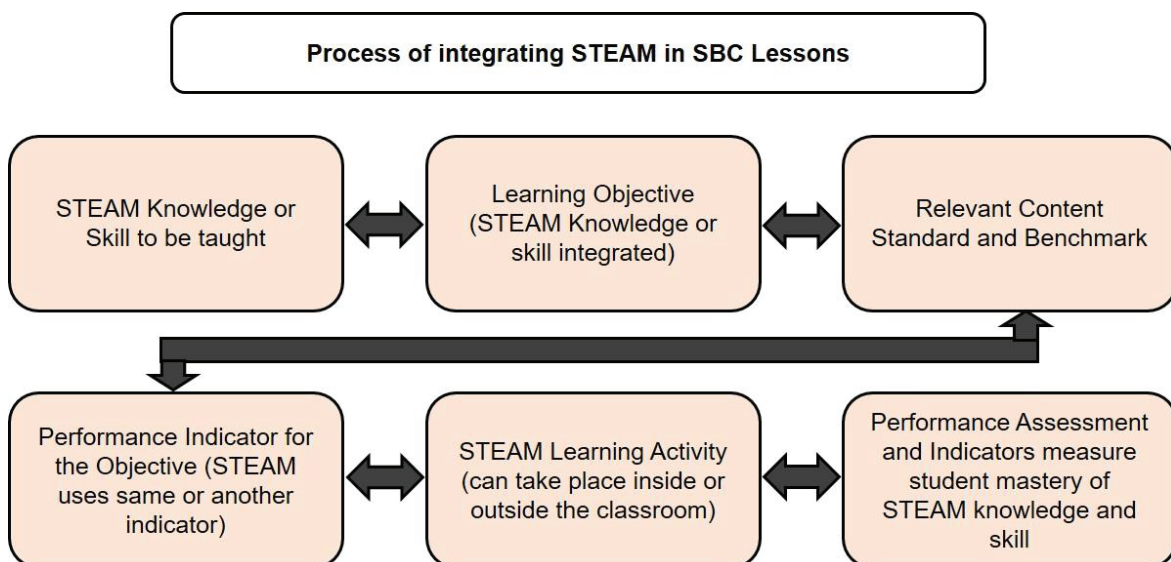
It is also important to review the **HACCP** system to determine if identified hazards were monitored effectively and the corrective actions were successfully implemented.

### 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 21<sup>st</sup> 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 21<sup>st</sup> 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.

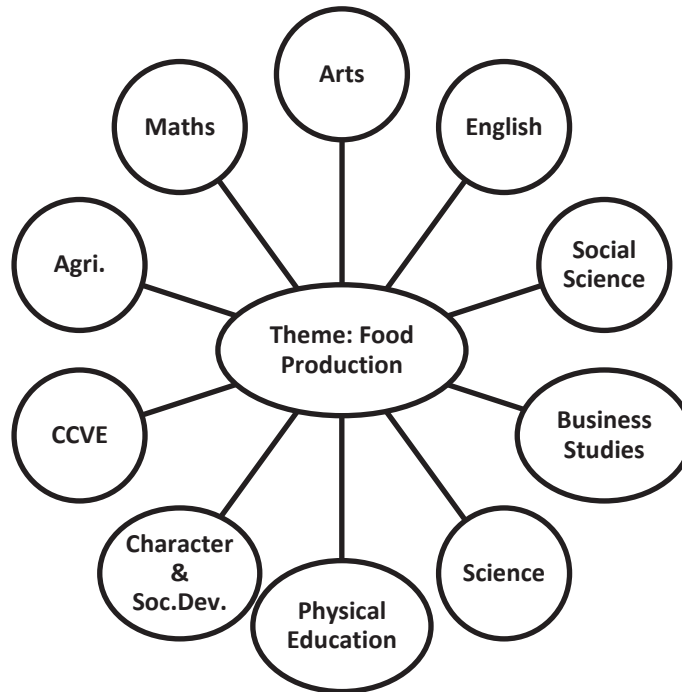
Curriculum integration is a holistic approach to learning thus curriculum integration in SBC will equip students with the essential 21<sup>st</sup> Century knowledge, skills, values and attitudes. Teachers must develop intriguing curriculum by going beyond the traditional teaching of content based or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

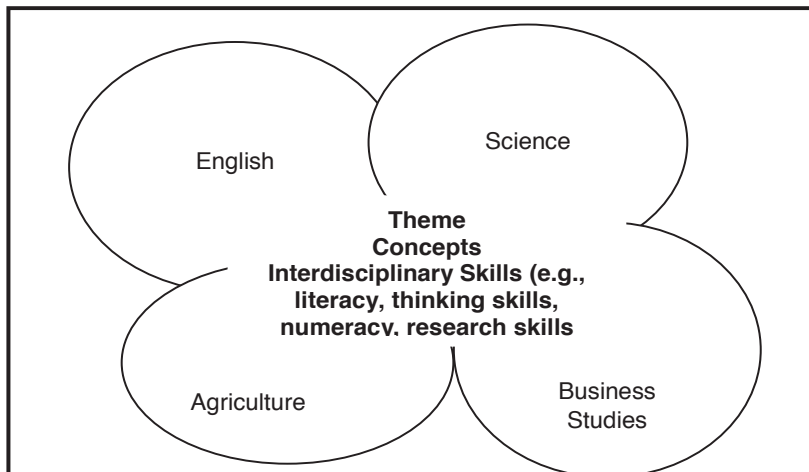
In this approach, learning involves a theme or concept that will be taught right across all subject area of study by students. For instance, if the theme is; “Food Production” all subject areas create lessons or project-based learning and assessment as per their subjects around this theme. The content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

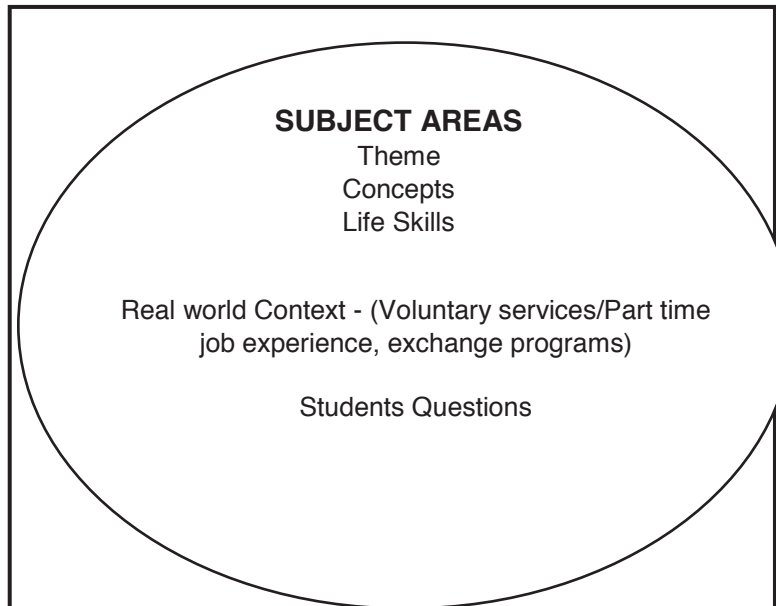
The three steps to planning project-based curriculum.

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.

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

## 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;	
<ul style="list-style-type: none"> <li>• Creativity</li> <li>• Branding</li> <li>• Communication skills</li> <li>• Technical expertise</li> <li>• Industry expertise</li> <li>• Critical thinking</li> <li>• Information technology skills</li> <li>• Innovation</li> </ul>	<ul style="list-style-type: none"> <li>• Building and engineering knowledge</li> <li>• Physical strength and stamina</li> <li>• Mathematical formulas in technology</li> <li>• <b>Technology and Industrial</b> language coordination</li> <li>• Technology skills</li> <li>• Problem solving skills</li> <li>• Prototype</li> </ul>

## Food Technology

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;	
<ul style="list-style-type: none"> <li>• Nature and properties of food</li> <li>• Classification of food</li> <li>• Food preservation</li> <li>• Food storage and packaging</li> <li>• Menu considerations</li> <li>• Food selections</li> <li>• Food safety</li> <li>• Food Science</li> </ul>	<ul style="list-style-type: none"> <li>• Chemical, physical and sensory properties of a food when subject to product development</li> <li>• Food processing</li> <li>• Food sources and the role of nutrients of food sources in the body.</li> <li>• Food for special needs and occasions</li> <li>• Nutrition</li> </ul>

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;	
<ul style="list-style-type: none"> <li>• Creativity</li> <li>• Critical thinking</li> <li>• Technical knowledge</li> <li>• Commercial awareness of food industries/catering services</li> <li>• Research and data handling capacity</li> <li>• Critical analysis and interpretation of materials</li> <li>• Management skills</li> <li>• Organizational skills.</li> <li>• Problem solving skills</li> <li>• Mathematical skills</li> <li>• Language literacy skills</li> <li>• Leadership</li> <li>• Innovative skills</li> <li>• Transformational skills</li> </ul>	<ul style="list-style-type: none"> <li>• Food server skills</li> <li>• Focus communication skills (approachability, circumstantial awareness, diligence, efficiency, thoroughness)</li> <li>• <u>Multitasking</u> skills</li> <li>• Attention to detail skills (multitasking, approachability)</li> <li>• Technical skills</li> <li>• Decision making skills</li> <li>• Coding</li> <li>• Information technology soft skills</li> <li>• Logical thinking</li> <li>• Collaboration</li> <li>• Teamwork</li> <li>• Software engineering</li> <li>• Software quality assurance</li> <li>• Customer service</li> <li>• Modeling</li> </ul>

### 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.

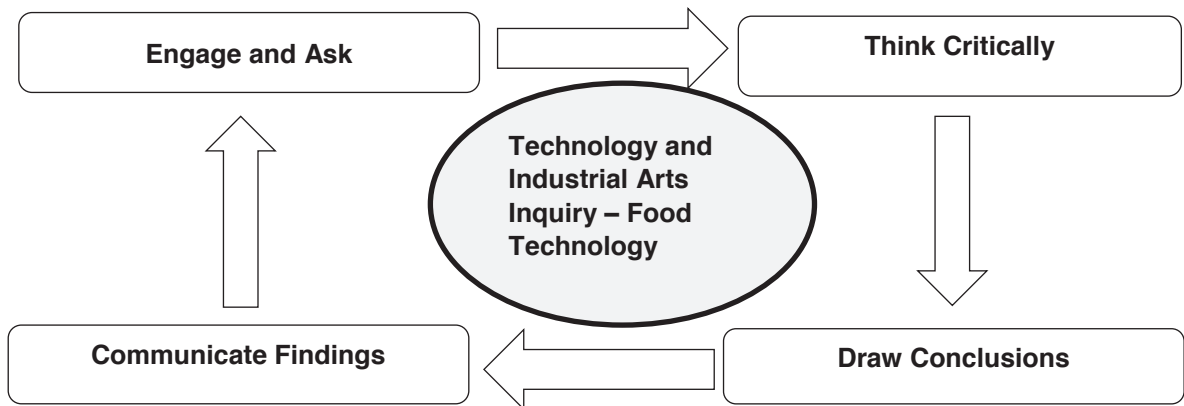
### Types of Processes- Inquiry processes for Technology & Industrial Arts subject

Technology & Industrial Arts Inquiry processes include:
<ul style="list-style-type: none"> <li>• Gathering information</li> <li>• Analysing information</li> <li>• Evaluating information</li> <li>• Making judgements</li> <li>• Taking actions</li> <li>• Instructional technology</li> <li>• Integration process</li> <li>• Project planning process</li> <li>• Organization of learning experiences</li> </ul>

## Technology &amp; Industrial Arts Inquiry Processes

<b>Engage and Ask</b>	<p>How will I engage my students in the topic and prompt them to ask questions?</p> <ul style="list-style-type: none"> <li>• Determine the enduring understandings about the topic being studied.</li> <li>• Engage your students with the topic by grabbing their interest with a hook connected to the enduring understandings.</li> <li>• Allow students to generate questions based upon the topic.</li> <li>• Determine what questions will be essential to achieving the enduring understandings. (Student generated or teacher determined)</li> <li>• With students, determine what other information is needed in order to fully answer the questions.</li> </ul>
<b>Think Critically</b>	<p>How will students access and analyse information about this topic?</p> <ul style="list-style-type: none"> <li>• Have students think about where they can find answers to the questions posed about the topic.</li> <li>• Gather and organize multiple primary and secondary sources.</li> <li>• Ensure that sources used expose students to different perspectives and viewpoints about the topic.</li> <li>• Students should use sources to collect, analyse, and interpret data.</li> <li>• Ensure students are analysing sources for credibility, bias, and perspective in order to identify gaps in the research.</li> </ul>
<b>Draw Conclusion</b>	<p>How will students synthesize ideas to answer the questions posed based on sources used?</p> <ul style="list-style-type: none"> <li>• Students should engage in civic discussion to answer the questions posed while respecting diverse opinions.</li> <li>• Engage students in evaluating possible courses of action and their consequences.</li> <li>• Students should make and justify an informed decision or choice and/or design an action plan supported by evidence from sources.</li> <li>• Have students evaluate the consequences of a decision or choice.</li> <li>• Allow students to make revisions based on feedback and further study.</li> </ul>
<b>Communicate Findings</b>	<p>How will students demonstrate what they have learned and take action on that learning?</p> <ul style="list-style-type: none"> <li>• Determine how students will apply what they have learned and share their findings with others.</li> <li>• Explore appropriate audiences for students to present conclusions.</li> <li>• Determine if there is an opportunity for students to take action and influence others to make more informed decisions.</li> <li>• Have students develop strategies to persuade others, including policy makers when applicable.</li> <li>• Prepare students to defend their analysis against alternative.</li> </ul>

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 10 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:	
<ul style="list-style-type: none"> <li>- Attributing</li> <li>- Comparing and contrasting</li> <li>- Grouping and classifying</li> <li>- Sequencing</li> <li>- Prioritising</li> <li>- Analysing</li> </ul>	<ul style="list-style-type: none"> <li>- Detecting bias</li> <li>- Evaluating</li> <li>- Metacognition (Thinking about thinking)</li> <li>- Making informed conclusions</li> </ul>

#### 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:	
<ul style="list-style-type: none"> <li>- Generating ideas</li> <li>- Deconstructing and reconstructing</li> <li>- Relating</li> <li>- Creating</li> <li>- Making inferences</li> <li>- Predicting</li> <li>- Making generalisations</li> <li>- Visualizing</li> </ul>	<ul style="list-style-type: none"> <li>- Synthesising</li> <li>- Making hypothesis</li> <li>- Making analogies</li> <li>- Inventing</li> <li>- Transformation</li> <li>- Modelling</li> <li>- Simulating</li> </ul>

**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
<ul style="list-style-type: none"> <li>• Sanctity of life</li> <li>• Truth</li> <li>• Aesthetics</li> <li>• Honesty</li> <li>• Human</li> <li>• Dignity</li> <li>• Rationality</li> <li>• Creativity</li> <li>• Courage</li> <li>• Liberty</li> <li>• Affectivity</li> <li>• Individuality</li> </ul>	<ul style="list-style-type: none"> <li>• Self-esteem</li> <li>• Self-reflection</li> <li>• Self-discipline</li> <li>• Self-cultivation</li> <li>• Principal morality</li> <li>• Self-determination</li> <li>• Openness</li> <li>• Independence</li> <li>• Simplicity</li> <li>• Integrity</li> <li>• Enterprise</li> <li>• Sensitivity</li> <li>• Modesty</li> <li>• Perseverance</li> </ul>

## 2. Social Values

Core Values	Sustaining Values
<ul style="list-style-type: none"> <li>• Equality</li> <li>• Kindness</li> <li>• Benevolence</li> <li>• Love</li> <li>• Freedom</li> <li>• Common good</li> <li>• Mutuality</li> <li>• Justice</li> <li>• Trust</li> <li>• Interdependence</li> <li>• Sustainability</li> <li>• Betterment of human kind</li> <li>• Empowerment</li> </ul>	<ul style="list-style-type: none"> <li>• Plurality</li> <li>• Due process of law</li> <li>• Democracy</li> <li>• Freedom and liberty</li> <li>• Common will</li> <li>• Patriotism</li> <li>• Tolerance</li> <li>• Gender equity and social inclusion</li> <li>• Equal opportunities</li> <li>• Culture and civilization</li> <li>• Heritage</li> <li>• Human rights and responsibilities</li> <li>• Rationality</li> <li>• Sense of belonging</li> <li>• Solidarity</li> <li>• Peace and harmony</li> <li>• Safe and peaceful communities</li> </ul>

### Types of Attitudes

Attitudes - Ways of thinking and behaving, points of view	
<ul style="list-style-type: none"> <li>• Optimistic</li> <li>• Participatory</li> <li>• Critical</li> <li>• Creative</li> <li>• Appreciative</li> <li>• Empathetic</li> <li>• Caring and concern</li> <li>• Positive</li> <li>• Confident</li> <li>• Cooperative</li> </ul>	<ul style="list-style-type: none"> <li>• Responsible</li> <li>• Adaptable to change</li> <li>• Open-minded</li> <li>• Diligent</li> <li>• With a desire to learn</li> <li>• With respect for self, life, equality and excellence, evidence, fair play, rule of law, different ways of life, beliefs and opinions, and the environment.</li> </ul>

# 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 21<sup>st</sup> 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 21<sup>st</sup> 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 10. 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.

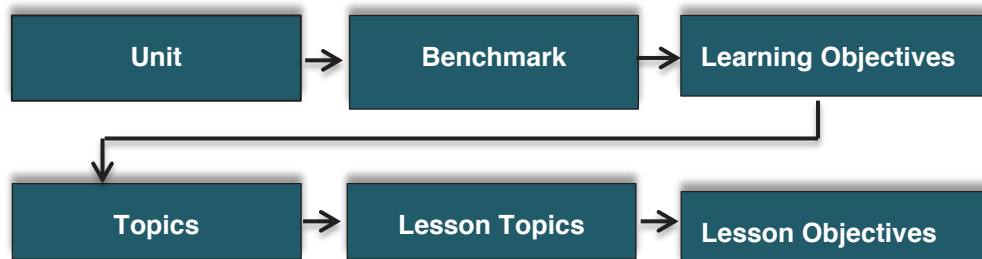
Benchmarks show grade level expectations of what students are able to do to demonstrate that they are making progress towards attaining the content standard.

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 10 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.

<b>Content Standard: 2.1</b> 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.			
<b>Units</b>	<b>Benchmarks</b>	<b>Topic</b>	<b>Suggested Lesson Titles</b>
1. Food and Nutrition	<b>10.2.1.1</b> Experiment and interpret the nature and properties of food and food product development	Properties of Protein Food and Food Development	<b>Lesson 1:</b> Properties and classification of meat
			<b>Lesson 2:</b> Properties and classification of poultry and poultry products
			<b>Lesson 3:</b> Recipe development Properties and classification of fish and seafood
	<b>10.2.1.2</b> Apply ethical principles and values, safety and hygiene practices in food product development and food science	Ethical Principles, Safety and Hygiene	<b>Lesson 1:</b> Food safety regulations and food safety standards
			<b>Lesson 2:</b> Food contamination
			<b>Lesson 3:</b> Food preservation
			<b>Lesson 4:</b> Tools, equipment and gadgets
	<b>10.2.1.3</b> Evaluate social, economic, technological impacts in meal preparation and food product development	Food Solutions in Food Product Development	<b>Lesson 1:</b> Social impacts in meal preparation
			<b>Lesson 2:</b> Economic impacts in food production
			<b>Lesson 3:</b> Technological impacts in food production
	<b>10.2.1.4</b> Apply safety and hygiene procedures in tools and equipment, food handling, meal preparation and food development and food service	Safety, Hygiene Practices and Food Service	<b>Lesson 1:</b> Tool and equipment handling
			<b>Lesson 2:</b> Safe food processing
			<b>Lesson 3:</b> Food service and considerations
	<b>10.2.1.5</b> Apply the design process to create food solutions	Food Solutions	<b>Lesson 1:</b> Create and evaluate a food product using the design process

<b>Content Standard: 2.2</b> 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	<b>10.2.2.1</b> Discuss and evaluate cultural, physical, chemical and nutritional characteristics of food and the impact in product development	Food characteristics and development	<b>Lesson 1:</b> Cultural properties of food
			<b>Lesson 2:</b> Characteristics and properties of food
	<b>10.2.2.2</b> Examine changes and properties of food which occur during food processing, preparation and storage	Food Processing	<b>Lesson 1:</b> Physical and chemical changes in food
			<b>Lesson 2:</b> Functional properties of food
			<b>Lesson 3:</b> Mechanical factors to food
	<b>10.2.2.3</b> Compare the biological and sensory characteristics of food and the impact in food product development to meet various needs, occasions and health	Food Product Development	<b>Lesson 1:</b> Biological characteristics of food
<b>Lesson 2:</b> Sensory characteristics of food			
<b>Lesson 3:</b> Impact of food development			
<b>10.2.2.4</b> Apply the management skills and create consumer awareness in food selection, meal preparation, preservation and storage of food	Consumer Behaviour and Marketing	<b>Lesson 1:</b> Consumerism	
		<b>Lesson 2:</b> Consumer behaviour	
		<b>Lesson 3:</b> Food marketing	
<b>10.2.2.5</b> Apply the design process to create food solutions	Food Solutions	<b>Lesson 1:</b> Design Process	
		<b>Lesson 2:</b> Design Brief	
		<b>Lesson 3:</b> 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 10**

## **Food Technology** Teaching Content

# **Grade 10**

## **Food Technology** Teaching Content

# Unit 1: Food and Nutrition

<b>Content Standard: 2.1</b> 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.			
<b>Units</b>	<b>Benchmarks</b>	<b>Topic</b>	<b>Suggested Lesson Titles</b>
1. Food and Nutrition	<b>10.2.1.1</b> Experiment and interpret the nature and properties of food and food product development	Properties of Protein Food and Food Development	<b>Lesson 1:</b> Properties and classification of meat
			<b>Lesson 2:</b> Properties and classification of poultry and poultry products
			<b>Lesson 3:</b> Recipe development Properties and classification of fish and seafood
	<b>10.2.1.2</b> Apply ethical principles and values, safety and hygiene practices in food product development and food science	Ethical Principles, Safety and Hygiene	<b>Lesson 1:</b> Food safety regulations and food safety standards
			<b>Lesson 2:</b> Food contamination
			<b>Lesson 3:</b> Food Preservation
			<b>Lesson 4:</b> Tools, equipment and gadgets
	<b>10.2.1.3</b> Evaluate social, economic, technological impacts in meal preparation and food product development	Food Solutions in Food Product Development	<b>Lesson 1:</b> Social impacts in meal preparation
			<b>Lesson 2:</b> Economic impacts in food production
			<b>Lesson 3:</b> Technological impacts in food production
	<b>10.2.1.4</b> Apply safety and hygiene procedures in tools and equipment, food handling, meal preparation and food development and food service	Safety, Hygiene Practices and Food Service	<b>Lesson 1:</b> Tool and equipment handling
			<b>Lesson 2:</b> Safe food processing
			<b>Lesson 3:</b> Food service and considerations
	<b>10.2.1.5</b> Apply the design process to create food solutions	Food Solutions	<b>Lesson 1:</b> Create and evaluate a food product using the design process

## Unit 1: Food and Nutrition

**Content Standard: 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: 10.2.1.1** Experiment and interpret the nature and properties of food and food product development.

**Topic:** Properties of protein food and food development

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

- Classify protein food sources.
- Compare and contrast sensory, physical and chemical properties of protein food in food product development.
- Develop food product using protein food sources.
- Identify the importance of balanced diet and the consumption of a wide variety of foods for an optimum health.
- Produce a food product using the processing system.

### Essential Questions:

- What are the properties and classifications of protein food?
- What are the changes that occur in protein foods during food preparation, processing and storage impact on the sensory and physical properties?
- What are the nutritional values in food?
- What are the food sources and the role of specific nutrients in the body?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Nature of food</li> <li>• Properties of protein food               <ul style="list-style-type: none"> <li>- meat</li> <li>- fish</li> <li>- poultry and eggs</li> <li>- alternative protein foods</li> </ul> </li> <li>• Classification of protein food</li> <li>• Chemical, physical and sensory properties of protein food when subject to product development</li> <li>• Food sources and the role of nutrients of protein food sources in the body</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Investigate properties and characteristics of food.</li> <li>• Compare and contrast the different classifications of protein food.</li> <li>• Plan and develop food product using ingredients from protein food classification</li> </ul>
<b>Values/Attitudes</b>	<ul style="list-style-type: none"> <li>• Adopt and promote the significance of inculcating protein food in the diet.</li> <li>• Make informed decisions in preparing protein food</li> <li>• Be mindful of properties when preparing protein food</li> </ul>

## Teaching and Learning Strategies

Teachers are required to employ various learning techniques to help reinforce and the content and concepts in the benchmark. Students will explore the various classifications and properties of protein, such as meat, poultry and poultry products and fish. They will classify meat in their categories; identify the protein structure, properties, nutritional properties and how they are prepared.

Students will further learn the key concept of recipe development and nutrition and its importance to human health. Apply the key concepts in preparing food product from raw materials.

Whilst introducing the topic, guided discovery and research will enable students to design and experiment will enable students to gain an understanding of protein, its classification and the effects of techniques that may have to be introduced on the food source. Knowledge prescribed must be taught. Students must be able to interpret what is taught and applied in their daily lives for optimum health.

Appropriate assessment tools can be drawn to assess student comprehension of knowledge. Student can use computers, internet sources to gather information. Engage student in practical activities to enforce the knowledge, skills, values and attitudes learnt.

### Learning Activities

#### Lesson 1: Properties and classification of meat

##### Activity 1:

**1a.** Engage students in identifying the classification of protein to discover the various protein sources.

**1b.** Investigate and describe the importance and relationship between food consumption, the nutritional value of protein food and the health of people.

**1c.** Students experiment on plant and animal protein to identify and evaluate the sensory and physical properties that influence selection.

**1d.** Students describe the effects of processing techniques on sensory and physical properties of food.

##### Activity 2:

**2a.** Prepare a design brief for a recipe to prepare a product using protein food sources and produce products using raw materials and processed foods, using appropriate technology and demonstrate cooking methods.

**2b.** Identify and classify various food sources of protein. The teacher guides the students and gives concrete examples of protein.

**2c.** Investigate the physical properties of protein food, economic and environmental consideration when purchasing locally produced commodities.

**Activity 3:** Applying the design brief, students plan and prepare food products using raw materials.

**Lesson 3: Properties and classification of fish and seafood**

**Activity 1:** Grill a piece of meat and a piece of fish of equal weight and analyze the cooking experiences.

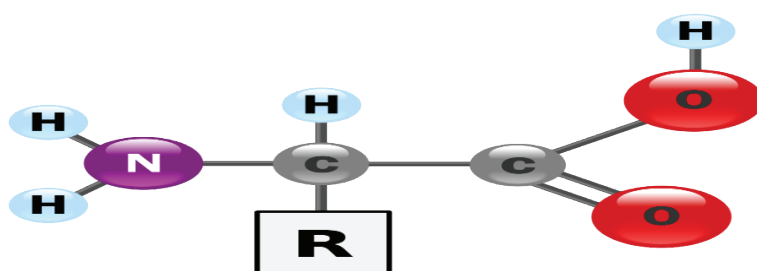
**Activity 2:** Students will plan, prepare and develop a food product using fish and seafood. Students will evaluate their practical experiences about fish and report their findings.

## Content Background

Proteins are found in both animals and plant foods. They are delicate food molecules in raw meat, poultry, fish, eggs, dairy foods, wheat flour and legumes. Heating protein foods, applying mechanical actions such as beating, changing the pH or combining with enzymes can change the shape and behavior of protein molecules. When we prepare, manipulate and cook protein foods, we use the active properties of protein foods, we use the active properties of protein to change consistencies and form new structures of frameworks, which results in the textures, shapes and colours of foods we enjoy eating.

### What are proteins?

Proteins are large molecules made up of smaller units called **amino acids**. Protein is a class of food nutrient which is a polymer of amino acids. It is composed of carbon, hydrogen, oxygen and nitrogen and often sulphur and phosphorus linked together by peptide bonds.



Protein contains various amino acids. The number and type of amino acids in the different types of protein chain vary considerably. The pattern of amino acids that form in the protein molecule determine the shape of that molecule and consequently its physical properties and the type of protein food. Each amino acid has its own chemical name and there are at least 22 different types.

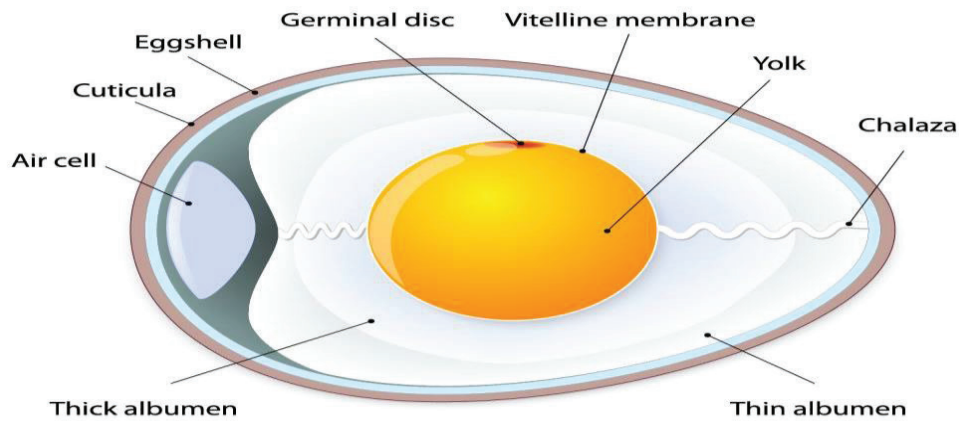
### Functional properties of protein

When preparing and cooking protein foods, such as meat, poultry, fish, dairy products, eggs, and legumes, the protein molecules undergo a permanent structural change known as **denaturation**. It can occur by the application of heat, mechanical actions, a change in pH or exposure to enzymes. Because of exposure to all or any of these, the protein becomes less elastic and less soluble.

**Coagulation** is a form of denaturation and occurs when there is permanent change in the protein from a liquid into a thick mass as a result of heat or the addition of acids. Here are two examples of denaturation of protein in food products:

1. When you beat egg white for meringue, air bubbles are captured so the liquid becomes light and foamy.
2. When you add acid such as vinegar in the water will assist in coagulation when poaching an egg.

## Structure of an egg



## Eggs in food preparation and cooking

Eggs are valuable ingredients in food preparation because of their versatility and the various functions they perform when combined with other foods. The main methods of preparing eggs by themselves are boiling, frying, scrambling, poaching and beating for omelette.

### Cooking with eggs

In each protein food, including eggs, all the molecules are identical in shape in their raw form. It is possible to denature egg protein in a variety of ways by heating, applying mechanical actions, adding sugar or /and acid.

### Coagulations of eggs

During cooking, heat is applied to eggs or egg mixtures, causing considerable changes in their physical properties. In its raw state, egg white is a clear liquid with a slimy texture, and the egg yolk is a dense yellow colour and is slightly more viscous than the white. When the egg is exposed to heat, the liquid white gradually sets to form a white rubbery mass and the yolk becomes firm. This denatures of the protein sets the eggs and it is termed **coagulation**. The egg white and egg yolk coagulate at different temperatures: egg white at 62-65% and egg yolk at 65-70%. The temperature at which egg protein coagulates or sets is dependent on several factors.

#### 1. Concentration

In a recipe, the dilution of egg protein increases the temperature at which the proteins coagulate. For example, a custard made with one whole egg thickens at a lower temperature than one made with only the egg yolk.

#### 2. Acidity

Adding acid to egg white decreases the pH so the proteins become less stable and more likely to denature. This means less stable and more likely to denature. This means small amounts of acid lowers the coagulation temperature of most egg protein. For example, adding vinegar to the water when poaching eggs causes the egg white to set more quickly and to hold its shape.

#### 3. Sugar

Adding sugar raises the temperature of coagulation of an egg mixture.

## Cooking eggs using dry heat

### *Effects of baking on eggs*

When baked products are cooked in the dry heat of an oven, the protein in eggs is an important structure builder. During the baking of cake mixture, the heat coagulates or sets the egg protein, contributing to the fixed shape and firm structure of the finished product. Often eggs work in conjunction with gluten, the protein in flour, to create the solid structure of baked products, and without them, many would collapse. The egg white is the strongest structural component, followed by the whole egg, then the egg yolk. Products that use the structural functions of eggs are;

1. Cakes,
2. Muffins,
3. Biscuits, and
4. Puddings.

In the final step before baking, pastries and scones are often brushed with an egg glaze. There is a very small amount of glucose in eggs; during baking it combines with the egg proteins, and complex reactions such as the **Maillard reaction** occur, resulting in brown colouration and intense flavour development. In baked products that include eggs the yellow-orange carotenoids in the yolk contribute to the internal yellow colour in cakes and biscuits.

The Maillard reaction does not just depend on temperature. Foods that are more alkaline, such as egg whites, undergo the Maillard reaction more easily and so browning becomes evident at a low temperature.

The egg proteins in baked custard and the filling for quiches gradually denature and coagulate when the mixture is heated in the oven and, in doing so, thicken to form the structure of the products. Without the coagulated egg, the mixture would remain runny.

Baked custards are very delicate mixtures and must be cooked with a gentle heat to ensure a smooth, even texture so they are cooked in a water bath within the oven. The water surrounding the baking dish prevents the direct heat coming into contact with the egg, creating a lower baking temperature. This slows down the process of coagulation and prevents curdling of the cooked mixture. The top surface of the baked custard becomes golden brown as the Maillard reaction occurs.

### *Effects of frying on eggs*



Frying is another dry cooking method regularly used to cook eggs. The heat is transferred through the frying pan to heat the fat or oil and as soon as the raw egg is added, its physical and chemical properties begin to change. The semi-liquid egg sets into a firm shape as the protein denatures and coagulates and the base of the egg begins to brown as the Maillard reactions become evident around the edge of the egg white.

Eggs can act as a binding agent to help batter and breadcrumbs adhere to foods that are fried, such as battered fish and schnitzel. The dry heat of frying coagulates the egg, and the crumbs are held within the firm structure. This property is also used to attach nuts and spices onto the surface of cakes and breads. In products such as hamburgers and meatballs, the liquid egg helps to bind ingredients together and makes shaping easier. When the hamburger is cooked, the egg coagulates and forms part of the structure of the product, preventing the hamburger from falling apart.

### **Cooking eggs using moist heat**

**Boiling** – this involves cooking food in a liquid at 100°C. When an egg is boiled, the texture changes from a semi-liquid to a firm, solid mass. The egg white changes from transparent to white and an oval shape is set within the shell as the process of coagulation takes place.

**Steaming** – is used to cook delicate mixtures such as egg custard sauces that are used as a base for ice cream. Using a double boiler and the gentle heat of steam prevents the egg custard from over-coagulating to produce a smooth, even-textured product. If an egg custard or sauce is overheated, the mixture is said to be '**curdled**'. This means the egg protein has over-coagulated and results in **weeping or syneresis**. It is easily recognised because tough bits of the egg protein float in pools of the squeezed-out liquid.

The juice of lemons, limes or oranges combines with eggs, sugar and butter makes a spread that can be used as a topping on bread or as a filling in tartlets. These fruit butters or curds are also cooked over steam, and the thickening process occurs as a result of the eggs coagulated when they are combined with the acid from the citrus fruit and heated.

### **Effect of acid on egg**

When eggs are **poached** in hot water, a small amount of acid in the form of vinegar can be added to assist in the denature process. The acid decreases the pH of the cooking solution so the proteins in the egg become less stable and more likely to denature. By combining the heat and an acid to denature the egg protein during poaching, it coagulates and holds its shape at a lower temperature, making the end product more appealing. However, if the water is allowed to boil when poaching eggs, the rapid movement of the bubbles in the water causes the delicate egg white to become ragged and misshapen.

When **beating** egg whites to make meringue, a small amount of cream of tartar, which is an acid, can be added. This addition of acid in the early stages of beating stabilizes the egg whites, the process may take a little longer, but the protein network that forms will help prevent over whipping and is more stable than if no acid was used.

### **Emulsification using eggs**

Egg yolks include lecithin, and this makes them an effective **emulsifying ingredient**. The yolk has the ability to prevent fat and water from separating. This function is helpful in cake and pancake batters, as well as doughs, because the egg yolk help keep the fat (such as butter) and liquids (such as milk) evenly distributed until baking or cooking. If eggs are too cold or are added too quickly to a creamed mixture of butter and sugar, the emulsion breaks and is said to have 'split' or 'curdled'. Egg yolk is also used in mayonnaise as the emulsifying agent.

## Aeration of eggs

When mechanical action is applied to egg whites that is, they are whisked or beaten-the protein is denatured, creating a foam that will aerate a mixture. As the egg white is beaten, the protein is stretched, forming a thin membrane that traps air bubbles. This mesh-like structure stabilizes the air bubbles in the foam. Providing protein molecules are not overstretched, the foam will continue to expand when heated, creating extra lightness. A pinch of salt may be added to help create a more stable, stiff foam without influencing the flavours because it helps bring the proteins together. Examples of this form of aeration can be observed when sponges and souffles are baked, and fluffy omlettes are cooked in a frying pan.

Eggs, either whole, yolks or whites, trap air as they are beaten to create a foam made from millions of bubbles that will increase the volume and create a light texture in a mixture. During whisking or beating, the egg-white protein, ovalbumin, is denatured or partially coagulated. The protein forms an elastic framework around the air bubbles and this trapped air expands when heated in the oven. The expanding bubbles lift the souffle or cake until the temperature of the mixture is hot enough to set the egg proteins. Egg white can aerate products such as meringues, soufflé and sponge cake.



### Stages in making an egg-white foam

To maximise the foaming properties of egg white when preparing them in the kitchen, it's important to:

- Ensure the whites contain no trace of egg yolk and therefore no fat.
- Ensure all utensils are clean and dry.
- Avoid using plastic utensils because they tend to retain fatty substances and inhibit the foam development.

Overbeating egg whites overstretches the protein molecules and the foam will collapse. Adding sugar to beaten egg foam will stabilise the mixture and maximise its volume when baked.

## Meat

Meat is the flesh of animals and birds that is eaten by humans. It is a rich source of nutrients and an excellent source of protein. Meat has been a principal food for many centuries. This is still a great demand even when it is expensive.

The main reasons for the high price of meat are;

- Amount of time
- Effort
- Feed it takes to rear animals for meat.

### Types of meat

The main meats eaten in Papua New Guinea are;

- Beef
- Veal
- Lamb
- Mutton
- Pork
- Kangaroo meat
- Wallaby meat

In Papua New Guinea, bandicoot and cuscus are also eaten, only when hunted.

### Structure and composition

Lean meat is composed of the muscles that move the body in an animal. Muscles are composed of **cells** in the form of long, slender **fibres**. These muscles fibres are made of two main proteins,

1. Myosin
2. Actin

### The size of muscle fibres affect the tenderness of cooked meat:

1. Slender, small fibres are associated with tender meat
2. Large, long fibres are associated with tougher meat

Muscle fibres increase in size as the animal gets older, so the older the animal, the tougher the meat from it.

Individual muscle fibres are formed into **bundles**, surrounded by substance called connective tissues. The bundles are then formed into groups which are also surrounded by **connective tissue**. Whole muscles are attached to bones by **tendons**.

Three of the main proteins in meat. These are;

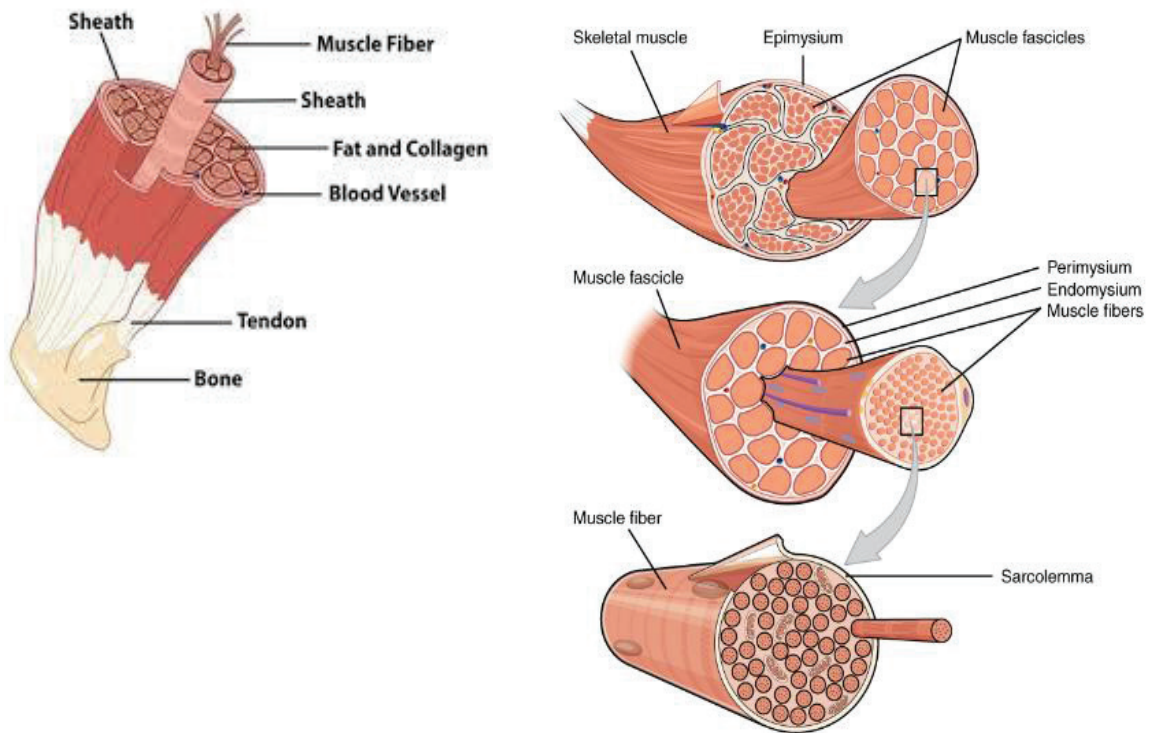
Connective tissue is made of two proteins,

1. collagen in connective tissues
2. myosin in the muscle tissue and,
3. elastin in the muscle fiber.

**Collagen** is the main component of tendons, and the connective tissue surrounding muscles, particularly those that do the most work. Collagen is less flexible than elastin, and when heated in the presence of moisture, it is converted into soluble **gelatin**, which greatly increases the tenderness of connective tissue and therefore of the meat.

Tough cuts of meat are cooked by slow, moist methods such as stewing, to allow this conversion to gelatin to take place. If tough cuts of meat are roasted slowly at 160°C, there is sufficient moisture within the meat to convert the collagen and make the meat tender.

**Elastin** is a main component of ligaments (in between bones) and has the ability to stretch and return to its original shape. It is an insoluble and tough protein but there is less elastin than collagen in muscles, so it does not have a major influence on the toughness of meat.



## Fat

Fat is found also in meat. This can be found in the following places:

1. Under the skin in the **adipose tissue**

The fat under the skin may be yellowish in colour, because of the presence of **carotenes** from plants, depending on what the animal was fed on.

2. Around vital organs such as Kidneys (suet)
3. Between bundles of muscle fibres (invisible fat)

The fat between the bundles of muscle fibres gives the meat a “marbled” effect. Marbling in lean meat is an important requirement when the meat is graded, and large amounts of feed are required to produce it. This is one of the reasons why lean meat is so expensive.

The fat content of meat helps to give;

- Flavor,
- Moisture, and
- Texture.

## Colour of meat

The colour of meat is mainly due to the presence of **myoglobin**, which is a purple/red tissue protein and **haemoglobin** from the blood, some of which is left in the meat after slaughter.

In a living animal, haemoglobin takes oxygen to the muscles, and myoglobin holds it there, so that the muscles can work. There is therefore more myoglobin in well-use muscles such as the heart and shin, and in older animals, and the colour of the meat is darker in both cases.

When oxygen is taken to the tissues, the myoglobin is converted to **oxymyoglobin** which is bright red. After slaughter, the meat remains dark red until it is cut and exposed to the oxygen in the air, then it becomes bright red.

When fresh meat is stored for a few days, its colour changes to brown/red, this is due to the formation of **metmyoglobin**. This does not seriously affect its palatability when cooked. If storage is continued, the meat may become green/brown through the effects of enzymes and bacteria. This will spoil the palatability.

### What makes meat tender?

The tenderness of a cut meat depends on the age of the animal and the part of the body from which it comes.

- a) The meat from young animals has short, fine fibres
- b) Meat from older animals has longer, thicker fibres and more connective tissue.

The level of activity an animal is directly related to the tenderness of its meat.

- a) Hard-working muscles of an animal's legs and neck are highly developed, so there is a greater build-up of connective tissue – the resulting cuts of meat are tougher, darker in colour and have a stronger flavour.
- b) The cuts of meat from around the ribs, the back and the rear parts of the animal that move less when the animal is in the pasture have less connective tissue and therefore produce the most tender cuts of meat.
- c) The tenderness of meat is also influenced by the methods of preparation and cooking used, as well as the cut selected. Meat can be partially tenderized mechanically by scoring or pounding or cutting across the grain. It can also be tenderized by marinating.

### Cooking meat

Cooking successfully is all about producing the best colour, texture and flavour. By applying heat, the Maillard reaction produces the meaty aromas and brown colour people enjoy. Denaturation and coagulation of protein occurs so the texture of meat becomes firm and holds its shape. The fat melts, contributing to the flavour and the crisp surface texture. Meat is also cooked to make it safe to eat by destroying any harmful microorganisms and to make it easier to chew and digest.

### Changes that occur when meat is cooking

The cooking process changes each main structural component of the meat.

**Muscle fibre** – During heating, the proteins in the muscle fibre begin to change shape; that is, they denature and coagulate. As the proteins change, there is contraction in the direction of the muscle fibre, resulting in the piece of meat shrinking and becoming firm as some of the water is expelled. The longer the meat is heated, the tougher it becomes, as more protein is denatured. If meat is overcooked, the toughened protein becomes less digestible.

**Connective tissue** – The protein collagen, which makes up connective tissue, is tough in its raw state and must be cooked sufficiently to convert it to water-soluble gelatin so that it becomes tender enough to bite through.

**Fat** – Before heat is applied, the fat in meat is solid, either on the edge of a cut of meat or marbled through the muscle fibre. During cooking, the fat melts and acts as a lubricant so that the muscle fibre appears less tough. Fat also contributes to the flavour and aroma of cooked meat.

**Water** – This is the largest component of meat and has a major influence on the flavour and texture of the cooked meat. When the meat is heated, for example when frying, a little water will flow out of the meat as the proteins, and if the meat is cooked at the correct temperature and for the correct time, it should be juicy and moist to eat. Meat that has been cooked too long will become dry because much of the water has been lost.

### **Effects of mechanical action on meat**

A meat mallet can be used to pound some meat cuts to break down the tough fibres. This tenderizes the meat or makes it thinner, so it will cook more quickly.

### **Effect of acids on meat**

Acidic ingredients, such as wine, vinegar or lemon juice, are often combined with flavourings to make a marinade for meat and poultry before cooking. The acidic ingredient in the marinade acts as a tenderizing agent by breaking down bonds between the proteins in the connective tissue and converting the collagen to gelatin. These acidic ingredients also increase the hydration or water-holding capacity of the muscle fibre—that is, the protein in the meat—which increases softening and tenderizing during cooking.

### **Effect of enzymes on meat**

The enzyme papain, an extract from papaya, is a common ingredient in commercial meat tenderizers – it breaks down the bonds between some of the protein molecules in tough meat fibres.

### **Meat products**

**A variety of meat products are available and are very popular. These include:**

- Sausages
- Meat extractives
- Cold cooked meats
- Burgers
- Pies
- Pasties
- Pastes and spread

### Sausages

Sausages have been made for many years, originally as a method of preserving and packing meat.

There are many different types, but the basic ingredients are a mixture of meat and cereal, such as bread.

Flavourings, herbs and spices are also added, and the mixture is encased in specially prepared intestines or edible synthetic casings.

### Meat extracts

These are sold as thick pastes, cubes, or powders for use as drinks or in gravies and stews. They contain flavourings from meat, plus salt and spices. They have little nutritional value and are mainly used for their flavours.

### Cold cooked meats

A large variety of cold meats can be bought. They are useful for packed lunches, picnics and salads. Corned beef is a popular cold meat which contains a useful supply of iron. Cold meats are usually prepared from meat, cereal, flavourings, and spices.

Cooked cold meat should be sold and stored separately from uncooked meat to prevent cross contamination by bacteria. They should be stored in a cold place and eaten within a few days of purchase.

Sausages and cooked meats normally have preservatives added, and some cold meats are sold in cans for long-term storage.

### **Poultry**

Poultry is the name given to birds eaten for food and includes;

1. Chicken
2. Turkey
3. Goose
4. Pigeon
5. Duck

### **Structure and composition**

Poultry meat has the same basic structure as other meat, except that there is less connective tissue, so the meat is more tender. The legs and wing muscles which do the most work is generally tougher and darker in colour, because of the presence of myoglobin.

### **Choosing poultry**

Poultry should be chosen according to the following factors:

#### **1. Appearance**

- a) Poultry meat should be pink/white, with darker meat on the wings and legs
- b) It should have a fresh smell

#### **2. Intended use**

### **Nutritive value**

The protein of poultry is easily digested and of high biological value. With the exception of goose and duck, poultry contains less fat than red meat. There is also less iron, thiamin, riboflavin, and nicotinic acid than in red meat.

### **Uses of poultry in food preparation**

#### **Chicken**

Whole or joints – roast, braise, boil casserole.

Joints – coat in egg and breadcrumbs, and fry, grill, casserole.

Cooked chicken can be eaten cold, in salads, snacks and picnic meals.

### **Turkey**

Turkey can be cooked in a similar way to chicken. Boneless turkey rolls can be roasted to provide three to four servings.

### **Duck and goose**

Duck and goose are usually roasted. To reduce the fattiness of the meat, they can be placed on a rack during cooking and pricked with a knife at regular intervals to release the fat. They are often served with a sharp, acidic sauce, e.g. orange, to counteract the greasiness.

Bones can be boiled to produce stock for use in soups, stews and sauces.

### **Poultry products**

A variety of poultry products is available, including:

- Chicken nuggets and nibbles
- Poultry burgers
- Chicken wing nuggets
- Poultry sausages

They are often made from poultry pieces pressed together or from mechanically recovered meat (MRM). This is a slurry made by sucking time scraps of flesh under high pressure from the carcasses, and the technique is used in processing poultry and other meat.

### **Cooking poultry**

Tender cuts such as tenderloins and breast fillets are best prepared using quick dry methods of cooking such as stir-frying or pan-frying to prevent dryness and toughness. Whereas, with red meat, the heat of the cooking process denatures and coagulate the proteins, in their raw state, cuts of poultry have a pinkish colour, are shiny on the surface and soft in texture. As heat is applied, the flesh becomes whiter and firm to touch. Browning on the outside when dry methods of cooking are used is a result of the Maillard reaction. Tougher cuts, such as drumsticks and thighs, have more connective tissue and are best baked or cooked using a wet method such as simmering for a curry or casserole.

### **Storage of poultry**

Fresh poultry should be kept in a cold place after the giblets (internal organs – neck gizzard and liver) and other organs have been removed. It should be eaten soon after purchase (two to three days if kept in the refrigerator).

Frozen poultry should be allowed to thaw completely before being cooked, and then thoroughly cooked to avoid salmonella food poisoning.

### **Offal**

Internal organs and parts of an animal are called offal. The term is derived from two words 'off fall', because the parts are removed from the carcass.

The internal organs include:

- Liver
- Heart
- Giblets (gizzard)

### Choosing offal

All offal, particularly the kidneys, livers and heart should be bought very fresh. It should be eaten 24 hours after purchase, and carefully washed and prepared before eating. Thorough cooking is necessary to prevent food poisoning and to tenderize the offal.

### Importance of offal in the diet

**Protein** – The protein of offal is of high biological value, and if well-cooked is readily digested.

**Fat** – There is less fat in offal than in muscle meat in general

**Carbohydrate** – Liver may contain a little glycogen but is not an important source.

**Vitamins** – Retinol (vitamin A) is stored in the liver, so liver is a very rich source. Pregnant women are advised to avoid eating liver, as high intake of vitamin A in early pregnancy can cause birth defects. Kidney and heart also contain some retinol.

Heart and liver contain useful amounts of **thiamin**. There is some **vitamin C** in liver, but it is not a valuable source.

**Minerals** - is an important source of iron.

### Storage

Offal should be kept in a cold place and used as soon as possible after purchase. It can be frozen for long-term storage.

### Seafood

There are great many varieties of fish, and at one time they were inexpensive and abundantly available. They can be found in fresh water or salt water.

At sea, fish is gutted, cleaned and frozen on board, before it reaches the shore, as it deteriorates very rapidly once caught.

### Types of fish

Fish are classified in two ways:

1. According to their origin.
  - a. Freshwater fish e.g. salmon, trout
  - b. Seawater fish which are divided into two categories:
    - i. Pelagic fish (which swim near the surface) e.g. herring, pilchard, mackerel;
    - ii. demersal fish (which swim near the bottom), e.g. plaice, cod, hake
2. According to their fat content and type.
  - a. Oily fish  
They have more than 5% fat in their flesh, which is therefore quite dark. Examples of these fish include mackerel, herring, pilchard, sprat, sardine, salmon
  - b. White fish  
They have less than 5% fat in their flesh, which is therefore white. They have oil in their liver. Examples: halibut, cod, whiting, coley, plaice, haddock, sole, hoki.
  - c. Shellfish are divided into;

- i. Molluscs (small, soft-bodied sea animals which live inside a hard shell), e.g. cockles, mussels, winkles;
- ii. Crustaceans (soft-bodied, jointed sea animals which are covered by a hard protective 'crust' or external skeleton), e.g. lobster, crab, shrimp.

### Structure and composition

Fish has a muscle composition similar to that of meat, but there is far less connective tissue, so it is much easier to tenderize and quicker to cook. It is important not to overcook fish as the protein easily is formed into flakes which separate on cooking.



There is a lot of wastage with fish, i.e. the bones, head, fins, and often the skin. The only internal organ to be eaten is the roe of some species, Cod and herring roe are often eaten, and the roe of the sturgeon fish (caviare) is a prized and very expensive delicacy.

### Choosing fish

As fresh fish deteriorates, rapidly, it is important to choose it carefully. Fresh fish should have:

1. Bright eyes, not sunken.
2. Plump, firm flesh.
3. Plenty of bright scales, firmly attached to the skin.
4. Moist skin.
5. A fresh, sea smell.
6. Bright red gills, not sunken.
7. Shellfish is normally sold cooked. As several species are scavenger feeders (i.e. they feed from sediment on rocks and pipes, often near sewage outlets), they harbor food poisoning bacteria and must be eaten as soon as possible after purchase.



Fish are sold in various ways:

**Large fish** e.g. cod, coley, haddock are cut into fillets, steaks or cutlets.

**Small and medium fish** e.g. herrings, mackerel, rainbow trout are usually sold whole, and can be filleted by removing the backbone, tail, head and fins.

**Very small fish** e.g. sprats and whitebait, can be fried and eaten whole.

### Importance of fish in the diet

Fish is a major source of protein for those who live in the coastal areas of Papua New Guinea. Like meat, the protein is of high biological value, and is readily digested and absorbed with little waste. White fish in particular is more easily digested than meat and is useful food for people with digestive disorders.

Unlike meat, the fat in fish consists mostly of oils containing, unsaturated fatty acids. The essential fatty acids in oily fish are of benefit to health.

## Nutritive value

### Vitamins

- a) Fat soluble,
  - a. Only oily fish contain useful amount of Vitamins A and D in their flesh.
  - b. Canned oily fish contains the most Vitamin D.
  - c. White fish contain Vitamin A and D in their liver oils, not in their flesh.
  - d. Shellfish are not good sources of these vitamins, as they have a low-fat content.
- b) Water soluble,
 

Fish does not contain any vitamin C. Most fish contain small amount of the B-group vitamins.

### Mineral elements

- a) Calcium
 

Most calcium in fish is found in the bones. If the bones of canned fish, which have been softened, are eaten, they provide a useful source of calcium.
- b) Iodine and fluoride
 

Seawater fish are good sources.
- c) Iron
 

Fish are poor sources of iron.
- d) Sodium, chlorine, potassium and phosphorus are found in all sources.

### Methods of preparation and cooking

Fish can be eaten in many dishes. Overcooking tends to lead to dryness and breaking up of the flesh.

### Storage

Fish should be eaten as soon as possible after purchase and should be stored in the coldest part of the refrigerator (but not the ice box), well wrapped, to prevent the strong odours from contaminating other foods.

It is advisable to freeze fresh fish bought from a shop as it must be frozen while very fresh.

### Preserving fish

Apart from being frozen, fish can be preserved by;

#### Curing

Smoking is carried out over wood smoke in carefully controlled conditions. The smoke develops flavours in the fish and has a preservative action.

#### Canning

Several varieties of oily fish are canned and may be served with oil or tomato sauce. The bones are softened and can be eaten, providing a good source of calcium.

#### Cooking seafood

The changes in the physical and sensory properties of fish are particularly evident during the cooking process. The characteristic includes:

In its raw states,

1. Translucent
2. Firm to touch
3. The juices are clear and watery

When the fish is cooked:

1. The proteins denature and coagulate.
2. The flesh becomes opaque and begins to separate into flakes and the juices are milky white.
3. Fish cooks quickly and when cooked, it is very tender, with a tendency to fall apart during cooking.

Fish as low-fat content, it is easier to digest than meat or poultry. Cooking whole fish rather than as fillet helps to keep the flesh moist and has superior flavours.

### **Effects of acid on seafood**

Fish has a small amount of connective tissue so is tenderized or softened very quickly when exposed to an acid such as lemon or lime juice. If fish is marinated in an acidic ingredient for longer than 5 to 10 minutes the raw flesh turns white and the texture becomes firm, in much the same way as the sensory properties of fish are changed during cooking.

### **Fish products**

A variety of fish products are available including;

- fish fingers,
- ready prepared fish pieces for oven baking,
- fish nuggets and rissoles, and
- ready prepared meals, e.g. seafood pie.

### **Alternative protein foods**

There have been many attempts to manufacture foods that are rich in protein as alternatives to meat for the following reasons:

1. Meat is expensive to produce and has risen in price,
  - a. Shortage of pasture land to rear animals
  - b. Increase in the cost of feeds for animals
2. In countries where there is a shortage of food (particularly protein rich food), there is an urgent need for new protein foods to be manufactured, especially for babies and young children who suffer most under conditions of famine.
3. Cheaper feeds for animals are required, as meat is in high demand in many countries. Several different raw materials have been used for the preparation of new protein foods, including:

### **Micro-organisms bacteria**

- i. Bacteria
- ii. Yeast
- iii. Algae
- iv. Plankton

## Plants

- v. Seeds
- vi. Legumes
- vii. Cereals
- viii. Seaweed

## Micro-organisms

Micro-organisms can be made to grow industrial or agricultural waste materials (paper, wood, cotton, sugar-refining waste) and the production of protein is fast and efficient. Bacteria can double their weight in 30 minutes and 80 % of these is protein (yeast, algae and plankton are slightly less efficient).

## Plants

Seeds and legumes (pulses) can be used to produce protein rich food. The main types used are soya beans, sunflower seed, groundnuts and sesame seed.

**Soya** is one of the most important sources of HBV plant protein. The soya plant comes from the Far East, but different varieties have been grown successfully in different climates. Soy beans must be well cooked to destroy the toxin soyin.

Soya beans were originally grown for the oil industry, but it was discovered that once the oil was extracted, the residues contained up to 50% protein and could be made into flours or flakes for various uses. The flakes can be further refined and concentrated so that they contain up to 70% protein.

The extracted protein can be textured and flavoured to resemble meat. This is known as **textured vegetable protein (TVP)**. The TVP can be shaped into 'meat' cubes or minced granules and used as a meat substitute in a variety of dishes. Usually other nutrients are added, e.g. iron, thiamine, and riboflavin, to bring the nutritive value close to that of meat.

**TVP** products are used in commercially prepared meat pies, stews, etc., and in canteen meals and vegetarian meals. They are a cheap alternative to meat but are unlikely to replace it because of the popularity of meat and the reluctance of people to change their eating habits.

Several other soya bean products are also important. Soya beans and flour are often added to vegetarian burger and sausage mixes, and soya flour can be used in baking in place of eggs.

Soya bean products are often used in stir fry meals and other Chinese cooking.

- Soya bean curd (tofu), which can be bought plain or smoked, is a good source of protein.
- Tempeh, specially fermented and cultured soya beans has been produced in China for 2000 years. It is easy to digest and is rich in protein and vitamin B<sub>12</sub> but low in fat.
- Soy sauce (tamari) and soy bean paste (miso) are made from fermented soya beans, are both high in salt.

- Soya milk is a substitute for cow's milk but needs to be fortified with vitamins and minerals. Soya desserts, cream substitutes, and yoghurts are also available.
- Pulses are a rich source of protein and other nutrient and are therefore a valuable food in their own rights.

## Gluten

Gluten is the protein component of many cereals and is found in high amounts in wheat flour. Gluten is formed only when flour is mixed with water. Under the microscope, it is possible to observe the two protein of wheat flour, gluten and gliadin, which join together when they are mixed with water to form gluten.

### Mechanical actions of Gluten

#### *Kneading a dough*

When gluten is developed in a flour mixture, it creates a strong network that can be stretched like an elastic band and will then spring back. The more the gluten is developed – using the mechanical actions of kneading or mixing – the more it is capable of stretching into a thin film without tearing or breaking.

The batters and doughs become smoother and stronger, when they are continuously mixed and kneaded. They can trap solid particles, liquids and gases as they expand. This property is important in the production of yeast doughs and pasta, which rely on a strong structural framework to enable them to hold their shape once cooked.

It is the opposite when making cakes, muffins and biscuits. The key sensory properties of cakes, muffins and biscuits is their light and tender texture. So, when we make these products with wheat flour, it is important to use minimal mechanical actions when combining the ingredients; for example, folding the flour in lightly rather than beating reduces the development of gluten and prevents a dry, tough texture.

#### *Gliadin and Glutenin formation*



### Making tofu

Tofu or bean curd is like custard and is high in protein made from curdled soy milk. Soy milk is cooked, then cooled and coagulated with salts. The curd is then pressed as in cheese making. The final product is a delicate but firm curd with a bland flavour that has the capacity to take on the flavour of foods with which it is cooked. When it is fried, the outside becomes golden brown due to Maillard reaction.

## Gelatine

Gelatine is a protein which is extracted from the collagen present in the skin, tendons, bones and connective tissue of cattle that have been slaughtered for meat.

### Properties

Gelatine is a tasteless, transparent, odourless, brittle solid which is faint yellow in colour. When mixed with water, the gelatine absorbs it and swells, because the protein molecules in it form a three-dimensional network, which entangles the water and immobilises it.

When the water is trapped in this way, it forms a gel. If the gel is then heated above 35°C it becomes a liquid and is called a **sol**. When cooled, the sol becomes solid, and this process is called **gelatine**.

The ability of gelatine to cause liquids to set in this way is used in food preparation for several purposes.

### Domestic uses

1. Jellies: clear or plain, sweet or savoury.
2. Whip: made by beating plain jelly into froth until thickens.
3. Sponges: made by adding whipped egg whites to a plain jelly, to form a spongy-textured sweet.
4. Bavarian: made by folding in whipped cream to a plain jelly.
5. Creams made with gelatine, milk, or cream and eggs.
6. soufflés: cold.
7. sweets: e.g. marshmallows, Turkish delight.
8. aspic: for setting meat, fish, and vegetables in a savory jelly.

### Industrial uses

1. Meats: for canned hams and pressed meat, meat loaves, pates, pies, sausages and brawn.
2. Thickening agent: for soup, cream.
3. Crystallized fruits: e.g. cherries.
4. Medicines: as a coating for pills and capsules.
5. Yoghurt: as a stabilizer to stop separation.

### Using gelatine in food preparation

#### Proportion to use

12.5g or 3 round teaspoon gelatine.

575 ml water or other liquid.

#### To dissolve gelatine

1. Sprinkle the gelatine into the liquid in a jug.
2. Stand the jug in a pan of hot water, stir, and leave to dissolve.
3. The gelatine is ready for use when it is clear and transparent.
4. Do not boil the gelatine liquid.

### **Adding gelatine to a mixture**

The dissolved gelatine should be poured slowly into the mixture, stirring all the time, to incorporate the gelatine completely. The mixture should not be icy cold as the hot gelatine liquid will not mix well and will form 'ropey' globules. This will prevent it from setting properly.

Fresh pineapple should be cooked first if used in a dish that is to be set. This is because pineapple contains an enzyme called **bromelain** which prevents gelatine from setting. Heating inactivates the enzyme.

Gelatine should not be used to help jam to set, but it will not keep so long if this is done.

### **Storing gelatine**

Gelatine absorbs moisture readily and so should be stored in a cool, dry place. It will also absorb odours from other foods, and so should be kept in an air-tight container.

### **The importance of gelatine in the diet**

Gelatine is a protein, but although it is an animal protein, it has a low biological value. It is not, therefore, as useful in the diet as was once thought.

Gelatine can be used to set jam for people suffering from diabetes, where sugar intake has to be limited.

## Unit 1: Food and Nutrition

**Content Standard: 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: 10.2.1.2** Apply ethical principles and values, safety and hygiene practices in food product development and food science.

**Topic:** Ethical principles, safety and hygiene

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

- Investigate and identify the implications of harmful organisms in food production areas.
- Explore and investigate what food contamination is.
- Explain what food preservation is.
- Demonstrate healthy and safe hygienic and food practices.
- Apply the skills in producing a food product using-kitchen equipment.

### Essential Questions:

- What hygienic practices should we follow in handling and preparing food?
- How does unsafe food practices and personal hygiene have an impact in our health and interfere in food preparation?
- What are the impacts of unhealthy and unhygienic practices in food handling, preparation and storage?
- What is food preservation?
- What is food contamination?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Ethical principles and safety;               <ul style="list-style-type: none"> <li>- Kitchen safety</li> <li>- Personal safety and hygiene</li> <li>- Food safety (food storage)</li> </ul> </li> <li>• Food borne illnesses</li> <li>• Food contamination</li> <li>• Food preservation</li> <li>• Tools, equipment and gadgets</li> <li>• Response to emergency</li> <li>• Food safety and hygiene practice</li> <li>• Food safety standards</li> <li>• Food poisoning</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Demonstrate awareness on the impacts of unhealthy safety and unhygienic practices in food handling, preparation and storage</li> <li>• Evaluate and communicate safe and hygienic practices in food preservation</li> </ul>
<b>Values/Attitudes</b>	<ul style="list-style-type: none"> <li>• Appreciate the value of food handling, preparation and storage</li> <li>• Make informed decisions on food preservation</li> <li>• Be responsible and show empathy during emergency</li> </ul>

## Teaching and Learning Strategies

Teachers are encouraged to use a variety of teaching and learning approach to guide the impartation of key knowledge, skills and values. Give students the opportunity to engage in guided discovery activities and research to motivate them to learn further. Organise practical lessons to motivate and create awareness the consciousness in students to embrace hygiene habits. Utilize the design brief concept.

### Learning Activities

#### Lesson 1: Food Safety Regulations and Food Safety Standards

##### Activity 1

**1a.** Engage students in identifying the significance of safe handling food practices and preparation.

**1b.** Investigate and describe the importance and relationship between safe food handling practices and food consumption.

**1c.** Discuss the key ideas and terminologies in food safety standards, kitchen hygiene rules and its significance in food preparation.

##### Activity 2

**2a.** Identify and experiment on the significance of kitchen equipment and gadgets and their roles and functions and effects on food in food preparation and product development.

**2b.** Give students the opportunity to experiment on the kitchen equipment and practice safe handling of equipment.

**2c:** Identify and discuss the safety standards and food handling practices in the Food industry.

##### Activity 3

**3a.** Experiment, observe and draw the types of moulds and bacteria that grow on food over time and discuss how to prevent moulds.

**3b.** Prepare a design brief or a recipe to prepare a product using raw food product and apply the skills in using the kitchen equipment and produce products using raw materials and processed foods, using appropriate technology and demonstrate cooking methods.

#### Lesson 2: Food Contamination

##### Activity 1

**1a.** Engage students in identifying food contamination and their effects on health.

**2a.** Research on the three (3) main types of food contamination: biological, chemical and physical.

**3a.** Give students the opportunity to use various kitchen equipment and practice how to handle them safely.

##### Activity 2

**2a.** Discuss, identify and classify micro-organisms.

**2b.** Investigate on bacteria yeast and moulds.

**2c.** Draw up a table for each food trays. You may allocate a tray to a different work group in the class and write down observations of the foods over a period of one week. Describe the micro-organism's growth on the food.

**Activity 3**

**3a.** Using raw food, experiment and observe the characteristics of contamination, biological, chemical and physical characteristics on food.

**3b.** Prepare a food product in a safe environment.

**Lesson 3: Food Preservation****Activity 1**

**1a.** Research on Microorganisms that cause food poisoning.

**1b.** Identify, discuss and present to the class the principles of food preservation. Explain the effect of temperature on the growth of micro-organism.

**Activity 2.** In groups, select one method of preserving food discussed in the lesson, identify four or five important stages in the process. Briefly describe the chemical and/or the physical changes to the food at each stage.

**Activity 3.** Research foods that can be processed to create interesting and convenient products.

**Lesson 4: Kitchen Tools, Equipment and Gadgets**

**Activity 1.** Students engage in identifying kitchen appliances, their roles and functions.

**Activity 2**

**2a.** Discuss and explain main terminologies and concepts in using the different kitchen appliances and gadgets and its importance in food product development.

**2b.** Demonstration of an electrical appliance to the students. Discuss its operation, uses in food preparation, cleaning, maintenance and safe use. (**Note:** For schools without electricity or electrical appliance, substitute by showing a picture).

**Activity 3.** Design a food product. Students will use electrical appliances to create a food product.

**Activity 4**

**4a.** Describe safe and hygienic work practices when handling food.

**4b.** Practice the food preparation methods to produce food products using local food.

**4c.** Discuss on the PNG HCCAP system that identifies potential food hazards and their control points at all stages in the production of food.

## Content Background

### Food Safety Standards

A series of standards is developed to ensure that food is kept safe by controlling any hazards that could occur in food production or food handling. Food safety programs is based on the principles of HACCP.

The global food trade has a huge impact of both the health of the people and the economy of the country. Many people become ill and some die each year from food borne illnesses according to World Health Organization (WHO).

The global trade in food products has increased over years in PNG. During this time, the global food supply chains have increased in complexity and a much greater range of products is traded internationally.

In the future, along the supply chains, it is vital that food is kept safe, is of good quality and is suitable for consumption when it reaches the consumer. Food safety standards and regulations are essential to ensure food is safe at all points along the supply chains in both international trade and within nations.

Trade is closely linked to food security, nutrition and food safety. It influences agricultural output, the variety, quality and safety of food and the composition of diets. Globally accepted standards enable trade by making it more transparent and efficient, giving confidence to all participants and allowing the smooth flow of food products between market.

### Code Alimentarius

The most important global body for food standards is the Codex Alimentarius Commission (CAC). It is the global food producers, processors, consumers, national food safety agencies and the international food trade.

CAC produces the Codex Alimentarius, which is a collection of harmonized international food standards, guidelines and codes of practice. The food safety measures are based on scientific principles to adapt to the evolving global food trade, the evolution of knowledge and changing consumer needs and preferences. The process involves specialists in multiple scientific areas, expert technical bodies, consumer organisations, production and processing industries, food control officials and traders.

A major Codex Code of Practice is,

1. The general Principle of Food Hygiene is to provide guidelines for food safety from primary production to final consumption.
2. HACCP guidelines

### Quality Control

Food manufacturers have to make sure that their products are of high quality. Shoppers will only buy from companies if they think their food is safe. So, it is important for manufacturers to have an effect control system, which carefully checks their procedures. Some of the quality checks are controlled by computer.

## Hazard Analysis

Manufacturers use hazard analysis to identify potential dangers. There are three kinds of dangers to food production:

1. Biological hazards, such as harmful bacteria.
2. Chemical hazards, such as cleaning fluids or machine oil getting into food (called contamination).
3. Physical hazards, such as pieces of glass or worker's hair entering food.

## Hazard Analysis Critical Control Points (HACCP)

In the Hazard Analysis Critical Control Points (HACCP) system is a food safety system that identifies potential food hazards and their control points at all stages in the production of food. Checks are made at the point where dangers are most likely to occur. This system is very successful for quality control.

HACCP has become the basis for ensuring that all food is prepared, manufactured and handled safely.

## Preventing food spoilage and poisoning using HACCP

Hazardous situations may still arise in the food chain, a system such as HACCP reduces the risk of unsafe food reaching the consumer, the main purpose of the HACCP system is to prevent food spoilage and food poisoning and to ensure a safe food supply for consumers. The HACCP system does this operating throughout the whole food supply chain, including all areas of primary production, as well as in the food manufacturing and food retailing systems.

The HACCP system enables primary producers and food manufacturers and retailers to:

- Examine every stage of production and identify any hazards that may occur.
- Note each point where a hazard poses high risk-these are noted as critical control points.
- Take steps to prevent, remove and reduce hazards.
- Closely monitor the critical control points in the HACCP system at regular intervals to ensure safety control procedures are being carried out.
- Monitor the steps where serious problems occur and address the problems as they arise.

## Food Standards Code

Food sold in the country must comply with the food standards in the Code. It is a criminal offense to supply food that does not comply with the standards outlined in the Code. The Code covers locally grown foods and processed foods as well as imported foods.

Food standards code is divided into four groups. These are;

1. General food standards
2. Food product standards
3. Food safety standards
4. Primary production standards

## 1. General Food Standards

This sets out the standards that apply to all foods. It contains information about:

- Definitions relating to the standards.
- Food labelling requirements.
- Substance added to food, such as food additives and vitamins and minerals.
- Contaminants and residues, for example the maximum agricultural and veterinary chemical residues that are permitted in food.
- Food requiring pre-market approval, for example food produced using gene technology.
- Microbiological and processing requirements; for example, liquid egg white cannot be sold for use in the manufacture of food products unless it has been pasteurized.

## 2. Food Product Standards

This contains standards for classes of food, including cereals, fruits and vegetables, meat, eggs, and fish, edible oils, dairy products, non-alcoholic beverages and sugars and honey.

The standards for each of these classes of foods prescribe exactly what the food must or may contain; nothing else is permitted in that food. The standards include information on the;

- identity of the particular food – describes or defines the food, for example cheese.
- composition – describes the make-up of the food, additives, the minimum nutritional content, the maximum amount of contaminants and residues; flour used for making bread must be fortified with folate and thiamin in place of non-iodized salt.
- Microbiological make up-includes the types and limits of microorganisms that can be added in the production of yoghurt.
- Analytical standard – refers to the methods used to measure components of the food, such as fibre content.
- Additional labeling requirements for specific foods, such as the types of fats.

## 3. Food Safety Standards

This established standards for food hygiene to ensure that only safe and suitable food is sold to consumers. It includes standards for;

- Food safety programs, based on the Hazard Analysis Critical Control Points (HACCP) system.
- Food safety practices; for example, the requirements necessary at all stages of food production, such as storage, processing, packaging, distribution and the recall of the food. It also includes requirements regarding the skills and knowledge of food handlers.
- Food premises and equipment; for example, premises must be designed to minimize food contamination and allow all fixtures and fittings to be cleaned thoroughly.

- Food services to vulnerable persons; for example, food that is produced for patients in hospital, residents in aged-care facilities and children in childcare centers.

#### 4. Primary Production Standards

This includes standards relating specifically to primary production requirements of food. This has been developed as a “whole food chain” approach to ensuring a safe food supply. The Primary Production and Processing (PPP) standards:

- Apply to the primary production sector to ensure that risk-management strategies are developed for the whole food supply chain from producer to consumer.
- Are based on HACCP principles
- Have been developed for various food industries.

The summary is outlined as such;

General food standards	Food product standards	Food safety standards	Primary production standards
Standards that apply to all foods labelling	Standards that describe exactly what a food must contain	Standards for food hygiene based on HACCP	Standards for the whole food chain, from producer to consumer.

#### Food Labeling

Food labeling regulations apply not only to food for sale through the retail market, but also to food that is prepared in restaurants, schools and canteens or by catering institutions.

#### Information that *must* appear on a Food Label

Food labels carry useful information that helps people make informed choices about the food they select to purchase. All products that are not weighted and packages in front of the purchaser must have the following information, written in English and clearly visible to the consumer.

Labelling requirements	Purpose of the requirement
Name of the food	Identifies the product and enables it to be easily recognised. The label must not be misleading.
Identification of packaging premises and job lot	Coded in numbers and/or letters. This identifies products in the case of a food recall.
Name and address of the manufacturer	Address must be shown in sufficient detail to ensure the purchase can contact the manufacturer directly.
Mandatory warning statements and declaration of any allergies present in the food	Enables consumers who have a particular food allergy or food sensitivity to avoid these products, e.g. nuts, milk, egg, gluten
List of ingredients	All ingredients listed in descending order by weight. Food additives must be shown in the ingredients list by category and

	number.
Use-by date or 'best-before' date	Applies to foods with a shelf life of less than two years. This enables consumers to eat food while it is in its best condition.
Nutrition and health related claims.	A nutrition content claim or health claim can only be included on a label approved by the governing body or is supported by scientific evidence.
Nutrition information panel	Must show the amount per serve and per 100 grams
Characterising ingredients or percentage labelling	The proportion of characterising ingredients must be shown in percentages.
Use and storage	Provides information about the storage and use of the product necessary to protect the health of consumers, e.g. 'refrigerate after opening.'
Country of origin	Identifies where the food was made and/or produced or packaged.
Weight and measure of contents	The weight must be stated in metric units of measurement and the word 'NET' must be included.

### Information that *must* not appear on a food label

The following information must not appear on a label.

- Anything false, misleading or deceptive, such as a picture of a strawberry on a confectionary that only contains strawberry flavouring.
- Any claim that a particular food is able to cure a specific illness or disease.
- A claim such as 'vitamin enriched' or 'vitamin fortified' or a comparison of the vitamin or mineral content with any other food.
- The word 'health' when used in conjunction with the name of the food.
- Any statement of claim that the food is claiming food or has weight-reducing properties.

### Information that *may* appear on a food label

The following information may appear on a label.

- Bar codes are a useful feature for both food manufacturers and food retailers. They can be scanned to provide food outlets with information about the price, date of manufacture and batch number of the product.
- Serving suggestions help consumers with ideas about accompaniments that could be served with the product or alternative methods of cooking the product.

## Food additives

Most processed foods contain food additives, which are chemicals added to food to keep them fresh or to enhance their colour, flavour, texture or processing properties. The more processed a food, the more food additives it is likely to contain.

Before a food additive is approved for use, the Food Standards Committee reviews evidence about how safe it is for human consumption. Food additives are listed in a food label according to their use and numbers:

**Colours** – used to add colour to a food or to restore colour lost during processing.

**Preservatives** – help extend the shelf life of food.

**Antioxidants** – slow the rate at which foods 'go-off', for example, when fats and oils become rancid.

**Artificial sweeteners** – provide a sweet flavour to food but with fewer kilojoules than sugar.

**Flavour enhancers** – used to improve the flavour or aroma of food.

**Emulsifiers** – enable oil and water mixtures to remain in suspension and not separate.

**Stabilizers and thickeners** – increase the viscosity in foods so that they have an improved consistency. Food labelling regulations require food processors to list additives on the label of a food product according to their numbers so that consumers can easily identify any they may be sensitive to and wish to avoid.

## Food spoilage

Food spoilage is a reduction in a food's quality, identified by deterioration in its physical, chemical and/or sensory properties. When the physical, sensory or chemical properties of a food, such as its nutrient content, colour, flavour, texture or appearance, begin to deteriorate or reduce in quality, the food is said to be spoiled. This means it is usually unpleasant to eat.

Food spoilage can be caused by several factors, including the actions of naturally occurring enzymes in the food, or moulds or yeasts, which can 'attack' the food. There will be clear changes in the physical appearance, texture, odour, colour or flavour of food that has spoiled. However, while the food may be less pleasant to eat, it will not generally be poisonous or cause any physical harm if consumed.

Some of the most common forms of food spoilage include:

- biscuits that have absorbed moisture from the air and become soft.
- Bread and cake that have absorbed moisture from the air and become soft.



- Bread and cake that have become stale because they have lost moisture.
- Mould on cheese, jam, bread or citrus fruit.
- Fruit that has become bruised and overripe vegetables that have become limp.

### Causes of food spoilage

Food spoilage usually refers to undesirable changes occurring in food due to the action of microorganisms, insects and enzymes. Foods vary greatly in the length of time for which they can be held in their natural form without spoilage. For purposes of food preservation, foods are classified as;

1. Perishable
2. Semi-perishable
3. Non-perishable

Perishable foods such as milk, meat, sea food and many fruits and vegetables begin to deteriorate almost immediately after harvest if not preserved. These foods have high moisture content and are highly susceptible to spoilage. Foods are spoiled by the action of:

1. microorganism
2. enzymes
3. insects

### Food poisoning

Food poisoning is an illness caused by consuming food contaminated by bacteria, toxins or a virus. Food that can cause food poisoning may appear harmless and its physical properties of appearance, aroma, flavour and texture may be normal.

Food is safe only if there is no risk of harm to humans when they consume it. There are several reasons for the high incidence and reporting of food-borne illness:

- Changing patterns of food consumption leading to more meals being eaten away from home.
- Greater diversity of food available.
- Emergence of new food borne pathogens.
- Increase in the group of the population most at risk-elderly people are now a greater proportion of the total population.
- Better diagnosis and food testing.
- Enhanced surveillance and greater awareness of the incidence through the media.

### Microorganisms that cause food poisoning

There are three groups of microorganisms that are closely linked to food poisoning and can make us very ill. The three types of food poisoning;

1. **Bacterial food poisoning - Bacteria** are microscopic organisms. Bacteria that are linked to food poisoning are found in the faeces, mouth, nose and ears of all human as well as in infected sores. The bacteria that are most commonly linked to food poisoning are *Salmonella*, *listeria monocytogenes* and *Campylobacter*.

2. **Chemical food poisoning - Toxins** are produced by some microorganisms including *Bacillus cereus*, *Clostridium perfringens* and *Staphylococcus aureus*. Toxins can survive cooking, even though the bacteria that produced them are killed.
3. **Biological Food poisoning - Viruses** are minute microorganisms that are even smaller than bacteria. Viruses don't grow in food but only a miniscule amount of a virus needs to be present in food to make us ill. Food borne viruses include hepatitis A, norovirus and rotavirus.

### Bacterial Food Poisoning

Bacterial food poisoning is the most common cause of food poisoning and stringent hygiene precautions must be taken in order to prevent outbreaks of this type of illness. Since most food poisoning incidents occur as a result of unhygienic practices, this means that they are preventable.



#### How is food contaminated?

Salmonella causes an infection when food that contains the live bacteria from contaminated food products, water or hands is eaten.

#### What food can be contaminated?

Raw meat, poultry, sausages, dried egg powder, mayonnaise.

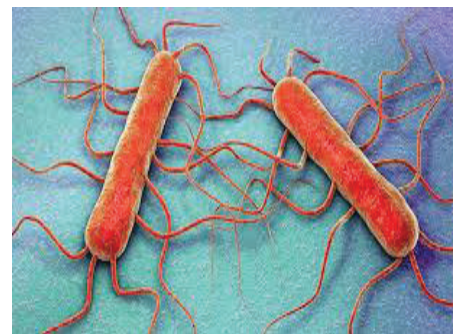
#### What is the effect of this food poisoning bacterium?

Salmonella is responsible for approximately 70 percent of all food poisoning cases. It can be fatal in the elderly, the sick and the very young. Symptoms including nausea, diarrhoea, fever, headache and abdominal cramps 12-72 hours after infection. The illness usually lasts 4-7 days.

### Listeria monocytogenes

How is food contaminated?

Listeria infection is caused by eating food that contains *Listeria monocytogenes* bacteria. These bacteria are widespread in the environment and are able to grow in extreme conditions, including refrigeration, and can survive the pasteurization process. They can contaminate certain high-risk foods that have not been prepared or stored hygienically or cooked thoroughly.



What is the effect of this food poisoning bacterium?

Listeria infection causes the food borne disease listeriosis and can result in death. It can cause pregnant women to miscarry or lead to still birth. It can also affect people who have a weakened immune system including the elderly.

Biological food poisoning is also caused by eating foods naturally occurring poisons. There are many examples of this type of poisoning including:

- a) Poisonous mushrooms – there are species of poisonous mushrooms such as *Amanita phalloides* which have caused illness and in some cases death. These mushrooms are very similar in appearance to the edible variety and may easily be eaten by mistake.
- b) Potatoes – are members of the nightshade family and green potatoes contains a substance called solanine which causes illness or even death if eaten in large quantities. Therefore, green potatoes should always be discarded.
- c) Red kidney beans – raw kidney beans contain a toxic substance called haemagglutinin. A number of cases of poisoning have occurred as a result of cooking the beans in a slow cooker at an insufficiently high temperature. Boiling the beans for 10 minutes destroys the toxin.

### Toxins that cause food poisoning

#### Bacillus cereus

*Bacillus cereus* is a spore-forming bacterium that produces toxins that cause food poisoning. These bacteria are normally found in the soil, but form spores and so are easily distributed in air and dust. The spores produce a tough protective coating that allows them to remain dormant for a long-time. The tough external coating also means the spores are resistant to high temperatures and can therefore survive cooking.



#### What foods can be contaminated?

Cereals, especially boiled rice that has been left to cook at room temperature before use, and vegetables that are high in starch such as potatoes.

#### What is the effect of this food-poisoning toxin?

Symptoms of *Bacillus cereus* infection include nausea, vomiting and diarrhea, but are generally mild and only last about 24 hours.

### Viruses that cause food poisoning

#### Hepatitis A

Hepatitis A is usually transferred from the faeces of an infected person and contaminates foods, drinks or food-handling equipment through poor personal hygiene practices. It can also be spread through contact with contaminated water. The virus can survive on the hands for several hours and resist removal by detergents. It is also able to survive in food kept at room temperature for a considerable length of time.

Hepatitis A can contaminate fresh food that uses water in its production, such as fruit and vegetables, and frozen foods. Contaminated shellfish have also been linked to hepatitis A infections.

#### What is the effect of this food poisoning virus?

The main symptom of hepatitis A is a viral infection of the liver. It usually appears about 4 weeks after infection. The most common symptoms are fever, nausea, abdominal pain, dark urine and jaundice.

## How bacteria reproduce

Food poisoning is usually caused by bacteria are single-cell microorganisms that can cause food poisoning if they are consumed live in food, or through the toxins they produce once ingested.

## Conditions required for growth of bacteria

Bacteria are living organisms that grow best under specific conditions. These are the main conditions for bacterial growth:

- Moisture - A moist environment.
- Temperature - A temperature between 5°C and 60°C.
- Time - Sufficient time to grow.
- pH. - A low acid environment.
- An appropriate food supply.
- Oxygen - Many bacteria also require oxygen for growth.



## Temperature control

Most bacteria will grow, provided they have enough food and moisture, and if the temperature is between 5°C and 60°C. This temperature range is called the 'danger zone'. Bacteria can be inhibited from growing if they are too cold; that is, if food is kept in the refrigerator – or if they are too hot, by cooked food being kept in a heated environment.



**Keep food hot:**  
60°C or above

**Food poisoning bacteria can live and multiply in foods with temperatures between 5°C and 60°C.**

**Keep food cold:**  
5°C or below

## Moisture

Bacteria need moisture to be able to carry out their normal cell functions and to be able to divide and multiply. In a food preparation area, bacteria can grow in any moist environment, such as on wet dishcloths and damp tea towels, in water left lying in the sink or in equipment and utensils that haven't been dried properly.

## Time

Given ideal conditions, one bacterium can reproduce itself by splitting into two and dividing every 20 minutes. This process of division is called 'binary fission'. Therefore, one bacterium can multiply to produce approximately 17 million bacteria within eight hours.

## Food supply

Bacteria grow much quickly in some foods. These foods are called 'high-risk foods' because they are foods most likely to cause food poisoning. Foods that are high in protein or starch and contain moisture allow bacteria to grow more quickly.

By contrast, food poisoning bacteria do not easily grow in foods that are acidic or high in fat. Foods that have a high concentration of sugar, salt or vinegar also inhibit growth of disease-causing bacteria.

**High risk foods** include foods such as;

- |  |                           |
|--|---------------------------|
| 1. milk and milk products such as soft cheese and cream, | 6. cooked pasta and rice, |
| 2. meat,   | 7. coconut,               |
| 3. fish,   | 8. gelatine,              |
| 4. poultry,  | 9. ice-cream, and         |
| 5. raw eggs and egg products,                            | 10. pastries              |

**Low risk foods are foods** such as;

- |                 |                   |
|-----------------|-------------------|
| 1. margarine    | 5. vinegar        |
| 2. butter       | 6. salted fish    |
| 3. cooking oil  | 7. jams, and      |
| 4. citrus fruit | 8. most vegetable |

### Low-acid environment

Bacteria require a low-acid environment to flourish; that is, a pH above 4.6 such as for protein-based foods, are less likely to grow in highly acidic foods such as fruit, vinegar, jams and most vegetables.

### Oxygen supply

Many bacteria need oxygen for survival and in order to reproduce. Food preservation techniques such as canning, bottling, dehydration and vacuum packaging rely on the removal of oxygen to extend the shelf life of foods.

### Preventative practices for a safe food supply

#### Preventing food poisoning

Food is very easily contaminated, so it is essential to establish rigorous food safety practices to minimize the risk of food poisoning. An effective food safety program covers a wide range of areas; for example, personal hygiene, the design and cleanliness of food premises including garbage and pest control, the purchase and storage of food supplied safe food-handling practices, and measures to avoid contamination.

#### Personal hygiene

The first step in the preparation of safe food is ensuring that anyone handling food follows sound personal hygiene practices:

Wash hands thoroughly before handling or preparing food, particularly after using the toilet, blowing your nose or coughing, handling raw food, eating, smoking, touching pets, or handling money or rubbish.

- Do not wear rings or any other jewellery.
- Keep fingernails short and do not wear nail polish or nail extension when handling food.
- Wear a clean apron or other protective clothing.
- Tie hair back or wear a hat or hairnet to prevent loose strands of hair contaminating food products.
- Sanitize cuts and cover with a clean, waterproof dressing.



## Design of premises

In the food industry, best-practice procedures ensure that the premises where food is prepared, stored and sold are well designed and maintained in a clean and sanitary manner. These procedures help to protect food and make sure that it is free from contamination.

Establishment of logical workflow and efficient movement from raw ingredients to finished product. This includes the safety of staff at each workstation.

- Separate areas for the preparation of raw and cooked food.
- Appropriate facilities to enable staff to maintain a high level of personal hygiene. An example is food-operated or magic-eye wash basins.
- Provision of workstations designed for easy cleaning and maintenance
- Adequate supply of hot and cold water.
- Temperature control for refrigeration, cooking and food display.
- Adequate lighting, ventilation and exhaust facilities.
- Appropriate pest control methods and garbage disposal.

## Cleanliness of premises

One of the most common causes of food contamination is poor cleanliness of the premises and the equipment used in food preparation. It is essential that premises and equipment are cleaned when changing from the preparation of one type of food to another, as well as at the end of each food preparation cycle. One of the most important rules to remember is “Clean as you go”.



Cleaning must cover all areas of the food preparation area, including the walls and floors, all fixtures and fittings such as benches, and all food preparation equipment, including stoves and mixers, and all crockery and cutlery.

Cleaning must cover all areas of the food preparation area, including the walls and floors, all fixtures and fitting such as benches, and all food preparation equipment, including stoves and mixers, and all crockery and cutlery.

It is essential to use detergent or a chemical sanitiser and very hot water (above 82°C) to make sure all bacteria are destroyed.



## Garbage

It is important to remove garbage regularly because it can contaminate food, smell bad and attract pests. Good practice in this area involves:

- Ensuring garbage containers are fly-proof and rodent-proof, and do not leak or absorb liquids.
- Using containers that are easily cleaned and have tight-fitting lids.
- Removing garbage and waste from food-handling areas and workstations as often as necessary—at least daily.
- Keeping garbage containers in food repair and cleaning them away from food preparation areas.
- Cleaning garbage storage areas regularly.

## Pest control

Pests such as insects and rodents can spoil food products by damaging the food itself or the package surrounding the food. Insects may not eat large quantities of the food, but once damaged, microbial growth is more likely to occur. Insects such as weevils spoil cereals and dried fruit by eating holes in the packaging material, leaving their faeces and body parts in the food and producing 'off' odours in the food. Rats and mice damage and contaminate food by gnawing and chewing and making body contact with the product and contaminating it with their faeces. They will eat anything, but prefer meat, fruit, vegetables and bakery goods.

Three strategies can be used to prevent insects and rodent infestation:

1. Build them out- seal unnecessary gaps around fittings, in walls and floors of the building, and ensure there is adequate space for cleaning.
2. Starve them out – Store food correctly, clean up all spills immediately, and clean food preparation areas effectively so there is no source of food for pests.
3. Chase them out – if pests enter the premises, baits can be used. These are toxic and should be handled and stored carefully to avoid contaminating food.

## Purchasing food

Contamination of food supplied can sometimes occur at the point of manufacture or processing or in the transportation of food. It is therefore essential to purchase food only from reputable suppliers who implement correct food handling and storage procedures. To ensure the food you purchase is safe and free from contamination:

- Check the use-by or best-before date.
- Examine the food for any sign of contamination, such as rancid smell or mould.
- Look for signs of damage on packaging and cans show signs of thawing.
- Ensure that frozen foods remain frozen and do not show signs of thawing.
- Check that the food is transported in a registered food transport vehicle that is kept hygienically clean and that the food is transported at the correct temperature.

## Storage

Storing food correctly is one of the key factors in preventing food poisoning. Shelf life is the period of time in which the quality of a food product remains satisfactory after processing and purchase. The shelf life of food will vary depending on the physical and chemical properties of the food and the methods of processing, packaging, distribution and storage.

Fresh foods or 'perishable' foods, including liquid. Milk, yoghurt, fresh meats, fish, poultry and fresh fruit and vegetables, are fragile and so their shelf life is short, particularly if there is poor temperature control during storage. These foods must be stored in refrigerator conditions to slow down changes that cause food to spoil and prevent growth of bacteria.

## Refrigeration

Refrigeration is the cooling of foods to below 5°C. This reduction in temperature delays the deterioration of food and slows down the microorganism growth and enzyme activity. The lower the temperature, the slower the chemical changes in food and the slower the microbial growth. Refrigeration does not kill the microorganisms; once the food has been returned to the room temperature, they will be reactivated and can continue to reproduce. Cover all cooked foods and store them on a shelf above uncooked foods. This minimizes the risk of food-poisoning organisms being transferred from uncooked to cooked foods through dripping of moisture.

## Tips for storing food safely

- Store perishable food such as meat, fresh milk and fresh fruit and vegetables in the refrigerator below 5°C.
- Separate cooked food and raw food in the refrigerator.
- Store raw food on a lower shelf so the juices cannot drip onto cooked food.
- Cover all the food stored in the refrigerator.
- Store poultry separately from fresh meat and other protein foods to avoid cross contamination.
- Make sure all foods that have a strong odour are firmly covered.
- Cool hot food for 20-30 minutes before placing in the refrigerator to avoid affecting the holding temperature of the refrigerator.
- Store frozen foods below -18°C.
- Store non-perishable foods as flour, sugar, canned and dry packaged food in a cool, dry place and above floor level.
- Check that all food is clearly labelled and includes a use-by or best-before date.
- Rotate all food in the refrigerator, freezer or pantry so that food is used on a "first in, first out" system.
- Do not store cleaning materials near food.

## Preventing cross-contamination

One of the most common causes of food poisoning is through the cross-contamination of food. **Cross contamination** of food involves the transfer of harmful bacteria from uncooked or raw food to food that has already been cooked or prepared. Cooking kills most of the harmful bacteria present in food. However, if raw food comes into contact with foods that have been cooked, bacteria may be transferred to the cooked food.

## Major risks in cross-contamination

**Storing raw and cooked ingredients together** – Processed or prepared foods should be stored in sealed containers above raw foods. Raw vegetables that contain microorganisms that might cause food poisoning should also be stored separately in refrigerated areas.

**Raw food such as chicken** – Cutting raw foods such as chicken on a chopping board can deposit salmonella bacteria in cracks or crevices on the board. Salmonella can then be transferred to a high-risk food, such as cooked meat, if another food is prepared on the same board and the board is not washed between food preparation tasks. The use of coloured boards for particular food types in commercial food preparation kitchens is one way in which health authorities have tried to overcome the problem of cross-contamination; for example, white boards for dairy products, red for raw meats and green for fruit and vegetables.

**The sink** – bacteria can transfer from one food to another when rinsed in the sink if the sink is not carefully cleaned between uses.

**Double dipping** - using a spoon to taste food and then using the same spoon to mix or stir the food allows bacteria present in the mouth to be transferred to the food that is being prepared. Equally dangerous is using one spoon to taste one food and then another product.

**Tea towel** – these should only be used to dry dishes. They should not be used to dry dishes and then wipe chopping boards, hands, or benches or to cover food.

## Food preservation (storing food safely)

Food preservation can be defined as the science which deals with the process of prevention of decay or spoilage of food, therefore allowing it to be stored in a fit condition for future use. The process used varied with the length of storage. It may be as simple as boiling milk so that it may keep for 24 hours or pickling mango or lemon where the intended period of storage may be as long as a year.



## Important of food preservation

Increasing food production to meet this shortage results in wastage due to inadequate facilities available for storage and preservation. It is therefore, important to improve and expand facilities for the storage and preservation of food. Preservation of food helps in:

1. Increasing the shelf-life of foods, therefore results in increasing the supply.
2. Making the seasonal food available throughout the year.
3. Adding variety to the diet.
4. Saving time by reducing preparation time and energy.
5. Stabilising process of foods.
6. Improving the nutrition of the population.

Preservation increases availability of foods, improving the nutrition of the people. Availability of seasonal foods throughout the year also helps in stabilising prices of such foods.

## Unit 1: Food and Nutrition

**Content Standard: 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: 10.2.1.3** Evaluate social, economic, technological impacts in meal preparation and food product development.

**Topic:** Food solutions in food product development

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

- Identify and research on factors that have an impact on food and food production.
- Discuss impacts of technology on food production and its effects on nutrition and health on humans.
- Plan and produce a food product using convenience food ingredients.

### Essential Questions:

- What are social factors influencing food choices and development?
- What are technological factors influencing food development?
- What are economic impacts on food development?
- What are the roles and functions of convenience foods?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• <b>Social</b> <ul style="list-style-type: none"> <li>- Changes in convenience foods</li> <li>- Fast food</li> </ul> </li> <li>• <b>Economic</b> <ul style="list-style-type: none"> <li>- Home –meal solutions in the supermarket</li> <li>- Dual oven able trays</li> <li>- Meal solutions on the supermarket shelves</li> </ul> </li> <li>• <b>Technological</b> <ul style="list-style-type: none"> <li>- Packaging for convenience</li> <li>- Future trends in shopping, home ordering and delivery of meals</li> </ul> </li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Research on the social, economic and technological impacts in food development</li> <li>• Explore and analyse the factors affecting food product development</li> <li>• Design a convenience food product using the design brief</li> </ul>
<b>Values/Attitudes</b>	<ul style="list-style-type: none"> <li>• Appreciate the social, economic and technological impacts in food development and be aware of their negative and positive impact to the body, people and markets</li> <li>• Respect and appreciate the past, current and future trends in shopping, home ordering and delivery of meals</li> </ul>

## Teaching and Learning Strategies

Teachers are required to introduce students to better understand the social, economic and technological impacts of food, food solutions and food production. Hence, students will apply and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to explore, investigate and develop food products that will enable students to gain an understanding of the factors that contribute to food production, social, economic and technological impacts of food to the body, health and markets. Knowledge prescribed must be taught. Students must be able to interpret what is taught and applied in their daily lives for optimum health.

## Learning Activities

### Lesson 1: Social impacts in food production

Grouped the activities listed below in 3 groups.

**Activity 1:** Students will complete review questions prepared by the teacher.

**Activity 2:** Students will work in groups. They will base their discussions on Food trends in PNG. They will relate their knowledge and understanding, to food and the way of life, its implications and influences on the PNG way of life. Students discuss the developments in food and the external influences on our native foods, and consumption practices in PNG. They will write a summary and communicate the information to students.

**Activity 3:** Students will conduct a survey and write an evaluative report on the nutritional status of the local communities and present in class.

Their investigations will include:

- The native foods of PNG and how they are obtained,
- Methods of food collection and techniques of preservation and distribution,
- Food preparation techniques,
- Papua New Guinean Food ways today,
- Changes in the food supply and
- Culture, History, Migration, Colonisation.

Teacher will compile and research document for students to execute and report.

### Lesson 2: Economic factors that impact food production

**Activity 1:** Students will complete review question set by the teacher

**Activity 2:** Work in groups to discuss and identify how the following factors will influence individual choices on food.

- (a) Taxes versus goods and service
- (b) New Food products
- (c) Poverty
- (d) The Barter Economy
- (e) Government Policies

**Activity 3:** Select a food product advertised on TV and observe its marketing procedures. What special techniques were used to capture the consumers attention and persuade them to buy the product. Overall was the advertisement, informative, misleading or exaggerated?

**Lesson 3: Technological impacts in food development**

**Activity 1:** Students will complete review question set by the teacher.

**Activity 2:** Students will be taken on excursion and they will tour a food processing outlet, would be a baking, soft drink factory, or fish cannery. Identify the range of technology used and their functions. Write a report and submit or complete review questions.

**Activity 3:** Write an essay: Describe how technology has been a factor change on food development.

## Content Background

Food choice and development is influenced by many things, including social, economic and technological influences.

Social influences are those which involve people. Some common social influences on food choices are family, peer group, personal likes and dislikes, lifestyle, for an example, employment, education, household structures, roles, geographic location, interests, religion, traditions and culture.

Technological influences involve changes in the way things are designed and conducted. Some areas affected by technological developments are the use of internet to shop, equipment, climate, food availability, packaging and storage.

Economic influence depends on a person's economic situation that is the amount of money available to spend which can influence food selection. Economic factors include; marketplace (retail and purchasing practices), resource availability such as food processing equipment and food preparation skills, occupation and finances.

Some social and technological factors influencing the food we choose to eat

Factor	Example of influence on food choices
Family	We buy chicken and chips every fortnight.
Personal Likes	I like to eat fresh vegetables.
Personal dislikes	I don't like beans.
Religion	We eat certain protein food apart from other food.
Tradition	We have whole mumu pig for marital feasts.
Culture	Mother of new born baby ia not allowed to eat red meat.
Media	I feel like chicken tonight or I like 2 minutes noodles advertised on TV/newspaper etc.
Education	I eat wholegrain bread because I know it is higher in fiber.
Climate	We have hot tea on cold nights or we drink cold water on hot days.
Availability	Kaukaus or sweet potatoes are available all year.
Equipment	It's quicker to cook it in the microwave oven.
Packaging	I like the shape of the jar.
Storage	We always store some UHT milk in case we run out of milk.

## Influences on food availability and selection

### Social, Economic and Political

Social, economic and political influences on food availability, including:

- effects of poverty and affluence/wealth
- type and state of the economy
- government policy, e.g. taxation, embargoes, subsidies, war, export strategies

### Social impact

Historical changes to the availability of food, including:

- global migration of cultural groups
- use of foods native to the country

**Technological impact**

Technological developments influential on food availability, including:

- production and manufacturing processes and equipment techniques
- storage and distribution techniques
- marketplace practices

**Physiological factor**

Physiological factors, including:

- hunger, appetite, satiety
- nutritional requirements, e.g. age, gender, size, activity level
- reactions to food, e.g. appearance, odor, taste, allergy

**Psychological factor**

Psychological factors, including:

- values, beliefs, habits, attitudes, emotions, self-concept, experiences

**Nutrition Education**

As people became more health conscious, the amount of available information is necessary hence being obtained from agencies that educate people about nutrition. As our knowledge of nutrition and improves, and our access to nutrition information increases, food fads or beliefs are less likely to influence our food choices.

## Unit 1: Food and Nutrition

**Content Standard: 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: 10.2.1.4** Apply safety and hygiene procedures in tool and equipment, food handling, meal preparation, food development and food service.

**Topic:** Safety, hygiene practices and food service

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

- Explore and analyse safe and hygienic practices in tool and equipment handling, food handling and safe food processing.
- Communicate and evaluate processes and factors involved in food service.
- Apply the skills in producing a food product using the kitchen equipment.

### Essential Questions:

- What are safe and hygienic practices in handling equipment for food product development?
- What the safe and hygienic ways involved when preparing food?
- How are foods prepared nutritionally, attractively and free from contamination for consumption?
- What are the different types of food services and food considerations?
- What are consumer rights?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Safety and hygienic procedures or/and practices in tool and equipment handling, food handling, food development               <ul style="list-style-type: none"> <li>- The knife</li> <li>- Mixing and processing</li> <li>- The food processor</li> <li>- Crushing, grating, mashing and grinding</li> <li>- Measuring and weighting</li> </ul> </li> <li>• Food Service               <ul style="list-style-type: none"> <li>- Catering for others</li> <li>- Economic and social values of food service and catering industry</li> <li>- Employment opportunities</li> <li>- Menu planning considerations</li> <li>- Consumer rights and responsibilities in relation to food</li> </ul> </li> </ul>
<b>Skills</b>	<p>Explore safe and hygienic procedures in tool and equipment handling, food handling and food development</p> <p>Research on the type of tools and equipment used in the kitchen</p> <p>Investigate economic and social values of food service and catering industry</p> <p>Examine and communicate consumer rights and responsibilities in relation to food</p>

**Values/Attitudes**

- Appreciate and be aware of the safe use of kitchen tools and equipment
- Value the importance of food service
- Make informed decisions of food consumer rights and responsibilities

**Teaching and Learning Strategies**

Teachers are required to introduce students to better understand safety and hygiene procedures in handling kitchen tool and equipment, food handling, meal preparation and food development. Students will examine food service and catering ventures and their operations across a variety of settings and investigate employment opportunities. Students will plan and prepare safe and appealing foods appropriate for catering for small or large scale functions.

**Learning Activities****Lesson 1: Tool and equipment handling**

**Activity 1:** Explore and research on what a kitchen is and its importance in terms of food storage, meal preparation and cleaning.

**Activity 2:** Research and compile a report on the different tools and equipment used for food preparation.

**Activity 3:** Work in groups to prepare a meal using safe handling practices on kitchen tools and equipment.

**Lesson 2: Safe food processing**

**Activity 1:** Research and present ideas on safe food processing.

**Activity 2:** Work in groups to plan and prepare safe food using food safety processes.

**Activity 3:** Explore and investigate on various safety symbols and First Aid Application.

**Lesson 3: Food service and considerations**

**Activity 1:** Research and compile a report on food service and considerations. Examine a variety of food service and catering operations. Discuss the contribution of the food service and catering industry to society.

**Activity 2:** Design, plan and prepare safe and appealing food items appropriate for catering for small or large scale functions.

## Content Background

Tools, equipment, gadgets and appliances are constantly being designed and developed to make the cook's tasks easier and more efficient. Many of the specialists' tools help the cook to create a professional finish when carrying out food production process.

The kitchen is a working room and, in order for it to be easy and efficient to work in, it must be well planned. There are different settings of a kitchen in PNG homes but its basic function is a place where food is stored and prepared for meals. Kitchens often contain a dining area, and some have a separate utility room for laundering.

The equipment and kitchen units should be positioned in a logical order so that they form a continuous working area to suit the sequence and stages of the main activities carried out in the kitchen. For meal preparation, this sequence would be:

Food storage - preparation – cooking – serving – clearing up

Storage space is needed in the kitchen for food, utensils, serving dishes, small and large equipment. Food can be divided into four main groups according to how it should be stored;

- Dry foods such as flour, coffee, sugar, tea, rice, biscuits and canned food should be stored in a dry cupboard.
- Semi-perishable foods such as bread, vegetables and fruits requires storage degree Celsius in a well-ventilated cupboard.
- Perishable foods such as eggs, cheese, milk, meat and fish should be kept in temperatures below 5<sup>0</sup>C that is in the refrigerator.

## Kitchen Equipment

### Mixers and blenders (liquidizers)

They are electrical machines that help people to have less time to spend in preparing food than they did in the past. The machine does the job more quickly and more efficiently.

### Equipment for mixing and processing

Many kitchen equipment or machines are multi-purpose or carry out a number of food processes quickly and efficiently such as slicing, grating, shredding, beating, juicing, whisking, kneading and mixing.

For an example, a food processor takes the place of many other tools and pieces of equipment in the kitchen. It will perform most of the basic tasks when preparing food such as mixing, blending, whisking, kneading, puréeing, grating, slicing and chopping. Different blade attachments chop meat and vegetables; make breadcrumbs, mix dough, purée soups, and slice, grate and shred vegetables and cheese.

Other kitchen tools include;

- Equipment for mixing and whisking
- Heated food trays and servers
- Pans
- Electric kettles
- Equipment for weighing and measuring
- Cutlery
- Cutting tools
- Tools for crushing, grating, mashing and grinding

- Tools for sieving and straining

### **Dishwashers**

In most PNG homes, eating and cooking utensils are washed in the sinks or in wash dishes. However, the introduction of dishwashers has made work easier for people in modern homes. The dishes and other items have to be stacked into the machine. They are then thoroughly washed, rinsed, and dried automatically.

### **Kitchen Safety**

The kitchen is a working space and therefore, it must be clean and safe. For example, in food preparation, tool such as knives must be handled with care, the kitchen floor clean and dry, electrical equipment are plugged in sockets safely. All danger symbols must be read and understood to prevent accidents. It is important to have a first aid kit.

### **Four (4) Steps to Food Safety**

- 1. Clean** - Clean cook, clean kitchen, clean food.
- 2. Separate** - Separate raw and ready –to-eat foods.
- 3. Cook** - Cook to correct internal temperature.
- 4. Store/chill** - Refrigerate foods promptly.

### **Food service and catering**

Food service and catering are important areas of the food industry. They provide people with both food and employment.

Food service and catering ventures including;

- profit, e.g. restaurants
- nonprofit, e.g. hospitals
- the economic and social value of the food service and catering industry

Employment opportunities including;

- back of house, e.g. chef, kitchen hand
- front of house, e.g. waiter, supervisor
- management
- delivery

Consumer rights and responsibilities in relation to food including;

- safety and hygiene
- value for money
- accurate information with regard to food labeling and marketing

Outline the responsibilities of the employer and employee under various Acts and legislation with regard to food establishments;

Assess and manage risks when preparing and managing foods

- anti-discrimination legislation

Outline the rights and responsibilities of consumers with regard to food.

Menu planning considerations such as;

- scale of function
- types of menus for example cyclic, a la carte
- facilities, staff, time, money
- time of year, time of day, occasion
- health, occupation, gender, age, preferences, number of people
- nutritional value of food

Recipe development including;

- ingredients to be used
- method of preparation
- quantity required for various portions

Cost per portion

- measuring
- recipe writing

Purchasing systems – ordering, receiving, controlling, issuing

Food service and catering considerations such;

- plating food
- style of meal
- number of courses
- customer requirements
- cost
- time available

Demonstrate safe work practices when preparing and serving food.

- Table setting and serving

## Unit 1: Food and Nutrition

**Content Standard: 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: 10.2.1.5** Apply the design process to create food solutions.

**Topic:** Food Design Solutions

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

- Use the design process to create a food solution.
- Create and communicate in a presentation, the design process steps followed in creating a food solution.
- Design, plan and prepare a meal/menu/dish suitable for people with special needs or different age groups.

**Essential Questions:**

- What are food design solutions?
- How is a design process used to make a food solution?
- What are the stages of the design process and what do they involve?

**Essential knowledge, skills, values**

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Food design process</li> <li>• Food design brief</li> <li>• Food solutions</li> <li>• Food management and evaluation</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Investigate and use the design process to create a food product</li> <li>• Evaluate the design process</li> </ul>
<b>Values/Attitudes</b>	<ul style="list-style-type: none"> <li>• Respect food and be aware of its benefits to the body, people, markets</li> <li>• Appreciate and value PNG Nutritional food</li> </ul>

**Teaching and Learning Strategies**

Teachers are required to introduce students to better understand the food design process. Hence, students will apply and master the knowledge prescribed in each benchmark and topic. Whilst introducing the topic, guided discovery and research will enable students to explore, investigate and develop a design brief that identifies the need for the product and specific information about the factors that will influence the development of the new product. Knowledge, skills, values and attitudes prescribed must be taught where students appreciate the importance of maintaining hygiene throughout the process and to evaluate the processed product.

## Learning Activities

### Activity 1: Design, Prepare and Evaluate a Processed Food Product

**1a.** Students plan and prepare a food solution for dried spices or any selected food type that suits their context.

**2a.** Design and create a food product that goes through one of the techniques of food preservation.

**3a.** Prepare a label for that food product.

### Activity 2: Conducting the Practical

Divide the class into groups of 5-6 students each. Each group should do the practical separately following the steps given below:

**1.** Identify a product or food item (that can be preserved and stored) that you would like to prepare, e.g., pickles, jams, squash,

**2.** Try and make it different from products already available in the market by using different raw ingredient(s) or consider using sugar. Make approximately 500 gm of the product. Try to use locally available fruits and vegetables/ fruit or vegetable peels e.g., watermelon rind, orange peel or lemon rind/ sweet lime rind, pumpkin seeds, melon seeds,

**3.** Make a list of vegetables/fruits, ingredients, preservatives, utensils, gadgets and medium of heat required, and collect all the items and materials.

**4.** List the criteria used in the selection of raw materials, equipment and accessories.

**5.** Write the recipe and method of preparation, step-wise, in detail.

**6.** Identify the packaging material e.g., glass/plastic bottle or polyethylene pouches or bags.

**7.** Prepare the product under as hygienic conditions as possible.

**8.** Do costing in terms of cost of food materials and ingredients, energy consumed, labour cost and cost of storage and packing material.

## Content Background

The notes describe the process of product development in large or commercial food industries. Modify or simplify the lesson activities depending on your context and availability of resources.

### Process of product development

Whether an existing product is to be redeveloped through a line extension, a new product is to be developed in response to competition, or a new product range is to be developed, food manufacturers will approach the problem by following the design process. The design process is a series of systematic steps that the manufacturer takes to develop the new food product.

However, while the company will begin the process of design in a systematic way, sometimes the design process may be interrupted at various stages as problems arise. This often occurs in the stage of developing alternatives, or when the company is designing a plan to produce a product. When problems happen, the project team may need to go back to the investigation or research stage, so that additional information can be found, and solutions suggested.

### Stage 1

#### Research Market

Market research is an important part of all new product development. Companies collect and analyse a wide range of information to assist them in their decision-making about product development. Through market research they find out about;

1. The demographics of their consumers;
  - i. Age,
  - ii. Gender,
  - iii. Socio economic background,
  - iv. Lifestyle,
  - v. Work,
  - vi. Family life, and
  - vii. General buying patterns.

As part of the research, the specialist also observes the societal trends and influences in the market place, which can create opportunities. The company uses this information collected because of market research to develop the concept for a new product.

### Stage 2

#### Design brief

The initial idea for a product may come from marketing specialists, who present a concept for a new product that they have developed as a result, of observing trends in the market place, or it may result from technical research.

Wherever the idea may come from, a **design brief** – a statement or outline of the new product- is developed from the initial proposal. The design brief clearly defines the aims and intentions of new product and includes all of the specifications or constraints and considerations. It provides directions for the product development teams.

The importance of storing initial design brief includes,

1. Avoid misunderstanding during the design and development of the product. A misinterpretation of the design brief could result in,
  - a. Company wasting valuable resources,
  - b. Waste of Time, and
  - c. Waste of finances/money.

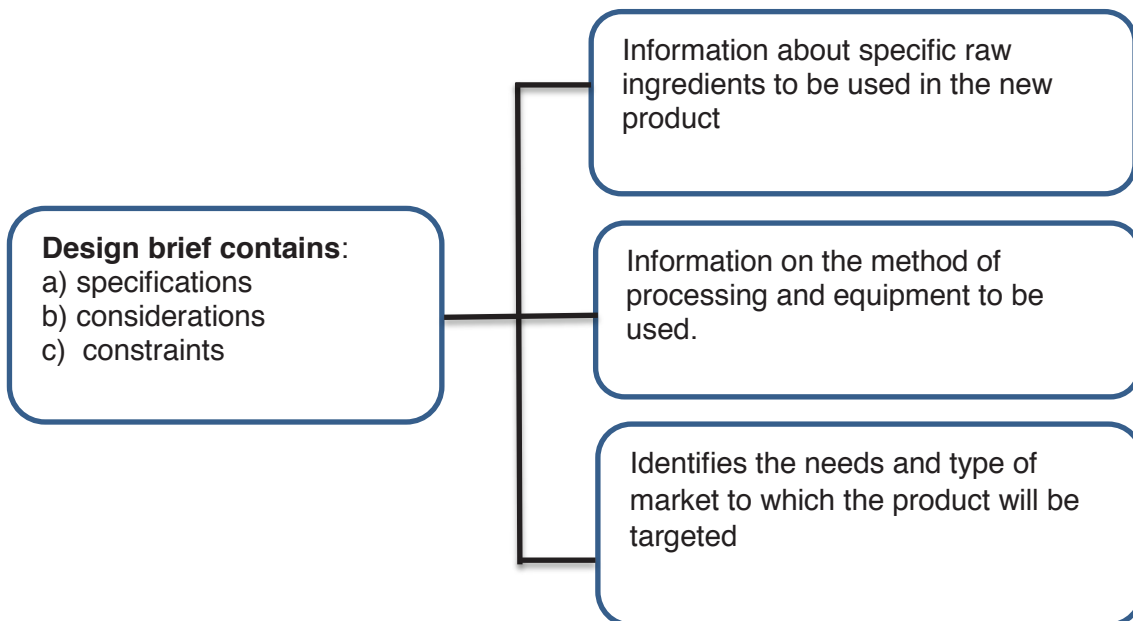
2. Once the initial design brief will be established and accepted,
  - a. A separate production brief will be prepared for different sections of the manufacturing process, including
    - i. Food technologists
    - ii. Packaging technologists

### Components of a design brief

The aim of the project must be written in clear and unambiguous language. The design brief outlines the focus of the new product and what is to be achieved.

Components of a design brief include

1. Information about specific raw ingredients to be used in the new product.
2. Information on the method of processing and equipment to be used.
3. Identifies the needs and type of market to which the product will be targeted.



### Stage 3 Evaluation Criteria

The aim of every company is to develop products that will be well accepted by consumers and therefore help the company to make a profit. A key part of the design process is the development of criteria that can be used to evaluate the product. This will help the company to determine whether the product is likely to meet the needs outlined in the design brief well before the product is launched in the market place.

The key aspects likely to be evaluated include issues such as whether the product will;

- a) Meet the constraints set out in the design brief
- b) Have acceptable sensory properties
- c) Utilize current expertise and resources available to the company
- d) Be profitable for the company.

## Stage 4

### Developing new and innovative product ideas

There are two stages in developing ideas for a new product

1. The innovative ideas stage
2. The evaluation and screening of these ideas or testing.

### Innovative ideas stage

This state is the brainstorming or ideas stage when marketing and technical experts in the company think up new ideas and try to determine which products will meet the needs of the consumers.

To generate new ideas, the company will use a range of strategies.

1. **Direct research**
2. **Creative research**

## Stage 5

### Prototype and product testing

The next step in the development of a product is to develop the ideas into a sample product or prototype. A prototype is a sample product or trial model of the product idea that was outlined in the design brief. It is produced on a very small scale to see whether the product idea is likely to be viable.

In developing the prototype, the food technologists carry out a range of experiments to determine the best combination of ingredients to ensure the product has appealing sensory properties and the shelf of the product is maximized. Their experiments also establish the processes to make the best product possible. Another important aspect is the need to develop a prototype for the packaging to be used for the product, considering issues such as shelf life, product protection, ease of handling and distribution, labeling requirements, consumer appeal and environmental sustainability. Once the prototype has been produced, it is subjected to qualitative or sensory analysis such as;

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

Comparison screening may also be undertaken by the company to ensure that the product will be competitive with similar products in the market place. This can involve purchasing a competitor's product and undertaking both a quantitative analysis and qualitative evaluation of the product and comparing it with the prototype. This will identify areas for improvement so that the product can offer enhanced features to the consumer.

Sometimes products are rejected at the prototype stage because it is apparent that while in theory they seemed appropriate, the ideas will not translate into feasible product. If it appears that the product is likely to be accepted, a recipe will be formulated ensuring that it meets all legal requirements.

## Stage 6

### Production

When a successful prototype is developed, the company will then move into the production phase of the product development. The company begins production trials in which the prototype is scaled up for production. The production trials take place in a pilot factory, which has similar equipment to that used in the main factory, but on a smaller scale.

Finally, the process engineer designs the production line to be as efficient as possible, specifying:

- the exact ingredients to be used,
- the precise processes required in the production, for example, whether the melt-and-mix method or the creaming method is used,
- the processing conditions such as oven temperature and length of baking or chilling, and
- a detailed Hazard Analysis Critical Control Points (HACCP) system.

### Packaging and labeling

Packaging and labeling are an important stage in the development of the product, as the packaging often sells the product.

## Stage 7

### Marketing/launch

A marketing campaign must also be developed to help launch the new product into the market place. The company may have its own marketing department, which is responsible for developing a promotional campaign for the product, or it may use the services of a professional marketing company. The goal of the marketing campaign is to encourage consumers to try the product; it doesn't matter how good the product is if no one buys it.

After consumers have made their initial purchase, the marketing campaign must encourage becoming repeat purchasers to maintain market sales.

The company will start planning the marketing campaign long before the first product come off the conveyor belt.

### Product, price, place and promotion

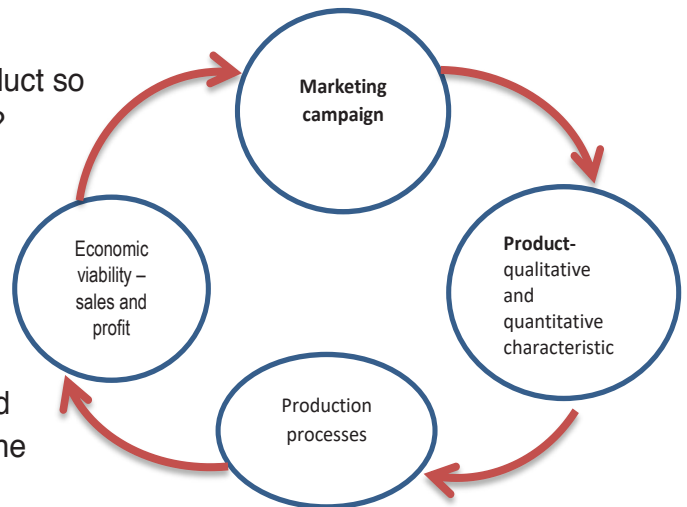
A key feature of the development of a successful marketing plan is establishing the marketing fundamentals for the campaign, the 4Ps – product, price, place and promotion. This means answering some key questions about the product:

- What is the product and who is the target market?



- ii) What price can it be marketed at to make a profit for the company but still be acceptable to the target market?
- iii) Where is the best market place or location to sell the product that it is accessible to the target market?
- iv). What is the best way to promote the product so that it is widely recognised by consumers?

The product launch is a key feature of the marketing campaign when the new product is introduced into the market place on a large scale. The launch usually includes an intensive advertising campaign, often involving television and magazine advertising, social media, billboard signage, in-store promotion and taste-testing. The marketing campaign must be exciting and create interest in the product to encourage consumers to purchase the product, not just once, but regularly so that the product continues to make a profit for the company.



## Stage 8

### Evaluation of a new food product

A comprehensive evaluation of all stages in the development of the product is undertaken by the company to make sure that the product meets the requirements set out in the design brief and that it will be successful in the market place, so that the company makes a profit. This will include an evaluation of the product, including its qualitative and quantitative characteristics, the production processes, its economic viability and the marketing campaign.

### Product evaluation

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. Although the company will undertake a similar evaluation during the development of the prototype, the company usually does some follow-up product evaluation using tasting panels and consumer testing to test the appeal of the product and its packaging to consumers. This assists the marketing team to develop marketing strategies to successfully launch the product in the market place.

### Valuation of the production process

The process engineer and the production manager review all stages of the production. This includes:

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

Consideration is also given to the

1. suitability of the cooking methods,
2. flavorings/ and
3. presentation of the food.

In addition, they also review;

1. the technical expertise required to produce the product,
2. whether staff require retraining or additional staff are needed,
3. They evaluate the effectiveness of the production processes,
4. the problems that arose during the scale-up and full production process, and
5. It is also important to review the **HACCP** system to determine if identified hazards were monitored effectively and the corrective actions were successfully implemented.

### Evaluation of the economic viability

When a new product is in the development stage, the company will undertake an economic analysis of costs involved in its production. These figures are really an estimate of the anticipated costs of the design and development of the product, and the likely profit if sales meet their target. This process is called a **financial feasibility study** and is used to determine a **break-even point** based on the costs of costs of development, marketing, production and number of sales required to make a profit.

### Evaluation of the market campaign

The company also evaluates all aspects of the marketing campaign, including the promotional strategies such as television and magazine advertising, social media, promotional displays, any competitions that have been run in conjunction with the product launch, supermarket demonstrations and free samples. Company employees, consumers and industry specialists are all asked for feedback on all aspects of the marketing mix.



The company also undertakes a SWOT analysis of the marketing plan to identify whether minor adjustments need to be made. A key aspect of the SWOT analysis is to;

1. Evaluate the competition from other manufacturers, determining the strength of the product in comparison with similar products in the market place.
2. Another key aspect of the evaluation of the marketing plan is a review of the target market. An analysis of sales identifies whether the needs of the target market are being met as anticipated. If sales are below expected levels, these needs may not be being addressed.
3. The product packaging is also evaluated to ensure that it is achieving its aim of protecting the product, as well as being a key feature of the marketing plan.

4. Establishing sales targets will be one of the important features of the marketing plan. If initial sales rise quickly and stabilise at a level that will ensure a profitable return to the company and meet the target, the company generally maintains the product in its range.

However, if the product does not prove to be economically viable, it is unlikely that the company will continue to support the product's promotion. Equally, if for any reason problems arise with the design or in the production of the product, the company may decide to 'kill' the product to protect the reputation of the company and sales of to the products in its range.

## Unit 2: Food Science

<b>Content Standard: 2.2</b> 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	<b>10.2.2.1</b> Discuss and evaluate cultural, physical, chemical and nutritional characteristics of food and the impact in product development	Food characteristics and development	<b>Lesson 1:</b> Cultural properties of food <b>Lesson 2:</b> Characteristics and properties of food
	<b>10.2.2.2</b> Examine changes and properties of food which occur during food processing, preparation and storage	Food Processing	<b>Lesson 1:</b> Physical and chemical changes in food
			<b>Lesson 2:</b> Functional properties of food
			<b>Lesson 3:</b> Mechanical factors to food
	<b>10.2.2.3</b> Compare the biological and sensory characteristics of food and the impact in food product development to meet various needs, occasions and health	Food Product development	<b>Lesson 1:</b> Biological characteristics of food
<b>Lesson 2:</b> Sensory characteristics of food			
<b>Lesson 3:</b> Impact of food development			
<b>10.2.2.4</b> Apply the management skills and create consumer awareness in food selection, meal preparation, preservation and storage of food	Consumer behaviour and marketing	<b>Lesson 1:</b> Consumerism	
		<b>Lesson 2:</b> Consumer behaviour	
		<b>Lesson 3:</b> Food marketing	
<b>10.2.2.5</b> Apply the design process to create food solutions	Food solutions	<b>Lesson 1:</b> Design, Prepare and Evaluate a Processed Food 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)

**Benchmark 10.2.2.1** Discuss and evaluate the cultural, physical, chemical and nutritional characteristics of food and the impact in product development.

**Topic:** Food characteristics and development

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

- Identify and explain the physical and chemical properties of food.
- Analyse and explain the impact of food processing on the characteristics and properties of food.

**Essential Questions:**

- What are the characteristics and properties of food?
- What happens to physical and chemical properties of food when they are processed?
- Why is it important to know about pH levels/values when processing food?

**Essential knowledge, skills, values**

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Characteristics and properties of food</li> <li>• pH value of food</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Research and analysing food impact or issues</li> <li>• Experimenting with and preparing by applying the concepts/principles</li> <li>• Designing, implementing and evaluating solutions to food situations</li> </ul>
<b>Attitudes /Values</b>	<ul style="list-style-type: none"> <li>• Appreciate the importance of food to the wellbeing of an individual</li> <li>• Respect self and others in relation to food choices</li> <li>• Make informed decisions and carry out responsible actions</li> </ul>

**Teaching and Learning Strategies**

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to understand the characteristics and properties of food. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning. Students must be given opportunities to apply their knowledge, to be creative and become problem solvers.

The lessons are focused on Cultural Properties of food, Physical and Nutritional Characteristics of food, Chemical and Sensory Characteristics of food and Impact of food processing and food development on food.

**Learning Activities****Lesson 1: Cultural properties of food**

**Activity 1:** Students conduct a research by interviewing people from different provinces and where they live. Find out about their food practices, beliefs, systems, values, lifestyles, traditions and what foods they ate, how they were obtained, what utensils and equipment they used and how cooked, served and eaten.

Write a report and some recipes and make a booklet to add to the school library as references material for other students.

**Lesson 2: Characteristics and properties of food**

**Activity 1:** Students work in groups. They discuss and describe presenting food for visual appeal at a mumu or barbecue outdoor setting. They decide on the menu and write what they would do to ensure the colours, appearance, size, shape, gloss, nutritional content and arrangement of the food and surroundings as appealing. Draw a labelled diagram to illustrate the setting.

## Content Background

Food Science is a multi-disciplinary field involving chemistry, biochemistry, nutrition, microbiology and engineering to give one the scientific knowledge to solve real problems associated with the many facets of the food system. The basis of the discipline lies in an understanding of the chemistry of food components, such as proteins, carbohydrates, fats and water and the reactions they undergo during processing and storage. A complete understanding of processing and preservation methods is required including drying, freezing, pasteurization, canning, irradiation, extrusion, etc. The ability to carry out analysis of food constituents is developed along with statistical quality control methods. The microbiology and the safety aspects of food must also be understood. Other areas include food additives, the physico-chemical properties of food, flavor chemistry, product development, food engineering and packaging. Food science integrates this broad-based knowledge and focuses it on food.

Foods have a variety of functional properties. In commercial and domestic food processing and preparation, information of food components and their associate qualities and properties is essential to produce a wide range of products. During food production, the outcome depends on the physical and chemical nature of the foods being combined or used. These qualities are called properties. Functional properties of food components are used to bring about changes to food. These are:

- Environmental factor, for example, heat, cold, light and air.
- Proportions of different foods that are combined in a recipe, for example, the ratio of butter to flour in pastry.
- Application of mechanical forces, for example, whisking, beating and stirring.
- Acid or alkaline levels in the food to be combined, such as the pH of foods.

How some foods change;

Action	Example of food	What happens?	Why?
Cutting	Potato, sweet potato	The apple goes brown	The air mixes (reacts) with enzymes (substances in the apple), which makes it brown
Whisking	Egg whites, eggs and sugar	Air is trapped in small bubbles	Protein in the egg stretches and holds lots of air
Cooking	Boiled rice, yams, cassava	The textures change from hard to soft	Starch granules absorb water, swell up and soften

### The pH scale

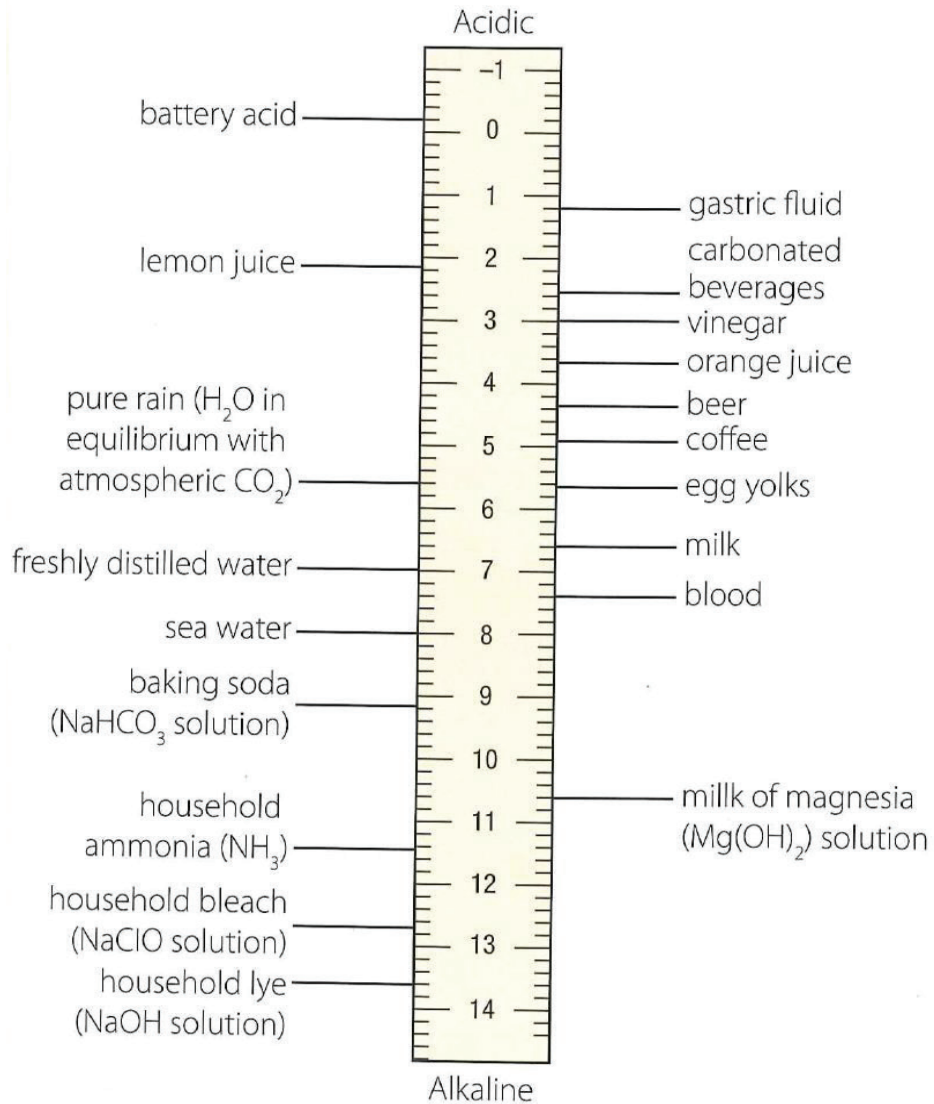
pH is a measure of the acidity of a solution. The 'p' stands for potenz, the potential to be, and the 'H' stands for Hydrogen. pH is measured on a scale of 1 to 14.

On the scale:

- Neutral solutions have a measurement of 7 and are therefore neither acid nor alkali
- Acidic solutions are found between 7 and 1 with the strongest acid at 1
- Alkaline solutions are found between 7 and 14 with the strongest alkali found at 14.

This information of the scale is critical for food manufacturers as acidity and alkalinity have far reaching effects on the functional properties of food components. pH levels are important in food technology. Micro-organisms such as yeasts, moulds and bacteria are sensitive to a food's pH. For example, by adding vinegar to food being pickled increases the acidic levels of the food because the vinegar contains acetic acid. Vinegar has a pH of less than 4.6, which causes the bacteria in the food to be destroyed. Chutney is another example of a food being preserved by using acid (along with sugar and salt).

### The pH scale



## 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)

**Benchmark 10.2.2.2** Examine the changes to the properties of food which occur during food processing, preparation and storage.

**Topic:** Food Processing

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

- Analyse and explain the processes of food processing, preparation and storage.
- Explain how these have an impact on the physical, chemical and nutritional properties of food.

**Essential Questions:**

- How do food processing, preparation and storage affect the properties of food?
- Why is it important to consider the properties of food in food processing, preparation and storage?
- What are the effects of food processing and preparation methods?

**Essential knowledge, skills, values**

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Changes to properties of food during food processing, preparation and storage</li> <li>• Food components and polymers</li> <li>• Vitamins and minerals</li> <li>• Fats and proteins</li> <li>• Carbohydrates and fibre</li> <li>• Types of food processing</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Explore the impacts of food properties</li> <li>• Investigate, evaluate and communicate the changes that occur in food processing</li> </ul>
<b>Attitudes /Values</b>	<ul style="list-style-type: none"> <li>• Appreciate</li> <li>• Make informed decisions</li> <li>• Be aware/advocate</li> </ul>

### Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to understand food science. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning. Students must be given opportunities to apply their knowledge, to be creative and to solve problems.

## Learning Activities

### Lesson 1: Physical and chemical changes in food during processing and storage

Teachers are encouraged to incorporate practical activities to support students learning. Field trips can be organised to food processing plants for students to broaden their learning on the effects of food processing, preparation and storage. Local knowledge should be utilized to give more relevance and meaning to learning, incorporate technology ideas to reinforce major concepts.

#### Activity 1:

**1a.** What are the physical changes that occur in food products during processing or in presentation?

**1b.** What are three examples of physical changes in food?

#### Activity 2:

**2a.** What are the five chemical changes that occur during food processing?

**2b.** What are chemical reactions in food processing when food is cooked in high temperature?

### Lesson 2: Functional properties of food

#### Activity 1:

**1a.** Read and summarize the factors that affect the functional properties of food: temperature, agitation, acidity, oxygen and enzymes.

**1b.** Describe and summarize working characteristics and functional properties in food processes;

- Thickening
- Tenderising
- Shortening
- Setting
- Laminating
- Glazing
- Fortification
- Foaming

### Lesson 3: Mechanical Impact to food processing

Activity 1: Discuss and critically analyse some of the mechanical processes in food processing and evaluate the usefulness of these mechanical processes. They include;

- Extension
- Large mixing
- Grinding
- Chopping
- Emulsifying equipment

**Activity 2:** Students will engage in discussions on the following mechanical processes in food processing. They include;

- Cleaning
- Size reduction
- Sorting
- Grading and removing of inedible parts
- Mixing and machnical separation
- Heating and cooling
- Evaporation and Freezing

## Content Background

### Food components and polymers

Phase transitions of food components are likely to alter the physical properties of food materials.

Foods are complex systems, but their physical state at a macroscopic level is often governed by phase transitions of the main components, that is, carbohydrates, lipids, proteins, and water. Significantly more important changes in phase and state can affect food material properties at the supramolecular level, which also provides fascinating opportunities for food materials science and the engineering of foods.

The macroscopic phase transition behavior of food solids has similarities to that of synthetic polymers. However, in foods, water is probably the most significant compound and diluent, which may significantly affect the physical state and properties of other component compounds.

Various first- and second-order phase transitions in food materials may occur during a number of processes, storage, distribution, and digestion. Food materials that are rich in water obviously become solid at freezing temperatures. The physical state of oils and spreads at various temperatures is dependent on the location of melting temperatures, which is an extremely important attribute. The relationships between food properties and the physical state are complex. The physical state of foods may be difficult to detect, as it is often extremely sensitive to temperature, time, and water. The main constituents of foods may exist in the liquid state or in the solid crystalline or amorphous noncrystalline state. Many of the component compounds, for example, sugars, fats, and water, in their chemically pure form, crystallize below the equilibrium melting temperature. However, the numerous chemical compounds that exist in food solids do not always allow the formation of such highly ordered equilibrium states.

Foods can seldom be considered as being equilibrium systems, which makes their phase behavior complex and time dependent.

### What is food processing and storage?

The most basic definition of **food processing** is “a variety of operations by which raw foodstuffs are made suitable for consumption, cooking, or **storage**”. **Food processing** includes any action that changes or converts raw plant or animal materials into safe, edible and more enjoyable, palatable food stuffs.

### Which nutrient is mostly affected by food processing and storage ?

The **nutrient** value of **food** is almost always altered by the kind of **processing** it undergoes. The water-soluble **vitamins** are **the most** vulnerable to **processing** and cooking. Careful cooking and **storage** will help retain the **nutrients** in your **food**.

### What are the effects of food processing and preparation methods?

**Processing** (including **preparation**) makes **food** healthier, safer, tastier and more shelf-stable. While the benefits are numerous, **processing** can also be detrimental, affecting the nutritional quality of **foods**. Blanching, for example, results in leaching losses of vitamins and minerals.

**What happens to food nutrients when processed?**

Depending on the degree of **processing**, many **nutrients** can be destroyed or removed. Peeling outer layers of fruits, vegetables, and whole grains may remove plant **nutrients** (phytochemicals) and fiber. Heating or drying **foods** can destroy certain **vitamins** and minerals.

**What are types of food processing?**

Early types of food processing included cooking, smoking, **fermentation**, and **drying**. These methods have been refined but are still in use today. New technologies have been developed, including irradiation, high-pressure, extrusion, and freeze-**drying**, that have generated new products and enhanced food safety and quality.

**Food processing**

Food is processed every day, for example, when preparing a meal for our family. All foods undergo some form of processing before they are ready to eat. Proper food processing is important to avoid food related sicknesses. The basic definition of food processing is when raw food are made suitable for consumption, cooking or storage. Food processing includes any action that changes or converts raw plant or animal into safe, edible and more enjoyable palatable foodstuffs. In large-scale food manufacture, processing involves applying scientific and technological principles to preserve foods by slowing down or stopping the natural processes of decay. It also allows changes to the eating quality of foods to be made in a predictable and controlled way. Food processing also uses the creative potential of the processor to change basic raw materials into a range of tasty attractive foods that provide interesting variety in the diets for consumers. Food processing has been used for centuries in order to preserve foods, or simply to make foods edible. In fact, processing spans the whole food chain from harvesting on the farm to different forms of culinary preparation in the home, and it greatly facilitates provision of safe food to populations around the globe.

Food processing can lead to improvements in, or damage to, the nutritional value of foods, sometimes both at the same time, and it can help to preserve nutrients that would otherwise be lost during storage. For instance, shock-freezing of vegetables shortly after harvesting slows the loss of sensitive nutrients. Raw beans are inedible and the simple process of heating (e.g. boiling) renders them edible by destroying or inactivating specific anti-nutritional factors they contain. The process of boiling vegetables does lead to losses of vitamin C but it can also release certain beneficial bioactive compounds such as beta-carotene in carrots, which would otherwise be less available during digestion because the heating breaks down the plant cell walls.

For centuries, ingredients have served useful functions in a variety of foods. Our ancestors used salt to preserve meats and fish, added herbs and spices to improve the flavour of foods, preserved fruit with sugar, and pickled vegetables in a vinegar solution. Today, consumers demand and enjoy a food supply that is nutritious, safe, convenient and varied. Food processing methods (e.g. food additives and advances in technology) help to make this possible. Food additives are added for a particular purpose whether it is to ensure food safety, to add nutritional value or to improve food quality. They play an important role in preserving the freshness, safety, taste, appearance and texture of foods. For example, antioxidants prevent fats and oils from becoming rancid whereas emulsifiers stop peanut butter from separating into solid and liquid fractions. Food additives keep bread free of mould for longer and allow fruit jams to "gel" so they can be spread onto bread.

## Effects of processing on nutritional quality

Food processing can lead to improvements in, or damage to, the nutritional value of foods. Simple food preparation processes in the domestic kitchen lead to inevitable damage to the cells of plant foods, leading to leaching of essential vitamins and minerals. However, if we are careful in the way we process foods, and choose a variety of processed foods, they can play an important role in a nutritious and balanced diet. Unlike the domestic environment, food manufacturers have access to commercial scale, fast processing methods which cause minimal nutrient losses, and they utilise processes which actually help to release positive nutrients (like lycopene in the cooking of tomatoes) or eradicate compounds of concern (like lectins in legumes).

### Vitamins and minerals

There are 13 vitamins, required by the body in small amounts, but nonetheless essential. Four are fat soluble (A, D, E, and K) and the remaining nine are water soluble (C, B group vitamins). No single food contains all the vitamins so a balanced and varied diet is necessary for an adequate intake. Processing affects different vitamins in different ways. For example, the water soluble vitamins tend to be more sensitive to processing and are often partially lost during boiling and heat treatment. However, newer 'non-thermal' processes such as Ohmic heating or ultra-high pressure treatment can help to retain vitamins because they subject the food to lower temperatures (if any) and the processes occur for a very short time. In some situations, processed foods actually contain more vitamins than fresh products. For example, frozen vegetables picked and frozen within hours retain more vitamin C than their fresh counterparts because more vitamin C is lost over time during chilled storage compared to frozen storage.

Minerals are inorganic elements which our body needs in small amounts, usually obtained sufficiently by consuming a conventional mixed diet. Food processing can have important beneficial effects on the availability of minerals from foods. For example, phytates in wholegrain cereals inhibit iron and zinc absorption but during fermentation, enzymes are released which degrade the phytates and increase the iron and zinc availability in the dough.

A variety of foods are now enriched with vitamins and minerals as a public health measure. Ready-to-eat breakfast cereals often have added iron and this has become one of the primary sources of iron in the diet of young women because their intakes of red meat have dropped (red meat having naturally high levels of easily absorbable iron). Iron deficiency is one of the biggest nutrient deficiency concerns in Europe, affecting up to 30% of young women. Breakfast cereals and flours in some countries are fortified with folic acid as a means of increasing the folate status in women of child-bearing age. This stems from the recognition that low folate status during pregnancy is associated with increased risk of neural tube defects (e.g. spina bifida) in unborn children.

### Carbohydrates and fibre

For mono- and oligosaccharides, little degradation occurs at temperatures right up to those used in UHT processing but there are several reactions that may affect nutritional quality. For example, some sugars could change their molecular structure during heating, which may affect digestibility. This could be advantageous in reducing the presence of indigestible oligosaccharides (like stachyose or raffinose present in legumes and some other foods) that cause flatulence if over-consumed.

Extensive research is currently underway to investigate the effects of processing on the solubility and digestibility of certain fibres and starches such as resistant starch. Low digestibility may be advantageous as it has been shown that slow-release carbohydrates may reduce the rise in blood sugar and insulin levels that occur after a meal. Excessive blood glucose and insulin levels have been associated with the development of insulin resistance, potentially a precursor for Type II Diabetes. Extrusion cooking has been shown to increase the 'solubility' of fibre. Soluble fibres such as  $\beta$ -glucan may lower serum cholesterol levels, thus being advantageous in reducing cardiovascular disease risk.

### **Fats and proteins**

Most fats are reasonably stable during processing. However, unsaturated fatty acids are prone to oxidation and rancidity during storage. The application of modified atmosphere packaging, antioxidants and aseptic packaging can lead to significantly increased storage times, thus alleviating these concerns.

Proteins are generally denatured at high temperatures, which can lead to detrimental effects on food structure. However, this can be advantageous nutritionally because it can mean increased protein digestibility. New research also shows that, newer methods of food processing like high pressure, electric field application or irradiation could have an impact on food allergens. Destruction of anti-nutritional proteins such as avidin in raw eggs is advantageous during processing because it enables the absorption of otherwise bound nutrients. Avidin strongly binds to biotin in raw eggs and in doing so blocks the absorption of this B vitamin, but the bond is released when avidin is denatured through heating.

### **Why are processed foods so important for modern society?**

Nowadays it is difficult to eat a diet based only on fresh, unprocessed foods. The major portion of our family's food needs comes from processed food products that add variety to our diets and convenience to our busy lives. Processed foods enable consumers to shop less frequently and to stock a wide range of foods on which to base varied and nutritious meals.

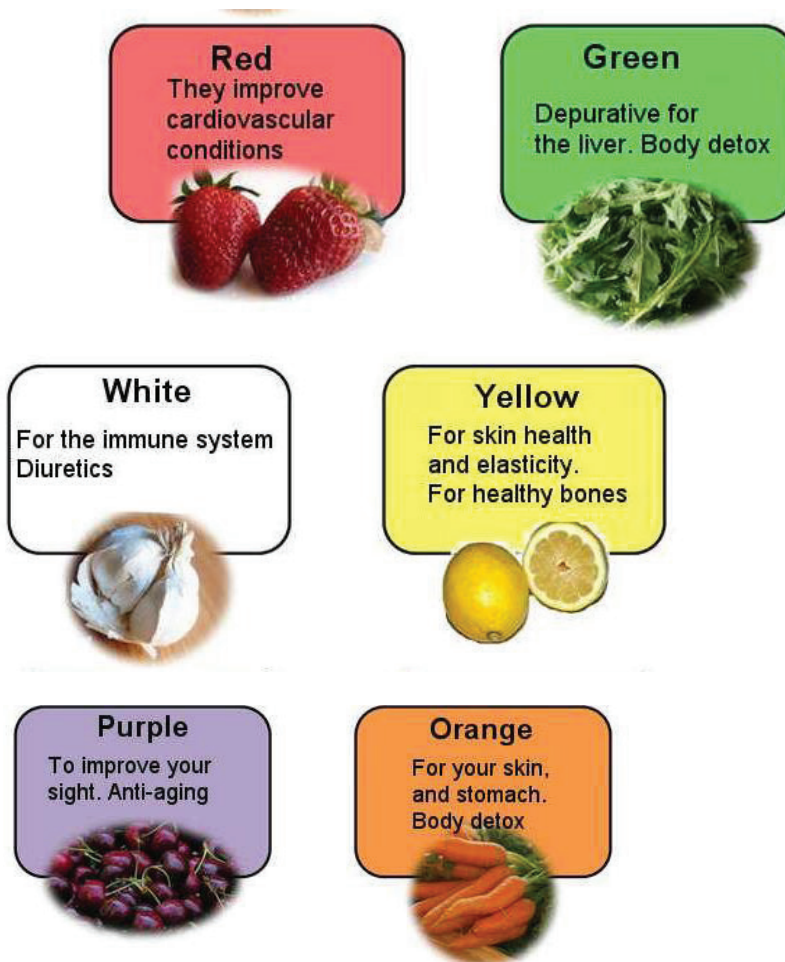
Many processed foods are just as nutritious or in some cases even more nutritious than fresh or home-cooked foods depending on the manner in which they are processed. For example, the folate and thiamine levels in beans survive the canning process better than the lengthy soaking and cooking necessary if home-prepared from dried beans. Frozen vegetables are usually processed within hours of harvest. There is little nutrient loss in the freezing process so frozen vegetables retain their high vitamin and mineral content. In contrast, fresh vegetables are picked and transported to the market. It can take days or even weeks before they reach the dinner table, and vitamins are gradually lost over time no matter how carefully the vegetables are transported and stored. Canned fish are a good source of calcium because the fish is often canned without being boned and the processing makes the small bones softer and more edible.

The inclusion of a wide range of foods, be it fresh, frozen, canned or otherwise processed enables consumers to reach their recommended daily intakes. For example, canned fruits, fruit juices and smoothies, and frozen vegetables all count towards the popular '5 portions of fruits and vegetables a day' target. The key for consumers is balance and variety – no one food provides enough nutrients to survive, and each method of processing affects nutrients differently.

## Facts about food processing

- Humans have been processing foods – preserving them for future use and to ensure their safety – for centuries.
- Food processing provides the means to extend shelf-life of otherwise perishable foods, thus increasing choice and reducing the dependency on seasonality.
- Storage losses in fresh foods are generally greater than those associated with food processing, and food processing can improve the nutritional value of certain foods.
- The addition of nutrients to foods and drinks is used globally as a public health measure and is a cost-effective means of ensuring nutritional quality of the food supply.
- Canned, fresh and frozen fruits and vegetables all provide nutrients needed for a healthy diet. Exclusively consuming fresh fruits and vegetables ignores the nutritional benefits provided by processed foods, which include both manufactured foods as well as foods processed in the home.

## Properties of colour in food



## 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)

**Benchmark 10.2.2.3** Compare the biological and sensory characteristics of food and the impact in food product development to meet the needs, occasions and health.

**Topic:** Food Product Development

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

- Define food development, functional properties of food and their impacts,
- Explain food product development to suit different needs, different occasions and health,
- Differentiate the biological and sensory characteristics of food and their functional properties,
- Define food product development as essential to meeting different needs, occasions and health.

**Essential Questions:**

- What is food product development?
- What happens in food product development?
- What are the functional properties of food?
- How do people's needs, different occasions and health dictate the development of food products?
- What are the sensory characteristics of food?

**Essential knowledge, skills, values**

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Food product development</li> <li>• Functional properties of food</li> <li>• Food for different needs occasions and optimum health</li> <li>• Sensory characteristics of food</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Compare, define</li> <li>• Plan menus</li> <li>• Design meals for optimum health</li> </ul>
<b>Attitudes /Values</b>	<ul style="list-style-type: none"> <li>• Respect and appreciate food Understand the effects of food on consumption</li> </ul>

**Teaching and Learning Strategies**

When introducing the lesson, ensure the required or prescribed knowledge is taught. Employ various teaching and learning methods and skills to support your teaching. Engage students in both theory and practical task to help them develop understanding and skills in relevant or key concepts in the lessons. The practical tasks are useful to increase knowledge, skills and experience as to importance of food and product development and consumption. Encourage students to utilise their ICT skills, communications skills and writing skills in the class projects and overall work as equals in groups hence they build up confidence and extend their learning boundaries.

## Learning Activities

### Lesson 1: Biological Characteristics of food

#### Activity 1:

**1a:** What is the difference between biological components and biological substances of food?

**2a:** What are the three (3) biological functions of food?

**Activity 2:** Use a variety of sources to identify and document on the subject 'Biological Value of Food'.

### Lesson 2: Sensory Characteristics of food

#### Activity 1

**1a:** Explain why sensory is an important parameter in food?

**1b:** Define sensory science?

#### Activity 2

**2a:** Define sensory analysis and explain how important in food product development.

**2b:** List the four sensory properties that are essential to food product development.

### Lesson 3: Impact of food development

**Activity 1:** The steps in developing in developing a food product are:

- Develop
- Design
- Produce
- Evaluate

Divide yourself in small groups; plan to develop a food product. The product must nutritious and marketable. Carry out a market research assist your planning to identify needs and economic viability. Submit the write – up of the project outlining steps from start to end. Include your constraints and successes.

**Activity 2:** Conduct a market survey. Select products of choice and complete as assessment report focused on all areas of impact of chosen products. Your assessment will focus on;

1. Socio-cultural impacts
2. Economic impacts
3. Environmental impacts
4. Nutritional impacts

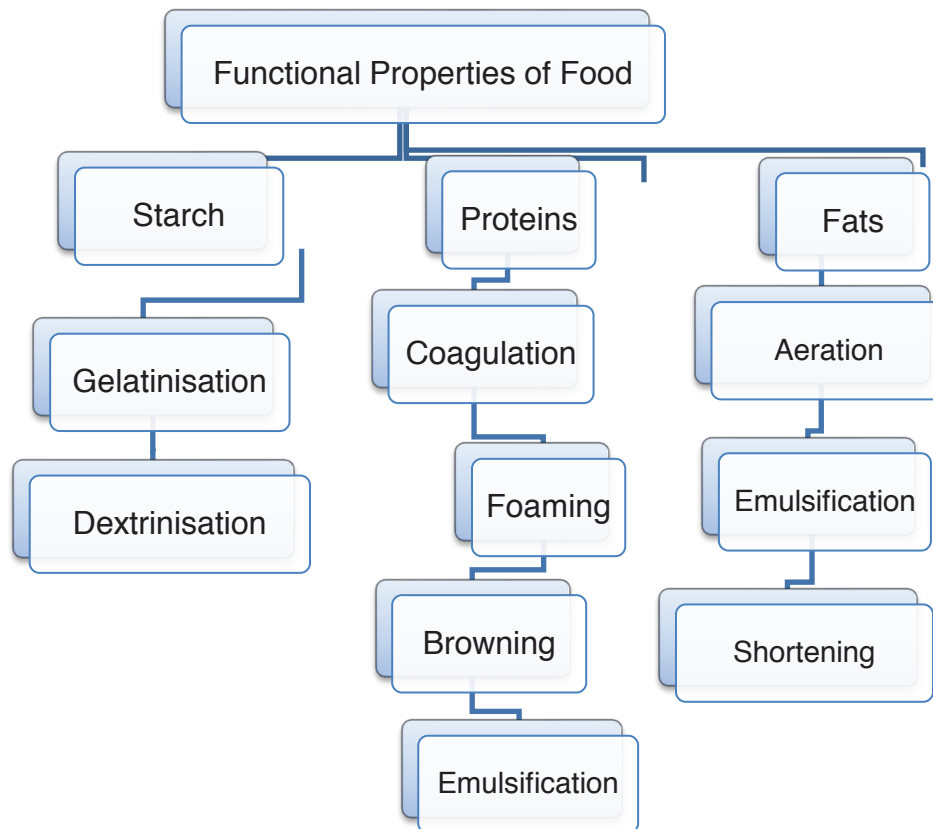
## Content Background

### Food Properties

The functional properties of food are the physical and chemical changes that occur during food storage, preparation and presentation. Every ingredient used in a recipe has a specific function, e.g.

- Starch (flour) is mainly used to thicken mixtures
- Sugars are used to add flavour and help with the browning of foods
- Eggs can function as an emulsifier, foaming agent and thickener
- Fats and oils play roles in food aeration, shortening and emulsions

Functional properties describes how ingredients behave during preparation and cooking, how they affect the finished food product in terms of how it looks, tastes, and feels.



### Carbohydrates

Carbohydrates are found in foods containing large amounts of sugar, fibre or starch. Cereal products, vegetables and fruit are the best sources of carbohydrate. Carbohydrates are involved in the following reactions:

### Functional Property: Caramelization

Caramelization is the chemical reaction in which monosaccharides and disaccharides turn brown with the application of heat (i.e. any product containing sugar may caramelize upon heating.) This occurs when products containing fruits, honey, milk, sugar cane, maple syrup and cereals come in contact with heat. Although not often recognized, Caramelization is responsible for many browning processes. A good example of this is the colour of toffee.

### Examples of practical applications:

Caramelization occurs in:

- Browning of biscuits
- Cakes and other baked products
- Commercial milks
- Ice-creams
- Honeycomb (Violet crumbles)
- Crème Caramel

### Factors affecting functional property:

The degree of Caramelization that occurs varies according to:

- the amount of sugar used
- the length of heating time
- the type of sugar
- the addition of other ingredients
- the temperature the sugar reaches



### Functional Property: Dextrinization

Dextrinization is the process involving **the browning of starch foods when subjected to dry heat**. It is defined as the breakdown of starch into dextrin's (disaccharides.) It is a **non-enzymatic browning and chemical change** which is easily digested as partial breakdown is complete. The characteristics of colour, taste, aroma and flavour may change as a result of this process.

### Examples of practical applications

- Toasting bread
- Baked goods
- Brown gravies and sauces
- Toasted breakfast cereals, Formation of baked crusts on vegetables e.g. potatoes, pumpkin and onions

### Factors affecting functional property

The degree of Dextrinization is determined by:

- the **length of time** the product is **heated**;
- the temperature,
- the type of starch in the product;
- addition of other ingredients;
- the action of certain enzymes,
- the action of acids; and
- the amount of exposure to dry heat the product encounters.



### Functional Property: Gelatinisation

The process wherein starch granules form a suspension in cold water. When heated in the presence of water, these swell and thicken and a gel results. The cellulose wall of the starch ruptures when swollen granules bump into each other and water is absorbed. This process is known as Gelatinisation.

### Examples of practical applications

- Lemon Meringue Pie (filling)
- Roux
- Cheese Sauce
- Custard

### Factors Affecting Functional Property

- **Temperature** (control of, to prevent burning whilst ensuring boiling point is reached);
- **Ratio of starch to liquid** (in accordance with use and type of starch used.
- **Length of time product is heated;**
- Degree of **agitation** (i.e. constant, steady stirring is required for effective gelatinisation.
- **Addition of other ingredients** e.g. acids, stabilising agent, sugar.



### Functional Property: Crystallisation

Crystallisation is the result of the **cooling of a supersaturated solution** (very concentrated) where solid crystals form. This occurs after substances **separate from solutions or where a change from a liquid to a solid causes crystals**. The result will occur only at very high concentration levels and is seen in the main in sucrose (and sometimes lactose and maltose.)

### Examples of practical applications

- Fudge
- Toffee
- Caramel
- Fondant

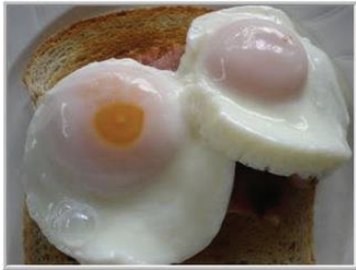
### Factors Affecting Functional Property

The size of crystal formation is dependent on these factors:

- the **rate of the formation of nuclei** i.e. the bases of crystal growth; the **rate of growth of the crystals**.
- The rate of crystal growth can be affected by: **The concentration of sugar** in the solution.
- The **concentration of sucrose** (disaccharide which increases rate of Crystallisation)
- The **temperature** of the solution;
- **Stirring** the solution causes a grainy textured product as Crystallisation occurs too fast;
- **Addition of additives such as fats, honey, corn syrup or cream of tartar** also change the form of the product.

## Proteins

There are many types of proteins. Proteins enable foods to become viscous, or to set. These properties have many applications in food preparation.



### Functional Property: Coagulation, Denaturation and Syneresis

Two important processes are denaturation and coagulation. The denature means to change properties; once a protein has denatured, it cannot return to its original form. An example of this is the application of heat to egg. The second step of denaturation is coagulation, whereby protein thickens

and changes into solid mass. The process of denaturation and coagulation is affected by the application of acid, alkalis, sugar and salt.

Syneresis occurs when the coagulation process continues due to heating. This is seen when the protein squeezes out the liquid in the product, for example curdling in custards, the separation of liquid from meat when it is cooked to well done and the weeping of liquid from meringue on top of a lemon meringue pie. **Syneresis** is the term that describes liquid oozing out of a large number of **foods** such as jams, jellies, sauces, dairy products, surimi and tomato juice, as well as meat and soybean products.

### Examples of practical applications

- Raw eggs to cooked (scrambled, boiled)
- Production of Cheese
- Baked/fried fish
- Creme Caramel
- Meringue (protein denatured during beating; heat causes coagulation)

### Factors Affecting Functional Property

- **High Temperature** - the higher the temperature, the faster coagulation will occur. Over heating causes a gel to firm.



- **Agitation** ( excessive mechanical action may cause over coagulation);
- The **action of enzymes** e.g. rennin causing milk to coagulate;
- A **change in pH**; and
- The **addition of salt** - begins the process of denaturation.

### Functional Property: Aeration

Foams are the process of whipping or beating air into a liquid (generally lipids.) Foams are a type of aeration. In this process, fat in the product becomes partially solidified and protein partially denatured. They are an extremely efficient way to incorporate air. They rely on the mechanical use of instruments to create spaces for oxygen to enter although excessive beating can cause a structural breakdown of the product.

### Examples of practical applications

- Cream
- Pavlovas
- Sponges
- Meringues
- Roulades
- Soufflés
- Mousses
- Omelette
- **Factors Affecting Functional Property**  
Factors affecting the rate and effectiveness of foaming include:
  - **The product** being beaten;
  - **The length of beating time**;
  - **The severity of the beating**;
  - The use of **additives** e.g. gelatine or sugar;
  - **The age of the product** (especially in products such as cream);
  - The **temperature** of the product.

### Lipids

Lipids or fats and oils have many functional properties that make them a useful ingredient in food and a useful component when frying food.

#### Functional Property: Emulsification

Emulsification is the dispersal of fat or oil throughout a liquid. Oil and water do not mix, so emulsification requires the use of a third ingredient. If oil and water are beaten for a period of time, the oil is reduced to very small droplets that appear to be distributed in the water. However if the mixture is left to stand for a while, it will separate. An example of this is a clear salad dressing, such as French dressing. Egg yolk, salt, paprika, and mustard are emulsifying ingredients that work by wrapping around the small oil droplets, preventing them from joining back together and separating from the water on standing.

#### Examples of Practical Applications:

- Mayonnaise
- Gravy
- Cheese

## 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)

**Benchmark 10.2.2.4** Apply the management skills and create consumer awareness in food selection, meal preparation, preservation and storage of food.

**Topic:** Consumer Behaviour and Marketing

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

- be informed of food products as consumers and reason why food is selected, prepared and eaten.
- identify the resources needed for food selection, purchase and storage.

### Essential Questions:

- What are the roles of a consumer?
- What are the skills, knowledge, attitudes and values involved in creating consumer awareness in food selection, meal preparation, preservation and storage of food?
- What are the effects and outcomes of consumer awareness on selecting, preparing and eating food?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Consumer awareness of food</li> <li>• Food selection</li> <li>• Food preparation</li> <li>• Eating food</li> <li>• Sensory characteristics of food</li> <li>• Food preservation</li> <li>• Advertising</li> <li>• Food Composition Table</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Investigate and communicate what is food consumerism</li> </ul>
<b>Attitudes/Values</b>	<ul style="list-style-type: none"> <li>• Value food and food products</li> <li>• Responsible behaviour towards food</li> </ul>

### Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to get a picture of food preparation and processing. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning.

## Learning Activities

### Lesson 1: Consumerism

#### Activity 1:

**1a.** What is a consumer?

**1b.** Why is it important for consumers to be aware of how to select, prepare and preserve food?

**Activity 2:** Identify factors that affect your choice of food

### Lesson 2: Food Marketing

**Activity 1:** Explain the different forms in which food is sold. Why is it important to be aware of food marketing?

**Activity 2:** Discuss some important tips to use when you plan to go shopping?

### Lesson 3: Consumer Behaviour

**Activity 1:** Identify and explain the factors that mostly affect your food choice or selection of food.

**Activity 2:** What are some factors that determine the cost of goods you want to purchase?

## Content Background

Selection or choice of food is very important in meal management. Providing food in a manner which is satisfactory to many people can be a complicated issue. Many decisions are required and careful thought and planning is important.

Resources are needed for the selection, purchase and storage of food. A caterer must consider the best use of these resources to produce the best results.

## Factors affecting Food Choice

Food choice refers to how people decide on what to buy and eat. A complex set of factors that vary from person to person and depend on culture, heritage and upbringing all influence food choice, sticking to a budget or food allergies may also have an impact on food choice.

The foods available to most people throughout the world are not radically different. They all fit into the same categories: fish, cereals, meat, poultry, 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. But even then, by the time the food arrived on the table these food availability factors had been overlaid by a whole host of other influences: religious taboos, beliefs, attitudes, or by custom and traditions that determined what types of food were given at what time of the day and in what order.

Today food choices and food production are influenced by an enormous variety of factors. These can be grouped into three areas.

Factors		
<b>1. physiological:</b>  to do with the physical needs and reactions of the body.	<ul style="list-style-type: none"> <li>Hunger, Appetite, satiety</li> </ul>	Hunger Appetite satiety
	<ul style="list-style-type: none"> <li>Nutritional requirements</li> </ul>	Age Gender Body size Level of health and illness Physical activity
	<ul style="list-style-type: none"> <li>Reactions to food</li> </ul>	Appearance Odour Taste
	<ul style="list-style-type: none"> <li>Food allergies</li> </ul>	
<b>2. psychological:</b>  aspects related to the mind	<ul style="list-style-type: none"> <li>Beliefs</li> </ul>	Food taboos Fads and fallacies Religious beliefs
	<ul style="list-style-type: none"> <li>Values</li> <li>Prestige and status</li> <li>Emotions</li> <li>Experiences</li> <li>Attitudes</li> <li>Habits</li> <li>Self-conscious</li> </ul>	
<b>3. social:</b>  aspects of our lives and lifestyle involving	<ul style="list-style-type: none"> <li>Culture</li> <li>Traditions</li> <li>Religion</li> </ul>	

interaction with other people.	<ul style="list-style-type: none"> <li>• Lifestyle</li> </ul>	Geographic locations Employment Household and family structures
	<ul style="list-style-type: none"> <li>• Technological resources</li> <li>• Social Interactions</li> </ul>	
	<ul style="list-style-type: none"> <li>• Media</li> </ul>	

Each of these factors combined with culture and technology, transform raw ingredients into a cuisine.

Selection or choice of food is very important in meal management and or meal planning. Providing food in a manner which is satisfactory to many people can be a complicated issue. Many decisions are required and careful thought and planning is important.

### Food Selection

The type of food one selects depends on;

- the money you have,
- the nutritional needs, and
- the effect of advertisements.

#### The money you have

The more money one has the more foods can be bought and the greater the choice. People who have a lot of money can afford a variety of meals and can eat away from home. People with small incomes have a limited choice and it becomes a hard task to buy enough food to meet family needs.

If a family has a limited food budget, they can save money by buying foods that are in season and buying cheaper cuts of meat as well as comparing prices in different shops.

#### Likes and dislikes

You eat to keep alive and healthy. At the same time most people also eat to enjoy the food. People tend to eat foods they like and avoid those they dislike.

Foods are normally disliked because of their colour, flavour and texture They are new and have never been tried They do not look attractive The food is associated with some ill feeling and the way it is cooked is not appealing.

Food is enjoyed when it is liked. Food is enjoyed because it provides some sensations for you the aromas and flavours that come from food are detected by special nerves in the sense organs of taste and smell. Sight and temperature also have a great effect on the enjoyment of food.

#### Advertisements

Another great influence on food choice is advertisement. Advertisements have a way of persuading people to make choices. Food manufacturers and shops advertise their products through television, radio, magazines, newspapers, posters and leaflets. Good adverts are decent, honest and truthful. They do not mislead the public about a product. They show a sense of responsibility to people. They conform to fair competition behaviour different manufacturers and businesses.

## Food Purchasing

Food purchasing can be a boring or interesting adventure depending on one's approach to it. To make food purchasing interesting you have to know much about the market place and ways in which you can make the most out of your food budget.

### Factors that determine the cost of goods you want to purchase

#### Production cost

This is the amount of money used to produce the item. In the case of food, the production cost will include the money spent on cleaning the land, sowing the seeds, harvesting and processing. The final cost of a product is determined by this amount plus others like transportation cost, profit and handling charges.

#### The season

Food items always cost less when they are in season because they are plenty and so the supply becomes high. When the market supply of a commodity becomes high the price of the commodity falls. Food items that are out of season become scarce and therefore their prices are higher.

#### Demand for item

Usually when many people want a certain item, its price increases.

#### Amount of processing

Processing adds value to products and it costs money. Foods that are processed to provide conveniences cost more than unprocessed ones.

### Factors that determine the amount of money we spend on food

For most people food budget is one of the largest expenses. Careful planning and shopping can result in substantial savings. Normally if you are rich you tend to spend more money on food and if you are earning little you spend less.

1. Your skills, personal preferences,
2. Your values and your lifestyle will all determine your food selection and hence the money you spend buying food.
3. The skill of bargaining for example would help you to buy goods at the cheapest possible cost.
4. Buying foods in season and in bulk also helps to cut down cost.
5. Buying food from farm gates instead of from retailers also cuts cost. When you buy food, buy them from places where prices are lower and where food sold is of good quality. Buy food from places that are clean and where the food is well stored.

### Forms in which food is sold

Foods are sold in many forms. The form you buy is determined by the storage facilities you have, how much convenience you need and what you want to use the food for. Foods are sold fresh, dried, frozen or canned.

### **Fresh foods**

Fresh foods provide most nutrients since processing may destroy the nutrients. Fresh foods are natural and do not require fortification or processing. They therefore cost less. However, because they are fresh they spoil fast.

### **Frozen foods**

Frozen foods are much nearer to fresh foods as far as nutrient content is concerned. Freezing prevents the action of enzymes and microorganisms. Microorganisms are minute organisms which we cannot see but which can be very harmful to us and can spoil our food. Frozen foods must be stored in the freezer in useable quantities. Remember that when you thaw a frozen food completely it must be used immediately to avoid spoilage. Thawed foods should not be refrozen.

### **Dried foods**

Dried foods have their moisture removed. Some dried foods like milk powder, can be reconstituted by adding water. Dried foods do not require refrigeration. They are light in weight and take up less storage space.

### **Canned foods**

Canned foods are convenient to use. They will not spoil as long as the can is not punched. Canned foods should be stored in cool dry places. They do not have the taste of freshly cooked foods. They are much more expensive than foods in other forms. They have long shelf life that is they last longer. Unless canned foods are fortified with nutrients they lose most of their nutrient content.

### **Tips for shopping**

When buying food, choose the form that you can easily handle and which you can afford.

1. Make a shopping list so that you buy the things you need without wasting time.
2. Choose the type and location of market appropriate to your needs.
3. Compare prices and quality of commodity before you buy.
4. Buy foods in bulk if you have storage facilities and money. It is cheaper.
5. Do not shop when you are hungry; it makes you buy more than necessary.
6. Do not take children along when you go shopping; they make you buy unnecessary things.
7. Avoid impulse buying; that is buying things you did not plan for.
8. When you buy canned or packaged foods, look out for the expiry date or 'use by' date. It is the last day a product is considered fresh. A food may still be safe to eat after this date but the taste and nutrient quality may not be good.

Do not buy processed foods when the following signs are seen:

- Cans are bulging or dented because they may cause food poisoning,
- Rusty can and may contain spoiled food,
- Frozen food packages that are soft or soggy may have thawed for a long time and may be spoilt,
- Refrozen foods, this can be detected as stained packages or crystallized products,
- Opened or damaged packages,
- Moldy or coloured dried foods, and
- Meat or fish that has dull or slimy surface.

Some unscrupulous sellers buy products which have expired from the large shops and sell them in the open markets at prices that are cheaper. Check the expiration dates and shapes of such items before you buy them.

### **Points to bear in mind when purchasing some food commodities**

#### **Fruits and vegetables**

High quality fruits and vegetables are the ones that are ripe, crisp, fine and free from bruises. Nutrient values of fruits and vegetables decrease over a period therefore, you should try to buy those that are fresh. Vegetables will usually wither when kept in the sun or kept for too long.

#### **Starchy roots and plantain**

Examples of such foods are banana, cassava, yam, cocoyam, water yam, potato and taro. When purchasing these foods care must be taken so that only good quality foods are bought. Roots should be free from bruises since this would make them rot quickly. They must be firm to touch. Softness in roots is a sign of spoilage. They must not start sprouting. Ripped banana should not have black spots on the skin.

#### **Animal and animal products**

Foods in this group are very expensive and they spoil very quickly. The most expensive animal foods are not necessarily the most nutritious. Bone in beef is just as nutritious as boneless beef. When buying animal foods, quality and safety are very important considerations. You can tell the quality of animal products as follows:

- Meat should have a deep red colour with white or creamy fat. Signs of poor quality are very dark brown or green colour and yellow fat. When the meat is greenish and smells bad it is of poor quality and not safe for eating.
- Poultry should have a meaty body with meaty legs and breasts. The skin should not have any discoloration.
- Fish should have firm flesh and shiny skin with a lot of tightly clinging scales. It must have bright and clear eyes and red shiny gills. Disagreeable colour, flesh that leaves a dent when pressed and dry skin are signs of spoilage.
- Eggs may have white or brown shells. The nutritive value is the same. Eggs can be bought fresh or dried. When buying eggs, look for shells that are rough and not shiny. Test for freshness by putting it in a jar of salt water. When it floats the egg is stale. Buy eggs that are clean and not cracked.
- Milk is sold in liquid or powdered form. Your choice will depend on what you want to use it for and the storage facility you have. Milk can be bought fresh. Its keeping quality is not good especially outside the refrigerator. When a milk tin is opened and used the remaining milk should be poured out of the tin and kept in the refrigerator or a cool dry place, well covered.

Legumes include groundnuts, cowpeas and soya beans. Legumes are sold shelled or unshelled. They are sold dry or canned. When buying legumes you must buy the ones that are not infested with weevils. Also they must not be mouldy. It is better to make your own groundnut paste than to buy from the market. Often groundnut paste is adulterated before it is sold in the market.

Cereals are normally sold in grains or in powdered form or as breakfast cereal. When buying cereals avoid the ones that have weevils or have grown moulds. Mouldy cereals are not good for consumption. Make your own corn dough instead of buying from the market.

## 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).

**Benchmark 10.2.2.5** Apply the design process to create food solutions.

**Topic:** Food solutions

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

- Apply the design process to create a food solution.

### Essential Questions:

- What is a design process?
- Why is it necessary to have a design brief?
- What are the benefits of making a food product?

### Essential knowledge, skills, values

<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Design process to create a food product</li> </ul>
<b>Skills</b>	<ul style="list-style-type: none"> <li>• Use the design process to produce a food product.</li> </ul>
<b>Attitudes /Values</b>	<ul style="list-style-type: none"> <li>• Respect food and be aware of its benefits to the body, people, markets</li> <li>• Appreciate food</li> </ul>

### Teaching and Learning Strategies

Teachers are encouraged to introduce students to simulations to better understand the concepts taught. Therefore students will learn effectively and master the knowledge prescribed in each topic. Whilst introducing the topic, guided discovery and research will enable students to get a picture of food preservation and food product development. The knowledge prescribed must be taught. It is not only about teaching what students should know but also to interpret that knowledge for students in a way that makes it relevant to them, and enables them to begin to acquire skills of analysis and problem solving, which will support teaching and learning.

### Learning Activities

#### Lesson 1: Design Brief

**Activity 1:** Identify and explain the different key stages of the design process.

**Activity 2:** Identify a need in your surroundings, use stage 1 (planning to create food solutions).

#### Lesson 2: Design Brief

**Activity 1:** What is a design brief?

**Activity 2:** Use the outline of the design brief to plan and create food solution.

#### Lesson 3: Evaluate the new product

**Activity 1:** Formulate questions that will be used to evaluate your finished product.

**Activity 2:** Evaluate what worked well and why and where improvements could be made.

## 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 that 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.

<b>Design</b>	<p><b>Problem:</b> Describes a scenario or context of the problem from which the brief arises.</p> <p><b>Brief:</b> A statement that presents the task and gives clear instructions for the task to be done.</p> <p><b>Specifications:</b> Identify key considerations or constraints for the design solution.</p> <p><b>Investigations:</b> 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.</p>
<b>Produce</b>	<p><b>Making:</b> Engages you in making, constructing and producing the product or solution by using appropriate materials, tools, equipment and the steps of production.</p>
<b>Evaluate</b>	<p><b>Evaluating/Testing:</b> 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.</p>

### 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.

# 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 (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. (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 (Grade 9 & 10 TIA Syllabus Page 30)

It is important to first identify the strand and unit names for familiarization and also the number of strands and units in the Grade 10 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 10 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.

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

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. These strands are comparable with the strands used internationally.

### Step 1: Identify the number of Strands and Units in the subject Syllabus (Refer to the Grade 9 & 10 TIA Syllabus Page 30)

#### 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 10 Technology and Industrial Arts Content Matrix

Consult the Grade 10 Technology and Industrial Arts Content Matrix showing the total number of strands, units, content standards, Benchmarks and topics to be covered in Grade 10.

Total Number Of Strands	Total Number Of Units	Total Number of Content Standards	Total Number Of Benchmarks	Total Number Of Topics
1	2	2	9	9
2	2	2	10	10
3	5	5	23	23
4	2	2	11	11
5	2	2	9	9
<b>Totals</b>	<b>13</b>	<b>13</b>	<b>62</b>	<b>62</b>

### 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 10 Technology and Industrial Arts

1. As per the Matrix, there are a total of 62 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.
6. Time Allocation for Grade 10 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).
7. There is a total of 40 teaching weeks in a school year. (4 Terms x 10 Weeks each)
8. 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).
9. 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 programmed 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 acquire 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.

**Grade 10 Technology and Industrial Arts Content distribution for the Teaching Year**

The Grade 10 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.

<b>Week</b>	<b>Textile Technology and Food Technology</b>	<b>Construction Technology</b>	<b>Communication and Computer Technology</b>
Insert number of weeks	Insert information on strand, unit, Content Standards (CS) and Benchmark Marks (BMs)	Insert information on strand, unit, CS and BMs	Insert information on strand, unit, CS and BMs
Program where assessment would be conducted. For example: Plan for assessment for weeks 3, 6 and 9			

## Grade 10 Technology and Industrial Arts Content Standards and Benchmarks Overview as per Strands and Units

The five (5) strands – Textile Technology, Food Technology, Construction Technology, Communication Technology and Computer Technology are unpacked into units to Benchmarks as outlined in the table below: Refer to the grade 9 Food Technology Teacher Guide to use as a sample to do the same for grade 10.

<b>Strand 1:Textile Technology</b>	
<b>Unit 1:Fibres and Fabrics</b>	
<b>Content Standard</b>	<b>Benchmarks</b>
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 2:Food Technology</b>	
<b>Unit 2:Food Science</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 3:Construction Technology</b>	
<b>Unit 1:Building Technology</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 3:Construction Technology</b>	
<b>Unit 2:Electrical Technology</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 3: Construction Technology</b>	
<b>Unit 3: Plumbing Technology</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 3: Construction Technology</b>	
<b>Unit 4: Welding Technology</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 3: Construction Technology</b>	
<b>Unit 5:Engineering Technology</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 4: Communication Technology</b>	
<b>Unit 1:Data Communication and Network</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 4: Communication Technology</b>	
<b>Unit 2: Computer Security and Safety</b>	
Write the content standard here	Write all the benchmarks for the units for the strand
<b>Strand 5:Computer Technology</b>	
<b>Unit 1:Computer Architecture</b>	
Write the content standard here	Write all the benchmarks for the units for the strand

**Strand 5: Computer Technology****Unit 2: Computer Software**

Write the content  
standard here

Write all the benchmarks for the units for the strand

## Grade 10 Technology and Industrial Arts Content Standards, Benchmarks and Topics Overview as per the Strands and Units prescribed in the TIA Syllabus.

Refer to the grade 9 Food Technology Teacher Guide to use as a sample to do the same for grade 10.

<b>Strand 1: Textile Technology</b>		
<b>Unit 1: Fibres and Fabrics</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 1: Textile Technology</b>		
<b>Unit 2: Textile and Clothing</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 2: Food Technology</b>		
<b>Unit 1: Food and Nutrition</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 2: Food Technology</b>		
<b>Unit 2: Food Science</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 3: Construction Technology</b>		
<b>Unit 1: Building Technology</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 3: Construction Technology</b>		
<b>Unit 2: Electrical Technology</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 3: Construction Technology</b>		
<b>Unit 3: Plumbing Technology</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 3: Construction Technology</b>		
<b>Unit 4: Welding Technology</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 3: Construction Technology</b>		
<b>Unit 5: Engineering Technology</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics
<b>Strand 4: Communication Technology</b>		
<b>Unit 1: Data Communication and Network</b>		
<b>Content Standard</b>	<b>Benchmark</b>	<b>Topic</b>
Write the CS	Write the BMs	Write the topics

<b>Strand 4: Communication Technology</b>		
<b>Unit 2: Computer Security and Safety</b>		
Content Standard	Benchmark	Topic
Write the CS	Write the BMs	Write the topics
<b>Strand 5: Computer Technology</b>		
<b>Unit 1: Computer Architecture</b>		
Content Standard	Benchmark	Topic
Write the CS	Write the BMs	Write the topics
<b>Strand 5: Computer Technology</b>		
<b>Unit 2: Computer Software</b>		
Content Standard	Benchmark	Topic
Write the CS	Write the BMs	Write the topics

## Grade 10 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: Refer to the grade 9 Food Technology Teacher Guide to use as a sample to do the same for grade 10.

<b>Strand 1:Textile Technology</b>	
<b>Unit 1:Fibres and Fabrics</b>	
<b>Topics</b>	<b>Lesson Titles</b>
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 1:Textile Technology</b>	
<b>Unit 2:Textile and Clothing</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 2:Food Technology</b>	
<b>Unit 1:Food and Nutrition</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 2: Food Technology</b>	
<b>Unit 2: Food Science</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 3: Construction Technology</b>	
<b>Unit 1: Building Technology</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 3: Construction Technology</b>	
<b>Unit 2:Electrical Technology</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 3: Construction Technology</b>	
<b>Unit 3:Plumbing Technology</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 3: Construction Technology</b>	
<b>Unit 4: Welding Technology</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 3: Construction Technology</b>	
<b>Unit 5:Engineering Technology</b>	

Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 4: Communication Technology</b>	
<b>Unit 1: Data Communication and Network</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 4: Communication Technology</b>	
<b>Unit 2: Computer Security and Safety</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 5: Computer Technology</b>	
<b>unit 1: Computer Architecture</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic
<b>Strand 5: Computer Technology</b>	
<b>Unit 2: Computer Software</b>	
Benchmarks	Write the BM coding
Write the topics from 1 to the last topic	Write the lesson numbers and their titles for the topic

### 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 below)

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.

Use the template given below for your convenience to help you plan for your termly program.

#### Grade 10 Textile and Food Technology yearly content overview

Week	Textile Technology and Food Technology	Content Standard	Benchmark	Topic	Lesson Title
Write the number of the week	Write the strand Write the unit	Write the CS	Write the BM	Write the topic	Write the lesson titles
Textile and Food summative assessment					

#### Grade 10 Construction Technology Yearly Content Overview

Week	Construction Technology	Content Standard	Benchmark	Topic	Lesson Title
Write the number of the week	Write the strand Write the unit	Write the CS	Write the BM	Write the topic	Write the lesson titles
Construction summative assessment					

#### Grade 10 Communication and Computer Technology Yearly Content Overview

Week	Communication and Computer Technology	Content Standard	Benchmark	Topic	Lesson Title
Write the number of the week	Write the strand Write the unit	Write the CS	Write the BM	Write the topic	Write the lesson titles
Communication and Computer summative assessment					

**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 strands of TIA. Below is a proposed Template to develop a Teaching Program for a Term. (13 weeks)

**Subject:** \_\_\_\_\_ **Grade:** \_\_\_\_\_ **Term:** \_\_\_\_\_ **Year:** \_\_\_\_\_

Week	CS	BM	Unit	Topic	LO	K	S	A/V	PS
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 LO 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)

**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	K	S	A/V	Suggested Learning Activities	PS
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, Stds. will be able to:  Write the LO 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: Stds 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	Lsn # & Titles	Lsn Obj.	Sug. Learning Act.
Write the Coding only	Write the Coding only	Write the Unit no:& Name	Write the Topic no:& Name	By the end of this Topic, Students will be able to:  Write the learning Obj. 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, stds will be able to;  Write the Performance Standard (if the Benchmark carries one)	Lsn 1:	L1 Obj.	
									Lsn 2:	L2 Obj.	
									Lsn 3: Etc.	L3 Obj.	

**Step 8: Review, Evaluate and Re-plan the yearly, termly, weekly Programs.**

**This process must be done collaboratively by all who teach the subject.**

### 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	These classes can be rotated so they all cover all the strands of TIA
Class 1 and Class 2	Food and Textile Technology	Home Economics Teacher	
Class 3 and 4	Construction Technology	Practical Skills Teacher	
Class 5 and Strand 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	These classes can be rotated so they all cover all the strands of TIA
Class 1 and 2	Construction Technology	Practical Skills Teacher	
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	These classes can be rotated so they all cover all the strands of TIA
Class 1 and 2	Communication and Computer Technology Food and Textile Technology	Home Economics Teacher	
Class 3 and 4	Food and Textile Technology	Home Economics Teacher	
Class 5 and 6	Construction Technology	Practical Skills	

**This process must be done collaboratively by all 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 planning 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 10.2.1** 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 10.2.1.1** Experiment and interpret the nature and properties of food and food product development.

**Topic:** Properties of protein foods and food development

**Lesson Title:** Classification and properties of meat

**Lesson Objective (s):** By the end of the lesson, students will be able to;

- Classify protein food sources.
- Identify food products using protein food sources.
- Compare and contrast sensory, physical and chemical properties of protein food in food development.

**Essential Questions:**

- What are the classifications of protein foods?
- What are the types of food products made from protein food sources?
- How is meat preserved?
- What happens when meat is cooked?

**Materials:** pictures, handouts, reference books, charts or posters

<b>Knowledge:</b>	<ul style="list-style-type: none"> <li>• Nature food</li> <li>• Properties of protein foods</li> <li>• Physical, chemical and sensory properties of protein food when subject to food processing</li> </ul>
<b>Skills:</b>	<ul style="list-style-type: none"> <li>• Investigate the classification of protein foods</li> <li>• Plan and develop food product using ingredients from protein foods</li> </ul>
<b>Values/Attitudes:</b>	<ul style="list-style-type: none"> <li>• Making informed decisions on food selection</li> <li>• Adopt awareness of healthy eating habits</li> </ul>

**Teaching and Learning Strategies**

<b>Teacher Activities</b>	<b>Student Activities</b>
<b>Introduction (time in minutes)</b>	
<p>Introduce the lesson by engaging students in groups to discuss the importance of protein food sources.</p> <p>Guide students to discuss on the traditional and modern methods of preparing /cooking and preserving meat.</p>	<p>Do the following in groups or in pairs;</p> <ul style="list-style-type: none"> <li>• Discuss and define what protein food sources are.</li> <li>• Compare and contrast ways in which meat is prepared and preserved in different cultures.</li> </ul>

<b>Body (time in minutes)</b>	
<b>Modeling</b>	
<p>Ask students in groups brainstorm on protein food sources and products.</p> <ul style="list-style-type: none"> <li>• How are protein food classified?</li> <li>• What are the different types of meat?</li> </ul> <p>Show a picture of a type of meat and ask students to identify the structure of the meat.</p>	<ul style="list-style-type: none"> <li>• Arrange and classify protein foods into their different source of groups.</li> <li>• Discuss and identify the structure of the meat.</li> </ul>
<b>Guided Practice</b>	
<p>Prepare and demonstrate what happens to the structural component of a piece of chicken meat when it is cooked.</p>	<ul style="list-style-type: none"> <li>• Predict and write their findings on what happens when the meat cooked?</li> </ul>
<b>Independent Practice</b>	
<p>Guide students to demonstrate what happens to the structural component of a piece of meat when it is cooked in terms of;</p> <ul style="list-style-type: none"> <li>- Muscle fibre</li> <li>- Connective tissue</li> <li>- Fat</li> <li>- Water</li> </ul> <p>Ensure that safety and hygiene is observed.</p>	<p>In groups students do the following;</p> <ul style="list-style-type: none"> <li>• choose a type of meat to prepare or cook.</li> <li>• Choose the cooking method.</li> <li>• Describe the following when meat is cooking. <ul style="list-style-type: none"> <li>- Muscle fibre</li> <li>- Connective tissue</li> <li>- Fat</li> <li>- Water</li> </ul> </li> <li>• Summarize what they have done in the activity.</li> </ul>
<b>Conclusion (time in minutes)</b>	
<ul style="list-style-type: none"> <li>• Summarize important points by asking students questions related to their reports – What did the students learn in this lesson?</li> <li>• Self-evaluation – Points to consider such as content, teaching and learning strategies for lesson improvement.</li> </ul>	<ul style="list-style-type: none"> <li>• Present their findings/report to the rest of the class.</li> <li>• Make corrections where necessary to their activities.</li> </ul>

### Assessment/lesson evaluation

Students can:

- Classify protein food sources.
- Identify food products using protein food sources.
- Compare and contrast sensory, physical and chemical properties of protein food in food development.

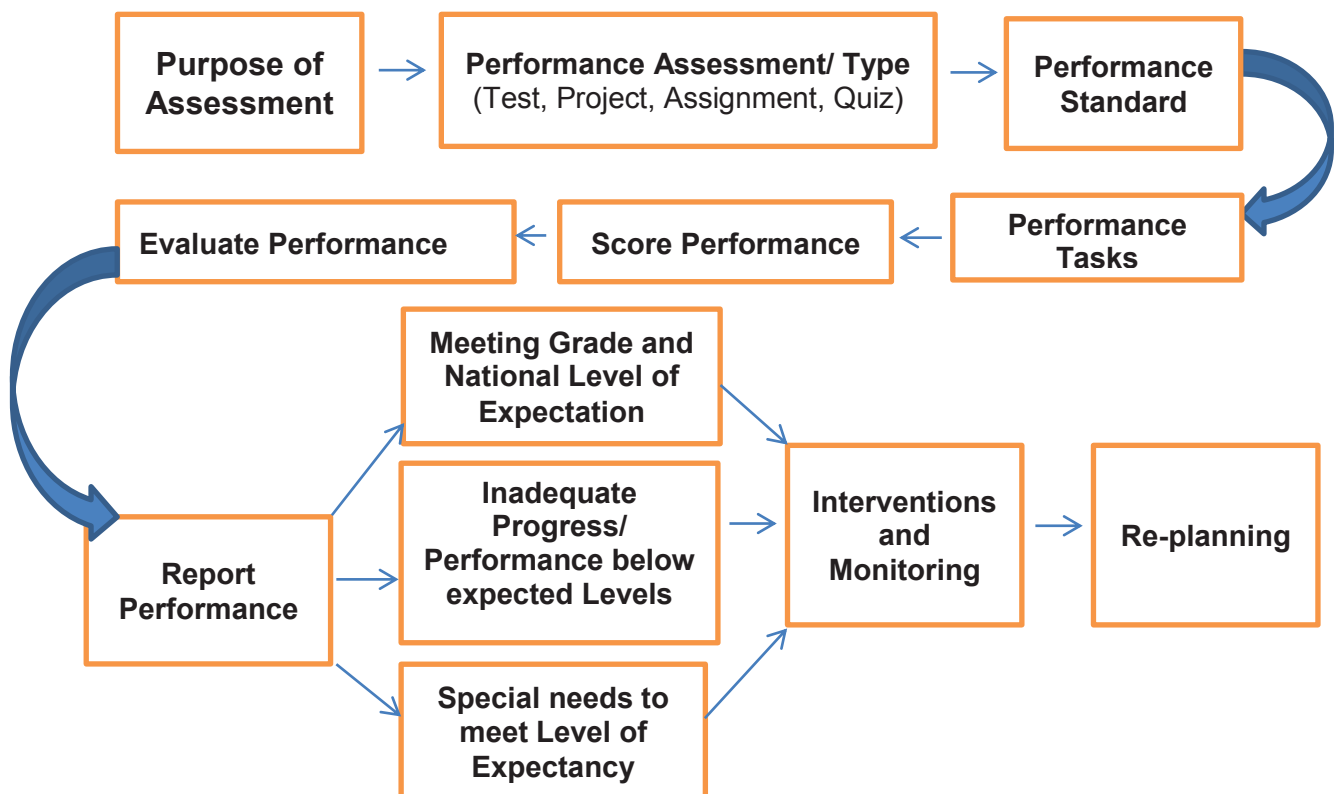
# Assessment, Monitoring and Reporting

## 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 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.

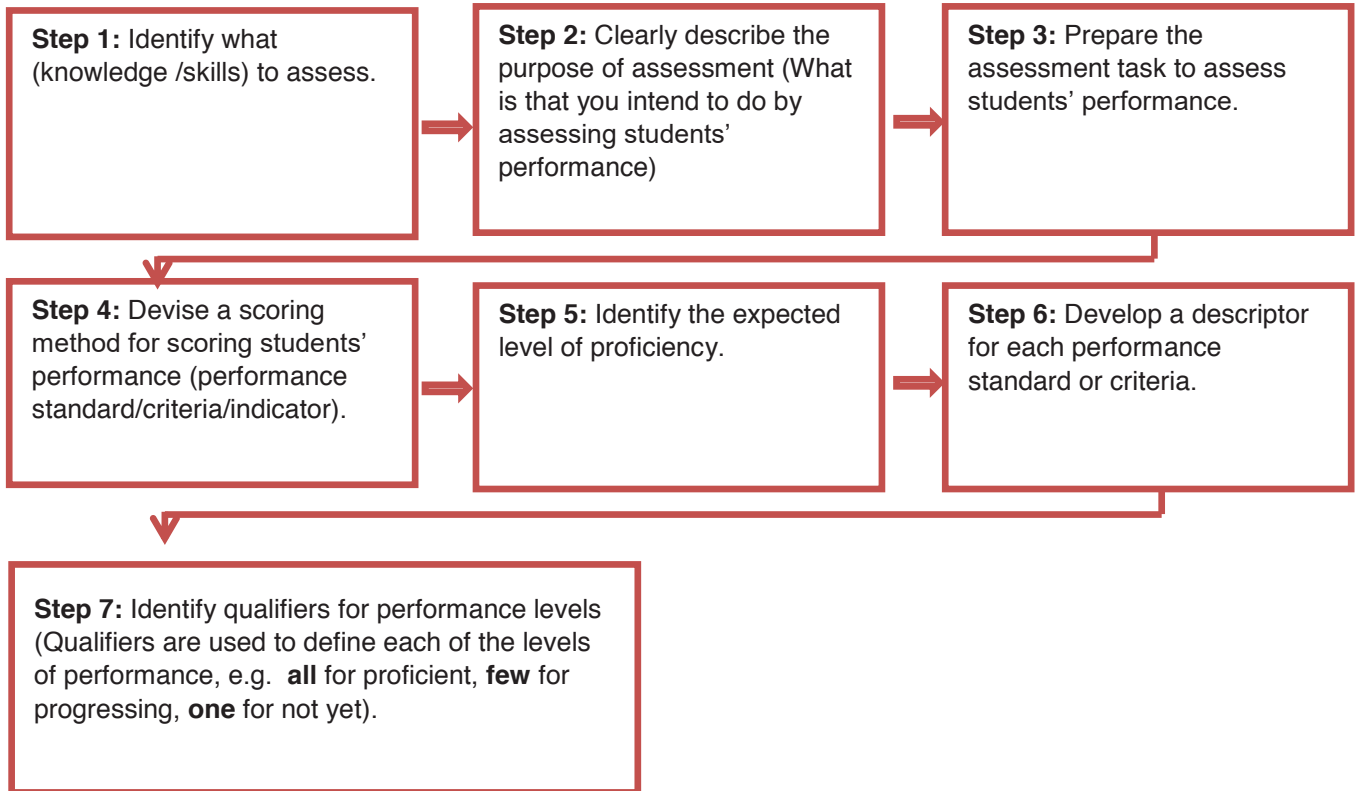
## Principles of Standards-Based Assessment

The principle of SBA is for assessment to be;

- emphasizing 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*

<b>Authentic Assessments</b>	<b>Traditional Assessments</b>
<ul style="list-style-type: none"> <li>• Portfolios, demonstrations, field work, case studies, assignments, lab reports</li> <li>• Students take an active role in process</li> <li>• Qualitative</li> <li>• Interpretive</li> <li>• Focuses on performance, process and product</li> <li>• High level thinking</li> <li>• Use of rubric</li> <li>• Use of criterion levels evaluation</li> <li>• Part of teaching and learning Process</li> <li>• Shows mastery and learning performance</li> <li>• Generally extends over time</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple choice tests, true-false, fill in the blanks, sentence completion, matching, diagram completions</li> <li>• External –(teacher driven – assessing performance of teacher rather than the student)</li> <li>• 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)</li> <li>• Quantitative (driven to collect marks)</li> <li>• Objective</li> <li>• End product (only looking for the end product and not concerned about the performance and process)</li> <li>• Standardised or norm referenced</li> <li>• Isolated facts</li> <li>• Low level content</li> <li>• Generally occurs in “one setting”</li> </ul>

## 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
<b>Knowledge</b> - 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	<ul style="list-style-type: none"> <li>• Prior knowledge inventory, misconception/preconception check</li> <li>• Focused listing, empty outlines</li> <li>• Pre-post test, quiz, quick poll</li> </ul>
<b>Comprehension</b> - 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	<ul style="list-style-type: none"> <li>• Minute paper, muddiest (or clearest) point</li> <li>• Observe and evaluate a student artifact or performance task using a rubric</li> <li>• Directed paraphrasing</li> <li>• Pre-post test, quiz</li> <li>• Interviews</li> </ul>
<b>Application</b> – 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	<ul style="list-style-type: none"> <li>• Observe and evaluate a student artifact, performance, or task using a rubric</li> <li>• Directed paraphrasing, real-world application (apply learning in a new context)</li> <li>• Test, quiz</li> <li>• Job/internship evaluation, skill ratings</li> </ul>
<b>Analysis</b> – 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	<ul style="list-style-type: none"> <li>• Pro and con grid, categorizing grid, compare and contrast, concept maps</li> <li>• Observe and evaluate a student artifact, performance, or task using a rubric</li> <li>• Journaling</li> <li>• Job/internship evaluation, skill ratings</li> </ul>
<b>Evaluation</b> – to judge the value of information based on established criteria	Appraise, argue, assess, attach, defend, judge, predict, rate, support, evaluate,	<ul style="list-style-type: none"> <li>• Reflection component of a portfolio or experience</li> <li>• Journaling</li> </ul>

	recommend, convince, judge, conclude, compare, summarize	<ul style="list-style-type: none"><li>• Peer evaluation</li></ul>
<b>Affective Learning</b>	appreciate, accept, attempt, challenge, defend, dispute, join, judge, praise, question, share, support	<ul style="list-style-type: none"><li>• Reflection component of a portfolio or experience</li><li>• Journaling</li><li>• Observe and evaluate group work</li><li>• Surveys, interviews, focus groups</li></ul>

The table shows different strategies that are applicable in the standards-based assessment types.

Strategy	Description
<b>Analogies</b>	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.
<b>Classroom Presentations</b>	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.
<b>Conferences</b>	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.
<b>Discussions</b>	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.
<b>Essays</b>	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.
<b>Exhibitions/ Demonstrations</b>	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.
<b>Interviews</b>	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.
<b>Learning Logs</b>	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.
<b>Observation</b>	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.
<b>Peer Assessment</b>	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.

<b>Performance Tasks</b>	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.
<b>Portfolios</b>	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.
<b>Questions And Answers (Oral)</b>	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.
<b>Quizzes, Tests, Examinations</b>	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.
<b>Questionnaires</b>	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.
<b>Response Journals</b>	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.
<b>Selected Responses</b>	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.
<b>Student Self-Assessments</b>	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.
<b>Case study</b>	This strategy is used to extend students' understanding of real life issues. The teacher provides 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.
<b>Debate</b>	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.

<b>Games and simulations</b>	<p>This strategy encourages motivation and creates a spirit of competition and challenge to enhance learning. The teacher being creative, 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 prizes. Students go into groups and organise. Follow the instructions and play to win.</p>
<b>Peer Teaching and Learning</b> <i>(power point presentations, pair learning)</i>	<p>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.</p>
<b>Project</b> <i>(individual/group)</i>	<p>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.</p>
<b>Use media and technology</b>	<p>Teacher is encouraged to use media &amp; 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.</p> <p>Viewing can provoke questions, debates, critical thinking, emotion and reaction.</p> <p>Students after viewing, students engage in critical thinking and debate.</p>

## 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 <b><u>complete</u></b> understanding of the problem. <b><u>All</u></b> requirements of task are <b><u>included in response.</u></b>	Demonstrate <b><u>considerate</u></b> understanding of the problem. <b><u>All</u></b> requirements of task are <b><u>included.</u></b>	Demonstrate <b><u>partial</u></b> understanding of the problem. <b><u>Most</u></b> requirements of task are <b><u>included.</u></b>	Demonstrate <b><u>little</u></b> understanding of the problem. <b><u>Many</u></b> requirements of task are <b><u>missing.</u></b>	Demonstrate <b><u>no</u></b> understanding of the problem.	<b><u>No</u></b> response/ <b><u>not</u></b> 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)
<b>Beyond</b>	<b>Beyond Standard (s) - Advanced in Performance and Understanding</b>
	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
<b>Consistent</b>	<b>Meet Standard (s) - Proficient in Performance and Understanding</b>
	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
<b>Inconsistent</b>	<b>Progressing - Not Yet Proficient in Performance and Understanding</b>
	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
<b>Seldom</b>	<b>Not Yet - Limited Performance and Understanding</b>
	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.

<b>Performance Standards/ Criteria</b>	<b>A 90 - 100</b>	<b>B 70 - 89</b>	<b>C 50 - 69</b>	<b>D 0 - 49</b>
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

<b>Score Range/Percentage Rating (%)</b>	<b>Grade</b>
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".

<b>Number scales</b>	1	2	3	4	5
<b>Rating</b>	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*.

<b>Criteria</b>	<b>Number Rating Scale</b>				
1. Collaboration is a 21 <sup>st</sup> 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.

<b>Excellent</b>	<b>Proficient</b>	<b>Adequate</b>	<b>Limited</b>
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.

<b>Excellent</b>	<b>Proficient</b>	<b>Adequate</b>	<b>Limited</b>
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		
<b>Total Theory Score</b>	____/40	<b>Total Practical Score</b>	____/60
<b>Total Scores of TAC + PAC = Total Scores out of 100</b>	_____/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
<b>Marks</b>	<b>100 %</b>	<b>A combination of design folios, practical applications, moderations and tests.</b>	

## 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
<b>Topic Tests x 2</b>	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
<b>Portfolio</b>	Individual Students will be assessed	10 marks
<b>Moderation</b>	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
<b>Project (Application)</b>	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
<b>Participation</b>	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	<b>K:</b> Physical and chemical properties of Food, pH Value of Food <b>S:</b> Investigate <b>A/V:</b> Being responsible
2. Character Social Development (CSD)	9.2.2.3 , 9.2.2.4, 9.1.5.2	<b>K:</b> Nutrition, Eating Disorders, Quality of Life <b>S:</b> Decision Making skills, <b>A/V:</b> 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	<b>K:</b> Descriptive writing, Ideas of writing, Clear and coherent ideas of writing, Information sources <b>S:</b> Research skills Interrogation skills, Comprehension skills, Presentation skills Report writing skills <b>A/V:</b> Being critical and considerate
4. Social Science (Geography)	9.1.3.4	<b>K:</b> Impact of migrations on places, resources, services, environments and cultures <b>S:</b> Analyze situations <b>A/V:</b> Being tolerant
5. Technology Industrial Arts (Communication Technology)	9.4.1.5	<b>K:</b> Range of communication and media products or services <b>S:</b> Problem solving <b>A/V:</b> 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,	<b>K:</b> Types of journals used in accounting process, Customer service strategies, Importance of marketing mix, Marketing on social media, 5 P's of Marketing Mix

		<p><b>S:</b> Financial skills, ICT Skills,  <b>AV:</b> Transparent and accountable, making business decisions,</p>
7. Agriculture	9.1.5.4, 9.1.3.1, 9.2.2.1	<p><b>K:</b> Food Crops, Animal Food products, Consumption needs of people, Food Demand and Supply, Food Security  <b>S:</b> Research and Analyze data  <b>AV:</b> Making informed decisions, show respect and consideration</p>
8. Maths	9.1.1.4	<p><b>K:</b> Calculation methods, Money is measured using numbers  <b>S:</b> Estimate a reasonable solution to a problem using rounding and estimation, mathematical Thinking Skills, Problem Solving  <b>AV:</b> Being trustworthy</p>
9. Arts	9.3.3.2, 9.3.3.5	<p><b>K:</b> Food presentation  <b>S:</b> Creativity, artistic thinking  <b>AV:</b> Care and consideration,</p>

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 widely 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 whatsapp 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 whatsapp 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	<ul style="list-style-type: none"> <li>Ethical issues</li> <li>Nutritional value of food</li> <li>Dietary needs for different groups</li> </ul>	<ul style="list-style-type: none"> <li>Public relation,</li> <li>Questioning techniques,</li> <li>Entering information</li> <li>Organize content logically</li> </ul>	<ul style="list-style-type: none"> <li>Appreciation</li> <li>Being responsible</li> <li>Respect views of others</li> </ul>
Survey Results and Recommendation	Compile a survey report, list recommendations and finalize for further action	<ul style="list-style-type: none"> <li>Food Nutritional values</li> <li>Health issues</li> </ul>	<ul style="list-style-type: none"> <li>Analyze survey information</li> <li>Compiling findings</li> </ul>	<ul style="list-style-type: none"> <li>Making informed decisions</li> </ul>
Food Product Development Planning	Plan and design nutritious food menus and recipes	<ul style="list-style-type: none"> <li>Food properties</li> <li>Nutritious value of food</li> <li>Dietary guidelines</li> <li>Cooking methods</li> <li>Food safety and handling</li> </ul>	<ul style="list-style-type: none"> <li>Design process – Investigating, analyzing,</li> <li>Problem solving,</li> <li>Classifying,</li> <li>Communicating ideas</li> </ul>	<ul style="list-style-type: none"> <li>Taking responsible actions,</li> <li>Making informed decisions,</li> <li>Being creative and innovative</li> </ul>
Technology Application	Create a food application, utilize Whatsapp or Facebook platforms (social media) to advertise and market food products	<ul style="list-style-type: none"> <li>Use of technology,</li> <li>Online platforms for sales and marketing,</li> <li>e-commerce</li> </ul>	<ul style="list-style-type: none"> <li>Operate technology devices,</li> <li>Create market venues on electronic devices,</li> <li>Create food app</li> </ul>	<ul style="list-style-type: none"> <li>Making informed decisions,</li> <li>Online citizenship</li> </ul>
Costing and Budget	Planning Budget and food costing	<ul style="list-style-type: none"> <li>Budget,</li> <li>Food costing</li> </ul>	<ul style="list-style-type: none"> <li>Accuracy,</li> <li>Mathematical calculations,</li> <li>Accounting skills</li> </ul>	<ul style="list-style-type: none"> <li>Consumer knowledge of food and purchasing food</li> </ul>
Food Product development	Prepare, process and package foods as per order	<ul style="list-style-type: none"> <li>Cooking methods</li> <li>Food ingredients</li> <li>Packaging</li> </ul>	<ul style="list-style-type: none"> <li>Safety and care</li> <li>Design process</li> </ul>	<ul style="list-style-type: none"> <li>Making informed decisions</li> <li>Problem solving</li> </ul>

Outdoor Presentations	Outdoor awareness presentation and food sale	<ul style="list-style-type: none"> <li>• Food and nutrition</li> <li>• Health and wellbeing</li> </ul>	<ul style="list-style-type: none"> <li>• Communication,</li> <li>• Advocacy and awareness,</li> <li>• Sales and marketing skills</li> </ul>	<ul style="list-style-type: none"> <li>• Commitment &amp; perseverance</li> </ul>
Cash Book Entry	Record revenue and expenditure	<ul style="list-style-type: none"> <li>• Money transactions</li> <li>• Profit</li> <li>• Revenue</li> <li>• Expenses</li> </ul>	<ul style="list-style-type: none"> <li>• Keep records of money</li> <li>• Math calculations (addition &amp; subtraction)</li> </ul>	<ul style="list-style-type: none"> <li>• Wise consumer</li> <li>• Transparency and accountability</li> </ul>
Project Evaluation	Identify: Evaluate successes and failures of the project. Make recommendations	<ul style="list-style-type: none"> <li>• Report Writing</li> </ul>	<ul style="list-style-type: none"> <li>• Judgmental skills</li> </ul>	<ul style="list-style-type: none"> <li>• Making informed recommendations,</li> <li>• Mental, physical and social preparedness</li> </ul>
Product: Folio completion and submission	Compile a folio attach project details, submit for assessment	<ul style="list-style-type: none"> <li>• Report Writing</li> </ul>	<ul style="list-style-type: none"> <li>• Folio &amp; write up</li> <li>• Research skills</li> </ul>	<ul style="list-style-type: none"> <li>• Transparency and accountability</li> </ul>

## 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 <b>accurate</b> results on time	Participants were knowledgeable and provided <b>satisfactory</b> results on time	Participants completed <b>some</b> tasks with care. Others were incomplete and needed help	Participants attempted to complete <b>few</b> tasks, and not all were attempted. Lack of motivation	/4
Survey Results and Recommendations	Questionnaires provided <b>precise</b> answers, <b>well-structured</b> information compiled, analyzed and logically presented	Questionnaires provided answers and information <b>satisfactorily</b> compiled, analyzed and presented	Questionnaires provided <b>partial</b> answers and some were irrelevant to topic and purpose	Questionnaires provided very <b>few</b> answers, information <b>incomplete</b> , not presented in a logical manner	/4
Food Product Development Planning	Menus and recipes are <b>well-structured</b> and contain precise instructions with nutritional considerations	Menus and recipes are of the <b>correct layout</b> with nutritional considerations	Menus and recipes are correctly structured, but <b>some had information gaps</b>	Menus and recipes are poorly structured but noted for <b>incomplete information</b>	/4
Technology Application	Successful uploading of information on social media accommodating <b>smart marketing strategies</b> and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ <b>some marketing strategies</b> to convince customers to buy food product or place food orders	Successful attempts to connect on social media. <b>Lack marketing skills</b> but attracted customers	Struggled with social media. Encountered problems getting started but convinced <b>only a few</b> customers and shows less team work	/4
Costing and Budget	Have an <b>in-depth</b> understanding on calculating food costs and develop realistic and reliable budget	Have <b>basic</b> understanding on calculating food costs and skills of budgeting	Have <b>partial</b> understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered <b>difficulty</b> in calculating food costs per portion and struggled to plan a budget	/4
Food Product Development	Food product/lunch <b>well</b> prepared, processed and package as per	Food product/lunch prepared, processed and package as per	Food product/lunch was <b>not well</b> prepared, processed and	Food product/lunch <b>lacked</b> the process of development,	/4

	order with consideration of food safety	order with <b>little</b> 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 <b>well organized</b> and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. <b>Exceptional</b> selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was <b>satisfactorily</b> 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 <b>partially</b> 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 <b>difficult to organize</b> . 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 <b>correctly</b> , checked and all balanced well. No outstanding/ uncollected money	Figures entered <b>correctly with minor errors</b> identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, <b>food was sold on credit</b> resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some <b>money was not accounted for</b> , made losses and outstanding money was not accounted for	/4
Evaluation	All aspects of the project was <b>well</b> discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was <b>fairly</b> discussed and evaluated, a general report finalized and presented on time	The project report was <b>partially</b> finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was <b>incomplete</b> and lack information and was not satisfactory compiled	/4
Folio Compilation and Submission	The folio contained <b>all</b> the requirements of the project in a logical order, was <b>well documented</b> and submitted on time	The folio contained <b>most</b> 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 <b>accurate</b> results on time	Participants were knowledgeable and provided <b>satisfactory</b> results on time	Participants completed <b>some</b> tasks with care. Others were incomplete and needed help	Participants attempted to complete <b>few</b> tasks, and not all were attempted. Lack of motivation	3/4
Survey Results and Recommendations	Questionnaires provided <b>precise</b> answers, <b>well-structured</b> information compiled, analyzed and logically presented	Questionnaires provided answers and information <b>satisfactorily</b> compiled, analyzed and presented	Questionnaires provided <b>partial</b> answers and some were irrelevant to topic and purpose	Questionnaires provided very <b>few</b> answers, information <b>incomplete</b> , not presented in a logical manner	4/4
Food Product Development Planning	Menus and recipes are <b>well-structured</b> and contain precise instructions with nutritional considerations	Menus and recipes are of the <b>correct layout</b> with nutritional considerations	Menus and recipes are correctly structured, but <b>some had information gaps</b>	Menus and recipes are poorly structured but noted for <b>incomplete information</b>	2/4
Technology Application	Successful uploading of information on social media accommodating <b>smart marketing strategies</b> and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ <b>some marketing strategies</b> to convince customers to buy food product or place food orders	Successful attempts to connect on social media. <b>Lack marketing skills</b> but attracted customers	Struggled with social media. Encountered problems getting started but convinced <b>only a few</b> customers and shows less team work	3/4
Costing and Budget	Have an <b>in-depth</b> understanding on calculating food costs and develop realistic and reliable budget	Have <b>basic</b> understanding on calculating food costs and skills of budgeting	Have <b>partial</b> understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered <b>difficulty</b> in calculating food costs per portion and struggled to plan a budget	3/4
Food Product Development	Food product/lunch <b>well</b> prepared, processed and package as per order with consideration of	Food product/lunch prepared, processed and package as per order with <b>little</b> consideration of	Food product/lunch was <b>not well</b> prepared, processed and package as per order with little	Food product/lunch <b>lacked</b> 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 <b>well organized</b> and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. <b>Exceptional</b> selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was <b>satisfactorily</b> 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 <b>partially</b> 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 <b>difficult to organize</b> . 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 <b>correctly</b> , checked and all balanced well. No outstanding/ uncollected money	Figures entered <b>correctly with minor errors</b> identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, <b>food was sold on credit</b> resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some <b>money was not accounted for</b> , made losses and outstanding money was not accounted for	3/4
Evaluation	All aspects of the project was <b>well</b> discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was <b>fairly</b> discussed and evaluated, a general report finalized and presented on time	The project report was <b>partially</b> finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was <b>incomplete</b> and lack information and was not satisfactory compiled	4/4
Folio Compilation and Submission	The folio contained <b>all</b> the requirements of the project in a logical order, was <b>well documented</b> and submitted on time	The folio contained <b>most</b> 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
<b>Total Mark</b>					<b>30/40</b>

## 2. How to Grade using the rubric

### Grading Rubrics

Score Range	Grade	Qualifier (Proficiency)	Descriptor	Percentage
30 – 40	A	Advanced	Description reflecting <b>highest</b> level of performance.	76% - 100%
20 - 29	B	Achieved	Description reflecting <b>mastery</b> level of performance.	46% - 75%
10 – 19	C	Progressing	Description reflecting <b>movement towards</b> mastery level of performance.	26% - 45%
0 - 9	D	Novice	Description reflecting <b>beginning</b> 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	<b>Advance</b> 76% - 100% 30 – 40 <b>A</b>	<b>Achieved</b> 46% - 75% 20-29 <b>B</b>	<b>Progressing</b> 26% - 45% 10 – 19 <b>C</b>	<b>Novice</b> 0% - 25% 0 – 9 <b>D</b>	<b>Scoring</b>		
Gathering information	Participants were well versed of the information and provided <b>accurate</b> results on time	Participants were knowledgeable and provided <b>satisfactory</b> results on time	Participants completed <b>some</b> tasks with care. Others were incomplete and needed help	Participants attempted to complete <b>few</b> tasks, and not all were attempted. Lack of motivation	3/4		
Survey Results and Recommendations	Questionnaires provided <b>precise</b> answers, <b>well-structured</b> information compiled, analyzed and logically presented	Questionnaires provided answers and information <b>satisfactorily</b> compiled, analyzed and presented	Questionnaires provided <b>partial</b> answers and some were irrelevant to topic and purpose	Questionnaires provided very <b>few</b> answers, information <b>incomplete</b> , not presented in a logical manner	4/4		
Food Product Development Planning	Menus and recipes are <b>well-structured</b> and contain precise instructions with nutritional considerations	Menus and recipes are of the <b>correct layout</b> with nutritional considerations	Menus and recipes are correctly structured, but <b>some had information gaps</b>	Menus and recipes are poorly structured but noted for <b>incomplete information</b>	2/4		
Technology Application	Successful uploading of information on social media accommodating <b>smart marketing strategies</b> and attracted many customers. Display good team work	Successful uploading of information on social media. Able to employ <b>some marketing strategies</b> to convince customers to buy food product or place food orders	Successful attempts to connect on social media. <b>Lack marketing skills</b> but attracted customers	Struggled with social media. Encountered problems getting started but convinced <b>only a few</b> customers and shows less team work	3/4		
Costing and Budget	Have an <b>in-depth</b> understanding on calculating food costs and develop realistic and reliable budget	Have <b>basic</b> understanding on calculating food costs and skills of budgeting	Have <b>partial</b> understanding on calculating food costs per portion, completed a budget plan with figures that seem exaggerated and unreal	Encountered <b>difficulty</b> in calculating food costs per portion and struggled to plan a budget	3/4		

Food Product Development	Food product/lunch <b>well</b> prepared, processed and package as per order with consideration of food safety	Food product/lunch prepared, processed and package as per order with <b>little</b> consideration of food safety	Food product/lunch was <b>not well</b> prepared, processed and package as per order with little consideration of food safety	Food product/lunch <b>lacked</b> the process of development, poor order done and no consideration of food safety	2/4
Outdoor Presentation – Nutrition Awareness and Lunch sale	Awareness was <b>well organized</b> and logically presented with tasks delegated well. Awareness messages were delivered with in-depth knowledge, creativity and confidence. <b>Exceptional</b> selling skills/techniques displayed, food sold and sales techniques maturely evident	Awareness was <b>satisfactorily</b> 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 <b>partially</b> 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 <b>difficult to organize</b> . 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 <b>correctly</b> , checked and all balanced well. No outstanding/ uncollected money	Figures entered <b>correctly with minor errors</b> identified, checked and all balanced. No outstanding/ uncollected money	Figures were entered however, <b>food was sold on credit</b> resulting in the delay of recouping all money for the records to be entered, checked and balanced	Figures were entered however, some <b>money was not accounted for</b> , made losses and outstanding money was not accounted for	3/4
Evaluation	All aspects of the project was <b>well</b> discussed and evaluated, a thorough report finalized and presented in the correct layout and on time	The overall project was <b>fairly</b> discussed and evaluated, a general report finalized and presented on time	The project report was <b>partially</b> finalized and submitted with information gaps and recommendations that lack the basis of the project	The project report was <b>incomplete</b> and lack information and was not satisfactory compiled	4/4
Folio Compilation and Submission	The folio contained <b>all</b> the requirements of the project in a logical order, was	The folio contained <b>most</b> 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	
<b>Total Mark</b>					<b>30/40</b>

**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 <i>Sphingomonas elodea</i> ; 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

# References

- British Nutrition Foundation, BNF (1999). *Nutrition and Food Processing*. Briefing Paper.
- Clarke, P., Compton, L., Keller, M., Stamenkovic, S., Valsamis, K., Ware. (2010). *Whole Food 2* Oxford
- Clarke, P., Compton, L., Keller, M., Stamenkovic, S., Valsamis, K., Ware. (2010). *Whole Food 1* Oxford
- Dengate, B., Ridgewell, T., Mortimer T., Braybon J., Hatch C. (1995) *Focus on Junior Food Technology*. Jacaranda Press.
- Department of Education (2009), Design and Technology Lower Secondary Teacher Guides, Waigani: DOE
- Grant, E., Fraser, P. (1994) *Food, Nutrition and People*: Jacaranda Press,
- Heath, G., McKenzie, H., Tully, L. (2001). *Food Solutions: Food and Technology Units 3 & 4*
- Henry, CJK., Chapman C. (2002). *The nutrition handbook for food processors*, 1<sup>st</sup> Edition. Woodhead Publishing Ltd.
- International Food Information Council (2009). From farm to fork: Questions and answers about modern food production.
- MacEvelly, C., Peltola, K (2003). *The effect of agronomy, storage, processing and cooking on bioactive substances in food*. Blackwell Publishing Ltd.
- Mills EN, et al. (2009). *Impact of food processing on the structural and allergenic properties of food allergens*. *Molecular Nutrition & Food Research* 53(8):963-969.
- Norman, P., Vagi, L. (2010) *Text Book Outcomes Edition for PNG Book 2*, Oxford
- Paschke, A. (2009). *Aspects of food processing and its effect on allergen structure*. *Molecular Nutrition & Food Research*
- Sheehan, V., Hill, S. *Food Technology Preliminary Course*, (1997) Longman
- Singh, N., Singh, I. S. (2018). *Food Nutrition, Science and Technology* [Book]. Woodhead Publishing India.
- Thompson, R., Thompson, B., Paterson, J., (1994) *Food Technology* Longmans Cheshire Ltd,
- Tull, A. (1996). *Food and Nutrition New edition in Colour*. Oxford University Press
- Weihen, L., Aduckiewicz., J, Amys, J. (1995). *Investigating Food Technology*: Rigby Heinemann

## Websites

<https://www.highspeedtraining.co.uk/hub/food-preservation-methods>

[https://wikieducator.org/Lesson 6: Food Selection, Purchasing and Storage#Food Purchasing](https://wikieducator.org/Lesson_6:_Food_Selection,_Purchasing_and_Storage#Food_Purchasing)

<http://theselfsufficientliving.com/preserving-and-storing-vegetables-and-fruits/>

[https://www.dimsumdaily.hk/listeria-monocytogenes-detected-in-cadbury-dairy-milk-cheesecake-and-caramel-cheesecake-may-cause-flu-like-symptoms-or-meningitis/listeria-monocytogenes\\_img/](https://www.dimsumdaily.hk/listeria-monocytogenes-detected-in-cadbury-dairy-milk-cheesecake-and-caramel-cheesecake-may-cause-flu-like-symptoms-or-meningitis/listeria-monocytogenes_img/)

<https://www.livescience.com/64031-salmonella.html>

<https://cwsimons.com/gluten-chemistry-and-functionality/>

<https://www.necropsymanual.net/en/teleosts-anatomy/skeleton-and-musculature/>

<https://weelicious.com/crispy-fried-egg/>

<https://www.chickens.allotment-garden.org/>

[www.educationvillage.org.uk](http://www.educationvillage.org.uk)

<http://9foodies.weebly.com/food-properties.html>

<https://www.necropsymanual.net/en/teleosts-anatomy/skeleton-and-musculature/>

<https://www.mcgill.ca/foodscience/what-food-science#:~:text=Food%20Science%20is%20a%20multi, facets%20of%20the%20food%20system.>

<https://www.sciencedirect.com/topics/food-science/physical-property-of-food>

<https://www.eufic.org/en/food-production/article/the-greatest-thing-since-sliced-bread-a-review-of-the-benefits-of-processed>

# Appendices

## Appendix 1: 21<sup>ST</sup> Century Skills

<b>Ways of thinking</b>	<b>Creativity and innovation</b> <ul style="list-style-type: none"> <li>• Think creatively</li> <li>• Work creatively with others</li> <li>• Implement innovations</li> </ul> <b>Critical thinking, problem solving and decision making</b> <ul style="list-style-type: none"> <li>• Reason effectively and evaluate evidence</li> <li>• Solve problems</li> <li>• Articulate findings</li> </ul> <b>Learning to learn and meta-cognition</b> <ul style="list-style-type: none"> <li>• Self-motivation</li> <li>• Positive appreciation of learning</li> <li>• Adaptability and flexibility</li> </ul>
<b>Ways of working</b>	<b>Communication</b> <ul style="list-style-type: none"> <li>• Competency in written and oral language</li> <li>• Open minded and preparedness to listen</li> <li>• Sensitivity to cultural differences</li> </ul> <b>Collaboration and teamwork</b> <ul style="list-style-type: none"> <li>• Interact effectively with others</li> <li>• Work effectively in diverse teams</li> <li>• Prioritise, plan and manage projects</li> </ul>
<b>Tools for working</b>	<b>Information literacy</b> <ul style="list-style-type: none"> <li>• Access and evaluate information</li> <li>• Use and manage information</li> <li>• Apply technology effectively</li> </ul> <b>ICT literacy</b> <ul style="list-style-type: none"> <li>• Open to new ideas, information, tools and ways of thinking</li> <li>• Use ICT accurately, creatively, ethically and legally</li> <li>• Be aware of cultural and social differences</li> <li>• Apply technology appropriately and effectively</li> </ul>
<b>Living in the world</b>	<b>Citizenship – global and local</b> <ul style="list-style-type: none"> <li>• Awareness and understanding of rights and responsibilities as a global citizen</li> <li>• Preparedness to participate in community activities</li> <li>• Respect the values and privacy of others</li> </ul> <b>Personal and social responsibility</b> <ul style="list-style-type: none"> <li>• Communicate constructively in different social situations</li> <li>• Understand different viewpoints and perspectives</li> </ul> <b>Life and career</b> <ul style="list-style-type: none"> <li>• Adapt to change</li> <li>• Manage goals and time</li> <li>• Be a self-directed learner</li> <li>• Interact effectively with others</li> </ul>

## Appendix 2: Teaching and Learning Strategies

Strategy	Teacher	Students
<p><b>Case study</b> Used to extend students' understanding of real life issues</p>	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.
<p><b>Debate</b> A method used to increase students' interest, involvement and participation</p>	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.
<p><b>Discussion</b> The purpose of discussion is to educate students about the process of group thinking and collective decision.</p>	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.
<p><b>Games and simulations</b> Encourages motivation and creates a spirit of competition and challenge to enhance learning</p>	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 prizes.	Go into groups and organize. Follow the instructions and play to win
<p><b>Observation</b> Method used to allow students to work independently to discover why and how things happen as the way they are. It builds curiosity.</p>	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 <ul style="list-style-type: none"> <li>• Observe and ask essential questions</li> <li>• Record</li> <li>• Interpret</li> </ul>
<p><b>Peer teaching &amp; learning</b> (<i>power point presentations, pair learning</i>) Students teach each other using different ways to learn from each other. It encourages; team work, develops confidence, feel</p>	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.

free to ask questions, improves communication skills and most importantly develop the spirit of inquiry.		
<b>Performance-related tasks</b> ( <i>dramatization, song/lyrics, wall magazines</i> ) 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.
<b>Project</b> (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.
<b>Use media &amp; technology to teach and generate engagement <u>depending on the age of the students</u></b>	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?

<p>Students draw the <b>FIRST AID</b> <b>SYMBOL</b> here</p>
--

- 2) Explain what is safety?

- 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.

<b><i>Injury</i></b>	<b><i>Action taken by student</i></b>
<i>A student using knife a cuts his/her finger.</i>	1.
	2.
<i>A student cooking burns his/her hand on a hot pot</i>	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.

<b>Project Name</b>	
<b>Total Unit (No of Project)</b>	

<b>Material List</b>				
<b>Quantity</b>	<b>Name of Material(s)</b>	<b>Description(s)</b>	<b>Unit Cost</b>	<b>Total Cost</b>

- 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)**

<b>No</b>	<b>Operations</b>	<b>Tools/Equipment Needed</b>
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%:  $(K75 - K50) / K50 = 0.50 \times 100 = 50\%$ .

## 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	<b>Idea Generation</b>										
	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	<b>Research</b>										
	a. Development of a survey questionnaire with a number of essential questions on their project ideas.										
	b. Safety for stages of <b>Planning, Prototyping, Production and Marketing.</b>										
	i. Draw safety precaution sign.										
	ii. Tool/items and injuries that may occur.										
	iii. Injuries and actions taken by students.										
3	<b>Planning</b>										
	a. Identify the various ways to cook them and find out ways to improve the taste for their intended project dish										
4	<b>Prototyping</b>										
	a. Select projects sketches that will be made into prototypes, be sampled and do detailed working diagrams/patterns/templates to ergonomics standards.										
5	<b>Production</b>										
	a. Select the materials according to the descriptions of materials needed for their project.										
6	<b>Costing</b>										
	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	<p><b>Marketing</b></p> <ul style="list-style-type: none"> <li>a. Review the responses/feedback from the Surveys done on the project idea and inform the interested people of the completed project.</li> <li>b. Create promotional webpages on social media to market the product.</li> </ul>								

### 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	<b>Idea Generation</b>																		
	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	<b>Research</b>																		
	a. Development of a survey questionnaire with a number of essential questions on their project ideas.																		
	b. Safety for stages of <b>Planning, Prototyping, Production and Marketing.</b>																		
	i. Draw safety precaution sign.																		
ii. Tool/items and injuries that may occur.																			
iii. Injuries and actions taken by students.																			
3	<b>Planning</b>																		
	a. Identify the various ways to cook them and find out ways to improve the taste for their intended project dish.																		
4	<b>Prototyping</b>																		
	a. Select projects sketches that will be made into prototypes, be sampled and do detailed working diagrams/patterns/templates to ergonomics standards.																		
5	<b>Production</b>																		
	a. Select the materials according to the descriptions of materials needed for their project.																		
6	<b>Costing</b>																		
	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.													
<b>7</b>	<p><b>Marketing</b></p> <p>a. Review the responses/feedback from the Surveys done on the project idea and inform the interested people of the completed project.</p> <p>b. Create promotional webpages on social media to market the product.</p>													

## ***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.

<b>Subjects</b> <i>(List of related Subjects)</i>	<b>Benchmarks</b> <i>( List the nominated Benchmarks Codes)</i>	<b>Essential KSAVs</b> <i>(Unpack and list the specific KASVs for each of the Subject Benchmarks )</i>

### 2. Unpacking Standards for the STEAM Assessment Project/Activitiy

**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**

<b>Category</b> <i>(List the main assessment task components in logical order (steps) to come up with the end product)</i>	<b>Task Description</b> <i>(Copy paste the task descriptions)</i>

### 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**

<b>Category</b> ( <i>Copy and paste Table 1 – Column 1</i> )	<b>Task Description</b> ( <i>Copy and paste Table 1 – Column 2</i> )	<b>Essential KSAVs</b> ( <i>Unpacked Task Description KSAVs</i> )

### 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**

<b>Criteria</b>	<b>Advance</b>	<b>Achieved</b>	<b>Progressing</b>	<b>Novice</b>	<b>Mark</b>
<i>Copy and paste Table 2 – Column 1</i>	<i>Description reflecting of highest level of performance</i>	<i>Description reflecting achievement of mastery level of performance</i>	<i>Description reflecting movement toward mastery level of performance</i>	<i>Description reflecting beginning</i>	<i>/4</i>

9. Consider the Application of the STEAM Rubric

**Note:** Refer to the STEAM assessment section for a Sample STEAM Assessment Project/Activity and further deliberations on how to Score, Grade and Report using the rubric.

## Appendix 5: Planning and Programming Options

### 1. Sequential

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 programming 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.

The 3 steps 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. Fibers and Fabrics	10.1.1.1
	2	Food Technology	1. Food and Nutrition	10.2.1.1
	3	Construction Technology	1. Building Technology	10.3.1.1
	4	Communication technology	1. Data Communication and Network	10.4.1.1
	5	Computing Technology	1. Computer Architecture	10.5.1.1
	6	Textiles Technology	1. Fibres and Fabrics	10.1.1.2
	7	Food Technology	1. Food and Nutrition	10.2.1.2
	8	Construction Technology	1. Building Technology	10.3.1.2
	9	Communication technology	1. Data Communication and Network	10.4.1.2
	10	Computing Technology	1. Computer Architecture	10.5.1.2

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 programming 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 approach in planning and programming

#### Term 1: Grade 10

Week	Linking Concept	Strand	Units	Benchmarks
1 - 2	Safety	1.Textiles Technology	1.Fibers and Fabrics	<b>10.1.1.4</b> Demonstrate adherence to safe practices and procedures for facilities, processes, tools, and equipment
		2.Food Technology	1.Food and Nutrition	<b>10.2.1.2</b> ; Apply ethical principles and values, safety and hygiene practices in food product development and food science
		3.Construction Technology	1.Building Technology	<b>10.3.1.4</b> Demonstrate an understanding of the safe and correct use of construction tools, equipment, and techniques
		3.Construction Technology	2. Electrical Technology	<b>10.3.2.3</b> Use technology to organize and manage electrical activities responsibly and effectively considering the interrelatedness of systems as a context for problem solving
		3.Construction Technology	3 Plumbing Technology	<b>10.3.3.2</b> Identify and apply OHS on plumbing materials, tools, in the workplace according to OHS standards
		3.Construction Technology	4.Welding Technology	<b>10.3.4.1</b> Apply safety procedures when handling tools and equipment

		4.Communication Technology	2.Computer Safety and Security	<b>10.4.2.1</b> Explain the need for individuals and members of the global community to practice cyber safety, cyber security, and cyber ethics when using existing and emerging technologies
3 ↓	<i>Design Process</i>	<i>Write the Strand names</i>	<i>Write the Unit names</i>	<i>Identify and write the benchmarks of the strands that have the linking concepts, skills, principles and processes that follow the design process</i>



**'FREE ISSUE - NOT FOR SALE'**