

# Agriculture

## Senior High

Grades 11 and 12

# Syllabus

Standards-Based



Papua New Guinea

Department of Education

'FREE ISSUE  
NOT FOR SALE'



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**Department of Education**

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

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# Acronyms

AAL	Assessment As Learning
AFL	Assessment For Learning
AOL	Assessment Of Learning
BOS	Board of Studies
CDD	Curriculum Development Division
CPM	Curriculum Panel Members
CS	Content Standards
DNA	Deoxyribonuclei acid
DOE	Department of Education
ESD	Education for Sustainable Development
GoPNG	Government of Papua New Guinea
IHD	Integral Human Development
KSAV	Knowledge, Skills, Values, and Attitudes
NDoE	National Department of Education
OBC	Outcome-Based Curriculum
OBE	Outcome-Based Education
SAC	Syllabus Advisory Committee
SBC	Standards-Based Curriculum
SBE	Standards-Based Education
SCG	Subject Curriculum Group
STEAM	Science, Technology, Arts, and Mathematics
STEM	Science, Technology, Engineering, and Mathematics
UNCRC	United Nations Convention on the Rights of the Child

# Secretary's Message

The ultimate aim of Standards-Based Education (SBE) in Papua New Guinea (PNG) is to prepare students for careers, higher education, and citizenship. This means that education should focus on equipping students with proficiencies that they can use in all spheres of their lives. It is, therefore, important that all children are provided an equal opportunity to achieve high academic standards that are internationally comparable. Education must also aim to motivate and prepare students to pursue Science, Technology, Engineering, Arts, and Mathematics (STEAM) courses in higher education and pursue careers in STEAM related fields.

A core pillar of SBE in PNG is to prepare children to earn and make a living. It is envisioned that all children will acquire essential career preparedness proficiencies that they can use to seek salaried jobs or create their own jobs before leaving school at the end of grade 12. PNG's formal economy does not have the absorptive capacity to engage every child leaving the education system. To absorb all children leaving school, the capacity of the economy needs to be expanded. One of the ways of expanding the capacity of the economy is to create more businesses. When more businesses are created, more jobs are simultaneously created.

Agriculture is fundamental not only to the preparation of children with essential knowledge, skills, values, and attitudes they can use to live productive and meaningful livelihoods, but also to harness PNG's untapped potential in horticulture, aquaculture, and bird and insect farming to create a robust and competitive economy. Thus, provide expanded opportunities for citizens to make and earn a living through small to medium enterprises and for PNG to commercialize the products already available in the informal economy at a large scale.

Teachers are encouraged to use the syllabus, in conjunction with the teacher guides, to teach the Agriculture content and enable all students to progressively learn and master the essential Agriculture knowledge, skills, values, and attitudes, and progressively prepare them for careers, higher education, and citizenship.

I commend and approve this Grades 11 and 12 Agriculture Syllabus to be used by teachers in all Senior High Schools throughout Papua New Guinea.



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

# Introduction

The introduction of Standards-Based Education in Papua New Guinea is an important Government directive to raise performance competencies in all aspects of education such as curriculum development, teacher training, student and teacher performance, monitoring, school management and leadership. The designing of courses in the curriculum have such been done to raise standards in teaching and learning at all levels of schooling in order to cater for the shift in the pedagogy.

The agriculture economy is in transition from traditional to semi-commercial and commercial economy. The majority of people in rural and urban communities are involved in some form of agriculture. Modern agronomy, plant breeding, agrochemicals such as pesticides and fertilizers, and technological developments have sharply increased yields, while causing widespread ecological and environmental damage. Selective breeding and modern practices in animal husbandry have similarly increased the output of meat, but have raised concerns about animal welfare and environmental damage. Environmental issues include contributions to global warming, depletion of aquifers, deforestation, antibiotic resistance, and growth hormones in industrial meat production. Genetically modified organisms are widely used, although some are banned in certain countries.

The number of school leavers who exit various points of the national education system is increasing every year. School leavers are ill prepared to earn and make a living in a postmodern society that is rapidly changing and driven by technology and knowledge creation and innovation. Digitization of economies, businesses, and jobs makes what is currently taught in the school system obsolete and contextually irrelevant. Children who leave PNG's education system lack essential 21<sup>st</sup> Century knowledge, skills, values, and attitudes. They also lack high level skills, problem-solving, reasoning, and decision-making skills. These skills are essential for working, studying, and living in the digital age.

An important way of creating more jobs and providing opportunities and a conducive environment for PNG citizens to create their own employment, enterprises, or businesses is to expand the economy. PNG's economy is quite small and does not have the absorptive capacity to provide a job for every citizen. To increase the economy's absorptive capacity, more businesses should be created in both the formal and informal economic sectors. The power of agriculture and its ability to engage a large proportion of citizens in agribusiness to enable them to live productive and sustainable livelihoods have been largely under-utilized.

PNG can expand its economy by investing more in other disciplines of agriculture such as horticulture, aquaculture and insect farming among others in harnessing and commercializing agriculture products that are already being harvested and marketed through the informal economy.

Time allocation for grades 11 and 12 Agriculture is 200 minutes per week.

# Aims and Goals

The ultimate aim of education in PNG is to prepare students for careers, higher education, and citizenship. To achieve this aim, a number of enabling aims and goals were formulated based on evidence. The ultimate aim and the enabling aims and goals are closely linked. The enabling or operational aims and goals are described below.

## Aims and Goals of Standards-Based Education and Curriculum

Curriculum aims and goals articulate the outcomes that will be achieved in the long-term and the medium-to-long term. They embed the development and educational aspirations of PNG and its citizens. These have been influenced by evidence from the analysis of context and research on teaching and learning, and on social, economic, political, technological, and cultural developments. There is a close link between the aims and goals of the curriculum. This is important for ensuring that the chain of learning results is clear.

**Aim 1:** Students will acquire essential and relevant knowledge, skills, values, and attitudes that will prepare them for careers, higher education, and citizenship.

## Goals

Students will be able to;

- (a) obtain prerequisite knowledge and skills and cultivate and foster important values and attitudes required to effectively function in a higher education and training environment.
- (b) achieve high language, mathematics, science, social science, moral, values, and ethical, creative and vocational skills, and citizenship standards that will ensure a smooth transition from secondary school to higher education and training institutions.
- (c) acquire and use intellectual, emotional, cultural, physical, creative, vocational, recreational, and spiritual knowledge, skills, values, and attitudes as bases for living fulfilling, purposeful, and productive lives in communities in which they choose to live.

**Aim 2:** Students will achieve high standards in Language, Mathematics, Science and Technology, Social Science, Civic and Citizenship Education, Character and Social Development, and Skills Education (Creative, Physical, and Vocational skills).

## Goals

Students will be able to;

- (a) acquire and use intellectual, emotional, cultural, physical, creative, vocational, recreational, and spiritual knowledge, skills, values, and attitudes as a basis for living a fulfilling and a productive life in the communities in which they choose to live.
- (b) understand and apply mathematical reasoning, processes, formulas, and concepts to solve mathematical problems.
- (c) examine and apply scientific reasoning, processes, and concepts to improve real life situations.
- (d) aware of scientific standards and methods and their application across all branches of science.
- (e) aware of logical and abstract thinking in the formulation of problems, the importance of mathematics in science reasoning, and recognize the role of science in every aspect of life.
- (f) explain the connection between science and technology and recognize the importance of technology in the development of communities, the improvement of peoples' lives, in communication, and industry.
- (g) acquire fundamental knowledge and skills to build and market different types of technology.
- (h) communicate orally and in writing, use different approaches and modes of communication, identify different purposes of communication, and understand and appreciate PNG's languages and the languages of people from different cultures.
- (i) aware of their civic and citizenship responsibilities, the importance of these responsibilities to harmonious living and maintaining social cohesion, and to community and national development and well-being.
- (j) acquire knowledge, skills, values and attitudes required for learning and practice of creative arts, and the application of knowledge and skills to express themselves, promote PNG's cultures, and make a living.
- (k) recognise the importance of healthy mind, body, and spirit, the importance of physical exercise and sport, balanced diet, and regular exercise in living a healthy life style.
- (l) recognise the importance of healthy mind, body, and spirit, the importance of physical exercise and sport, balanced diet, and regular exercise in living a healthy life style.
- (m) attain essential agriculture knowledge, skills, values, and attitudes required for making a living in agriculture related contexts, starting and managing agriculture businesses for personal and family sustainability, and pursuing agriculture-oriented livelihoods.

**Aim 3:** Students will attain both regional and internationally comparable standards in literacy and numeracy

### Goals

Students will be able to;

- (a) acquire essential reading skills to enable them to learn to read and read to learn throughout their lives.
- (b) learn basic skills of writing, comprehending and evaluating information, following instructions, analysing others writing, and communicating with others.
- (c) learn and apply basic mathematic skills in real life situations to improve their own personal growth and the advancement of their communities and the nation.

**Aim 4:** Students will develop their full potential and empowered to be dynamically involved in the process of freeing themselves from oppressive situations, contribute to promoting the common good and welfare of society, and develop a sense of responsibility for oneself and others.

### Goals

Students will be able to;

- (a) recognize and critically analyse the situations that oppress and marginalize them and others, and take appropriate individual and collective actions to transform these situations in order to improve their wellbeing.
- (b) develop a positive attitude towards community service and responsibility for the well-being of the community while being responsible for their personal behaviour and conduct and hold others to account for their behaviour and attitudes in the interest of public good.
- (c) develop effective communication and social skills, and think critically and rationally when solving problems and making decisions at different stages of their personal development.
- (d) interpret language and cultural expressions attributed to oppressed and marginalized groups by dominant and powerful groups and challenge these in order to improve their situations.

**Aim 5:** Students will contribute towards the development of knowledge-based economy and society, and the transformation of Papua New Guinea from a developing to a middle income country by continuously learning and applying knowledge, skills, values, and attitudes to improve the prevailing social, economic, political, cultural, scientific, and technological conditions.

### Goals

Students will be able to;

- (a) value creativity and innovation; the spirit of autonomy and independence; and foster an attitude to knowledge creation and application to improve working and development conditions.
- (b) obtain relevant knowledge, skills, values, and attitudes that will enable them to be multi-skilled, lifelong learners, and knowledge-based workers capable of functioning in a changing world and work environment.

**Aim 6:** Students will continue to learn throughout their lives and apply the outcomes of learning to improve their personal and collective learning, growth and development, and the quality of life for oneself and others.

### Goals

Students will be able to;

- (a) think sensibly for themselves and to develop as individual members of a community.
- (b) develop and foster an attitude towards continuous learning as a basis for improving one's own knowledge, thinking, practice, value and belief system and hence improve life outcomes.
- (c) cultivate a positive attitude towards research, reflection, and critical analysis as bases for lifelong learning.

**Aim 7:** Students will acquire essential knowledge, skills, values, and attitudes necessary for the building of peaceful and safe communities, living together, upholding the principles of a democratic state and society, building social cohesion, promoting equity and social justice, and ensuring economic prosperity for all.

### Goals

Students will be able to;

- (a) value justice, responsibility, equality between men and women, mutual respect and cooperation, and actively contribute to the building and fostering of peaceful, safe, and inclusive communities.
- (b) use effective communication skills and think creatively in a rational manner and develop better problem solving and decision making skills at appropriate levels and ages.

**Aim 8:** Students will foster an understanding and an appreciation of PNG's many cultures and languages, their influence on the construction and representation of Papua New Guinean's identities, and the value, knowledge, and belief systems that underlie these diverse cultures and languages; while embracing the cultural and linguistic differences, and take actions to sustain the good and eliminate the bad aspects of cultures.

### Goals

Students will be able to;

- (a) have pride and responsibility towards their cultures and languages, and preserve and promote one's identity through language and culture while at the same time learning, appreciating, and tolerating other cultures and languages, both local and international.
- (b) communicate with other people through written and spoken language, through mathematics and through other ways such as art, music and movement.
- (c) investigate the underlying knowledge, value, and belief systems of different cultures and languages, and take appropriate individual and collective actions to eliminate aspects of cultures that hinder the building and fostering of healthy relationships and peaceful and safe environments, that are oppressive and detrimental to human development, and detrimental to the promotion of inclusive development and a hindrance to promoting and safeguarding fundamental human rights.

**Aim 9:** Students will develop their knowledge and an appreciation and respect for the natural environment and physical and human resources, and the need to develop these in ways that are sustainable for the benefit of current and future generations.

### Goals

Students will be able to;

- (a) cultivate and maintain an attitude to respect life, care for nature, and contribute to the protection of the environment.
- (b) help develop and sustain Papua New Guinea's environment and its physical and human resources, for the benefit of current and future generations.
- (c) become wise guardians of Papua New Guinea's resources.
- (d) act responsibly and within the spirit of environment sustainability in the use of natural resources with the knowledge that local actions on environment have both local and global consequences.

**Aim 10:** Students will develop healthy self-concepts; contribute to the establishment and sustainability of healthy communities; the eradication of common diseases; and improvement in the health status of all citizens.

### Goals

Students will be able to;

- (a) demonstrate an understanding of the different stages of child development from conception to childhood, adolescence to adulthood.
- (b) show awareness and understanding of the importance of building and promoting healthy life styles and healthy communities as prerequisites for healthy living and life style.
- (c) investigate common diseases in PNG and their causes and symptoms, appreciate the consequences and impact they have on the citizens, look at what is being done to eradicate these diseases, and know how they can contribute to eradicating these diseases.

**Aim 11:** Students will understand that parenthood is a lifelong responsibility however, in exercising this right they should be aware of the impact of uncontrolled population growth and its consequences on families, communities, the environment, available resources, and the nation.

### Goals

Students will be able to;

- (a) appreciate the importance of having a family unit and show awareness of parental responsibilities, recognize the consequences of the decisions they make regarding the size of their families, recognizing the fact that the quality of life for their students depend on the decisions they make.
- (b) aware of the contributing factors to population growth and demonstrate an understanding of the consequences of uncontrolled population growth.

**Aim 12:** Students will acquire knowledge, skills, values, and attitudes required for social and economic development, for gainful employment and self-employment, and for transforming individual and collective livelihoods and alleviating poverty.

### Goals

Students will be able to;

- (a) acquire knowledge, skills, values, and attitudes required for active participation in the formal and informal economy as means for making a sustainable living.
- (b) explain and apply the concepts and practices of self-reliance and personal viability to create own employment as an alternative to formal employment.
- (c) foster an attitude towards work by acquiring relevant values, knowledge, and skills that will prepare them to pursue vocational skills occupations.

**Aim 13:** Students will develop required values and respect for oneself, others, and the community, and use these as a basis for developing effective national and global citizenships traits.

### Goals

Students will be able to;

- (a) learn about and show awareness about past and present outstanding and model citizens whose character, moral standing, ethical standards, and contributions have shaped PNG and the world.
- (b) demonstrate awareness and understanding of their civic and citizenship roles and responsibilities, the importance of performing these responsibilities in a transparent and accountable way for the greater good of PNG and their communities, and the consequences of neglecting these roles and responsibilities.
- (c) develop and foster values, behaviours, attitudes, and communication competencies required to live together and in harmony with peoples of other cultures and linguistic groupings.
- (d) show awareness and concern for the welfare and the rights of others, contribute to the promotion of justice for all and the empowerment of the oppressed and marginalized people, promote gender and social inclusion as the basis for protecting and promoting the rights of all.

# Overarching Curriculum Principles

Curriculum principles identify, describe, and focus attention on the important concerns that must be addressed when developing the curriculum at all levels of schooling. They are based on significant social, economic, political, cultural, religious, philosophical, environmental, and educational values and beliefs. Curriculum principles are evidence-based and influenced by best practice. The following principles underpin the design, development, and implementation of SBC in PNG.

## Relevance

The national curriculum should target the national, community, and personal; social, economical, political, cultural, environmental, and spiritual development needs and aspirations. Curriculum should aim to prepare students for careers, higher education and citizenship. Students should be equipped with essential, in demand knowledge, skills, values, and attitudes to meet the demands and challenges of working, studying, and living in a complex, knowledge-based, and technology driven economy and society of the 21<sup>st</sup> Century. This can be achieved through the development of rigorous and comparable learning standards, design, development, implementation, and monitoring of a quality SBC, and embedding of values and critical, creative, decision-making, reasoning, problem-solving, high level, 21<sup>st</sup> Century, and STEAM skills in the curriculum.

The national curriculum will enable teachers to support students' learning by encouraging teaching and learning in real-life contexts, and providing opportunities for students to address the problems posed by the natural and physical environments by developing creative and innovative solutions. This means students will relate and use the knowledge, skills, values and attitudes learnt in different subjects to real life situations.

## Multiculturalism

PNG is blessed and fortunate to have so many languages and cultures. The diversity of our cultures is the source of our knowledge, skills, attitudes, and values. As a multicultural society, we must protect, promote, and respect our many cultures and languages. There are many people from our own ethnic groupings and from other countries with their own cultures living and working together in PNG. This is the most multicultural country in the world. We must ensure that we promote and share our cultures with the rest of the world. We must also critically examine and address the problematic aspects of our cultures.

## Ethics, Morals, and Values

Papua New Guinea is striving to create a society in line with democratic liberal traditions. The citizens of PNG should recognise appropriate social relationships based on sound human and religious ethics, morals and values. These are required for interaction with families, villages, and other economic groups and people from other provinces and nations. The process of socialisation requires a belief in the ethics, morals and values of the Melanesian extended family, dialogue with and respect for others and a willingness to conserve and promote those aspects of our traditions, which are consistent with studying, working and living in the 21<sup>st</sup> Century global society. Socialisation also requires an awareness of the interdependence of individuals, societies and nations in the postmodern world. It requires involvement with family, school, church, community and the world beyond.

## Integral Human Development

Integral human development focuses on the holistic development of every person. National curriculum should provide opportunities for all students to receive an education that will enable them to;

- be dynamically involved in the process of freeing themselves from every form of domination and oppression so that they will have the opportunity to develop as integrated persons in relationship with others. This means that the national curriculum must integrate and maximise socialisation, participation, liberation and equality,
- be aware of human potential and the willingness to develop and maximize this potential so that each individual can solve his or her own problems, contribute to the common good of society and maintain, promote and improve the learning, working, and living conditions of all, and
- acquire and consistently use Biblical and spiritual values, personal, social and sustainability values, and work, relationship, health, and peace values in their lives.

Papua New Guinea is a rapidly changing society and faces many challenges. To face these effectively, an individual must strive to become an integrated person and to work with others to create a better community.

The process of integral human development calls for a National Curriculum, which helps individuals to;

- identify their basic human needs,
- analyse situations in terms of these needs,
- see these needs in the contexts of spiritual and social values of the community and
- take responsible action in co-operation with others.

The success of a national curriculum requires the integrated involvement of all the agents of education such as the home, church, school and community.

## The Right to Healthy Living

The health status of Papua New Guinea is very low. All citizens have a right to a healthy life such as clean water, nutritious diet, improved sanitation, appropriate and better local health services. Students need to learn attitudes; skills and knowledge that will help them become productive, healthy and contented citizens of PNG. They need to be given a set of skills that will enable them to improve their own and their community's health in order to improve the health status of PNG. The National Curriculum will ensure that students have the opportunity to learn about healthy living.

## Nation Building and National Unity

Our nation is young and there is still a great deal of nation building to be done. Students need to be given the skills to undertake this task and participate in nationally organised events. The national curriculum should enable them to understand how Papua New Guinean societies work and how they can be a useful part of these societies. Students should learn that they have a place in PNG and that PNG has a place in the world as a whole.

They will be able to help PNG develop a national identity as one nation if they learn to;

- work together with tolerance,
- respect one another, their traditional ways and resolve problems peacefully,
- respect and act in the spirit of the National Constitution,
- recognise their capabilities and develop their own talents,
- participate in the development of the national community and
- protect and safeguard the national wealth and resources.

## Sustainability

The natural environment of PNG is as diverse as its cultures. It is often a violent natural and physical environment, which is under threat from rapid population and misuse of resources such as over logging, abuses associated with mining, over fishing, dynamiting reefs and dumping toxic wastes. Our diverse cultures are also under threat from over exploitation and commercialisation of sacred cultural practices. Our cultural traditions are not being handed down from generation to generation. The national curriculum will guide students to further appreciate, respect and value their natural environment, cultures, customs and traditions. It will give them the skills and knowledge to identify problems and issues and to take action to sustain these aspects of life in PNG.

## Gender Equity and Social Inclusion

Gender is what it means to be a woman or a man. It refers to those behaviours and attitudes that are culturally accepted as ways of being a woman (femininity) and being a man (masculinity). Addressing gender issues goes well beyond ensuring that females have the same opportunities as males to receive an education. A person's experiences determine the way they understand and make sense of the world. Gender is also culturally determined. In PNG, there is a need for sensitivity to local cultural practices and values, with respect to traditional roles for males and females. The national curriculum will provide students with subjects, resources, activities, and experiences that value the needs of both girls and boys.

Females are generally a disadvantaged group in PNG. PNG does not have in place a good record about gender equity for females. Violence against females is widely acknowledged as a serious problem. A number of health and other indicators of human development show that females have a lower quality of life than males. Females have lower literacy rates and lower income levels than males. Males hold nearly all positions of leadership, authority, and decision making.

Men hold most senior positions in government departments and the community. It is a similar situation in the Department of Education, provincial education divisions, and schools. The national curriculum will provide students with opportunities to consider these problems and ways of addressing gender issues.

## Inclusive Curriculum

The national curriculum is inclusive and designed to meet the needs of all students irrespective of their abilities, gender, geographic locations, and cultural language, or socio-economic backgrounds. The national curriculum must be implemented by teachers in ways that are inclusive of all students at all levels of schooling. Much more can be achieved if parents, community leaders, churches, and schools co-operate and communicate with each other.

Students learn in different ways. It is best to use a variety of methods to teach them. No one method is best. It is true that students are very different and even the same students learn best from different methods at different times. By using a range of teaching methods, it is more likely that the needs of all students will be met. In order to be inclusive of all students, teachers need to cater for a range of physical, social, cultural, emotional, spiritual, and intellectual needs of their students. This can be achieved through using appropriately and carefully planned learning activities, a range of teaching methods and strategies, and thoughtful use of the language of communication.

To be inclusive, teachers will need to ensure that all girls and boys have the opportunity to participate. Teaching practices, including classroom organisation and management, should ensure that girls and boys are able to participate fully in all learning activities. Participation requires that individuals are motivated to achieve the goal of socialisation fully where they are encouraged to develop

a sense of obligation for the opportunity to contribute. Through participation, individual creativity can be recognised and encouraged, without losing sight of the principle of communal sharing. Participation is the key to social interaction and can lead to social mobility. It can also help to conserve and generate knowledge and cultural values for future generations.

### **Student-Centred Learning**

Student-centred learning recognises the fact that no two classes are alike and no two students are the same with respect to their needs. A teacher who uses a student-centred approach will endeavour to create a classroom environment that will motivate students to discover new skills and knowledge. In such an environment, the teacher might focus on teaching students how to learn and help them discover relevant information. It is essential to teach students how to learn while at the same time teaching them important content. A student-centred classroom will usually involve students working together in small groups using activity centres set up in the classroom while the teacher works more closely with one or two students. The national curriculum describes what all students are expected to learn in all subjects. A student-centred approach allows teachers to be more flexible in determining the most effective ways to help all students achieve these learning outcomes

### **Lifelong Learning**

School is an important part of a student's education but learning continues throughout life. The initial experience that students have with the school curriculum is critical in encouraging them to continue learning throughout their lives. Going to school should be an enjoyable and satisfying experience for the students and should prepare them for life after school. Students know many things when they come to school. They will learn many things outside of school and continue to learn after they leave school. The national curriculum should build on what students already know. Teachers should make use of this knowledge and skills. When students are learning new, unfamiliar things, teachers should relate the new things to what students already understand. This important learning will continue throughout life as students increasingly take responsibility for their own learning. Increasingly, students who leave school will look for opportunities to continue their education and to return to school or some other educational or training institutions in order to improve their qualifications.

### **Language Development Across the Curriculum**

The national curriculum will provide opportunities for language development across the curriculum. Language development across the curriculum should be encouraged because all subject areas provide meaningful contexts for purposeful learning. Specific subjects have different language requirements such as, the vocabulary and language features of science and the written and oral genres to narrate, explain, persuade, report, and discuss the particular content of various subjects. The conventions and differences must be explicitly taught in relevant contexts across the curriculum.

## **21<sup>st</sup> Century Knowledge, Skills, Values, and Attitudes for Careers, Higher Education, and Citizenship.**

PNG shapes and is being shaped by the 21<sup>st</sup> Century social, economic, political, cultural, religious, and environmental discourses and practices. It is important to provide opportunities for students to learn in-depth and master the 21<sup>st</sup> Century knowledge, skills, values, and attitudes to prepare them for careers, higher education, and citizenship. There is an increasing demand for knowledge-based workers and workers with qualifications in STEAM globally. This cadre of workers is not available in PNG because education is not geared towards preparing this category of workers. PNG students should be equipped with the necessary 21<sup>st</sup> Century and STEAM proficiencies to ensure that they are marketable globally and can contribute meaningfully to the development of PNG.

### **Science, Technology, Engineering, Arts, and Mathematics**

The majority of careers in the 21<sup>st</sup> Century is STEAM related. However, demand for STEAM graduates and experienced workers far exceed the supply of this cadre of workers. What is more, although a slow paradigm shift is taking place, careers in STEAM fields are dominated by males. Females are beginning to venture into these careers but at a very slow pace. There is an enormous gender parity gap in this area. Thus, it is critical for STEAM knowledge, skills, values, and attitudes to be taught from prep to post-secondary school level to provide opportunities for all students to attain STEAM related proficiencies before leaving school. The main aim of this education is to shape students' thinking, motivate, and influence them to develop an interest in careers in the STEAM field, and pursue STEAM related academic programs in institutions of higher education.

# Standards-Based Curriculum Principles

The principles of SBC include the following:

- Setting of high academic standards and a careful and continuous assessment and reporting of students' performance against these standards will motivate students to perform at a much higher level.
- Standards allow every student, every parent, and every teacher to share in common expectations of what students should know, understand, and be able to do.
- Students will learn more when more is expected of them in school and at home.
- The setting of clear, measurable, and attainable standards is the key to attaining high academic standards and hence the attainment of the desired quality of education.
- All students are capable of learning and achieving high academic standards, regardless of their backgrounds.
- Students can learn in their own ways and at their own pace.

# Protection of Children's Rights

It is paramount that children's rights stipulated in national legal and policy frameworks, and international conventions such as the United Nations Convention on the Rights of the Child (UNCRC) are recognised, promoted, protected, and safeguarded by everyone and every organisation working and dealing with children's welfare and well-being. A child is defined by UNCRC as a human being below the age of 18 years. However, definitions of a child may differ based on the socio-cultural contexts of different countries. Notwithstanding the differences in definitions, biologically, a child is generally anyone between birth and puberty.

The four core principles of UNCRC underpinning children's rights are;

- non-discrimination,
- devotion to the best interests of the child,
- the right to life, survival and development, and
- respect for the views of the child.

Children's rights are human rights and therefore they should be promoted and safeguarded by the whole of the education system. They should permeate all education plans, policies, programs, and activities, and firmly embedded in the school curriculum, teaching and learning practices, and the overall management of the education system

# Agriculture Rationale, Aim and Goal, and Guiding Principles

## Rationale

Agriculture was a way of life for Papua New Guineans in the traditional society and it will continue to underpin their livelihoods in years to come. Notwithstanding this, Papua New Guineans are increasingly transiting from a traditional to a modern economy and society, characterized by mass production and marketing of goods and services, and a new trading paradigm, which involves the exchange of goods and services for money. In this context, crops, livestock, insects, plants, and fish that were once used for the purpose of sustaining families are commoditized, that is, they are now seen and used as commodities that could be produced and marketed. Hence, they are now commercially farmed and marketed to earn an income for individuals and families, and generate revenues for the State. Money earned from Agriculture products is used by individuals and families to purchase modern goods and services to meet their needs and wants and the State to procure and provide goods and services to the citizens.

Papua New Guinean agriculture sector is underdeveloped and its economic potential has not been fully maximized. It is either poorly resourced and not supported by the government, for example, by not providing markets for farmers to sell their products nationally and globally, is not knowledge and technology-based, or does not attract and maintain a cadre of workers, entrepreneurs, and multi-corporations who can contribute to the mass production and marketing of quality products. Provision of a quality agriculture education will provide an essential platform for preparing and motivating students to pursue higher education programs in all strands of Agriculture and pursue careers in Agriculture related fields. The more students studying Agriculture in schools the better it would be in preparing the cadre of citizens who will drive Agriculture going forward and maximize its economic potential.

Moreover, the majority of students will not make it to higher education and get a white-collar job. It is important that they are equipped with relevant and essential viability knowledge, skills, values, and attitudes that they can use to make a living and sustain themselves by creating their own jobs. By learning and practicing Agriculture thinking, principles, processes, concepts, and skills, students will be equipped with essential readiness knowledge, skills, values and attitudes that they can use to farm, produce, and market a variety of crops, plants, livestock, insects, and fish.

These knowledge and skill sets can empower students to create and foster sustainable livelihoods, contribute to community and national development, and use other pathways to pursue and achieve their personal goals. In addition, studying of crops, plants, livestock, insects, and fish farming will enable students to understand their importance not only as income earning ventures but also as means for sustaining oneself. It will help them to promote and increase food production using different and progressive farming practices and techniques, and manage their resources well for their benefit and the benefit of the communities they live in.

## Ultimate Aim

The ultimate aim of Agriculture is to empower students with appropriate and in-demand proficiencies so that they can make a meaningful contribution towards improving the material and social welfare of people, creating and living sustainable and resilient livelihoods, and sustaining an acceptable quality of life through the sustainable use of natural resources and creative and innovative farming and production methods to meet people's needs.

## Goals

Students will be able to:

- (a) acquire knowledge and skills which will foster their understanding of the interaction of human beings and the environment in order to satisfy human needs.
- (b) understand that the physical and biological world around us is quite complex and therefore needs to be understood in a holistic manner by the society in order to sustain the natural resources.
- (c) understand plants, soils, insects, microorganisms, climate, and how they interact with each other within agroecosystems.
- (d) understand that the sustainability of our natural resources requires advanced technology through the efficient and effective usage of equipment, materials, and processes.
- (e) develop knowledge, understanding, creativity, practical, and experimental skills as a solid foundation for academic training to prepare them for creative and meaningful adult life.
- (f) develop self-confidence, self-knowledge, and understanding of the world in which they live, through meaningful scientific agricultural activities.
- (g) develop a sense of responsibility towards the environment and relating scientific agricultural practices to sustainable use of natural resources.
- (h) demonstrate desirable behavioral patterns and an attitude of mind in interacting with the environment in a manner that is protective, preserving, and nurturing.
- (i) develop attitudes and practices, further knowledge, and activities that promote the physical and mental health of the society.
- (j) develop economic values and practice for the purpose of uplifting the standard of living in our society.
- (k) develop a lively, questioning, appreciative, and creative intellect to enable them to discuss issues rationally, to make careful observations and analysis, to think scientifically and metacognitively, to solve problems, and apply these skills in their study of different agriculture domains and all aspects of their lives.
- (l) use technology to learn agricultural content and engage in agriculture practices, create knowledge, and solve problems relating to agriculture.
- (m) develop and foster informed and responsible attitudes and choices towards population growth, natural resources, human needs, ecological sustainability, and the quality of life for all citizens.

## Guiding Principles

Agriculture guiding principles describe and focus attention on the important processes and skills, concepts, ideas, and facts, and contexts that should be considered when planning, teaching, and assessing students learning. Guiding principles are influenced by significant agriculture tenets, practices, and socio-economic conditions and aspirations.

## Creating and Fostering Sustainable Livelihoods

Every society faces a conflict between unlimited wants and limited resources. To meet people's wants and needs, varieties of methods have been and continue to be developed to increase supply. These methods include hunting and gathering of plants, animals and wood, subsistence farming of plants and animals, and commercial farming using more advance methods and technology. People need natural resources such as rain, sun, oxygen, soil, fuel, water, animals, plants, fiber, and different types of food to live a decent quality of life. A steady supply and equitable access to natural and man-made resources have been and continue to be essential to people creating and living sustainable livelihoods.

Agriculture has and continues to play a pivotal role not only in meeting people's daily need for food, protein, fiber, fuel, and natural resources such as water, sun, and clean air, but also in developing and sustaining monetary economic systems. To create and foster sustainable livelihoods in the modern economic context, people need to have essential social, economic, political, environmental, and cultural capital in order to contribute to, and benefit from, modern development. A large proportion of citizen's lives in rural communities depend on agriculture to make and earn a living. Investing and expanding the agriculture sector and maximizing its potential, ensuring that all citizens are literate and proficient in agriculture, and harnessing its vast untapped potential in non-tradition agriculture domains will contribute to increasing the country's economic base, provide expanded opportunities for citizens to be gainfully employed, and improve the living conditions and quality of life of all citizens.

## Sustainable Use of Natural Resources

Natural resources should be used to meet our needs and the needs of generations to come. We depend on the natural environment for our existence and survival and the natural environment depends on us to remain healthy and continue to nourish us. This fundamental reciprocal relationship between all living and non-living things is key to the survival and sustainability of planet earth and all its inhabitants. Thus, we have a duty of care and a critical stewardship role to ensure that natural resources are sustainably used for the benefit of current and future generations, and not exploited and plundered by selfish and greedy individuals and organisations to the detriment of humans and ecosystems.

The importance of using natural resources such as the trees, fish, animals, crops, soil, water, air, and sunlight sustainably is emphasized at the national and global levels. At the national level, the need for sustainable use of natural resources is emphasized in the national goal and directive principle number four. It states "We declare our fourth goal to be for Papua New Guinea's natural resources

and environment to be conserved and used for the collective benefit of us all, and be replenished for the benefit of future generations”. At the global level, the need for both local and global actions on sustainable use of natural resources and radical stewardship of the natural environment are described in the United Nations’ Sustainability Development Goals, 2030.

Plundering of the environment and resources have been catastrophic, threatening the survival of the human race and all other living things. The depletion of the ozone layer, caused mainly by pollution emitted from industries, slash and burn methods of farming, and destruction of natural forests, has contributed to the onslaught of climate change and the warming of the earth. This has caused massive destructions to the natural environment and impacted all aspects of human life. Intensity of bushfires and other natural and man-made disasters are testaments of what can and will happen if the mutual relationship between humans and the natural environment is not valued and undermined.

### **Harnessing and Maximising Our Agriculture Potential**

Focus in agriculture in PNG has on the cultivation of conventional crops such as coffee, oil palm, cocoa, and coconuts, animals such as pigs, cattle, sheep, and insects such as bees. Even though these crops continue to provide opportunities for PNG citizens to make a living, only very small proportion is engaged in these conventional forms of agriculture. Moreover, school leavers hardly get employed or make a living in these sectors. They either lack essential knowledge, skills, and attitude or are simply not motivated to pursue careers or further education and training in crop farming and animal husbandry.

Agriculture plays a key role in food security and economic development. However, income currently earned from existing agriculture commodities is not enough to help increase the national monetary capacity. This is because, amongst other reasons, PNG has been under utilizing its agriculture potential and not investing money into research and development to expand and grow its agriculture sector. To increase its annual gross domestic product and expand its annual budget, PNG needs to harness and maximize its agriculture potential by investing in the mass production and commercialization of agriculture products currently being sold in the informal markets and those yet to be discovered.

Horticulture, aqua farming, and insect and bird farming are areas that should be targeted for investment and commercialization. Medicinal, ornamental, and pesticidal plants, cereals, fruits and nuts, vegetables, and oilseed, root/tuber, spice, leguminous, fiber, and tobacco crops should be targeted by the government for commercialization. This strategy will not only bring in much needed revenue for the country, it will also provide more and varied opportunities for citizens to earn and make a living.

## **Agriculture is Key to Poverty Reduction and Improved Quality of Life**

An environment conducive to equitably shared economic growth is essential to reducing poverty and enabling each and every person to have access to food and meet other essential needs such as shelter, protein, fiber, and fuel. Investment in the agricultural sector can contribute to the participation of the majority of citizens in both the formal and informal economies. Participation of citizens in the national economy through agriculture is crucial to raising income levels of the poor and the underrepresented, and increasing food supplies and ensuring food security for all.

All citizens, regardless of their backgrounds, abilities, or gender, should be provided equal opportunities and supported with necessary resources to learn and become literate in agriculture, and acquire essential proficiencies that are needed to earn and make a living in the 21<sup>st</sup> Century. They should be supported by enabling government policies and a conducive economic environment to start and grow their own enterprises and businesses in agriculture, and have readily available local and global markets to market their products and earn an income. This will benefit both the citizens and the nation. Citizens will earn an income and improve their quality of life while the nation will receive much needed income from taxes and foreign exchange, and expand its economic base.

# STEAM Rationale, Aim and Goals, and Guiding Principles

## Rationale

The majority of careers in the 21<sup>st</sup> Century is STEAM related. However, demand for STEAM graduates and experienced workers far exceed the supply of this cadre of workers. What is more, although a slow paradigm shift is taking place, careers in STEAM fields are dominated by males. Females are beginning to venture into these careers but at a very slow pace.

There is an enormous gender parity gap in this area. Thus, it is critical for STEAM education to be introduced and taught from elementary prep to the higher education level to provide opportunities for students to study in-depth and master the STEAM related knowledge, skills, values, and attitudes, and provide equal opportunity to be engaged in real life experiences to learn and have hands-on experience of applying STEAM concepts, processes, ideas, skill, values, and attitudes to solve real problems and come up with solutions. The main aim of this education is to shape students' thinking, motivate, and influence them to develop an interest in careers in the STEAM field, and to pursue undergraduate and postgraduate programs in institutions of higher education.

## Aim

The ultimate aim of STEAM education is to develop a STEAM literate society in which all citizens have the expected level of STEAM literacy. STEAM literacy refers to an individual's;

- knowledge, skills, values, and attitudes to identify problems and questions in life situations, explain the natural and design world, and draw evidence-based conclusions about STEAM issues,
- understanding of characteristic features of STEAM disciplines as forms of human knowledge, inquiry, and design,
- awareness of how STEAM disciplines shape our material, intellectual, and cultural environments, and
- willingness to engage in STEAM related issues and with the ideas of STEAM as a constructive, concerned, and reflective citizen.

## Goals

The following are the goals of STEAM:

- (i) Provide students with STEAM related experiences and opportunities to use STEAM concepts, ideas, and skills to solve problems relating to the natural and physical worlds, and use the evidence to make informed decisions about the interventions.
- (ii) Build positive attitudes and embed essential STEAM values in students thereby motivating them to choose STEAM related careers or undertake STEAM related academic programs or courses of study.
- (iii) Provide students opportunities to work in collaboration and partnership with people engaged in STEAM related careers or disciplines to learn about how STEAM skills, concepts, processes, and ideas are applied in real life.
- (iv) Build a pool of STEAM workers who can contribute to national and global development and progress.
- (v) Enable students to achieve high academic standards

## Guiding Principles

### **Integration and application of knowledge and skills in real life situations**

Integration of STEAM knowledge and skills and their application to real-life situations inside and outside of the classroom setting will enable students to explain how STEAM disciplines shape our material, intellectual, cultural, economic, social, and environmental contexts.

### **Emphasis is on the learning and the application of STEAM knowledge and skills to investigate, explain, and solve problems rather than on content**

STEAM education emphasizes the learning and the application of knowledge, and skills to investigate, explain, and solving physical and natural problems rather than on in-depth teaching and learning of STEAM content.

### **STEAM related knowledge and skills are used to investigate, explain, and solve problems relating to the natural and physical environments**

STEAM education focuses on providing the learners real life experiences of how STEAM related skills, concepts, processes, ideas, principles, values, and attitudes are applied and used to identify problems and questions in real life situations, explain the natural and physical world, and draw evidence-based conclusions.

# Core curriculum

A core set of common learning's (knowledge, skills, values, and attitudes) have been integrated into the curriculum to provide all students an opportunity to acquire and master these before they are career, higher education, and citizenship ready. 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;
- Spiritual values and virtues;
- Reading, writing and communication skills, and
- Essential values and attitudes.

The above knowledge, skills, values and attitudes should be taught and assessed by all teachers from prep to grade 12. These are reinforced at each school grade and school level to enable students to become proficient in their application in different careers, higher education and citizenship contexts.

# Essential Knowledge, Skills, Values, and Attitudes

Students' level of proficiency and progression towards the attainment of content standards will depend on their mastery and application of essential knowledge, skills, values and attitudes in real life or related situations.

These knowledge, skills, values and attitudes have been integrated into the content standards and benchmarks. They will also be integrated into the performance standards. Teachers are expected to plan and teach these essential knowledge, skills, values and attitudes in their lessons, and assess students' performance, proficiency and progression towards the attainment of content standards.

Provided here are examples of different types of knowledge, processes, skills, values and attitudes that all students are expected to learn and master as they progress through the grades. These are expanded and deepened in scope and the level of difficulty and complexity are increased to enable students to study in – depth the subject content as they progress from one grade to the next.

## Types of Knowledge

**There are different types of knowledge. These include:**

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Public and private (privileged) knowledge</li> <li>• Specialised knowledge</li> <li>• Good and bad knowledge</li> <li>• Concepts, processes, ideas, skills, values, attitudes</li> <li>• Theory and practice</li> <li>• Fiction and non-fiction</li> <li>• Traditional, modern, and postmodern knowledge</li> </ul> | <ul style="list-style-type: none"> <li>• Subject and discipline-based knowledge</li> <li>• Lived experiences</li> <li>• Evidence and assumptions</li> <li>• Ethics and Morales</li> <li>• Belief systems</li> <li>• Facts and opinions</li> <li>• Wisdom</li> <li>• Research evidence and findings</li> <li>• Solutions to problems</li> </ul> |
|--|--|

## Types of Processes

**There are different types of processes. These include:**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>• Problem-solving</li> <li>• Logical reasoning</li> <li>• Decision-making</li> <li>• Reflection</li> </ul> | <ul style="list-style-type: none"> <li>• Cyclic processes</li> <li>• Mapping (e.g. concept mapping)</li> <li>• Modelling</li> <li>• Simulating</li> </ul> |
|---|---|

## 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:**

<p>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 generalisations, claims, and conclusions.</p>	<p>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.</p>
<p><b>Key words</b></p>	<p><b>Key words</b></p>
<p>Analyse, compare, contrast, classify, distinguish, infer, explain, separate, select, categorise, connect, differentiate, discriminate, divide, order, point out, prioritise, sub-divide, survey, advertise, appraise, breakdown, calculate, conclude, correlate, criticize, devise, deduce, arrange, discover, establish, examine, organize, outline, investigate, examine, simplify, see, research, recognize, highlight, in-depth, discuss, list, find, group, divide, focus, question, experiment, test, illustrate, identify, deconstruct, simplify,</p>	<p>Evaluate, criticize, order, appraise, judge, support, compare, decide, discriminate, recommend, summarise, assess, choose, convince, defend, estimate, find errors, grade, measure, predict, rank, score, select, test, argue, conclude, consider, monitor, check, debate, determine, justify, explain, give reasons, interpret, opinion, validate, value,</p>

## 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;**

Synthesis/Creative 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.

### Key words

Categorise, combine, compose, create, devise, design, explain, generate, modify, organize, plan, rearranges, construct, deconstruct, reconstruct, relate, reorganize, revise, rewrite, summarise, tell, write, formulate, invent, hypothesise, develop, compile, prepare, produce, arrange, rearrange, assemble, role-play, anticipate, make, predict, act-out, model, build, convert, discuss, elaborate, solve, propose, visualize, imagine, extend, tabulate, transform, integrate, innovate, maximize, minimize,

2. **Reasoning Skills** - Reason is a skill used in making a logical, just, and rational judgment.
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** – These skills involve finding solutions to challenges or unfamiliar situations or unanticipated difficulties in a systematic manner.

## Types of Values

### 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 civilisation</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>

## 3. 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>

# Content Standards, Benchmarks, and Evidence Outcomes

Content standards, benchmarks, and evidence outcomes are all curriculum standards. However, they have specific curriculum purposes. Despite this, these curriculum standards are interconnected and enable the intended learning outcomes to be attained.

## Content Standards

Content Standards are broadly stated expectations of what students should know, understand, and be able to do in a particular subject, grade, or school level. They embed essential knowledge, skills, values, and attitudes that all students are expected to learn and master in each strand or unit to prepare them for the next grade or level of schooling.

## Benchmarks

Benchmarks are specifications of content standards or more detailed descriptions of a specific level of performance expected of students at particular ages, grades, or levels of development. Benchmarks focus on the essential knowledge, skills, values and attitudes that all students are expected to learn, master and demonstrate proficiency.

## Evidence Outcomes

Evidence outcomes are indicators that indicate students' progress towards meeting an expectation at the mastery level. They measure students' mastery and application of knowledge, skills, values, and attitudes at each grade, cluster or school level. They indicate that a student is meeting an expectation or achieving a benchmark at the mastery level. They enable teachers to know if a student can do what he/she was expected to know, understand, and do in real life or relevant situations. Evidence outcomes are given for each strand in each grade to describe what all students should do at the end of the different strands of Chemistry.

# Content Standards and Benchmarks Coding

The following is the coding system used to code the content standards and benchmarks to not only make it easier to interpret and understand the relationship between these two learning standards but also to guide lesson planning, instruction, assessment and reporting of students' performance in relation to a benchmark and content standard.

Grade	: Grade is indicated by the first number (for example, <b>11.1.1.1</b> )
Strand	: Strand is indicated by the second number (for example, <b>11.1.1.1</b> )
Content Standard	: Content Standard is indicated by the third number (for example, <b>11.1.1.1</b> )
Benchmark	: Benchmark is indicated by the fourth number (for example, <b>(11.1.1.1)</b> ).

Thus, the code will read as **Content Standard 11.1.1.** and **Benchmark as 11.1.1.1**

# Content Overview

Grades 11 and 12 Agriculture Syllabus is organized around five strands and twenty-three units. Each unit has a national content standard. National content standards describe the content that all students are expected to learn and demonstrate proficiency in each of the units from prep to grade 12. What students are expected to know and do is deepened in scope and increased in the level of sophistication to allow students to explore the essential agriculture processes, skills, facts, principles, ideas, and concepts in-depth and at different levels and contexts of meaning and significance. Grades 11 and 12 Agriculture strands and units are provided in the table below.

**Table of strands and units**

<b>Strand</b>	<b>Grade 11 Units</b>	<b>Grade 12 Units</b>
<b>1. Crops</b>	1. Soil 2. Types of Crops 3. Crop Farming Practices and Management Systems 4. Crop Farming and Technology 5. Types of Plants 6. Plant Farming Practices and Management Systems 7. Plant Farming and Technology	1. Soil 2. Types of Crops 3. Crop Farming Practices and Management Systems 4. Crop Farming and Technology 5. Types of Plants 6. Plant Farming Practices and Management Systems 7. Plant Farming and Technology
<b>2. Animals</b>	1. Types of Animals 2. Animal Farming Practices and Management Systems 3. Animal Farming and Technology 4. Types of Birds 5. Bird Farming Practices and Management Systems 6. Bird Farming and Technology	1. Types of Animals 2. Animal Farming Practices and Management Systems 3. Animal Farming and Technology 4. Types of Birds 5. Bird Farming Practices and Management Systems 6. Bird Farming and Technology 7. Types of Aqua farming Plants, Animals, and Fish
<b>3. Aquaculture</b>	1. Types of Aqua farming Plants, Animals, and Fish 2. Aqua farming Practices and Management Systems 3. Aqua farming and Technology	1. Types of Aqua farming Plants, Animals, and Fish 2. Aqua farming Practices and Management Systems 3. Aqua farming and Technology

<b>4. Integrated Natural Resource Management</b>	<ol style="list-style-type: none"> <li>1. Types of Capture Fishery</li> <li>2. Capture Fishery Harvesting Practices and Management Systems</li> <li>3. Capture Fishery and Technology</li> <li>4. Types of Forestry and Forests</li> <li>5. Forest Harvesting Practices and Management Systems</li> <li>6. Forestry and Technology</li> </ol>	<ol style="list-style-type: none"> <li>1. Types of Capture Fishery</li> <li>2. Capture Fishery Harvesting Practices and Management Systems</li> <li>3. Capture Fishery and Technology</li> <li>4. Types of Forestry and Forests</li> <li>5. Forest Harvesting Practices and Management Systems</li> <li>6. Forestry and Technology</li> </ol>
<b>Agribusiness</b>	<ol style="list-style-type: none"> <li>1. Starting Up and Managing an Agribusiness</li> </ol>	<ol style="list-style-type: none"> <li>1. Starting Up and Managing an Agribusiness</li> </ol>

## Grades 9 and 10 Strands

### Strand 1: Crops

#### Rationale

Crops such as coffee, cocoa, oil palm, coconut, rubber, tea and vanilla and others which generate high income are being farmed by the majority of people in Papua New Guinea. The majority has to be equipped with the essential competency and proficiencies necessary for crop farming and production. These essential skills must begin at early child hood and emphasized and practiced throughout the developmental stages and become part of student's livelihood to make and earn a living after the formal education. Hence students are provided with essential crop production knowledge, skills, attitudes and values as well as other agricultural competencies beginning at the high school level. Today, agricultural ventures are particularly impacted by the development of commodity crop production. It is important for students to understand the impact of crop production so that they can make informed decisions and choices in the development and advancement of agricultural economy

#### Evidence Outcomes

Grade 11	Grade 12
<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• analyse and describe the physical properties of soil and its formation to plant, humans, and animal life.</li> <li>• compare and categorize the physical properties of soil involved in plant and land use including site analysis, soil sampling, soil structure, and soil texture.</li> <li>• distinguish different types of crops and classify them according to the types of environments where they are farmed.</li> <li>• compare the distinguishing characteristics of different crops.</li> <li>• appraise and explain the effectiveness of crop farming practices used in different contexts and environments.</li> <li>• examine and categorize farming practices used in different environments and propose ways of improving these practices.</li> <li>• compare and classify different types of horticulture plants and assess their functions, purposes, and benefits.</li> </ul>	<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• identify and outline different soil improvement practices and explain how they contribute to improving soil fertility.</li> <li>• compare and explain different strategies and processes for sustaining soil fertility.</li> <li>• explore and explain the purposes and benefits of different crops.</li> <li>• inquire and classify crops according to their growing cycle, species, variety, season, land type, crop use, and type of product, how the crop is processed, and cultivation methods.</li> <li>• examine and explicate crop management systems and practices used in different contexts.</li> <li>• explore and expound on crop cultivation and management principles.</li> <li>• compare and contrast different types of plantation crops, ornamental plants, and bedding plants, and analyse their functions, purposes and benefits.</li> </ul>

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| <ul style="list-style-type: none"><li>• explore and categorize fruit trees, vegetable plants, and spice plants according to their species, functions, purposes, and benefits.</li><li>• study and elucidate how fruit trees, vegetables, and spices are cultivated and processed in different environments and places.</li><li>• explore and explain how fruit trees, vegetables and spice products are processed, preserved, and marketed in different contexts and environments.</li><li>• compare and communicate the differences between pomology, Olericulture, Ornamental plants, Arboriculture and Landscaping horticulture.</li><li>• examine and explain how to cultivate, process, preserve, market, regulate and consume pomology, Olericulture, Ornamental plants, Arboriculture and Landscaping</li><li>• compare and discuss the advantages and disadvantages of technology used for crop cultivation.</li><li>• survey and summarize different types of technology used to manage crops and evaluate their effectiveness.</li></ul> | <ul style="list-style-type: none"><li>• explain how ornamental and bedding plants are cultivated and processed in different environments and places.</li><li>• distinguish and explain how plantation crops, ornamental plants and bedding plant products are processed, preserved, and marketed in different contexts and environments.</li><li>• Investigate and discuss types of horticulture cultivation and production principles and management systems used in different environments.</li><li>• appraise and explain horticulture cultivation and management practices used in different environments, contexts, and places.</li><li>• explore and explain how technology could be used to improve plant propagation.</li><li>• assess and summarize the impact of propagation technology on plant physiology and anatomy.</li></ul> |
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## Unit 1: Soil

There are many types of soils, usually placed in classes (types) based on their color, profile, texture, composition, or structure. Each soil type is formed differently and can be found in specific places on the earth's immediate surface, mid, and deep under the surface. Soils on the surface (a few millimeters deep) are usually exposed to direct climatic and environmental factors, and are easily blown away by wind, washed away by water or even broken down by temperature changes, human, and animal activity. There are also soils found deep beneath the earth, often protected from climatic and environmental factors.

Even though not all plants and crops grow on soil, it is important for students to understand that soil is an essential factor of plant and crop growth and yield. Food goes from the soil to the spoon for human consumption. An understanding of the processes involved in the formation of different types of soil and mineral compositions of each type can help students to make informed decisions about crop cultivation.

By the end of grade 12 students would be familiar with how different soil types obtain nutrients and carry out soil analysis. They would have learnt about how soil types affect crop production.

### Content Standard 1.1

Students will be able to explain the process of soil formation, examine the nutrients, characteristics, uses and functions of different types of soil, and investigate strategies and processes for improving soil fertility to support crop cultivation and maximize crop production returns in different environments.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.1.1</b> Investigate and explain how different types of soil obtain their nutrients.</p> <p><b>11.1.1.2</b> Analyse each soil type to determine the composition of different types of nutrition.</p>	<p><b>12.1.1.1</b> Examine soil topography and analyse soil distribution and uses in different locations.</p> <p><b>12.1.1.2</b> Research and compare crop production returns to type of soil.</p>

## Unit 2: Crop types

Knowing the types of crops, crop physiology, and purposes, and the contexts in which they grow is essential for students to understand the identity of each crop and how it could be cultivated to meet human needs. Students will learn that the types of crops grown depend on environmental and climatic conditions, market demands, preference, and human needs. Some crops have a limited growth range dependent on temperatures, available water supply, pests, and other factors. Others may be cultivated in a wider range of conditions.

Crops are classified according to their growing cycle (temporary/permanent), crop species, crop variety (for example, hybrid/ordinary cocoa), season (for example, winter/spring, wheat), land type (for example, wetland/dry land rice), crop use (for example, pumpkin for food/fodder), type of product (for example, fresh/dried beans, how the crop is processed (for example, industrial crops), and cultivation methods (for example, crops grown under protective cover). The more broader categories of crops are cereals, vegetables and melons, fruits and nuts, oilseed crops, root/tuber crops, beverage and spice crops, leguminous crops, sugar crops, and other crops such as grasses and other fodder crops, fiber crops, medicinal, aromatic, pesticidal, or similar crops, rubber, flower crops, tobacco, and other crops both temporary and permanent.

By the end of grade 12 students would be familiar with the general botany, anatomy and physiology of common crops. They would have learnt about fundamental crops processes and the effect of different environment on crop yield and growth.

### Content Standard 1.2

Students will be able to identify and examine the characteristics and physiology of different types of crops, categorize them according to their characteristics, purposes, and benefits, and explore the different contexts, environments, and places where they are farmed.

Grade 9 Benchmarks	Grade 10 Benchmarks
<p><b>11.1.2.1</b> Investigate and explain the botany of different crops.</p>	<p><b>12.1.2.1</b> Investigate and explain the fundamental crop processes (photosynthesis, respiration, environmental health, nutrition, hormone functions, photo-morphogenesis, etc).</p>
<p><b>11.1.2.2</b> Examine the anatomy of different crops and explain how different environments influence the formation of different parts of crops.</p>	<p><b>12.1.2.2</b> Analyse different crops and explain their physiology.</p>

### Unit 3: Crop Farming Practices and Management Systems

Students will learn that farming methods and practices are informed by evidence and knowledge. Having a good understanding of crops and the factors of crop farming will enable students to understand the different farming practices and underlying reasons for employing these practices in different environments and climatic conditions. For example, to meet the demand for food and enhanced food security, crops are genetically modified to increase both the yield and production of crops. To mitigate drought and barren soil, aquaponics is used to grow a variety of crops to meet consumption needs of people. Crop farming practices have evolved from monocropping to mixed cropping to genetic engineering of crops.

Students will be enabled to understand that quality and quantity of farm outputs depend, to a larger extent, on how effectively, creatively, and innovatively internal and external crop farming factors are managed. Agricultural farming management systems are a set of strategies to manage the available resources to achieve economic and sustainable agricultural productivity to meet the needs of the farm household. Students will learn that preserving the resources and maintaining the environment will improve and sustain the health of crops and contribute to improved yields. Effective management and mitigation of external and internal factors can improve crop health and yield, and increase supply to meet demand.

By the end of grade 12 students would be familiar with the basic economics and technologies used in general crop production. They would have learnt the fundamentals of crop production, processing, preserving and marketing.

#### Content Standard 1.3

Students will be able to investigate and analyse crop farming, processing, marketing, regulation, and management principles, systems, and practices used in different contexts, environments, and places

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.3.1</b> Identify and explain the factors of crop production.</p>	<p><b>12.1.3.1</b> Research and explain how different crops are processed, stored, and transported to markets.</p>
<p><b>11.1.3.2</b> Investigate the principles of marketing and explain how these can be used for marketing and sale of crops.</p>	<p><b>12.1.3.2</b> Investigate and explain how each process of crop cultivation, production, and marketing is regulated.</p>

## Unit 4: Crop Farming and Technology

Improvement of crop farming and management practices, increasing the supply of food, protein, fiber, fuel, etc., to meet demand, elimination of hunger and poverty, and equitably shared economic growth and prosperity depends on the construction and use of new knowledge using technology to mitigate the prevailing challenges and develop creative and innovative technological solutions. It is important that students understand the important relationship between technology and food demand and supply.

Students will understand that technology is intertwined with crop farming and has been used in crop production since the cultivation of plants by human beings. Crop Farming ideas, practices, systems, machinery, and equipment have evolved and changed over time from simple implements to more complex and sophisticated automated systems to genetic engineering to artificial intelligence. Technology will continue to be developed and used to mitigate crop farming problems in different environments and climatic conditions to improve outputs and meet an increasing demand for food driven by an increasing population. Students will also learn and become aware of the role they can play in identifying crop farming challenges and developing creative and innovative solutions to improve crop farming practices and management systems and improve food security and the creation of sustainable livelihood for all people.

By the end of grade 12 students would be familiar with technologies used in general crop production. They would have learnt the fundamentals of crop production, processing, preserving and marketing.

### Content Standard 1.4

Students will be able to examine how technology is used in the cultivation, regulation, and management of crops in different societies and environments, and analyze their advantages and disadvantages.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.4.1.</b> Evaluate the use of internet and mobile phones to communicate and disseminate crop farming information and market crop products.</p> <p><b>11.1.4.2.</b> Identify and evaluate the effectiveness of different technology used for regulating and monitoring the cultivation, production, marketing, and consumption of different crops.</p>	<p><b>12.1.4.1.</b> Research and explain how technology are being used to increase crop yields and supply to meet demand.</p> <p><b>12.1.4.2.</b> Research and identify problems affecting the cultivation, production, and making of crops and develop appropriate solutions.</p>

## Unit 5: Plants

“Horticulture is the growing of flowers, fruits and vegetables, and of plants for ornament and fancy. It is the cultivation, processing, and sale of fruits, nuts, vegetables, and ornamental plants as well as many additional services”. It also includes plant conservation, landscape restoration, soil management, landscape and garden design, construction and maintenance, and arboriculture. In contrast to agriculture, horticulture does not include large-scale crop production or animal husbandry.

In horticulture, plants are classified according to their species, characteristics, and uses. These include medicinal plants (for example, aloe vera, chamomile, Moringa, noni), ornamental plants (for example, roses, lilies, tulips), narcotic and chewing plants (for example, tobacco, betelnut, cocoa), Fuel/biofuel plants (for example, jatropha, sugarcane, soybeans), beautification/aesthetic plans (for example, roses, jasmine), fiber plants (for example, cotton, pandanus), perfume plants (for example, lavender, jasmine, eucalyptus), fruit plants (for example, pawpaw, lemon), onion family plants (for example, garlic, onion), amaranth family plants (for example, beetroot, spinach), cashew family plants (for example, mango, cashew), and carrot and ginseng family plants (for example, parsley, celery, carrot, ginseng). Students will learn the importance of these plants and investigate how these plants are farmed and commercialized in large scales in different countries and draw appropriate lessons for PNG.

### Content Standard 1.5

Students will be able to identify and examine the characteristics and physiology of different types of plants, categorize them according to their characteristics, purposes, and benefits, and explore the different contexts, environments, and places where they are farmed.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.5.1.</b> Identify and examine different types of aromatic and herbal plants, and analyse their functions, purposes, and benefits.</p>	<p><b>12.1.5.1.</b> Research and explain the anatomy of fruit trees and flower trees and spice, herbal, aromatic, and ornamental plants.</p>
<p><b>11.1.5.2.</b> Research and classify aromatic and herbal plants according to their species, functions, purposes, and benefits.</p>	<p><b>12.1.5.2.</b> Investigate and explain the physiology of fruit trees and flower trees and spice, herbal, aromatic, and ornamental plants.</p>
<p><b>11.1.5.3.</b> Investigate and explain how aromatic and herbal plants are cultivated and processed in different environments and places.</p>	<p><b>12.1.5.3.</b> Discuss how herbal, aromatic, and spice plants in PNG could be grown and commercialised at a large scale.</p>
<p><b>11.1.5.4.</b> Examine and explain how aromatic and herbal plant products are processed, preserved, and marketed in different contexts and environments.</p>	

## Unit 6: Horticultural Practices and Management Systems

The challenge is both to produce more fruit and vegetables, and to do it sustainably. A sustainable horticultural production system with an ecosystem approach is necessary to cope with an increasingly degraded environment and uncertainties resulting from climate change, while taking into consideration social, political, economic and environmental impacts. The main purpose is to support the transition from subsistence farming to income-generating agriculture by adding value to products to achieve greater returns for producers, while catalyzing public-private linkages between producers, processors, supply chain actors and government support and regulatory mechanisms. The aim is to increase the availability of high quality and safe horticultural produce by developing improved crop management practices (e.g. good agricultural practices, integrated production and pest management, integrated soil health management, organic farming) for sustainable and environmentally friendly horticultural crop production systems.

### Content Standard 1.5

Students will be able to identify and examine the characteristics and physiology of different types of plants, categorize them according to their characteristics, purposes, and benefits, and explore the different contexts, environments, and places where they are farmed.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.6.1</b> Assess different approaches and practices for producing and preserving horticulture products.</p>	<p><b>12.1.6.1</b> Explain the principles of marketing and discuss how these can be used for marketing horticulture products.</p>
<p><b>11.1.6.2</b> Investigate and explain how the cultivation, processing, preservation, sales and marketing, and consumption of horticulture products are regulated in different places.</p>	<p><b>12.1.6.2</b> Investigate and evaluate the importance of horticulture marketing functions and marketing channels for horticulture crops.</p>

## Unit 7: Horticultural Practices and Technology

It is important for students to learn about how plant farming technology evolved over time and the key drivers of technological change and assess the outputs. Farming technology includes implements and knowledge used to grow plants. Knowledge is learned and acquired from lived experiences, lessons learnt, and from research. This knowledge is used to develop new and improved technology and practices over time to improve the cultivation of plants and yields to meet human needs. Plant farming technology evolved and changed from prehistoric gatherers, medieval peasants, and gardeners. An array of technological approaches from primitive tools were developed and used for irrigation, propagation, cultivation, pruning and training, drying, and fermentation.

Horticultural technology has been continuously improved over the years leading to dramatic changes that have transformed horticulture from a craft to a science. Recent technology trends have seen the development of production technology, particularly in the development of seed products and sowing mechanically to enable them to germinate quickly, plant genetic manipulation using DNA techniques to develop gene transfer and plant regeneration technologies, biotechnology for enhancing the growth of crops through the diagnosis and control of plant diseases and improving productive and the quality of food grains using plant-cell and tissue culture, greenhouse technology used in the production of seedlings for transplanting, and use of robots in the mass cultivation and production of plants. Plant farming and production technologies will continue to improve through further research and production of technical knowledge, and diffusion of this knowledge to farmers to improve their plant farming practices and improve the quality and quality of outputs.

### Content Standard 1.7

Students will be able to examine how technology is used in the cultivation, processing, preserving, marketing, regulation, consumption, and management of plants in different types of environments, and analyze their advantages and disadvantages.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.1.7.1</b> Investigate and explain how technology could be used to mass produce and commercialise herbal, aromatic, spice, and ornamental plants in PNG at a large scale.</p> <p><b>11.1.7.2</b> Investigate and identify a problem related to the cultivation, production, and marketing of products from horticulture plant, and develop appropriate solutions to solve the problem.</p>	<p><b>12.1.7.1</b> Research and design a system for cultivating horticulture plants at a larger scale.</p> <p><b>12.1.7.2</b> Research and explain genetic engineering and evaluate its implications for horticulture.</p>

## Strand 2: Animals

### Rationale

The livestock sector has been undergoing change at an unprecedented pace over the past few decades. Booming demand in the world's most rapidly growing economies for food derived from animals has led to large increases in livestock production, supported by major technological innovations and structural changes in the sector. This surging demand has been mostly met by commercial livestock production and associated food chains. At the same time, millions of rural people still keep livestock in traditional production systems, where they support livelihoods and household food security.

Livestock contributes 40% of the global value of agricultural output and support the livelihoods and food security of almost 1.3 billion people. The livestock sector is one of the fastest growing parts of the agricultural economy. The growth and transformation of the sector offer opportunities for agricultural development, poverty reduction, and food security gains, but the rapid pace of change risks marginalizing smallholders, and systemic risks to the natural resources and human health must be addressed to ensure sustainability.

In many developing countries, livestock keeping is a multifunctional activity. Beyond their direct role in generating food and income, livestock are a valuable asset, serving as a store of wealth, collateral for credit, and an essential safety net during times of crisis. Livestock is the world's largest user of land resources, with grazing land and cropland dedicated to the production of feed representing almost 80% of all agricultural land. Feed crops are grown in one-third of total cropland, while the total land area occupied by pasture is equivalent to 26% of the ice-free terrestrial surface.

### Evidence Outcomes

Grade 11	Grade 12
<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• identify and discuss the cultural and societal uses of animals locally and globally.</li> <li>• Examine and explain ways in which animals have and continue to contribute to standard of living</li> <li>• analyse and expound on the positive and negative impacts of animal agriculture on the environment.</li> </ul>	<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• compare and contrast monogastric and polygastric animals.</li> <li>• distinguish and discuss the physiological systems and functions of monogastric and polygastric animals.</li> <li>• examine and explain the procedures and practices involved in monogastric and polygastric animal husbandry management.</li> </ul>

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| <ul style="list-style-type: none"> <li>• explain the relationship between domesticated and farmed monogastric and polygastric animals.</li> <li>• examine and discuss the environments in which monogastric and polygastric animals are domesticated and farmed.</li> <li>• categorize monogastric and polygastric animals based on their feeding systems, functions, purposes, and benefits.</li> <li>• identify and explain the basic anatomy of monogastric and polygastric domesticated and farmed animals.</li> <li>• analyse and discuss the purposes and benefits of different animals.</li> <li>• explore and classify animals according to their species, breeds, products and uses.</li> <li>• explain the purposes and benefits of different animals.</li> <li>• evaluate and summarize the impact of technology in animal farming.</li> <li>• examine and discuss the use of current animal farming technology, explain its associated problems, and develop solutions of improving it.</li> <li>• compare and contrast the current and emerging trends in animal farming technology and justify how it is used to improve farming, production, and marketing of animal products.</li> <li>• investigate and explain the importance of poultry production.</li> <li>• compare and contrast the characteristics of domesticated and farmed birds and classify birds in each of these two categories</li> <li>• appraise the poultry farming principles, systems, and practices used in different environments.</li> <li>• investigate the systems and practices used to farm birds in different climatic conditions and critically reflect on the challenges</li> <li>• determine and categorize the different technologies used in the poultry farming.</li> <li>• summarize the advantages and disadvantages of technologies used in poultry production systems in different environments.</li> </ul> | <ul style="list-style-type: none"> <li>• ascertain and discuss the different approaches and strategies used by farmers to manage animals.</li> <li>• examine and outline approaches and strategies used by farmers to manage animals.</li> <li>• Identify and explain the organs and functions of the reproductive system.</li> <li>• analyse animal reproductive behaviour.</li> <li>• practice proper handling techniques and explain the related psychological behavioural principles.</li> <li>• compare and categorize breeds of farmed birds according to their characteristics, functions, and purposes.</li> <li>• investigate and analyse the principles and factors of poultry production in different contexts.</li> <li>• recognize and deliberate on post-harvest technology used for processing and preserving animal products.</li> <li>• examine and expound on technological innovations that have contributed to the enhancement and mass production of animal products.</li> <li>• distinguish and categorize types of technology that enable online marketing of animal products.</li> <li>• investigate and explain poultry production systems used in different environments and places, and assess their advantages and disadvantages.</li> <li>• compare and discuss poultry management principles, systems, and practices used in different contexts.</li> <li>• survey and summarize the impact of technology used in poultry farming on different environments and people.</li> <li>• examine and categorize technology used in harvesting processing, and preserving poultry products and evaluate their effectiveness and impact on the environment.</li> </ul> |
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## Unit 1: Types of Animals

The type and importance of animal species that are used for livestock production varies between regions and with the categories of livestock owners. The different species play important roles for food production and income generation and have also other important non-food functions. There are different types of livestock including pigs, horses, goats, sheep, cows, and poultry. In some parts of the world, many other partly wild animals are domesticated and considered to be livestock. These include camels, yaks, reindeer, and emus. Animals are classified as large ruminants (for example, cattle, buffaloes), small ruminants (for example, sheep, goats), pigs/swine, equines (for example, horses, mules and hinnies), camels and camelids (for example, camels), poultry (for example, chickens, ducks, geese, turkeys, guinea fowls, pigeons), and insects (for example, bees, silkworms). Each group of animals is further classified according to their physiology, species, feeding behaviours, purposes, and functions.

### Content Standard 2.1

Students will be able to identify and appraise the characteristics of different types of domestic and farm animals, categorize the according to their characteristics, feeding system, purposes and their benefits and investigate the different context, environments, and places where they are formed

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.2.1.1</b> Explain the terminology of apiculture and discuss types of insects used for apiculture and the environment which they are cultivated</p>	<p><b>12.2.1.1</b> Identify and analyse the factors that contribute to the production of quality monogastric and polygastric animal and apiculture products.</p>
<p><b>11.2.1.2</b> Examine the purposes and the cultivation and management systems and practices of apiculture.</p>	<p><b>12.2.1.2</b> Evaluate and discuss the benefits of improved and value added monogastric and polygastric animal, and apiculture products.</p>
<p><b>11.2.1.3</b> Discuss the methods and processes used in apiculture cultivation and production in different contexts</p>	

## Unit 2: Animal Farming Practices and Management Systems

Animal farming practices include mixed livestock production, intensive farming, and extensive farming. Generally, these systems exploit both irrigated and non-irrigated land. Mixed livestock farming can be either intensive or extensive. Intensive breeding farms look more like factories to breed *pigs, chickens, laying hens, cattle, and even fish*. These farms are common in heavy populated areas, where, for instance, the demand for meat and proteins is very high. Intensive animal farming or industrial livestock production is a type of intensive agriculture, specifically an approach to animal husbandry designed to maximize production, while minimizing costs. To achieve this, agribusinesses keep livestock such as cattle, poultry, and fish at high stocking densities, at large scale, and using modern machinery, biotechnology, and global trade. The main products of this industry are meat, milk and eggs for human consumption. There are issues regarding whether intensive animal farming is sustainable or ethical. Extensive farming is a livestock management system used on large non-cultivated land where animals can graze freely. It is mainly chosen for cattle, to produce meat and milk, sheep and goats.

Efficient livestock production requires good management practices which include appropriate feeding and health care and the selection and development of breeds that are well adapted to the specific production environments. Animal farming in some form or the other has been practiced in the various parts of the world since the dawn of civilization. With the onset of Industrial revolution, however, the position underwent a radical change. The structure of agroindustry became extremely complex. At this stage, the development of agriculture theory of management became absolutely necessary.

### Content Standard 2.2

Students will be able to investigate and analyse the different types of animal husbandry and management principles, systems and practices used in different environments and places to farm animals.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.2.2.1</b> Investigate and analyse the challenges of managing livestock using the feeding regime, grazing land tenure, and herding arrangements.</p> <p><b>11.2.2.2</b> Discuss and evaluate husbandry principles and practices use in mass production of animal products.</p>	<p><b>12.2.2.1</b> Research and explain the factors of husbandry animal production.</p> <p><b>12.2.2.2</b> Evaluate emerging trends in animal agriculture and justify how it is used to improve current practice</p>

### Unit 3: Animal Farming and Technology

Livestock operations are becoming more efficient with new high-tech gadgets. New products and technology are developed to address prevailing and possible future challenges of animal farming and providing enough food to meet increasing demands and ensure food security. New technologies have been developed to monitor the reproductive activity of animals. Dairy shed technologies, pasture and feeding technologies, and virtual herding technologies have been developed to improve efficiency in the management of animals and increase the desired outputs.

Biotechnology and smart computing and sensing technologies have made significant improvements and change to the way the animal farming is practiced and managed. Biotechnology is used to improve and enhance farming techniques and production. Modern animal biotechnology is based on genetic engineering. Genetic engineering is a modification of an organism's characteristics by adjusting its genetic material. This can be done by old-fashioned breeding, transgenics, or by cloning. Transgenics is the transfer of a gene from one organism to another. And cloning is where scientists produce multiple genetically identical copies of the same organism, or part of an organism (like a cell or gene). This is done when an animal or plant is found to have a lot of desirable traits. Biotechnology can be used to create animals with more lean muscle mass, increased growth rates, reduced environmental impact, and increased resistance to disease. While smart technologies are used to improve animal welfare and foster technology and science innovation through the creation and application of knowledge to address challenges related to animal farming.

#### Content Standard 2.3

Students will be able to explore how technology is used in the farming, processing, preservation, marketing, consumption, regulation, and management of animals in different contexts and environments, and analyse their advantages and disadvantages.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.2.3.1</b> Rationalize the importance of technology to animal production and the achievement of desired outputs</p>	<p><b>12.2.3.1</b> Explain the advances in electronic agriculture and analyze the its impact on animal farming.</p>
<p><b>11.2.3.2.</b> Explain how technology can be used to regulate the farming, production, and consumption of animal products.</p>	<p><b>12.2.3.2</b> Identify a technology problem related to the farming of animals and develop appropriate solutions.</p>
<p><b>11.2.3.3</b> Investigate and report on the application of communications technology in animal farming.</p>	

## Unit 4: Types of Birds

Poultry farming is the form of animal husbandry which raises domesticated birds such as chickens, ducks, turkeys, and geese to produce meat or eggs for food. Poultry—mostly chickens – are farmed in great numbers. Chickens raised for eggs are known as layers, while chickens raised for meat are called broilers. Birds are generally classified according to their class (groups of birds from a common geographical area such as American, Asiatic, English, Mediterranean, Continental and all other standard breeds), breed (birds within a class that differ in body shape or size, skin color, number of toes or feathering on the legs, variety (birds within a breed that differ in feather color, feather pattern or type of comb, and strain (birds within varieties developed for specific traits such as egg production, egg color or meat production). Genetic makeup and purposes for farming birds are also used to classify poultry.

Poultry is the major source of food and income for most Papua New Guineans and, therefore, students need to be equipped with the necessary proficiencies to prepare them to earn and make a living in poultry related careers and pursue higher education programs in bird farming.

### Content Standard 2.4

Students will be able to identify and evaluate the characteristics of different types of domesticated birds, categorize them according to their characteristics, functions, and benefits, and investigate the different contexts, environments, and places where they are farmed.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.2.4.1</b> Investigate and explain how birds are domesticated in different environments and places.</p> <p><b>11.2.4.2</b> Investigate and explain how birds are farmed in different environments and places.</p>	<p><b>12.2.4.1</b> Analyse and explain the anatomy of domesticated and farmed birds</p> <p><b>12.2.4.2</b> Analyse and explain the physiology and anatomy of farmed and domesticated birds</p>

## Unit 5: Poultry Farming Practices and Management Systems

Various methods are used in poultry farming. These includes intensive farming, which also includes free range farming. Free range farming method is used for large number of poultry birds with high stocking density. There are some basic differences between intensive and free-range poultry farming. Intensive poultry farming method is a highly efficient system which saves, land, feed, labor and other resources and increases production. In this system the poultry farming environment is fully controlled by the farmer. So, it ensures continuous production throughout the year in any environment and seasons. Intensive poultry farming has some disadvantages too. Some people say intensive system creates health risks, abuse the animals and harmful for the environment. On the other hand, free range poultry farming method requires a large place for raising the birds and the production is about the same as intensive method.

However, in the case of both intensive and free-range poultry farming method, the producers have to use nationally approved medications like antibiotics regularly to keep the poultry birds free from diseases. Poultry farming are kept under a wide range of conditions which can be classified into one of four broad production systems: free range extensive system, backyard extensive system, semi intensive, and intensive.

In free range condition, the birds are not confined and can scavenge for food over a wide area. Rudimentary shelters may be provided and these may or may not be used. The birds may roost outside usually in trees and nests in the bush. The flock contains birds of different species and varying ages. In the backyard extensive system, poultry are housed only at night but allowed free range during the day. They are usually fed a handful of grain in the morning and evening to supplement scavenging. The semi intensive system is combination of the extensive and intensive systems where birds are confined to a certain area with access to shelter. In the run system, the birds are confined in an enclosed area outside during the day and housed at night. Feed and water are available in the house to avoid wastage by rain, wind, and by wild animals. Intensive systems are used by medium and large-scale commercial enterprises and are also used at the household level. Birds are fully confined either in houses or in cages. Capital outlay is higher and the birds are totally dependent on their owners for all their requirements. Production however is higher.

**Content Standard 2.5**

Students will be able to investigate and analyze the different types of farm and management principles, systems, and practices used in different environments and places to farm birds.

<b>Grade 11 Benchmarks</b>	<b>Grade 12 Benchmarks</b>
<p><b>11.2.5.1</b> Investigate and analyse the different approaches and practices of producing and preserving bird products.</p> <p><b>11.2.5.2</b> Investigate and explain how the cultivation, processing, preservation, sales and marketing, and consumption of bird products are regulated in different places.</p>	<p><b>12.2.5.1</b> Explain the process of setting up and managing a poultry project, and evaluate each step.</p> <p><b>12.2.5.2</b> Investigate and assess the ability and effectiveness of different poultry pest and disease control and management strategies.</p>

## Unit 6: Bird Farming and Technology

There are many types of poultry equipment available which are necessary for successful poultry farming. Proper management, care, and sufficient equipment are a must for successful production of poultry. Some essential poultry products/equipment include poultry housing, incubator, feeder, water pot, heater, laying nests, egg handling nests, fencing, flooring, coops and cages, and others. A lot of research has been and continues to be carried to address the challenges of the existing technologies and come up with creative and innovative technologies to make poultry farming, management, production, and marketing more efficient and productive, while providing safer products for consumers.

Chicken houses, for example, are now fully computerised and environmentally controlled. The ability to control the temperature in the houses is a key advancement in the poultry industry. Many years ago, a serious heat wave would have caused significant losses. Tunnel ventilation and cooling cells changed the nature of the industry. Temperature changes can be monitored through applications on the cell phones and adjustments can be done remotely when necessary. Even on hottest days, the combination of evaporative cooling and wind chill in modern tunnel

### Content Standard 2.6

Students will be able to investigate how technology is used for bird farming, processing, preservation, marketing, consumption, regulation, and management in different contexts and environments, and analyze their strengths and weaknesses.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.2.6.1</b> Investigate technology used for regulating, managing, and monitoring poultry farming, production, and consumption, and evaluate their effectiveness.</p> <p><b>11.2.6.2</b> Investigate and identify poultry farming problems and develop appropriate solutions.</p>	<p><b>12.2.6.1</b> Research and identify poultry harvesting problems and develop appropriate solutions.</p> <p><b>12.2.6.2</b> Research and assess technologies used in different contexts to improve and add value to poultry products to meet the demand for these products.</p>

## Strand 3: Aquaculture

### Rationale

From ancient times, fishing has been a major source of food for humanity and a provider of employment and economic benefits to those engaged in this activity. Sustainable aquaculture plays a critical role in food and nutrition security, and in providing for the livelihoods of millions of people. Much of the fish are caught by household members and traded in local markets. Small-scale fisheries and aquaculture make critical contributions to development in the areas of employment, with over 41 million people worldwide, the vast majority of whom live in developing countries, working in fish production; food security and nutrition, with fish constituting an important source of nutrients for the poor and often being the cheapest form of animal protein; and trade, with a third of fishery commodity production in developing countries destined for export.

With most capture fisheries worldwide considered fully exploited or overexploited, aquaculture will be central to meeting fish demand, which will continue to increase with population growth, rising incomes and increasing urbanization. As aquaculture develops, however, governments will need to manage its potential ecological and social impacts. Aquaculture faces numerous challenges, including resource conflicts and difficulties in accessing credit, quality seed and feed, and information. Also, key to meeting growing demand will be improvements in postharvest processing to reduce fish losses. Both fisheries and aquaculture are often neglected in national development policy and donor priorities, as policy makers often do not have access to data which reflect the importance of fisheries and aquaculture to development. Appropriate policies and regulation remain important; however, both in managing capture fisheries and ensuring that aquaculture development is pro-poor and sustainable.

## Evidence Outcomes

Grade 11	Grade 12
<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• investigate and make sense of the historical background of aqua farming.</li> <li>• rationalise the importance of aqua farming.</li> <li>• distinguish between freshwater, brackish water, and salt water environment.</li> <li>• analyse the attributes of fresh water, brackish water, and salt water.</li> <li>• investigate and discuss the cultivation of different fresh, brackish and salt water plants in different environments.</li> <li>• examine the principles of aqua farming and explain their importance in understanding aqua farming practices.</li> <li>• investigate and explain aqua farming systems and practices used in different places and environments.</li> <li>• explore and discuss fish farming and management practices and systems used in different places and environments.</li> <li>• identify and outline the tools, equipment and other devices used in aqua farming.</li> <li>• evaluate and summarize technologies used in aqua farming,</li> <li>• survey and summarize problems associated with the use of technology and develop recommend solutions.</li> </ul>	<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• investigate and summarize on the cultivation of different fresh, brackish, and salt water animals in different environments.</li> <li>• distinguish and categorize different fresh, brackish, and salt water animal characteristics, species, functions, and purposes.</li> <li>• ascertain and explain aqua plant farming and management systems and practices in different places and environments.</li> <li>• summarize different ways of preserving plant, animal, and fish species and sustaining the environments in which they farmed.</li> <li>• distinguish and explain fish farming, harvesting, and preservation technology used in different environment and places.</li> <li>• assess and summarize the effectiveness of different technology used for producing and processing aqua farming products.</li> </ul>

## Unit 1: Types of Aqua farming Plants, Animals, and Fish

Aquaculture is defined as the farming of aquatic organisms such as fish, mollusks, crustaceans and aquatic plants in all types of water environments, including oceans, lakes, ponds, and rivers. Globally, an enormous variety of water bodies, including rivers, irrigation canals, flood plains, lakes and ponds, can be used for fish farming. Fish not only provide a source of sustenance for fishing communities, but they are also an important component in marine biotic communities. Particular kinds of aquaculture include fish farming, shrimp farming, oyster farming, mariculture, algaculture (such as seaweed farming), and the cultivation of ornamental fish. Types of farmed fish include tilapia, trout, barramundi, catfish, perch, carp, hybrid striped bass, and salmon. Apart from fish, shrimps, oyster, ornamental fish, and seaweed can also be farmed. Students should learn about aquaculture, mariculture, algaculture. Fish are categorized according to their physiology, species, breed, eating habits, their origins, color, habitats, and purposes.

### Content Standard 3.1

Students will be able to define aquaculture, investigate the different types of plants; animals and fish cultivated using this method of farming, categorize them according to their characteristics, purposes and benefits, and investigate the different contexts, environments, and places where they are farmed.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.3.1.1</b> Investigate and examine the cultivation of different brackish, and salt water fish in different environments.</p> <p><b>11.3.1.2</b> Examine the characteristics and species of fish farmed in different environments and places.</p>	<p><b>12.3.1.1</b> Investigate and discuss the background and importance of mariculture and brackish.</p> <p><b>12.3.1.2</b> Explore suitable fish species for aquaculture farming in PNG environment.</p>

## Unit 2: Aqua farming practices and management systems

Aqua farming practices include freshwater, brackish water, metahaline, and mariculture farming. Particular methods include aquaponics and integrated multi-trophic aquaculture, both of which integrate fish farming and aquatic plant farming, are used to farm fish, animals, and plants. Aquaculture or aqua farming employs a number of methods and management systems, including extensive aquaculture in ponds, which includes polyculture and integrated farming, intensive freshwater and aquaculture, which involves creating water reservoirs and joining them to nearby rivers, either in a raceway or in a closed or recirculation system, and composite fish farming, which involves the farming of a few selected species of fish together in proper proportion in a pond.

Other aqua farming systems include the use of household rice fields, which are usually modified to improve fish growth or in community-managed seasonally flooded rice fields, use of ponds, which is artificially constructed water body, usually made of earth, essentially a static body of water with limited water exchange with the surrounding environment during grow-out, cages and pens, which are water-based aqua-ecosystems in which there is a ready exchange of water with the surrounding environment, raceways or running water ponds, which have brick or concrete sides and bottom as they have relatively fast flowing water, and recirculating aqua-ecosystems, which comprise tanks with water recycling and water treatment through various biological, chemical and/or mechanical filtration devices. Mollusks and seaweeds in coastal areas are farmed in various ways, including racks and rafts to suspend them in the water.

Aqua farming begins with the breeding and supply of different fish stocks to fish farmers. According to the model of breeding, there are two categories, natural breeding and induced breeding. Natural breeding is carried out in special types of ponds where natural water resource conditions are managed for the breeding of culturable fish. Induced breeding is an artificial method of fertilization where the ovaries from the females and the sperms from the males are taken out by artificial mechanical process and the eggs are fertilized by the sperms. Different methods are used for induced breeding.

### Content Standard 3.2

Students will be able to investigate and analyze the different types of aqua farming and management principles, systems, and practices used in different environments and places to farm, process, preserve, market, regulate, and consume plants, animals and fish.

Grade 11 Benchmarks	Grade 12 Benchmarks
<b>11.3.2.1</b> Investigate and explain the factors of aquaculture production in different places and environments.	<b>12.3.2.1</b> Examine the principles of mariculture g and explain their importance in understanding mariculture practices.
<b>11.3.2.2</b> Research and explain the process and ways of processing and marketing aquafarming products.	<b>12.3.2.2</b> Examine mariculture production, marketing, and management systems and practices.
<b>11.3.2.3</b> Examine how aquafarming and consumption of its products are regulated.	<b>12.3.2.3</b> Analyse and explain the anatomy and physiology of different aquafarming plants, animals, and fish.

### Unit 3: Aqua farming and Technology

The application of science and technology developments in aquaculture is very crucial for the sustainable development of the industry. On aqua farms, high-volume systems control food, light (in indoor farms), and growth stimulation. Genetic engineering is used to accelerate growth, and hormones may be injected into fish to change their reproductive behavior. In some countries, fish farmers also add antibiotics to the fish's food or water, and residues of these drugs have been found in fish sold for human consumption.

Biotechnology and other technological interventions as well as the creation of new knowledge will be necessary in the development of improved and sustainable practices and systems of breeding, farming, producing, and managing aquatic organisms such as fish, plants, mollusks, crustaceans, and plants in all types of water environments, ensuring a consistent supply of food and protein, and the protection and sustainability of aquatic ecosystems. Biotechnology and genetics have great potential to increase production and enhance ecological sustainability.

#### Content Standard 3.3

Students will be able to examine how technology is used in aqua farming and the processing, preservation, marketing, consumption, regulation and management of plants, animals and fish in different environment and places and evaluate their strengths and weakness.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.3.3.1</b> Examine post-harvest technologies and evaluate their advantages and disadvantages.</p>	<p><b>12.3.3.1</b> Examine mariculture post-harvest technologies and evaluate their advantages and disadvantages.</p>
<p><b>11.3.3.2</b> Research and discuss the processes of using communications technologies in sales and marketing of aqua farming products.</p>	<p><b>12.3.3.2</b> Research and suggest ways of improving aqua-farming and mariculture technologies.</p>
<p><b>11.3.3.3</b> Examine and explain the relevance of fisheries policies, rules and regulations in monitoring and managing all aspects of aquatic resources.</p>	<p><b>12.3.3.3</b> Investigate and analyse the trends in aqua farming technology and explain how new technology could be used to improve the farming, production, and marketing of animals, fish, and plants.</p>

## Strand 4: Natural Resource Management

### Rationale

Natural Resource Management refers to the sustainable utilisation of major natural resource such as land, water, air, minerals, forests, fisheries and wild flora and fauna. It deals with managing the way in which people and natural landscapes interact. It brings together land use planning, water management, bio-diversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry.

Together, these resources provide the ecosystem service that provides better quality for human life. It specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources.

Natural resource management issues have attracted increasing attention in recent decades, partly in response to a sequence of crises in energy, food, water, and other resources. Effective governance and management of resources have always been important, but have become increasingly challenging in the face of changing climate, livelihoods, and market pressures.

### Evidence Outcomes

Grade 11	Grade 12
<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• distinguish the importance of conserving and managing our natural resources: land, forests, salt and fresh water, and oceans to maintain a high standard of living.</li> <li>• examine the need for proper salt and fresh water management to conserving and managing our natural resources.</li> <li>• analyse the importance of fish production and sustainable approaches and practices.</li> <li>• investigate and discuss the historical background of capture fisheries and rationalize its importance.</li> <li>• discuss the principles of capture fishery and explain their importance in understanding capture fishery practices.</li> <li>• distinguish and explain the attributes of freshwater and marine water environments.</li> <li>• investigate and discuss the capture of different fish and other consumable aquatic organisms and plants in different environments.</li> </ul>	<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• analyse the importance of land to agriculture, fish and forestry production to society to ensure and improve sustainable standards.</li> <li>• compare and contrast forest products and categorize the products according to their market value and uses.</li> <li>• examine and interpret integrated forestry management approaches and practices</li> <li>• explore and expound on capture fish and other aquatic organisms and plants in different environments</li> <li>• compare and distinguish different capture fish and other aquatic organisms and plants according to their characteristics, species, functions, and purposes.</li> </ul>

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| <ul style="list-style-type: none"><li>• investigate and elaborate on the harvesting of different capture fish and other aquatic organisms and plants in different environments</li><li>• compare and categorize different capture fish and other aquatic organisms and plants according to their characteristics, species, functions, and purposes.</li><li>• recognize and discuss the tools, equipment, and other devices used in capture fishery.</li><li>• evaluate and summarize technologies used in capture fishery, identify their problems, and develop appropriate solutions.</li><li>• examine and explain the importance of different types of forestry and forests.</li><li>• distinguish and discuss the attributes of different types of forestry and forests in different environments.</li><li>• investigate and discuss the impact harvesting of forests in different environments.</li><li>• examine and discuss the principles of forest and explain their importance in understanding forest harvest practices.</li><li>• survey and explain forest harvesting practices used in different places and environments.</li><li>• examine and ascertain tools, equipment, and other devices used in the harvesting of forests.</li><li>• communicate types of technologies used in forestry, ascertain their problems, and propose appropriate solutions.</li></ul> | <ul style="list-style-type: none"><li>• evaluate and explain capture fishery management systems used in different places and environments.</li><li>• analyze and discuss capture fisheries regulation and monitoring systems and practices in different places and environments.</li><li>• deliberate and discuss different ways of preserving plant, animal, and fish species and sustaining the environments in which they are caught.</li><li>• investigate and explain capture fishery and aquatic organisms and plants harvesting and preservation technology used in different environment and places.</li><li>• determine and discuss the effectiveness of technology used for producing and processing capture fisher and other aquatic organisms and plant products.</li><li>• examine and classify capture fishery and aquatic organisms and plants harvesting and preservation technology used in different environment and places.</li><li>• deduce and summarize the effectiveness of different technology used for producing and processing capture fisher and other aquatic organisms and plant products.</li><li>• explore and expound on forest management systems used in different places and environments.</li><li>• compare and discuss forest regulation and monitoring systems and practices in different places and environments.</li><li>• research and outline the different ways of preserving and sustaining forests in different environments</li><li>• discover and illustrate forest monitoring and preservation technology used in different environment and places.</li><li>• summarize the effectiveness of different technology used for processing and marketing forestry products</li></ul> |
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## Unit 1: Aqua farming practices and management systems

Capture fishery refers to all kinds of harvesting of naturally occurring living resources in both marine and freshwater environments. Fisheries that are captured from nature are called captured fisheries. Fisheries mean not only fishes but also other consumable aquatic organisms and plants. There are two main types of fisheries: Inland or fresh water fisheries and marine fisheries. On a broad level, capture fisheries can be classified as industrial, small-scale/artisanal, and recreational.

Capture fisheries resources are highly diverse. FAO landing statistics refer to about 2, 500 species or group of species most of which are finfish. By far the most numerous fish species, and those most important to aquaculture and fisheries, are teleost, or bony fish, which in the sea extend from small “grazing” species such as anchovy to large active predatory fish such as tuna. A similarly wide range is also found in freshwater, with the most important species from a production point of view belonging to the carp family. Fisheries can be categorized into two types - fin fisheries and non-fin fisheries. The former is fisheries of true fishes, whereas the latter is the fisheries of organisms other than true fish like prawn, crab, lobster, mussel, oyster, sea cucumbers, frog, sea weeds, etc. Fish are further classified according to their physiology, characteristics, species, and purposes.

### Content Standard 4.1

Students will be able to define aquaculture, investigate the different types of plants, animals and fish cultivated using this method of farming, categorise them according to their characteristics, purposes and benefits, and investigate the different contexts, environments, and places where they are farmed.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.4.1.1</b> Investigate and examine the cultivation of different brackish, and salt water fish in different environments.</p>	<p><b>12.4.1.1</b> Investigate and discuss the background and importance of mariculture and brackish.</p>
<p><b>11.4.1.2</b> Examine the characteristics and species of fish farmed in different environments and places.</p>	<p><b>12.4.1.2</b> Explore suitable fish species for aquaculture farming in PNG environment.</p>

## Unit 2: Production Management of aqua farming

Traditional fishing techniques will vary considerably in detail from region to region. The techniques and tools used depend on the type of habitat being exploited. In the modern context, more advanced fishing methods and practices are used to harvest fish and other aquatic organisms. While fishing lines of all sorts are used to catch fish, the use of fishing nets is the most efficient and economical way of catching fish. Fish is captured through trawling. Trawling is an active fishing method and it works by chasing the fish into the net and keeping them there. There are different types of trawls. These include bottom trawls, mid-water trawls, beam trawls, Denise seine, purse seine, and mono nets.

The management and sustainability of fish and other aquatic organisms and plants is important to ensure a sustainable supply of fish to meet the food and nutritional needs of current and future generations, and preserve the aquatic ecosystems. The Ecosystem Approach to Fishery (EAF) management is being used to manage fishery resources, human needs, and human and natural environments in an integrated and sustainable manner.

### Content Standard 4.2

Students will be able to investigate and analyse the different types of aqua farming and management principles, systems and practices used in different environments and places to farm, process, preserve, market, regulate and consume plants, animals and fish

Grade 11 Benchmarks	Grade 12 Benchmarks
<b>11.4.2.1</b> Investigate and explain the factors of aquaculture production in different places and environments.	<b>12.4.2.1</b> Examine the principles of mariculture and explain their importance in understanding mariculture practices.
<b>11.4.2.2</b> Research and explain the process and ways of processing and marketing aquafarming products.	<b>12.4.2.2</b> Examine mariculture production, marketing, and management systems and practices.
<b>11.4.2.3</b> Examine how aquafarming and consumption of its products are regulated.	<b>12.4.2.3</b> Analyse and explain the anatomy and physiology of different aquafarming plants, animals, and fish.

### Unit 3: Post Harvests and marketing in aqua farming

In small-scale fishing, fisherman use less advanced technology where the fisherman's wealth is his fishing gear (boats, motors, nets, and lines), which is subject to rapid change. They depend for their success on local and indigenous knowledge, much of which has been passed down from generation to generation through a strong oral tradition. Estuary fishing nets, spears, poisons reef fishing, spear guns, spears, hook and lines, bamboo poles, scoop nets, spears, bow and arrows, river fishing dams, night fishing kerosene lanterns, dugong fishing nets, and turtle fishing nets are used to catch fish.

#### Content Standard 4.3

Students will be able to examine how technology is used in aqua farming and the processing, preservation, marketing, consumption, regulation and management of plants, animals and fish in different environment and places and evaluate their strengths and weakness.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.4.3.1</b> Examine post-harvest technologies and evaluate their advantages and disadvantages.</p>	<p><b>12.4.3.1</b> Examine mariculture post-harvest technologies and evaluate their advantages and disadvantages.</p>
<p><b>11.4.3.2</b> Research and discuss the processes of using communications technologies in sales and marketing of aqua farming products.</p>	<p><b>12.4.3.2</b> Research and suggest ways of improving aqua farming and mariculture technologies.</p>
<p><b>11.4.3.3</b> Examine and explain the relevance of fisheries policies, rules and regulations in monitoring and managing all aspects of aquatic resources.</p>	<p><b>12.4.3.2</b> Investigate and analyse the trends in aquafarming technology and explain how new technology could be used to improve the farming, production, and marketing of animals, fish, and plants.</p>

## Unit 4: Types of Forestry

Forestry is the science and craft of creating, managing, using, conserving, and repairing forests, woodlands, and associated resources for human and environmental benefits. Forests are required to maintain a healthy environment and a balanced ecosystem. They also provide shelter to several species of flora and fauna, produce oxygen required by human beings and animals and absorb carbon dioxide. Forestry is practiced in plantations and natural stands. They are essential for human survival and well-being. They harbor two thirds of all terrestrial animal and plant species.

They provide us with food, oxygen, shelter, recreation, and spiritual sustenance, and they are the source for over 5,000 commercially-traded products, ranging from pharmaceuticals to timber and clothing. The biodiversity of forests—the variety of genes, species, and forest ecosystems—underpins these goods and services, and is the basis for long-term forest health and stability. Promoting ways to use forest biodiversity in a sustainable way, and with clear social and economic benefits for the poor, are important.

There are five types of forestry. They are farm forestry, agroforestry, extension forestry, community forestry, and silviculture or scientific forestry. There are also different types of forests. They are very dense and sparsely populated. Forests can be classified mostly into moist tropical forests, dry tropical forests, montane temperate, montane subtropical forests and alpine forests. The various types of forests present in a particular place are dependent on the temperature of the region and the longitude & latitude. Different latitudes have different eco-zones. Good examples are the Boreal forests that are found near the poles, tropical forests are found near the equator, and temperate forests are located at mid-latitude.

### Content Standard 4.4

Students will be able to define forestry, investigate the different types of forestry and forests, categorize them according to their characteristics, purposes and benefits, and investigate the different contexts, environments, and places where they grow and are harvested.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.4.4.1</b> Identify and examine different types of forest products and analyse their properties, functions, purposes, and benefits.</p> <p><b>11.4.4.2</b> Research and classify forest products according to their species, properties, functions, purposes, and benefits.</p> <p><b>11.4.4.3</b> Investigate and explain how different forest products are cultivated and processed in different environments and places.</p>	<p><b>12.4.4.1</b> Research and explain the properties of common trees species in the different types of forestry.</p> <p><b>12.4.4.2</b> Investigate and explain the physiology of common trees in the different types of forestry.</p> <p><b>12.4.4.3</b> Discuss how common tree species could be grown and commercialised on a large scale.</p> <p><b>12.4.4.4</b> Examine and explain how forest products are harvested processed, preserved, and marketed in different contexts and environments.</p>

## Unit 5: Forestry Management Systems and Practices

Forest regeneration is the process by which new tree seedlings become established after forest trees have been harvested or have died from fire, insects, or disease. Regeneration is key to sustainable forestry and can be accomplished through two basic approaches: natural regeneration, which occurs when new seedlings or sprouts are produced by trees left on or near the site and artificial regeneration, more commonly known as tree planting. The other way of ensuring the growth and sustainability of forests is through the method of agroforestry. Agroforestry is a land-use system in which various plants, including trees are planted on the same land management unit as agricultural crops and animals or both. Farmers have practiced agroforestry for centuries. Agroforestry focuses on the wide range of working trees grown on farms and in rural landscapes.

Forest Management is the way that forests and the trees within them are protected and used to provide forest products and other benefits. Two management approaches that are used to manage forests are Sustainable Forest Management (SFM) and Ecosystem Approach to Forestry management. SFM is an approach that balances environment, socio-cultural and objectives of economic development in line with the forest principles. Ecosystem approach is a strategy for integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way.

### Content Standard 4.5

Students will be able to investigate and analyze the different types of forestry practices and management systems used in different environments and places to harvest, process, preserve, market, regulate, and consume forests products.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.4.5.1</b> Assess different approaches and practices practiced in producing and preserving forest products.</p>	<p><b>12.4.5.1</b> Explain the principles of marketing and discuss how these can be used for marketing forest products.</p>
<p><b>11.4.5.2</b> Investigate and explain how the cultivation, processing, preservation, sales and marketing, and consumption of forest products are regulated in different places.</p>	<p><b>12.4.5.2</b> Investigate and evaluate the importance of marketing functions and marketing channels for forest products.</p>

## Unit 6: Forestry Technology

Forest monitoring, harvesting, marking, and processing technology has progressed from labour intensive to paper less technology. Smart technology such as cloud and mobile application, geographical information systems, global position system, artificial intelligence, drones, and terrestrial laser scanning technology are now used to monitor, protect, sustain, and manage forests. Information about all aspects of the forest and environment are recorded, processed, managed, and moved wirelessly between all stakeholders, including the local forest management areas, forest officers, local communities, and different levels of government. For example, a GPS-aided definition of the logging area and of any nature protection sites that must be preserved travels via satellite to the digital maps of the forest company, from the forest company to the harvester's computer, and from the harvester to the trucking company.

The tagging of logs, which is normally done manually, will in the future be done using RFID tags. Every log will be stamped with an active RFID by the head of the harvesting machine. Each log could be individually recorded as it is loaded on the truck and delivered to the mill by having an RFID reader on the lifting arm of the truck. Forest inventory could be assessed by scanning a wood pile with an RFID reader to get the exact log count. Artificial intelligence will also be used for image recognition.

When the power of mobile technology into forestry is harnessed, apps with image recognition, augmented reality, and machine learning will be used to perform tasks like identifying species, log grades, and weight. Cloud computing is enabling an instrumented world where computing can be harnessed to analyze and respond to virtually any issue. GIS will be a key enabling information technology for most big IT initiatives in the coming years—essentially integrating location intelligence into large to massive enterprise and cloud-based systems and hybrid systems. GIS provides a comprehensive approach for working with virtually all information sources

### Content Standard 4.6

Students will be able to examine how technology is used in the harvesting, processing, preservation, marketing, regulation, consumption, and management of forestry in different environments and places, and evaluate their strengths and weaknesses.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.4.6.1</b> Investigate and explain how technology could be used to grow timber species in PNG on a large scale.</p> <p><b>11.4.6.2</b> Investigate and identify a problem related to the establishment, production, and marketing of forest products and develop appropriate solutions to address the problem.</p>	<p><b>12.4.6.1</b> Research and design a system for establishing a plantation for a certain common tree species.</p> <p><b>12.4.6.2</b> Research and explain clonal forestry and evaluate its benefits to forest products.</p>

## Strand 5: Agribusiness

### Rationale

Agribusiness is the business sector encompassing farming and farming-related commercial activities. The business involves all the steps required to send agricultural goods to market: production, processing, and distribution. It is an important component of the economy in countries with arable land, since agricultural products can be. Agribusiness treats the different aspects of raising agricultural products as an integrated system. Some agricultural businesses start and operate as small to medium enterprises and grow over time to become big organizations while others are developed and operated using prevailing business models, established processes, and mechanisms.

Market forces have a significant impact on the agribusiness sector. Changes in consumer taste alter what products are grown and raised. For example, a shift in consumer tastes away from red meat may cause demand—and therefore prices—for beef to fall, while increased demand for produce may shift the mix of fruits and vegetables that farmers raise. Businesses unable to rapidly change in accordance with domestic demand may look to export their products abroad, but if that fails, they may not be able to compete and remain in business.

Agribusiness strand provides a foundation in agricultural business for students in PNG. Students engage in an instructional program that integrates academic and technical preparation and focuses on career awareness, career exploration, and skill preparation in agribusiness. Students will learn about agricultural business operations and management of resources. Topics include accounting, finance, economics, business organization, marketing, and sales in agriculture and farming. The strand emphasizes real-world, occupationally relevant experiences of significant scope and depth in agribusiness. Integral components of classroom and field instruction, supervised agricultural experience projects, and leadership and interpersonal skills development to prepare students for continued training after secondary education.

## Evidence Outcomes

Grade 11	Grade 12
<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• Identify and expound on the economic systems, practices, and factors of starting-up and managing agribusinesses, differentiate among the components of the free-enterprise system and other forms of economic systems.</li> <li>• communicate basic agricultural economic terminology.</li> <li>• apply the law of supply and demand and evaluate its effect on price determination.</li> <li>• assess how agriculture uses scarce resources to meet the needs and demands of its consumers.</li> <li>• predict how the law of diminishing returns impacts agricultural production and marketing.</li> <li>• summarize how governmental, economic, and cultural factors affect international trade.</li> <li>• compare and contrast PNG trade policies with those of other important trading partners.</li> <li>• summarize the importance of agricultural imports and exports and explain its impact on agribusinesses.</li> <li>• research how biotechnology affects trade and global economies.</li> <li>• distinguish the benefits of private, public, and governmental organizations, including the value and impact of cooperatives.</li> <li>• understand how participation in organizations would be beneficial in supporting various agricultural operations.</li> <li>• explore and develop a business plan for starting and operating an agribusiness or enterprise.</li> </ul>	<p>At the end of the grade, all students can;</p> <ul style="list-style-type: none"> <li>• explore environmental issues that impact agribusiness.</li> <li>• determine the meaning and importance of risk and uncertainty.</li> <li>• describe alternative approaches to reducing risk, including the use of insurance for product liability, property, production or income loss, and for personnel life and health.</li> <li>• prepare a comprehensive risk management and contingency plan.</li> <li>• determine the most effective methods for assessing customer needs and wants.</li> <li>• analyze and describe the stages in making a successful sale and the various techniques used to approach potential customers and overcome their objections.</li> <li>• explain and demonstrate effective verbal and written communication skills required for agribusiness sales and marketing.</li> <li>• examine the physiological and psychological factors that influence motivation to purchase, including the fundamental steps in making a purchase.</li> <li>• examine and outline the processes of obtaining and managing start-up capital, including finance, for an agribusiness and assess their strengths and weaknesses</li> </ul>

## Unit 1: Starting Up and Managing an Agribusiness

Agribusiness is influenced and shaped by fundamental business principles and informed by business management best practice. These include market research, strategic and business planning, factors of production, sales and marketing principles and practices, and management functions such as planning, communicating, coordinating, managing, decision-making, delegating, evaluating and monitoring, and information management. It also includes finance and accounting, ICT, human resource management, business insurance, and technology. Students will learn about the fundamental principles of business and important processes and skills, ideas, and concepts, regulatory, financial, policy, political, economic, cultural, and social contexts, and their influence and impact on agribusiness decisions, choices, and risk management strategies. Students will learn the processes of starting up and operating an agribusiness, sales and marketing of different agriculture products, sourcing and managing finance, mitigating internal

**Content Standard 5.1:** Students will be able to investigate and analyze the different types of forestry practices and management systems used in different environments and places to harvest, process, preserve, market, regulate, and consume forests products.

Grade 11 Benchmarks	Grade 12 Benchmarks
<p><b>11.5.1.1</b> Examine different business records and explain how these are used to manage businesses and for decision-making.</p>	<p><b>12.5.1.1</b> Discuss the importance of inventory control systems and explain how they are implemented in business.</p>
<p><b>11.5.1.2</b> Identify and analyse the major sources of funding for a business.</p>	<p><b>12.5.1.2</b> Explain and calculate the operating cycle (accounts receivable turnover and inventory turnover).</p>
<p><b>11.5.1.3</b> Compare and contrast debt and equity financing and explain the impact on financial statements.</p>	<p><b>12.5.1.3</b> Explain and prepare a bank reconciliation.</p>
<p><b>11.5.1.4</b> Discuss the importance of analysing financial statements to determine the financial health, cash flow, and worth of a business.</p>	<p><b>12.5.1.4</b> Explain and apply the double-entry system of accounting to record business transactions and prepare a trial balance.</p>
<p><b>11.5.1.5</b> Analyse cash flow from operating activities to assess profitability and liquidity.</p>	<p><b>12.5.1.5</b> Explain accounts receivable and accounts payable and develop a plan for managing these accounts.</p>
	<p><b>12.5.1.6</b> Compare actual income and expenses to budgeted amounts for a specific period.</p>

# Assessment, Monitoring, and Reporting

The relationship between content standards, benchmarks and performance standards is that they all define students' expected level of proficiency or education quality but at different levels of schooling. Content standards describe the national expectations that all Papua New Guinean students are expected to meet while benchmarks describe the grade-level expectation that all students in a particular grade must meet before proceeding to the next grade. Conversely, performance standards describe students' level of proficiency in a specific knowledge, skill, value or attitude taught in a lesson and measure students' progress towards meeting grade-level expectations and the content standards. Effective instruction and assessment are aligned to performance standards, grade-level expectations, and national content standards.

## What is Assessment?

The term "assessment" is generally used to refer to all activities that teachers use to assess students' mastery of what is learned, and to measure and monitor students' progress towards meeting grade-level expectations and the content standards. Assessment is an on-going process of gathering and interpreting information about students' performance and progress towards meeting grade-level expectations as well as the achievement of the content standards described in the subject syllabuses. Data should also be used to help and guide students who are yet to meet grade-level and national expectations to make the required progress towards meeting these expectations.

## What is Standards-Based Assessment?

In standards-based curriculum, assessment is used to assess students' level of competency or proficiency of a specific knowledge, skill, value, or attitude taught using a set of performance standards (indicators or descriptors) and measuring, monitoring, evaluating, and reporting their progress towards meeting grade and national-level expectations. Assessment is viewed not only as a measurement activity that is performed after a course or a curriculum topic has been taught (summative), but more importantly, as a continuous process (formative) that provides students' performance data to teachers and students regarding their progress towards achieving the intended standards. Timely and ongoing assessment of student's learning and mastery of what is learned are key to the learning process and the attainment of the desired learning outcomes. Throughout the year, teachers will be assessing students' performance and progress towards meeting each grade-level benchmark (grade-level expectation) and each content standard (national-level expectation), and using the data to identify areas where a student or a group of students need more attention, and monitor their progress towards meeting the required standards.

## Purpose of Assessment

The primary purpose of assessment is to improve students' learning and teachers' teaching. The other purposes of assessment are to;

- improve students' learning, levels of proficiency, and progress towards meeting the expected standards,
- provide data that teachers, schools and Department of Education can use to make informed decisions about how to improve the quality of teaching and learning in the education system,
- inform teachers about the progress of students towards meeting grade-level and national expectations (standards) and enable them to adjust their lesson planning, instruction, and assessment to improve student learning and proficiency levels,
- inform parents and guardians about their students's achievements and status of progress towards meeting national standards; and what needs to be done to close the gaps and enable students to make the progress required to meet these standards, and
- provide information for schools and systems about teaching strategies, resource allocations and curriculum; and other educational institutions, employers and the community about the achievements of students in general or of particular students.

Whatever its purpose, assessment is seen as an integral part of the teaching and learning program rather than a separate process.

## Types of Assessment

The following types of assessment have been adopted to assess and monitor students' achievement of the education standards.

- Assessment For Learning
- Assessment Of Learning
- Assessment As Learning

Assessment For and assessment Of learning are also known as formative and summative assessments.

## Assessment For Learning

Assessment For Learning (AFL), also known as classroom assessment is different. It is an ongoing process that arises out of the interaction between teaching and learning. It is not used to evaluate learning but to help learners learn better. It does so by helping both students and teachers to understand;

- the performance standards, grade-level benchmarks and content standards that students are expected to meet to achieve the desired level of proficiency or quality of education,
- where each learner is in relation to the national curriculum standards,

- where they need to be, and
- what they need to do to make progress towards meeting the expected standards.

### **Assessment Of Learning**

Assessment Of Learning (AOL) is the use of a task or an activity to measure, record, and report on a student's level of achievement in regards to specific learning expectations such as unit tests and end of term or year exams. It is normally referred to as Summative Assessment.

### **Assessment As Learning**

Assessment As Learning (AAL) is the use of an assessment task or an activity by the teacher in his/her everyday teaching. This strategy provides students with opportunities to understand what they have learnt or are having difficulties with. Self and peer assessments allow students to reflect on their own learning and identify areas of strengths and weaknesses. These tasks offer students the chance to set their own personal goals to improve their own learning.

### **Diagnostic Assessment**

Apart from these three main types of assessment, teachers are expected to do the diagnostic test/assessment to identify strengths and weaknesses in students. This can be done before any teaching and learning of a new content and for new entry levels for students.

Diagnostic assessment is a form of pre-assessment that allows a teacher to determine students' individual strengths, weaknesses, knowledge, and skills prior to instruction. It is primarily used to diagnose student difficulties and to guide curriculum and lesson planning.

### **Assessment Methods**

These are some methods that teachers can use to assess students' performance.

- Observing students during the lesson
- Conferencing with students
- Student's Portfolio
- Tests
- Assignments
  - projects/reports/quizzes/presentations/practical work samples

## Recording and Reporting

### Recording

Teachers must keep accurate records of students' performance and achievements. They must report these achievements in fair and accurate ways to parents, guardians, teachers and students. Examples of recording methods include:

- anecdotal notes in a journal or diary,
- checklists,
- portfolios of students' work,
- progressive records, and
- work samples with comments written by the teacher.

### Reporting

Reporting is communicating clearly to students, parents, guardians, teachers and others the information gained from assessing students' learning.

Students' reports should be based on assessment information collected from ongoing assessments. Schools will decide on how best the reports will be presented to suit the needs of their communities. Methods will include interviews and written reports. Written reports should include;

- a written record of progress made towards meeting grade-level expectations and the attainment of content standards by each student since the previous report,
- a written record of each student's learning and mastery problems and what needs to be done to make the required progress towards meeting grade-level benchmarks and national content standards, and
- information about students' attitudes, values and general behaviour.

### Monitoring and Evaluation

Assessment information should be used to make judgments about students' achievements and monitor their progress towards meeting grade-level expectations and national content standards.

### Monitoring

Data from performance assessment should be used to monitor and report on students' performance towards meeting grade-level and national expectations. Performance standards or indicators should be used to report and keep a tab on each students' progress towards meeting the expected level of proficiency or competency. Teachers should develop a clear and measurable set of performance standards or indicators to monitor and report on students' progress and achievements on a regular basis.

## Evaluation

Teachers should use assessment data to evaluate the effectiveness of their teaching and their students' learning, and make improvements to their teaching practices in order to improve student learning outcomes. Evaluation tools such as written records, questionnaires, logs and diaries, submissions or records of meetings and discussion with general staff members, teaching staff, parents and other community members should be used to evaluate students and teachers' competency levels, and make informed decisions about how these could be improved.

# Glossary

Terms	Definitions
Agriculture	The utilization of biological processes on farms to produce food and other products useful and necessary to man. Both a “way of life” and “means of life” for the people involved in this industry
Agribusiness	Is the business sector encompassing farming and farming-related commercial activities.
Agronomy	The science of crop production and soil management
Alfalfa	A valuable leguminous crop for forage or hay used in livestock
Animal Unit	The unit of measurement of livestock, the equivalent of one mature cow weighing 1000lbs. The measure is used in making comparison of feed consumption. Five matured ewes are also considered an animal unit
Annual	A plant that completes its life cycle from seed to plant, flower, and new seed in one year or less
Apiary	Colonies of bees in hives and other bee keeping equipment for the production of honey
Aquaculture	Farming of aquatic organisms such as fish, mollusks, crustaceans and aquatic plants in all types of water environments, including oceans, lakes, ponds, and rivers. Globally, an enormous variety of water bodies, including rivers, irrigation canals, flood plains, lakes and ponds, can be used for fish farming.
Artificial Insemination	The mechanical injection of male semen into the womb of the female with a special syringe- like apparatus
Assessment	Activities teachers use to help students learn and to measure and monitor their progress towards the attainment of expected levels of proficiency.
Assessment as Learning	Assessment used to help students understand and reflect on what they have learnt or are having difficulties with, identify areas of strengths and weaknesses, and set clear, measurable, and attainable personal goals to improve their own learning.
Assessment for Learning	A common form of assessment. It is an ongoing assessment process that arises out of the interaction between teaching and learning. Also referred to as formative assessment.
Assessment of Learning	Provides a summary of students learning over a given period of time and is generally carried out at the end of a course of study. Also referred to as summative assessment.
Assessment Strategies	Different ways or approaches of assessing students’ work.
Authentic	Based on facts; accurate, reliable, or real-life situations.
Benchmarks	These are more detailed descriptions of a specific level of performance expected of students at particular ages, grades, school levels or levels of development. They are the specific components of the knowledge, process, skills, concepts, principles, or ideas identified by a content standard.
Capture fishery	Refers to all kinds of harvesting of naturally occurring living resources in both marine and freshwater environments. Fisheries that is captured from nature is called captured fisheries. Fisheries means not only fishes but also other consumable aquatic organisms and plants.
Content Standards	Content Standards are broadly stated expectations of what (content) students should know and do (demonstration of proficiency). They describe the knowledge, skills, values, and attitudes that students should attain.
Evidence Outcomes	These indicators indicate students’ progression towards the attainment of grade-level benchmarks and national content standards, or mastery of essential knowledge, skills, values and attitudes, or attainment of expected proficiencies at the end of each grade or school level.

Forestry	Is the science and craft of creating, managing, using, conserving, and repairing forests, woodlands, and associated resources for human and environmental benefits. Forests are required to maintain a healthy environment and a balanced ecosystem.
Horticulture	Is the growing of flowers, fruits and vegetables, and of plants for ornament and fancy. It is also the cultivation, processing, and sale of fruits, nuts, vegetables, and ornamental plants as well as many additional services". It also includes plant conservation, landscape restoration, soil management, landscape and garden design, construction and maintenance, and arboriculture. In contrast to agriculture, horticulture does not include large-scale crop production or animal husbandry
Performance Assessment	A form of assessment that is focused on measuring students' performance and proficiency on a component of benchmark or content standard.
Standard	A standard is a level of quality or achievement, especially a level that is thought to be acceptable. It is something used to measure or estimate the quality or degree of something, for example, how good a piece of work is.
Standards-Based Assessment	A systematic and ongoing process of collecting and interpreting information about students' achievements.
Standards-Based Curriculum	Describes what all students should know and be able to do at the end of a grade or school level. The main idea behind the Standards-Based Curriculum is standards.
Standards-Based Education	An academic program in which clearly defined academic content and benchmarks are aligned. It spells out what schools and communities need to do to ensure achievement of expectations. The main idea behind Standards-Based Education is standards.
STEAM Education	Refers to the teaching and learning in the fields of Science, Technology, Engineering, Arts, and Mathematics in both formal and informal classroom settings
Sustainability	the ability to be sustained, supported, upheld, or confirmed
Technological change	Changes in the uses of applications of devices, machines and techniques in business
Units	A sub division of a bigger formation. In the case, of curriculum, it is a sub division of a strand
Values	Important and lasting beliefs or ideals shared by the members of a culture about what is good or bad and desirable or undesirable.

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