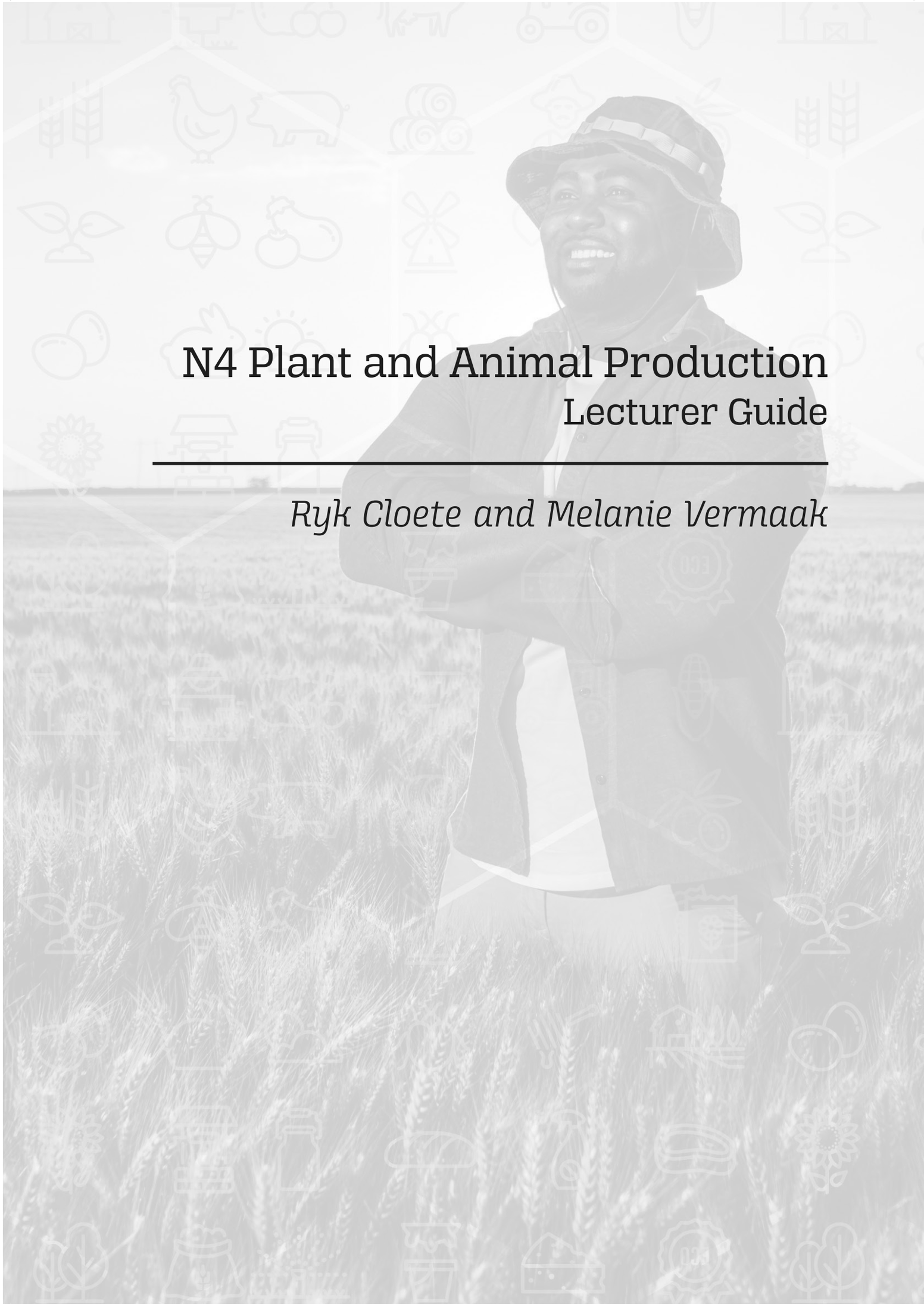

N4 Plant and Animal Production
Lecturer Guide

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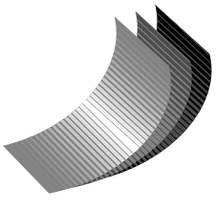

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Lecturer guidance

1. General aims

Students must be able to make a productive contribution as managers or owners of a farming enterprise. Students must develop the knowledge, interest and skills that will enable them to apply the principles of plant and animal production in a farming business.

Students must develop the faculty of critical thinking and the ability of working independently. Students must develop the social skills and economic independence that will empower them to take their rightful place in the community.

2. Specific aims

Students must be able to identify the different soil types, formation of soil and management of soil fertility. Students must also be able to explain the role of soil nutrition in plant growth as well as the production principles.

Students must be able to identify the different principles of the morphology and physiology of plants. Students will acquire practical knowledge of crop production, irrigation, fertilisation as well as pest and disease management. Students will also be able to explain different types of weed control and harvesting procedures.

Students must be able to identify and explain the different types and structures of the digestive systems of farm animals. They must be able to manage a poultry production and goat/sheep production unit. Students will also be able to explain and demonstrate their ability to handle livestock at all stages of rearing and production.

3. Prerequisites

Students must have passed English or Afrikaans at at least First Additional Language level in the National Senior Certificate (NSC), or its equivalent, as well as with 50% for Mathematical Literacy or 40% for Mathematics.

4. Duration

Full-time: one semester (17 weeks); six hours (of which five must be lecturer contact hours and one hour for e-learning) per week for one semester.

5. Evaluation

Evaluation is conducted continuously by means of assignments, case studies, class tests and oral work. A semester mark of at least 40% as well as a minimum examination mark of 40% is required to pass the instructional offering. The semester mark and the examination mark will be calculated together in a ratio of 40:60 to derive the promotion mark.

The examination in Plant and Animal Production will be conducted as follows:
Paper 1: Module 1–3
Duration: 3 hours (200 marks)

Candidates are allowed to answer these papers in one language only. Papers will only be set in Afrikaans and English, but provision will be made for other languages should the need be expressed by commerce and industry.

Emphasis is placed on the practical application of the learning content as required in the world of work. The mark distribution of the content of the paper will be in accordance with the weighted values as set out in the modules.

Weighting: Recall, comprehension, application, analysis, synthesis and evaluation of learning content are important aspects in determining a student's knowledge and understanding of the learning content of the instructional offering.

The following weights are consequently awarded to each category:

RECALL	APPLICATION	ANALYSIS	EVALUATION
Knowledge	**Comprehend and apply**	**Analyse and synthesise**	**Evaluate**
30–40	40–50	10–20	10–20

6. Examination mark allocation

Module 1: ± 65 marks
Module 2: ± 65 marks
Module 3: ± 65 marks

7. Pass requirements

In order to pass the instructional offering, students must obtain a final mark of 40%, with a submission of 40% for the semester mark and the examination mark. The semester mark and the examination mark will be added together in a ratio of 40:60 to obtain the promotional mark.

The semester mark consists of the following:

- One written test; consisting of 50% of the syllabus (± 70 marks, 1 hour)
- One practical assignment, consisting of 80% of the practical component of the syllabus; theoretical questions may be included (100 marks, open-book, two to three working days).
- One internal examination, consisting of 80–100% of syllabus, including theoretical and practical questions (130 marks, 2 hours).

8. General information

An interactive didactic approach should be followed in order to equip students with the general and particular skills of Animal and Plant Production. Practical applications and skills development must take place continuously.

The weighted value of the modules out of 100 indicates the relative importance of each module in the teaching time allocated to it as well as its relative examination value.

9. Didactic guidelines

An interactive didactic approach should be followed in order to equip students with the general and particular skills of Animal and Plant Production. Practical applications and skills development must take place continuously.

Theoretical principles should be applied to practical real-life situations and discussion and evaluations should be done on the basis of case studies.

Theoretical principles should be linked to other modules, such as interviewing, correspondence, meetings, etc., which are all applications of the basic communication process. Although the art of effective listening could be formally introduced and refined in oral work, it should be practised continually and become part of the student's way of life
Role play, excursions, film clips and interviews could all contribute to an understanding and evaluation of the communication process.

10. Work schedule

Week	Module	Topic	Activity	Hours
1-5	**Module 1** Soils and their components	1.1 The importance of soil science	Activity 1.1	40 hours
		1.2 Essential nutrients	Activity 1.2	
		1.3 Soil pH	Practical activity 1.1 Activity 1.3	
		1.4 Soil sampling methods and tests	Practical activity 1.2 Activity 1.4	
		1.5 The effects of different elements on the growth of plants	Case study Activity 1.5	
		1.6 Water and mineral uptake from soil	Activity 1.6 Summative assessment: Module 1	
6–10	**Module 2** Plant production	2.1 Morphology and physiology of plants	Activity 2.1	40 hours
		2.2 Plant reproduction and crop yield	Activity 2.2	
		2.3 Cultivation of vegetables	Activity 2.3 Practical activity 2.1 Activity 2.4 Practical activity 2.2 Activity 2.5 Practical activity 2.3 Activity 2.6 Practical activity 2.4 Activity 2.7 Activity 2.8	
		2.4 Scheduling and operating irrigation	Activity 2.9 Practical activity 2.5	
		2.5 Weeds and methods of weed control	Activity 2.10 Practical activity 2.6	
		2.6 Pests and diseases affecting crops	Activity 2.11 Practical activity 2.7	
		2.7 Harvesting and storage	Practical activity 2.8 Summative assessment: Module 2	
11–15	**Module 3** Animal production	3.1 Structure and functioning of the digestive systems of farm animals		40 hours
		3.2 Poultry production	Activity 3.1 Practical activity 3.1 Case study Case study Practical activity 3.2 Practical activity 3.3 Practical activity 3.4 Practical activity 3.5	
		3.3 Sheep and goat production	Activity 3.2 Case study Practical activity 3.6 Case study Practical activity 3.7 Practical activity 3.8 Practical activity 3.9 Practical activity 3.10 Summative assessment: Module 3	
TOTAL				120 hours

11. Annual teaching plan

	Week 1	Week 2	Week 3	Week 4	Week 5
Topic Module 1: Soils and their components	1.1 The importance of soil science 1.2 Essential nutrients	1.3 Soil pH 1.4 Soil sampling methods and tests	1.5 The effects of different elements on the growth of plants	1.6 Water and mineral uptake from soil	Revision Summative assessment: Module 1
Assessment	Activity 1.1 Activity 1.2	Practical activity 1.1 Activity 1.3 Practical activity 1.2 Activity 1.4	Case study Activity 1.5	Activity 1.6	
	Week 6	**Week 7**	**Week 8**	**Week 9**	**Week 10**
Topic Module 2: Plant production	2.1 Morphology and physiology of plant 2.2 Plant production and crop yield	2.3 Cultivation of vegetables	2.4 Scheduling and operating irrigation 2.5 Weeds and methods of weed control	2.6 Pests and diseases affecting crops 2.7 Harvesting and storage	Revision Summative assessment: Module 2
Assessment	Activity 2.1 Activity 2.2	Activity 2.3 Practical activity 2.1 Activity 2.4 Practical activity 2.2 Activity 2.5 Practical activity 2.3 Activity 2.6 Practical activity 2.4 Activity 2.7 Activity 2.8	Activity 2.9 Practical activity 2.5 Activity 2.10 Practical activity 2.6	Activity 2.11 Practical activity 2.7 Practical activity 2.8	
	Week 11	**Week 12**	**Week 13**	**Week 14**	**Week 15**
Topic Module 3: Animal production	3.1 Structure and functioning of the digestive systems of farm animals	3.2 Poultry production	3.3 Sheep and goat production	Revision Summative assessment: Module 3	Revision
Assessment		Activity 3.1 Practical activity 3.1 Case study Case study Practical activity 3.2 Practical activity 3.3 Practical activity 3.4 Practical activity 3.5	Activity 3.2 Case study Practical activity 3.6 Case study Practical activity 3.7 Practical activity 3.8 Practical activity 3.9 Practical activity 3.10		Examination

Module 1

Soils and their components

After students have completed this module, they should be able to:

- define *soil*;
- describe the functions of soils in the environment;
- discuss the impact of agricultural activities on soil;
- describe soil fertility management;
- list the essential nutrients in soil;
- list and explain the functions of macronutrients in soil;
- list and explain the functions of micronutrients in soil;
- define *pH*;
- describe how to measure pH;
- discuss the effect of pH on nutrient availability;
- briefly explain crumb structure as a result of humus content;
- explain how to ensure that samples give a fair representation of a plot;
- take samples from a plot and administer simple tests;
- list major nutrient elements and explain why plants need them;
- explain the importance or aeration; and
- explain ion exchange.

This module will take about five weeks to cover and will count ±65 marks in the examination.

Introduction

When we study agriculture, we need to study soil and soil components, because both plant and animal life depend on it. Plants grow in soil, and domesticated farm animals eat plants, so if there's no soil and no plant growth, there will be nothing for those animals to eat. Soil is also one of the greatest assets of a country, because the amount of soil that a country has is finite and cannot be increased.

Introductory activity SB page 2

The introductory activities are designed to test students' baseline knowledge of plant and animal production. There are no right or wrong answers, and students need to compare their answers with the new knowledge they have gained after completing the module. The aim of this activity is to encourage class discussion and to build on existing knowledge.

Activity 1.1 SB page 15

1. **Define the word *soil*.**
   Soil is the loose material on the surface of the earth that covers most of the land.

2. **Place the rock particles in ascending order of size:**
   Clay; Silt; Sand

3. **List and discuss the functions of soil in the environment.**
   Growing medium for plants
   Soil provides a place for plants to grow their roots into and from which to get water and nutrients. The main factors determining the productivity of a soil are its depth, texture, structure and the amount of nutrients it contains.

   Regulating the supply of water
   The soil absorbs rain that falls on the land, which makes it available for plants and organisms that live in and on the soil. As soil gets more and more wet, the water moves down through the soil until it is drawn back up towards the surface again by the transpiration of plants or by evaporation.

   Recycling raw materials
   The recycling of raw materials is one of the most important functions of soil. When plants and animals die, their bodies are broken down (decomposed) by microorganisms, such as bacteria and fungi. The organic matter from the dead plants and animals becomes humus, which is dark, spongy and sweet-smelling, and looks like black breadcrumbs. Humus is nutrient-rich and very good for plant growth. Certain animals that live on or in the soil, such as millipedes, earthworms and woodlice, also help to break down organic matter.

   Habitat for organisms
   The soil provides a place for many living organisms of various sizes to live. In fact, about 25% of all living organisms on Earth live in the soil! Billions of microorganisms that decompose organic matter live beneath and on top of the soil, and organisms such as earthworms burrow into the soil and create tunnels for air to penetrate into the soil. The organisms that live in the soil depend on the soil for their food, air and water, and organisms that live on top of the soil depend on it as a place to find food and shelter.

4. **The texture of soil impacts how much water it can hold. Discuss the drainage properties and amount of water held by each of these soils:**
   - **4.1 Sand**
     Sand drains quickly because of the large spaces between the particles. Sandy soils do not hold water; they dry out quickly and without irrigation they cannot easily be used to grow crops.
   - **4.2 Clay**
     Clay drains slowly because the spaces between the particles are very small. Clay soils hold a lot of water. When all the spaces between the particles fill with water, no air is left in the soil and the soil is then waterlogged. Except for rice, guavas and amadumbe, very few plants grow in waterlogged soils.
   - **4.3 Loam**
     Loam drains faster than clay, but slower than sand. Loam soils hold water, but not as much as clay soils. When wet, it still contains air.

5. **Describe the impact of agricultural activities on soil.**
   Tillage removes the plant cover, leaving the soil bare so that it is easily eroded by wind or rainwater. Lack of plant cover means that rainwater easily runs off instead of entering the soil to replenish the surface and ground water supplies. The use of pesticides and fertilisers can introduce chemicals into fresh water supplies, which in turn can negatively affect wildlife and the health of people and animals. Overgrazing destroys the natural vegetation so that the land can support fewer animals.

   If farming is sustainable, it means it can be continued with minimal negative impact on the environment. Sustainable agriculture makes the best long-term use of natural resources, and uses natural processes to conserve water, conserve soil and control pests, diseases and weeds.

6. **The fertility of soil is important for the growth of plants. List and discuss any THREE ways in which the fertility of soil can be increased.**
   Any THREE of the following:
   - **Using legumes to produce nitrogen**
     Nitrogen is an element that plants need in large amounts in order to survive. If soil is short of nitrogen, the plants growing in it are usually undersized and yellow in colour instead of a healthy green colour. Although there is a large amount of nitrogen gas in the atmosphere, plants cannot absorb it in this form. They can only absorb nitrogen in the form of nitrates or nitrites in the soil. Legumes are a family of plants that have a special way of improving soil fertility. All legumes produce their seeds in pods. Examples of legumes are beans, peas and lucerne.

     Legumes have little lumps (nodules) on their roots that contain special *Rhizobium* bacteria that convert nitrogen in the soil into nitrates and nitrites that plants can absorb. The legume gets some of this nitrate while it is growing, and some of it enters the soil. We can ensure that there's sufficient nitrogen in the soil by planting legumes and mixing *Rhizobium* bacteria with plant seeds manually before planting. You can buy *Rhizobium* from seed shops where you buy legume seed.

   - **Adding organic matter**
     Organic matter that breaks down as a result of soil microorganisms and invertebrates that live in it is called humus. Farmers usually add one of six types

of organic matter to the soil to provide or add to existing humus: animal manure, liquid manure, compost, ash and green manure.

- **Fertilisers**
  Fertilisers contain minerals and are made in factories. If you don't have enough organic matter to keep your soil fertile, you can use fertilisers. However, fertilisers only add a few of the minerals to the soil and they don't improve the soil in other ways like organic matter does. The over-use of fertilisers can also lead to the build-up of salts in the soil, which causes salinisation.
- **Crop rotation**
  With crop rotation you grow a different crop on the same piece of land each year for a period of three to five years. Different crops absorb different types and amounts of minerals out of the soil. They take the minerals from different depths in the soil because the roots of different plants grow to different depths. If you plant the same crop every year, the same minerals are removed from the same depth in the soil.
- **Inter-cropping**
  You can also get the benefits of crop rotation by growing two or more crops together. This is known as inter-cropping. For example, you can grow pumpkins, maize and climbing beans together. The beans climb up onto the maize and the maize gets nitrogen from the beans, because beans are a legume. Pumpkins are large spreading plants, so they shade the soil and help to keep it moist. The maize shades the pumpkins and helps to prevent the pumpkin fruit from being burnt by the sun.

7. Which rules should you keep in mind when planning a crop rotation?

- Don't grow the same crop on the same land for two years or seasons.
- Don't grow crops in the same family on the same land for two years or seasons.
- Always include a legume in the crop rotation, because legumes add nitrogen to the soil.

8. You have a very sandy plot of land where you would like to grow maize. Describe how you would increase the fertility of the plot.

To increase the fertility of the plot, add the following organic matter:

Animal manure

Animal manure is the solid waste (faeces) of animals. Animal manure is an excellent source of minerals, especially nitrogen. You can collect animal manure from wherever animals are housed. Because fresh manure can burn the leaves of young plants, it's better to use dry manure or to let the manure dry out for about two weeks before planting. Collecting and spreading manure requires a lot of work. You can avoid some of this work by keeping your animals in fenced areas so that they add the manure directly to the soil while they graze. You can then use these areas to grow crops. The figure shows how to use chickens to provide manure. The fence is moved to plant vegetables over the area where the chickens have dropped their manure. A moveable chicken coop can be moved every two weeks to a new cropping area.

Liquid manure

Liquid manure is a good way to give minerals to plants while they are growing. To create liquid manure, you fill a cloth sack with animal manure and put it in a drum of water. After one week, you take the liquid out of the drum with a jug and pour it around the plants. Be careful not to get the liquid manure on the leaves or stems of plants, as it can burn the plant if it is very concentrated.

Compost
Compost is organic matter that you have set aside to break down into humus. Compost contains various minerals, but doesn't contain as much nitrogen as manure does. The microorganisms and soil animals that break down organic matter need air, water and warmth. You can make your own compost by piling organic matter into a heap, or by putting it into a pit that you've dug. Compost pits are better than compost heaps in hot and dry areas, because the organic matter is surrounded by soil and does not dry out as quickly.

Ash
When organic matter is burnt, the ash that remains contains large amounts of minerals, especially potassium and calcium. It also contains smaller amounts of micronutrients such as zinc and copper. Sprinkle ash onto the soil or add it to compost heaps or pits.

Green manure
Green manure is the name we give to fast-growing plants that are planted on a piece of land to improve soil fertility and to protect the soil from erosion. Green manure plants are normally low spreading plants that grow fast and cover the soil surface quickly after planting. During or after the growing season, the green-manure plants are cut and dug into the soil. They then decompose into humus and release nutrients that improve the soil. Common legumes used as green manure include cowpeas, vetch, red clover and lupins. Green manures can also be non-legumes such as barley, rye grass, pumpkins and mustard. All these crops are grown in summer, except for rye grass, lupins and barley, which can be grown in winter.

Activity 1.2 SB page 17

1. Differentiate between *macronutrients* and *micronutrients*.
Macronutrients are nutrients that plants need in large amounts to maintain optimal growth and development. Micronutrients are nutrients that plants need in small amounts to assist in growth and metabolism.

2. Complete the table by filling in the missing nutrient or function.

Macronutrient	Function(s)	Micronutrient	Function(s)
Carbon (C)	2.1 primary energy source and used in the building of cells	Nickel (Ni)	2.10 essential for seed germination, and important bacteria and fungi that support plant growth also depend on it
2.2 Potassium (K)	required for fruit to ripen, seeds to fill, stems to lengthen and to build resistance to pests and diseases	Zinc (Zn)	2.11 required in the production of growth hormones, proteins and chlorophyll and aids in root development
Magnesium (Mg)	2.3 required for photosynthesis, as it is a key part of chlorophyll	2.12 Boron (B)	required for cell development and to produce pollen and seeds
2.4 Calcium (Ca)	required for cell development and the growth of roots, stems and leaves	2.13 Copper (Cu)	needed to sustain a plant's metabolism to enable respiration and photosynthesis, and forms part of the structure of cell walls
2.5 Hydrogen (H)	required to produce energy	Iron (Fe)	2.14

Macronutrient	Function(s)	Micronutrient	Function(s)
Sulphur (S)	2.6 required for chlorophyll, protein and plant oil production and increases yield	2.15 Manganese (Mn)	required for photosynthesis, to produce chlorophyll, absorb nitrogen, grow roots and produce a number of other elements
Nitrogen (N)	2.7 ensures that energy is available for the leaves to grow properly	Chlorine (Cl)	2.16 required in the opening and closing of the pores (also called stomata) on a plant's leaves to absorb and release gases
2.8 Oxygen (O)	required for photosynthesis and stored to use as energy	Molybdenum (Mo)	2.17 required to successfully absorb and utilise nitrogen and phosphorous
Phosphorous (P)	2.9 required for root growth and to produce flowers, fruit and seeds and increases disease resistance		

Practical activity 1.1: Soil pH — SB page 21

In this practical activity, students collect soil samples to conduct simple pH tests. Guide them through the collection and pH testing. You can use the checklist in Addendum A to gauge their understanding.

1. **Students record the initial pH reading of Sample 1.**
2. **Students record the initial pH reading of Sample 2.**
3. **Students record the initial pH reading of Sample 3.**
4. **The pH reading of Sample 1 increased. The sample became more alkaline.**
5. **The pH reading of Sample 2 decreased. The sample became more acidic.**
6. **The pH reading of Sample 3 stayed constant. The pH reading stayed the same.**

Activity 1.3 — SB page 22

1. **Categorise the following pH readings as acidic, neutral or alkaline:**
   - 1.1 **pH 10,0**
     alkaline
   - 1.2 **pH 8,2**
     alkaline
   - 1.3 **pH 6,1**
     acidic
   - 1.4 **pH 7,0**
     neutral
   - 1.5 **pH 2,4**
     acidic

2. **Define the term *pH*.**
   pH stands for potential hydrogen and is a measure of the concentration of hydrogen ions in a sample.

3. **Very acidic soils can lead to toxic levels of certain nutrients. List any TWO of these nutrients.**
   Any TWO of the following:
   Zinc (Zn); Copper (Cu); Boron (B); Manganese (Mn)

Practical activity 1.2: Soil texture test — SB page 27

In this practical activity, students collect soil samples to conduct a simple bottle or jar test for soil structure. Some students might struggle with the calculation of percentages. Guide them where necessary. You can use the checklist in Addendum A to gauge their understanding.

1. Students write down the percentage of sand, silt and clay for each of their samples.
2. The answer to this question will depend on the results of the bottle or jar tests on the samples.
3. The debris is called organic matter.

Activity 1.4 — SB page 30

1. Describe the process of preparing a plot of land for soil sampling.

Step 1: Look closely at the entire plot of land you want to test and note any visible differences in soil structure.
Step 2: If there are obvious differences, samples should be collected from each of the different soils.
Step 3: If there aren't major differences, samples can be taken from the entire plot of land.
Step 4: Ensure that the surface area is clear of rubble or organic material.

2. Up to which depth will you find topsoil?

Topsoil is found in the top 30 cm of soil.

3. Discuss the methods of collecting a soil sample:

3.1 Using a spade

Dig a square hole of about 60 cm wide and 60 – 100 cm deep. Use the spade to scrape about a handful of topsoil (the top 30 cm) and place it in the topsoil container. Do this again, but for the soil below the top 30 cm (the subsoil) and place it in the subsoil container. You will repeat this procedure at each of the sites you have identified, and the topsoil and subsoil from each site will be added to the respective containers for each.

3.2 Using an auger

Place the tip of the auger at the site you have identified. Twist the handle and apply downward pressure on the auger so that it cuts into the soil. Once you have reached the required depth (for topsoil or subsoil samples), pull the auger straight up. You can now remove the soil and place it in the topsoil or subsoil container. You will repeat this procedure at each of the sites you have identified, and the topsoil and subsoil from each site will be added to the respective containers for each.

4. A jar test result shows 34% sand, 33% silt and 33% clay. How would you describe the soil sample?

Clay loam

5. Write down the steps involved when testing a soil sample using a test kit.

Step 1: Collect your soil sample.
Step 2: Mix the soil sample with distilled water in a clean container, shake vigorously and allow the mixture to stand for 10 minutes.
Step 3: Use a dropper to collect water from the container with the soil sample and fill a test tube with this water.

Step 4: Pour the chemical into the test tube, shake well and allow it to stand for 10 minutes. The water will change colour depending on which nutrient you are testing for and the concentration of that nutrient.
Step 5: Compare the colour of the water to the colour chart that is included in the kit.

6. **When taking a representative sample of a plot of land, you collect samples in an S, W or Z pattern. Why is it important to move in these patterns?**
It is important to move in an S, W or Z pattern to ensure that a representative sample is collected randomly from the entire plot.

Case study — SB page 33

Create a poster that summarises the information in the case study. Your poster should include the different parts of the world mentioned, as well as the macro- and micronutrients that are lacking in each of /these areas and the main reason(s) for the deficiency.

In this activity, students need to read the case study with understanding and summarise what they have read on a poster. They can use cut-outs from magazines or newspapers to make their posters more appealing.

Ensure that the summary each student makes contains the correct information from the case study. Where students have quoted the incorrect information, guide them to where in the case study they can find the correct information.

Activity 1.5 — SB page 34

1. **Define the following:**
1.1 Amino acid
Amino acids are simple organic compounds that combine in long chains to form proteins.

1.2 Protein
Proteins are large, intricate molecules that are crucial for the structure, operation and control of tissues.

2. **A soil sample shows very low levels of phosphorous. If a crop is grown in this soil, what would you expect to see?**
A lack of phosphorus will lead to a plant with a small root system and it may drop the flowers and fruit. Many plants get purple streaks on their leaves when they don't have enough phosphorus, or their roots cannot grow properly or are damaged.

3. **In which functions in plants does nitrogen play a part?**
Plants need nitrogen to produce proteins and chlorophyll. During photosynthesis, plants use energy form sunlight to convert carbon dioxide and other nutrients into elements that are further synthesised into amino acids that form proteins when they join. Nitrogen ensures that energy is available for plant stems and leaves to grow properly. Dark green leaves indicate that there is enough nitrogen.

4. **What factors can cause a lack of Ca in soil?**
A lack of calcium can be caused by cold soil, acidic soil and droughts.

5. **Discuss the effects of a lack of potassium on plants.**
If the soil is short of potassium, fruit doesn't ripen properly, seeds are small and may not germinate, plants are easily attacked by pests and diseases, stems are short, and the leaves are a yellow with brown along the edges.

Activity 1.6 SB page 38

1. **Discuss why aeration is important for healthy plant growth.**
The structure of soil has a direct influence on the amount of air and water, and therefore the amount of dissolved nutrients, that are available to plants. Sandy soil has large spaces between the particles, and therefore has a lot of air between particles but does not hold water well and dries out quickly. Clay soil has small spaces between the particles, and therefore holds less air but holds a lot of water and can become waterlogged. Loam has large and small spaces between particles, and therefore holds an amount of water and air between that of sand and clay. Loam drains slower than sand, but faster than clay and has a crumbly structure.

   The soil water that is found between soil particles is where nutrients that plants need are dissolved. If soil is properly aerated, it creates spaces for water and nutrients to collect. The roots of plants grow towards these spaces where water and nutrients are located, in order to take up the nutrients that the plants need. Root hairs on the roots of plants create a large surface area in order for plants to take up water and nutrients via osmosis.

2. **Describe the process of osmosis.**
Osmosis is the process in which water moves through a semipermeable membrane from a high concentration to a lower concentration in order to equalise the concentrations on both sides of the membrane.

3. **What does the word *transpiration* mean?**
Transpiration is the loss of water through the stomata in the leaves of a plant.

4. **Which part of a plant conducts water from the roots to the leaves?**
Xylem conducts water from the roots to the leaves.

5. **An atom is made up of five protons and six electrons.**
   - 5.1 **Does the atom have a net positive or a net negative charge?**
   The atom has a net negative charge, because there are more electrons than protons.
   - 5.2 **What is this type of atom called?**
   A negatively charged ion is called an anion.

6. **Describe the process of cation exchange.**
Clay and organic matter particles in soil are negatively charged and hold on to positively charged particles, while repelling other negatively charged particles. This works exactly like the poles of a magnet, where opposite poles attract each other, while like poles repel each other. Positively charged cations are therefore attracted to the negatively charged clay and organic matter particles.

   Cation exchange occurs when the cations are attracted to the charged surfaces of root cells, and as soon as the cation has been attracted to the surface of the root cell, the root releases a hydrogen ion, which causes the pH of the soil surrounding the root to decrease.

The cations that have been exchanged with the plant root are then absorbed and transported through the xylem throughout the plant to where they are needed.

Summative assessment: Module 1 SB page 40

1. **A soil sample shows 21% clay, 66% sand and 13% silt. How would you describe this type of soil?**
   Sandy clay loam. (3)

2. **As a growing medium for plants, soil provides a place for roots to grow into. List and discuss the main factors that determine the productivity of soil.**
   Soil depth
   The soil depth is the height of the layer of soil above a layer of rock. If the soil is shallow, it can become waterlogged when it rains, because the rock layer stops the water from draining away. Most crop plants need soils that are at least 90 cm deep - this is about the length of a spade. Some vegetables can grow in soils that are 50 cm deep, as long as the soil doesn't become waterlogged.

   Soil texture
   The texture of a soil influences how much air and water it holds. It also determines how easy it is to dig. All of these aspects affect soil productivity. Waterlogged clay soils and sandy soils that do not hold water have low soil productivity.

   Soil structure
   Using the same piece of land for many years can make the soil hard and compacted. Plants don't grow well in compacted soil, because the air and water that they need cannot circulate freely, and because their own roots cannot easily penetrate it. We say that compacted soil has a poor structure. Plants typically grow well in soil that is soft and crumbly - like fresh breadcrumbs. This is because crumbly soil holds a lot of water and air, and roots can easily spread through it. Crumbly soil has a good structure, sometimes also called a crumb structure. Soils with a crumb structure are rich in organic matter.

   Nutrients
   When farmers clear their land and plant crops for the first time, they typically get a good crop yield. But if they plant the same crops in the same fields year after year without adding anything to the soil, their crop yield gets smaller and smaller. This is because plants take nutrients and mineral elements out of the soil as they grow. If these are not replaced, the soil gradually becomes less and less fertile. To keep the soil fertile and productive, farmers need to add nutrient elements to the soil every year to replace those that have been used. This can be done by adding organic matter, adding fertilisers, crop rotation, inter-cropping or planting legumes to produce nitrogen. (8)

3. **Describe sustainable crop and animal production practices.**
   Sustainable crop and animal production practices include the following:
   - Using legumes to produce nitrogen: legumes have little lumps (nodules) on their roots that contain *Rhizobium* bacteria that convert nitrogen in the soil into nitrates and nitrites that plants can absorb
   - Adding organic matter: microorganisms break organic matter such as animal manure, liquid manure and compost down into humus

- Crop rotation: growing a different crop on the same land each year for a period of three to five years
- Rotational grazing: dividing grazing land into different areas, one of which is grazed while the others are rested.

If agricultural activities are not managed effectively, it could lead to serious challenges to the sustainability of the environment, such as erosion, desertification, salinisation, compaction and pollution. (8)

4. **"Salinisation is the process during which high quantities of salts accumulate in the soil." Discuss this statement with regard to the causes of salinisation and how it might impact the ecosystem.**
Salinisation can be caused by natural processes or human activities such as improper irrigation practices and the over-use of fertilisers. Salinisation poses a big threat to ecosystems, as it limits the nutrient uptake of plants and decreases the metabolism of organisms that live in the soil. (3)

5. **Describe the FIVE types of organic matter that can be added to soil.**
Animal manure
Animal manure is the solid waste (faeces) of animals. Animal manure is an excellent source of minerals, especially nitrogen. You can collect animal manure from wherever animals are housed. Because fresh manure can burn the leaves of young plants, it's better to use dry manure or to let the manure dry out for about two weeks before planting. Collecting and spreading manure requires a lot of work. You can avoid some of this work by keeping your animals in fenced areas so that they add the manure directly to the soil while they graze. You can then use these areas to grow crops. The figure shows how to use chickens to provide manure. The fence is moved to plant vegetables over the area where the chickens have dropped their manure. A moveable chicken coop can be moved every two weeks to a new cropping area.

Liquid manure
Liquid manure is a good way to give minerals to plants while they are growing. To create liquid manure, you fill a cloth sack with animal manure and put it in a drum of water. After one week, you take the liquid out of the drum with a jug and pour it around the plants. Be careful not to get the liquid manure on the leaves or stems of plants, as it can burn the plant if it is very concentrated.

Compost
Compost is organic matter that you have set aside to break down into humus. Compost contains various minerals, but doesn't contain as much nitrogen as manure does. The microorganisms and soil animals that break down organic matter need air, water and warmth. You can make your own compost by piling organic matter into a heap, or by putting it into a pit that you've dug. Compost pits are better than compost heaps in hot and dry areas, because the organic matter is surrounded by soil and does not dry out as quickly.

Ash
When organic matter is burnt, the ash that remains contains large amounts of minerals, especially potassium and calcium. It also contains smaller amounts of micronutrients such as zinc and copper. Sprinkle ash onto the soil or add it to compost heaps or pits.

Green manure
Green manure is the name we give to fast-growing plants that are planted on a piece of land to improve soil fertility and to protect the soil from erosion. Green manure plants are normally low spreading plants that grow fast and cover the soil surface quickly after planting. During or after the growing season, the green-manure plants are cut and dug into the soil. They then decompose into humus and release nutrients that improve the soil. Common legumes used as green manure include cowpeas, vetch, red clover and lupins. Green manures can also be non-legumes such as barley, rye grass, pumpkins and mustard. All these crops are grown in summer, except for rye grass, lupins and barley, which can be grown in winter. (5)

6. Describe the process of crop rotation.
With crop rotation you grow a different crop on the same piece of land each year for a period of three to five years. Different crops absorb different types and amounts of minerals out of the soil. They take the minerals from different depths in the soil because the roots of different plants grow to different depths. If you plant the same crop every year, the same minerals are removed from the same depth in the soil.

When you rotate crops, however, different types and amounts of minerals are removed from different depths in the soil. Crop rotation therefore makes better use of the minerals that are in the soil, and stops the soil from becoming infertile. Crop rotation is also used to control pests and diseases. When you plan a crop rotation, you must choose plants of different families. This is because plants of the same family use the same soil minerals and are attacked by the same pests and diseases. (3)

7. List the main functions that each of the following macronutrients plays in the lifecycle of plants:

7.1 Nitrogen
Nitrogen (N) ensures that energy is available for the leaves to grow properly. (2)

7.2 S
Sulphur (S) is required for chlorophyll, protein and plant oil production and increases yield. (2)

7.3 Calcium
Calcium (Ca) is required for cell development and the growth of roots, stems and leaves. (2)

8. List the main functions that each of the following micronutrients plays in the lifecycle of plants:

8.1 Ni
Nickel (Ni) is essential for seed germination and important bacteria and fungi that support plant growth also depend on it. (2)

8.2 Zinc
Zinc (Zn) is required in the production of growth hormones, proteins and chlorophyll and aids in root development. (2)

8.3 Molybdenum
Molybdenum (Mo) is required to successfully absorb and utilise nitrogen and phosphorous. (2)

9. **pH is a measure of the concentration of hydrogen ions in a sample. If a soil shows a pH of 12, is it more likely to have a high or a low concentration of hydrogen ions?**
Soil with a pH of 12 will have a low concentration of hydrogen ions. (2)

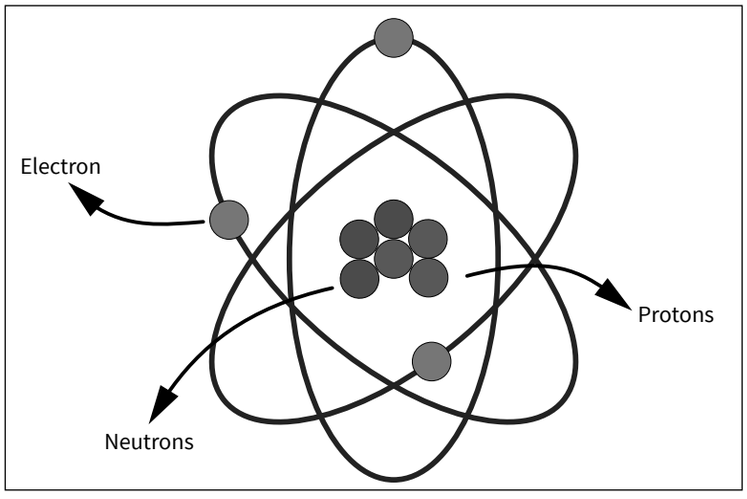
10. **Describe the process of using a pH meter.**
To use a pH meter, the prongs or sensor is pushed into the soil or a water and soil mixture, and the pH value is read off the meter. If a soil sample is mixed with water, it is important to use distilled water with a pH of 7. (3)

11. **The soil on a piece of land looks uniform. Which type of soil sampling would you suggest: simple random sampling or stratified random sampling?**
Simple random sampling (1)

12. **The leaf from a crop shows signs of chlorosis. List the nutrients that the plant could be lacking.**
Nitrogen (N); Potassium (K); Calcium (Ca); Magnesium (Mg) (4)

13. **A piece of land is in an area that gets very cold and often experiences droughts, and the soil is very acidic. Which nutrient could these environmental conditions cause a lack of?**
These environmental conditions can cause a calcium deficiency. (1)

14. **Draw the structure of an atom and name all parts.**



(5)

15. **Is the following true or false? If it is false, give the correct answer.**
A protein is an atom with a net electric charge due to the loss or gain of one or more electrons.
False. An ion is an atom with a net electric charge due to the loss or gain of one or more electrons. (2)

16. **List the most common soil cations.**
Calcium; Magnesium; Potassium; Ammonium; Hydrogen; Sodium (3)

17. **List the most common soil anions.**
Chlorine; Nitrate; Sulphate; Phosphate (2)

TOTAL: 65

Module 2
Plant production

After students have completed this module, they should be able to:

- identify the macroscopic and microscopic parts of a plant;
- explain the role each part plays in the plant;
- define *physiology*, *morphology*, *photosynthesis* and *respiration*;
- explain the process of photosynthesis and respiration in general terms;
- discuss the plant environment in terms of climatic requirements, season, aspect, light, temperature and water;
- explain the interrelationships between the above concepts;
- explain how plants reproduce from pollination to fruit growth and set;
- explain how morphology and physiology impact plant reproduction;
- explain how morphology and physiology impact crop yield and include yield measurement per unit area;
- establish which principles govern vegetable production;
- select a crop suitable to the climatic and soil conditions;
- prepare the soil following the requirements of the selected crop;
- plant the crop according to set procedures (spacing, fertiliser application, watering, etc.);
- monitor the development of the crop (pest and disease control, weed control, application of fertilisers);
- apply sustainable post-harvest or on-farm storage procedures for crop;
- examine the production of vegetables in hydroponic systems, its benefits and drawbacks;
- define *irrigation* and present the parameters that govern its use;
- identify and explain the different types of irrigation methods;
- select the irrigation method most suited to the identified crop;
- identify and explain the different elements of an irrigation schedule with special regard to its timing and the movement of equipment;

- develop an irrigation schedule for the workplace;
- use the schedule designed to operate the irrigation;
- define *weed* and *weed control*;
- explain the importance of weed control;
- explain the different types of weed and weed control;
- provide examples of weeds and weed control;
- define the concept of pests in terms of plant production;
- identify disease in terms of plant production;
- identify and explain pests and diseases that affect crops;
- explain how pests and diseases that affect crops can be controlled;
- explain different harvesting methods using examples;
- compare and contrast various harvesting methods; and
- practise different harvesting methods.

This module will take about five weeks to cover and will count ±65 marks in the examination.

Introduction

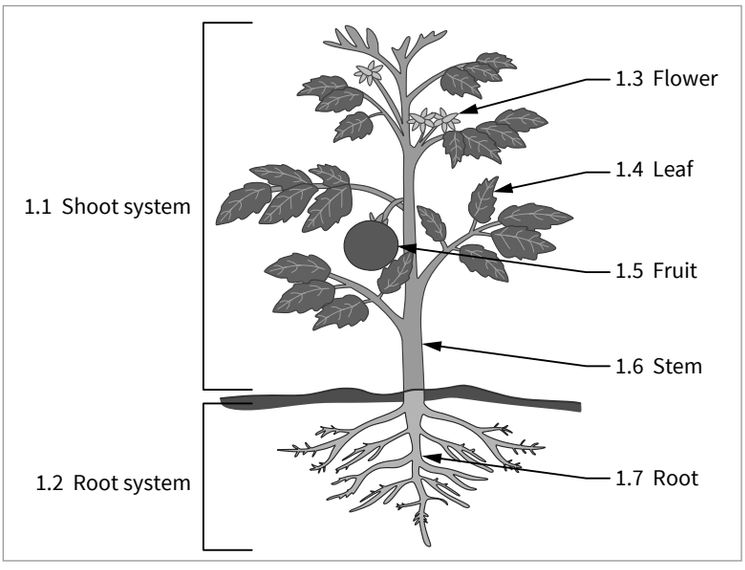
Plant production is the growing of crops for food and for use as inputs in the production of other products. It is important to understand the external and internal structure of plants in order to optimise crop yield by applying the right amount of organic and chemical fertilisers, water, weed and pest control, and to know the proper way of harvesting and storing crops.

Introductory activity SB page 42

The introductory activities are designed to test students' baseline knowledge of plant and animal production. There are no right or wrong answers, and students need to compare their answers with the new knowledge they have gained after completing the module. The aim of this activity is to encourage class discussion and to build on existing knowledge.

Activity 2.1 SB page 57

1. **Label the macroscopic parts of a plant.**



2. **Discuss the main roles of the following parts of plants:**

2.1 Roots

Plants use their roots to absorb water and nutrients and to stay firmly secured in the soil. The root system is usually the part of the plant that is beneath the soil, and some plant tissues are found continuously throughout the plant.

2.2 Stem

The stem along with the roots make up the two main structural elements of a plant. The stem supports the leaves, flowers and fruit, and it transports water and dissolved nutrients between the roots and the leaves. The stem also stores nutrients and produces new living tissue that makes the plant grow.

2.3 Leaf

Plants use their leaves to produce food through photosynthesis and to exchange gases with the environment. Leaves come in many different forms, sizes and textures, although not all leaves have all the same structures. The petiole is the part

of the leaf that is connected to the stem. The blade or lamina is the expanded flat part of the leaf where photosynthesis occurs. A midrib is found along the middle of the blade and helps keep the leaf upright. Veins are also visible on the blade.

2.4 Flower

Plants use flowers for sexual reproduction. Each part of the flower plays a specific role in the reproduction process and each flower contains both male and female reproductive organs. The male reproductive organ is called the stamen and the female reproductive organ is called the pistil.

2.5 Seed

The main function of seeds is to keep the plant species in existence. Seeds are produced by plants after fertilisation and they come in many different sizes; some are as small as a speck of dust, while others are larger than a tennis ball! The seed keeps the tiny plant embryo inside it alive until conditions are just right for the seed to germinate and give the seedling the best chance at survival.

3. Describe the process of photosynthesis in detail.

Photosynthesis is essential to most life on Earth. Plants, algae, and some types of bacteria carry out the process by capturing solar energy to create oxygen (O_2) and chemical energy stored in glucose (a type of sugar). Consequently, herbivores get this energy from eating plants, and carnivores get it from eating herbivores. Plants absorb water (H_2O) and carbon dioxide (CO_2) from the soil and atmosphere during photosynthesis. Water is oxidised, which means it loses electrons, while carbon dioxide is reduced, which means it receives electrons, inside the plant cell. Water is converted into oxygen (O_2) and carbon dioxide into glucose as a result. After storing energy within the glucose molecules, the plant releases the oxygen back into the atmosphere though its stomata.

4. Tabulate the differences between *photosynthesis* and *respiration*.

Photosynthesis	Respiration
A process in all green plants containing chlorophyll	A process in all living things, including plants and animals
Food is produced	Food is oxidised
Energy is stored	Energy is used
Carbon dioxide and water are converted into glucose and oxygen with the addition of sunlight	Glucose and oxygen are converted into carbon dioxide, water and energy in the form of ATP
Occurs only during the day	Occurs during the day and night

5. Discuss the impact that the following climatic elements have on the growth of plants:

5.1 Season

The time of year when crops and other plants grow successfully is known as a growing season. A growing season's length varies depending on where you live, and a growing season of at least 90 days is required for most crops.

The growing season may last the whole year in tropical areas where the temperature is warm all year long. However, a wet season can sometimes interrupt the growing season in tropical areas. Crops cannot be grown then because of the flooding. The length of the growing season in temperate countries, which have chilly winters and

mild summers, is mostly influenced by temperature. The length of some growing seasons might reach eight months. The length of the growing season decreases with distance from the equator and might be as short as two months in areas close to the polar regions.

5.2 Aspect

The aspect of a plant refers to how it is planted in relation to other plants and the sun, and is a key aspect that farmers must take into consideration when planning their fields. Aspect has a direct influence on the amount of sunlight and the brightness of the sunlight that is available to plants during the process of photosynthesis.

Aspect is also important when calculating how densely crops must be planted. Plants that are spaced too close together will block the sun from each other and will not allow for interplanting. Plants that are spaced too widely will waste valuable field space and the soil around them will dry out more quickly. The optimal planting density depends on the region in which the crops are grown and other climatic conditions.

5.3 Light

Light is among the most crucial environmental conditions for plant development. It is necessary for the plant to photosynthesise and the plant is directly dependent on it to produce organic matter from mineral substances. The energy needed for photosynthesis, which creates the organic materials for the plant's growth and development, is provided by light.

Light, temperature, and carbon dioxide increase photosynthetic activity and efficiency, so it is essential to provide proper light if you want to assure optimum crop development and increased output. The efficiency of photosynthesis increases with lighting level, which also has an impact on how quickly a plant can grow. The rate of photosynthesis, however, hits a limit as light intensity rises. The light saturation point, or maximum point, is where the speed of the process of photosynthesis becomes constant.

5.4 Temperature

Temperature has an influence on most plant processes, including photosynthesis, transpiration, respiration, germination and flowering. Photosynthesis, transpiration and respiration increase together with increases in temperature up to a point when the processes become constant. When temperature is combined with an increased number of daylight hours, plant growth changes from vegetative growth to reproductive growth.

Germination of seeds is affected, as different seeds require different temperatures in conjunction with water in order to start germinating. Depending on the requirements of specific plants, temperature also induces flowering, followed by fruit production. But temperature has an influence on the quality of crops too. Low temperatures reduce energy usage and increase storage of sugars. This increases the sweetness of low temperature flowering crops. High temperatures, however, could cause stunted growth and bitter crops.

5.5 Water

Water is needed throughout all stages of the growth of plants, although most plants require more water when fully grown than when they have just been planted.

The water needs are determined by a combination of evaporation from soil and transpiration from the leaves. Evaporation is a more important factor when plants are very small, while transpiration is more important when plants are fully grown.

6. **A specific crop grows well in cold arid desert conditions. In which THREE of South Africa's provinces can this climatic zone be found?**
Eastern Cape; Northern Cape; Western Cape

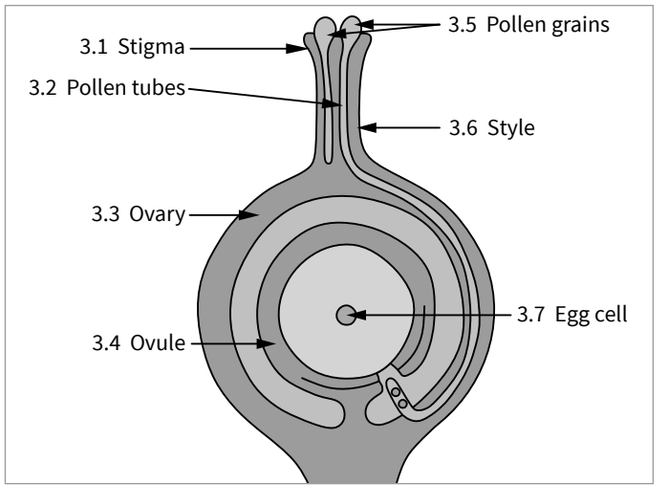
Activity 2.2 SB page 66

1. **Describe the process of fertilisation in plants.**
Fertilisation is the next step in the reproduction process. Once the pollen has been deposited on the pistil, it has to fertilise an egg inside the ovary. After the pollen grains have landed on the stigma, they grow pollen tubes through the style of the pistil and into the ovary. Sperm cells inside the pollen grains travel down the pollen tubes and into the ovary, which contains the ovules. Fertilisation occurs when one sperm cell fuses with an egg inside the ovule.

   Now that they are fertilised, each ovule develops into a seed that contains an undeveloped plant called an embryo. Once fertilisation has occurred, all parts of the flower die, except the ovary, which develops into a fruit that contains the developing seed (one or more seeds).

2. **What are the THREE types of pollination that can occur?**
Self-pollination; Cross-pollination; Pollination by pollinators

3. **Label the parts of the plant that are involved in fertilisation.**



4. **Discuss the following forms of asexual reproduction in plants:**

   4.1 Budding
   Budding is a type of asexual reproduction where a new plant develops from a bud, where cell division takes place on the parent plant. Once the new plant has grown roots, it can be detached from the parent plant and planted elsewhere.

   4.2 Fragmentation
   Fragmentation is a type of asexual reproduction where a new plant is formed from a part of the parent plant. Each of the fragments can develop into a mature clone of the parent plant. This type of reproduction is often used by nurseries to produce a lot of plants in a short amount of time.

4.3 Vegetative production

Vegetative production is a type of asexual reproduction where new plants are produced from the vegetative parts of the parent plant. The stem can produce runners that usually run horizontally above the ground. These runners have nodes where new buds are formed, and these buds grow into new plants. Some plant roots develop into tubers that can each grow into a new plant. Certain plants also use their leaves for asexual reproduction, where the leaves drop to the ground and develop tiny plantlets that grow into mature plants.

4.4 Spore formation

Some plants, such as ferns and mosses, form spores in order to reproduce asexually. The spores are surrounded by a protective covering to protect them against extreme weather conditions. When the conditions are just right, the spores germinate and grow into mature plants.

5. Write down the distinguishing characteristics of monocots and dicots in a table with regard to the following parts: embryonic leaves, veins, flowers, roots, stems and pollen.

Part	Monocot	Dicot
Embryonic leaves	One	Two
Veins	Parallel veins	Branched veins
Flowers	Flower parts in multiples of three	Flower parts in multiples of four or five
Roots	Network of roots (fibrous roots)	Taproot system
Stems	No growth rings	Growth rings
Pollen	One groove	Three grooves

6. Discuss crop yield and the different factors that have an impact on it.

Note to lecturer: Students can summarise their answers, but must cover all the main points discussed below.

Crop yield is a measurement of the amount of a crop that can be grown per unit area of land. Many new innovations, such as improved farming tools, the addition of fertiliser, better farming methods and new crop varieties, have made it possible to improve yields. Higher yields and more intensive farm use have led to higher productivity and profitability of farms.

Crop yield is measured in kilograms per hectare. While yields are defined by the weight of the crop produced per unit of land, agricultural productivity is measured by the amount of money produced per unit of land. In order to increase yields by a few per cent, a farmer may spend a significant sum of money, such as with an extremely expensive fertiliser, but if the cost is so high that it does not yield a comparable return on investment, profits will decline. In this situation, the higher yield may actually result in lower agricultural productivity.

You can determine the necessary harvesting strategy, transportation network and storage capacity by estimating potential yields. A yield estimate will be impacted by a variety of production-related and crucial plant growth stage parameters. This will be crucial in hot

and dry weather with changing drought conditions and sporadic rain that supplies crop-saving moisture and promotes plant growth.

Sustained hot weather (above around 35 °C) will cause lower pollen production, will cause pollen to die and the female parts of flowers will dry out. When this happens, pollination cannot occur and the yield from the crop will be low. Research shows that after four days of such high temperatures, the yield will decrease by around 1% for each additional day above that temperature. But high temperatures have another impact on crop yield. Pollinators can be sensitive to high temperatures and their visitation rates reduce after the temperature reaches a certain level.

Extremely cold weather can also have a devastating effect on crop yield. Cold weather injures flower tissues when the temperature falls below the hardiness level of the plant. Prolonged cold weather also adversely affects the pollination period of the ovules, the receptivity of the stigma to pollen and the rate of pollen tube growth. Some pollinators, especially insects, cannot function at very low temperatures and therefore cannot pollinate as many flowers as they would be able to in warmer weather.

The availability of water has a measurable impact on crop yield too. When there is not enough water available, flowers do not develop as they should, pollen tubes do not develop properly and ovules might not develop properly. Low levels of available water also impacts the production of nectar that attracts certain pollinators.

When there is too much water available, plant roots get damaged, which means they cannot take up the proper amount of water needed, pollen gets waterlogged and cannot be moved to a receptive stigma and certain pollinators might not be able to get to the flowers of plants in order to pollinate them.

Activity 2.3 SB page 69

Identify the vegetable most suited to the following temperature and soil conditions:

1. **22–32 °C in sandy loam that drains well with pH 6–6,8**
   Butternut
2. **12–28 °C in sandy loam that drains well with pH 6–7**
   Garlic
3. **20–30 °C in sandy loam that drains well and has high organic content with pH 6–7**
   Pumpkin
4. **15–20 °C in loose sandy loam that drains well with pH 5–6**
   Carrot
5. **Sandy loam or clayey loam that drains well with pH 6–7 and temperatures between 20–24 °C**
   Tomato

Practical activity 2.1: Cultivation of vegetables SB page 69

In this practical activity, students collect soil samples to conduct simple tests. Guide them through the collection and testing. Students should write down their findings in the table provided in Addendum A in the Student Book.

Activity 2.4 SB page 72

Describe the soil preparation and months most suited to sowing in both summer and winter rainfall areas for the following vegetables:

1. **Tomato**
   Plough soil to a depth of 400 mm, clean and level soil before planting
   Organic matter should be mixed to a depth of 300 mm
   Summer rainfall: January; February; March; August; September; October; November; December
   Winter rainfall: September; October; November

2. **Pumpkin**
   Plant green cover top 12–16 weeks before planting
   Cut the green cover top and plough to a depth of 500 mm, clean and level soil before planting
   Organic matter should be mixed up to a depth of 200 mm
   Summer rainfall: September; October; November
   Winter rainfall: September; October; November

3. **Butternut**
   Plough soil six weeks before planting date to a depth of 300–400 mm, clean and level soil before planting
   Use a subsoiler to loosen compaction
   Organic matter should be mixed to a depth of 300–400 mm
   Summer rainfall: September; October; November
   Winter rainfall: September; October; November

4. **Garlic**
   Plough soil to a depth of 200 mm, clean and level soil before planting
   Organic matter should be mixed to a depth of 200 mm
   Summer rainfall: February; March; April
   Winter rainfall: February; March; April

5. **Cabbage**
   Plough soil to a depth of 300–400 mm, clean and level soil before planting
   Organic matter should be mixed to a depth of 300–400 mm
   Summer rainfall: February; March; April; May; August; September; October; November; December
   Winter rainfall: March; April; May; August; September; October; November; December

6. **Lettuce**
   Plough soil to a depth of 300–400 mm, clean and level soil before planting
   Add mulch to reduce water evaporation and control weeds
   Organic matter should be mixed to a depth of 200–300 mm
   Summer rainfall: March; April; May; August; September; October; November
   Winter rainfall: March; April; May; August; September; October

7. **Pepper**
   Mix organic matter into the soil, clean and level soil before planting
   Organic matter should be mixed up to a depth of 400 mm
   Summer rainfall: September; October; November; December
   Winter rainfall: September; October; November

Practical activity 2.2: Soil preparation SB page 72

In this practical activity, students prepare the soil for vegetable production. Guide them through the preparation according to the information given in the table in the Student Book. Students should write down their preparation in the table provided in Addendum A in the Student Book.

Activity 2.5 SB page 74

List the planting requirements and average watering requirement per week for each of the following vegetables:

1. **Potato**
   Tubers are planted directly in the soil at 150 mm deep
   Space 30 cm apart with row spacing at 800 mm apart
   30–40 mm per week

2. **Sweet potato**
   Cuttings are placed 300 mm apart in ridges of soil
   Space 250–350 mm apart with row spacing at 900–1 500 mm
   40–45 mm per week

3. **Onion**
   Sow directly in soil at 10–15 mm deep, or in seedling trays
   Transplant when ± 200 mm tall
   Space 100 mm apart with row spacing at 250 mm
   35–40 mm per week

4. **Cauliflower**
   Sow in seedling trays
   Transplant when ± 150 mm tall
   Space 500 mm apart with row spacing at 600 mm
   15–30 mm per week

5. **Broccoli**
   Sow in seedling trays
   Transplant when ± 150 mm tall
   Space 500 mm apart with row spacing at 500 mm
   25–35 mm per week

Practical activity 2.3: Planting vegetables SB page 74

In this practical activity, students plant vegetables. Guide them through the planting according to the information given in the table in the Student Book. Students should write down their planting procedure in the table provided in Addendum A in the Student Book.

Activity 2.6 **SB page 81**

List THREE pests and THREE diseases that plague the following vegetables:

1. **Spinach**

   Any THREE of the following pests:
   Nematodes
   Snails
   Cutworm
   Aphids
   Slugs
   Hawaiian beet worm
   Loopers
   Leaf miners
   Caterpillars

   Any THREE of the following diseases:
   Leaf spot
   Spinach blight
   Mosaic virus
   Downy mildew
   Curly top
   White rust
   Powdery mildew

2. **Beetroot**

   Any THREE of the following pests:
   Red spider mite
   Aphids
   Cut worm
   Nematodes

   Any THREE of the following diseases:
   Cercospora leaf spot
   Scab
   Brown rust
   Downy mildew
   Root rot

3. **Carrot**

   Any THREE of the following pests:
   Nematodes
   Cut worms
   Bollworm
   Plusia looper
   Carrot fly

   The following THREE diseases:
   Alternaria leaf blight
   Bacterial leaf blight
   Cottony rot

4. **Cabbage**
   Any THREE of the following pests:
   Bollworm
   Aphids
   Diamond-back moth
   Cabbage webworm

   Any THREE of the following diseases:
   Blackleg
   Black rot
   Downy mildew
   Clubroot
   Soft rot
   Sclerotinia rot

5. **Broccoli**
   Any THREE of the following pests:
   Bollworm
   Aphids
   Root fly
   Diamond-back moth
   Webworm

   Any THREE of the following diseases:
   Blackleg
   Black rot
   Downy mildew
   Clubroot
   Soft rot
   Sclerotinia rot

Practical activity 2.4: Vegetable development — SB page 81

In this practical activity, students monitor the development of their vegetables. Guide them through the monitoring according to the information given in the table in the Student Book. Students should write down their expected time until harvest and the fertiliser they applied in the table provided in Addendum A in the Student Book.

Activity 2.7 — SB page 83

Describe the storage requirements for each of the following vegetables:

1. **Carrot**
   Store at 2–5 °C and relative humidity > 90%
   Store up to 21 days

2. **Onion**
   Store in a cool, dry environment while turning the bulbs often
   Store up to six months
   Ensure adequate ventilation during storage

3. **Gem squash**
   Store in a cool, dry environment for up to three weeks

4. **Beetroot**
   Cold storage after harvest of 4–5 °C and relative humidity > 90%
   Can be stored up to six months at 1–2 °C and relative humidity > 90%

5. **Pumpkin**
   Store at 10 °C and 60–70% relative humidity
   Store up to three months
   Ensure adequate ventilation during storage

6. **Cauliflower**
   Cold storage after harvest of 2–5 °C and relative humidity > 95%
   Can be stored up to one month at 0,5–2 °C and relative humidity > 95%

7. **Sweet potato**
   Store in a cool, dry environment
   Store for up to six weeks
   Ensure adequate ventilation during storage

8. **Tomato**
   Store at 2–4 °C and relative humidity > 90%
   Store for up to 12 days
   Ensure adequate ventilation during storage

Activity 2.8 SB page 87

1. **Discuss what hydroponics entails.**
   Hydroponics is process of growing plants without soil. It is a food production system that harnesses the power of water, while keeping micro- and macronutrients at optimal levels for crop production.

   In a hydroponics system, the plant roots are exposed to water or supported physically by media such as gravel, perlite, coir or vermiculite. Because plants in a hydroponic system are provided with the optimal mix of nutrients and other environmental factors, they can develop faster than plants in soil. The growing conditions in hydroponics systems are carefully controlled, and because it uses less space than traditional methods of growing plants, small-scale production is possible, for example in urban gardens or on rooftops.

2. **Describe wick system hydroponics.**
   The wick system is the most basic hydroponic system. A wick is placed between the container in which the vegetable is grown and the nutrient solution. As the vegetable needs water, it draws nutrient-rich water from the nutrient solution via the wick. The wick system works well for small-scale urban farmers, but might not provide large vegetables with enough water.

3. **Describe drip system hydroponics.**
   The drip system consists of drippers that are installed above the growing medium of

each vegetable, and a timer controls the amount and timing of nutrient solution that is applied to each plant.

4. Tabulate the advantages and disadvantages of hydroponics.

Advantages	Disadvantages
• High-quality vegetables produced • Soil preparation eliminated • Weeding eliminated • High yields in a small area • No need for soil • Efficient use of water • Soil pollution reduced • Vegetables grow at faster rates • Continuous production, independent of season • Washing of crops is greatly reduced	• Large capital outlay • Labour-intensive • High degree of knowledge needed • Needs to be managed daily • Only soluble nutrients can be used • Pests and diseases are still a problem

Activity 2.9 SB page 98

1. Discuss the THREE types of surface irrigation.

Furrow irrigation

In furrow irrigation, farmers dig small trenches (furrows) between their crops and allow water to flow down the furrows. The water can be pumped into the furrows or deposited there by human or animal power. This type of irrigation is often used in developing nations for crops that are grown in rows, for low-value crops or for very large fields.

Border strip irrigation

In border strip irrigation, fields are divided into strips and separated by ridges that run down the gradient of the fields. Unlike basin irrigation, the water drains freely out at the end of the strips, and is not allowed to form ponds. This type of irrigation is often used for close-growing crops.

Basin irrigation

In basin irrigation, fields are surrounded by high ridges in order to form basins, and the fields are then flooded with water that pool in the basins. Crops such as rice benefit from basin irrigation.

2. Describe the differences between *drip irrigation* and *mini-bubbler irrigation*.

Drip irrigation is a type of irrigation where water is delivered straight to the root zone of plants in droplets. This is one of the most water-efficient irrigation methods, because evaporation and water runoff are minimised. When drip irrigation is managed correctly, the field water efficiency can be as high as 80–90%. In a process known as fertigation, nutrients can also be delivered by drip irrigation.

Mini-bubbler irrigation is a type of irrigation that is permanently installed and consists of low-pressure water delivery via a bubbling head. It is often used to water trees, where the water floods the basin around the tree and then seeps the soil.

3. Describe sprinkler irrigation.

Sprinkler irrigation is an irrigation system where water is delivered under high pressure through pipes and distributed with high-pressure sprinklers. Sprinkler irrigation systems are used on big fields where the water pressure is sufficient to drive these systems.

4. **Discuss centre pivot irrigation.**
Centre pivot irrigation is a type of sprinkler irrigation where several pipe segments, made from galvanised steel or aluminium, are joined and supported by trusses connected to towers with wheels. Sprinklers are positioned along the length of the pipe segments.

As water is pumped into the system, it moves in a circle around the field and is fed from the centre tower (or pivot). Sprinklers are positioned a few feet above the crops to eliminate water loss through evaporation. Centre pivot sprinkler systems were previously powered by water pressure, but modern systems employ hydraulic or electric motor systems.

5. **List the irrigation methods suitable to the following vegetables:**

5.1 Carrot
Furrow
Border strip
Sprinkler

5.2 Lettuce
Furrow
Border strip
Drip
Sprinkler

5.3 Pepper
Furrow
Border strip
Drip

5.4 Spinach
Furrow
Border strip
Drip

5.5 Tomato
Drip
Sprinkler

6. **Discuss the elements of an irrigation schedule.**
Crop yield and quality are in large part dependent on the farmer's decision of when to irrigate and how much water to apply. Water is a scarce resource, especially in certain parts of South Africa, and should not be used uneconomically. To schedule irrigation means to make a decision of when to water plants and how much water to apply. There are various factors that influence this decision of when and how much to irrigate. These include the following:

- Spacing of plants and rows: Plants that are close together will shield the soil from much of the heat of the sun, while plants that are spaced further apart will have more of the surrounding soil exposed to the elements.
- Continuous data collection on evapotranspiration: This will indicate how much water is transferred to the atmosphere by evaporation and transpiration.

- Moisture levels in soil: This indicates how much water the soil is able to store.
- The type of crop and age of the plants: Not all crops have the same water requirements in general, and they have specific water requirements during the different growth stages.
- Irrigation method (surface/micro-/sprinkler irrigation) and the delivery rate of the irrigation method
- Rainfall during the growing season: This is used to calculate penetration to the active root and buffer zones.

Practical activity 2.5: Irrigation SB page 98

In this practical activity, students irrigate their vegetables. Guide them through the irrigation process according to the information given in the table in the Student Book. Students should write down their method of irrigation and their irrigation schedule in the table provided in Addendum A in the Student Book.

Activity 2.10 SB page 106

Scenario: Weed infestation (oral presentation)

- **Students must be able to identity a relevant weed and then provide relevant solutions to the problems posed.**
- **Students must also mention the impact on maize as an important crop and how this could affect food security.**
- **Students must mention that this could have an economic impact for the farmer, as it will reduce the crop yield.**
- **An oral rubric has been provided for you to assess this activity.**

Practical activity 2.6: Weeds and weed control SB page 106

In this practical activity, students monitor their vegetables for weeds and control the weeds. Guide them through the weed control process according to the information given in the table in the Student Book. Students should write down their identified weed(s) and best way of dealing with the weed(s) in the table provided in Addendum A in the Student Book.

Activity 2.11 SB page 117

1. **What is the difference between a *pest infestation* and a *disease* in relation to crops?**
   Pests are any infestation of insect, mite, snail or slug and can be detected by seeing wilting leaves, nibbling on the leaves with stems and leaves falling off. Pests will infest a plant and begin to eat the plant.

   Diseases are changes in the physiology of the plant, which can be caused by biotic or abiotic agents. A disease hampers the growth and development of the plant. Fungal, viral or bacterial organisms cause most plant diseases. Some nematodes can also cause plant diseases

2. **What is meant by chemical control of pests and diseases?**
   Chemical control is the use of pesticides, fungicides and bactericides to control pests and diseases. One disadvantage is that there could be some crop damage. Some chemicals are tilled into the soil and others are sprayed directly onto the plant.

3. **Explain TWO ways to ensure that pests and diseases are controlled.**
   Any two of the following:
   - **Ensure that soil is healthy.** Healthy soil will encourage friendly insects that will add to the biodiversity of the farm and will also prevent plant diseases. Use methods such as tilling to ensure that soil stays healthy and well oxygenated.
   - **Plant crop varieties that are resistant to particular pests and diseases.** Farmers must do sufficient research to ensure that they plant crops that are well suited for that particular area as well as provide some resistance to pests and diseases that are common in that area.
   - **It is important to space plants correctly.** Overcrowding will result in easy infestation of the plants if they are too closely planted together.
   - **It is important to plant crops at the right time.** Incorrect timing could impact the growth of the crop and make the crop more susceptible to pests and diseases.

4. **How do pests and diseases impact food security?**
   It is important that pests and diseases are controlled by the farmer, as they are a huge threat to food security because they can damage and harm crops, which reduce the crop yield and can also increase the cost of food. Pests and diseases also negatively affect the taste, look and quality of crops.

5. **Briefly explain how to eradicate spider mite.**
   - High-pressure water washing of dusty areas is important to control spider mites. Trees and plants that are too dry may be more susceptible to spider mites. This means that it is important to ensure enough irrigation to crops.
   - Washing down trees and vines can assist.
   - Chemical control is also an option using insecticidal/miticidal oils.
   - The oils can be used on woody plants, but avoid spraying any flowers or buds, as they may be damaged.
   - Spider mites are repelled by Chinese parsley, chrysanthemums, dill, garlic, leeks, lemongrass, peppermint, and rosemary. Planting these plants as barriers may protect crops.

6. **What is neem oil and how is it used as a pesticide?**
   Neem oil is a natural pesticide made from the neem tree. Neem oil impacts the insects' hormones, making them stop eating and breeding.

7. **Explain what powdery mildew is and how it impacts a plant.**
   Powdery mildew is a powdery growth on leaves and shoots. This powdery growth on leaves hampers the process of photosynthesis in the plant, which reduces the plant's ability to produce. Climates with warm days and cooler nights are ideal conditions for the development of powdery mildew.

8. **Why is the control of pests and diseases so important to farmers?**
   Farmers would want to ensure that they are able control pests and diseases to prevent any crop loss. It is best to try to prevent any pests or diseases before too much damage

is done. This means that the farmer must inspect the crops regularly to act quickly to prevent too much loss. Crop yield has an impact on the profit that a farmer is able to make and if there is pest or disease infestation, the profits earned on that crop are compromised.

Practical activity 2.7: Pest and disease control SB page 117

In this practical activity, students monitor their vegetables for pests and diseases and control the pest or disease. Guide them through the pest and disease control process according to the information given in the tables in the Student Book. Students should write down their identified pests and diseases and the best ways of dealing with the pests and diseases in the table provided in Addendum A in the Student Book.

Practical activity 2.8: Harvesting and storage SB page 122

In this practical activity, students find the best method to harvest their vegetables and harvest them according to this method. Guide them through the harvesting and storage process according to the information given in the table in the Student Book. Students should write down their preferred harvesting and storage method in the table provided in Addendum A in the Student Book.

Summative assessment: Module 2 SB page 124

1. **Describe the process of respiration in detail.**
   During the process of respiration in plants, the sugars created during photosynthesis are combined with oxygen to create energy for plant development. Respiration takes place in organelles called mitochondria, where the sugars are broken down into energy and carried on ATP molecules to be used by cells when needed.

   Respiration in leaves and green stems
   Stomata are microscopic pores found on the surface of plant leaves and green stems. Gases are exchanged through stomata in the leaves during respiration. Oxygen from the air penetrates a leaf through the stomata and diffuses through the leaf to all the cells. The respiration process in leaf cell respiration uses this oxygen. Carbon dioxide created during respiration then diffuses from the leaf into the atmosphere.

   Respiration in woody stems
   When it comes to woody stems, the trunk possesses tiny pores called lenticels that allow for gas exchange. Lenticels are dead cells that are loosely packed and enable gaseous exchange in plants. They can only be found in a small patch of the bark.

   Respiration in the roots
   Even though the roots of plants are underground, they still require oxygen for respiration and the release of energy for internal use. A plant's roots absorb air from the spaces between the soil particles. The air between the soil particles comes into contact with the root hairs and oxygen diffuses into the root hair and reaches all of the root's cells, where it is used for respiration. Diffusion causes carbon dioxide that is produced in the root cells during respiration to exit through the same root hair. (5)

2. Describe the roles that flowers play in plants in detail.
Plants use flowers for sexual reproduction. Each part of the flower plays a specific role in the reproduction process and each flower contains both male and female reproductive organs. The male reproductive organ is called the stamen and the female reproductive organ is called the pistil.

Plants produce pollen in the male reproductive organ that needs to be transferred to the female reproductive organ, the pistil. The petals are usually brightly coloured to attract pollinators to the flower. (5)

3. Define the term *plant physiology*.
Plant physiology is the study of the way plants function, including all the processes involved in growth, metabolism, reproduction, defence and communication. Fundamental processes studied by plant physiologists include photosynthesis, respiration, plant nutrition, plant hormones, environmental stresses, seed germination and transpiration. (2)

4. Which cells in plants store energy?
Chloroplasts (1)

5. Discuss the relationship between *photosynthesis* and *respiration*.
Photosynthesis and respiration are almost opposite processes to one another. The molecules that are produced during photosynthesis are used during respiration (called a reactant), and vice versa. The figure shows the relationship between photosynthesis and respiration. (4)

6. There are FOUR aspects that have an impact on the growth of plants. Describe the growth impact that each of these aspects has:

6.1 South-facing
South-facing fields receive a lot of sunlight and are usually very bright. They warm up very early in the growing season and could require more regular watering, as the soil tends to dry up more quickly. Crops that require full sun grow best in this aspect, but mulch may need to be added to slow down water evaporation.

6.2 North-facing
North-facing fields receive less sunlight than south-facing fields. They usually warm up later in the growing season and tend to be cooler. The difference between high and low temperatures is less in north-facing fields. Crops that require shade or cooler temperatures grow best in this aspect.

6.3 East-facing
East-facing fields receive a lot of sunlight in the morning, with more shade in the afternoon. Crops that require partial shade grow best in this aspect.

6.4 West-facing
West-facing fields receive a lot of sunlight in the afternoon, with more shade in the morning. Crops that grow best in this aspect must be able to tolerate the morning shade as well as the afternoon sun.

(4 × 2) (8)

7. Describe the role of pollinators in plant reproduction.
Pollinators are animals such as bees, other insects, birds or mammals that are attracted by a flower's colour or smell. When the pollinator lands on the flower or drinks the flower's nectar, pollen sticks to the pollinator's body. As the pollinator moves between flowers, the pollen is deposited onto the stigma of other flowers. (2)

8. Discuss the differences between *simple fruit*, *aggregate fruit* and *multiple fruit*.
Simple fruits are formed from only one pistil. They are further divided into fleshy and dry fruits.

Aggregate fruits are formed from a cluster of many separate pistils from the same flower. Examples of aggregate fruits are raspberries and strawberries.

Multiple fruits are formed when a cluster of ripened ovaries from many flowers are formed together. Examples of multiple fruits are citrus, pineapples and figs. (6)

9. Describe monocot reproduction.
Monocotyledons are usually pollinated by insects (about two-thirds), but pollination by wind or water also occurs. Monocots can have bisexual flowers on the same plant, separate male and female flowers on the same plant, flowers of only one sex, and bisexual and male and female flowers on the same plant.

Monocots can be self- or cross-pollinated, depending on factors such as the abundance of pollinators and competition. When cross-pollination is preferred, the chances of self-pollination are lowered by, for example, separating the sexual organs. When self-pollination is preferred, sexual organs are placed closer together so as to lower the chances of cross-pollination. (3)

10. Describe the following types of hydroponics:

10.1 Deep-water culture system
The deep-water culture system consists of vegetables suspended above a nutrient solution in a container, with an air pump oxygenating the solution. The roots of the vegetables grow directly in this solution.

10.2 Nutrient-film system
The nutrient-film system consists of pipes or trays where water and nutrients flow over the vegetable roots continuously. The water flows into a reservoir and is recirculated to the vegetables, but the vegetable roots are not submerged in the water completely as in the deep-water culture system. Instead, vegetables are placed in pots with a growing medium and can be harvested individually as desired.

10.3 Ebb-and-flow system
The ebb-and-flow system consists of vegetables in a growing medium with a large reservoir of nutrient-rich solution. The nutrient solution is pumped through the system by using a timer and then returns to the reservoir. Vegetable roots are not continuously submerged in the solution and the timing is dependent on the environment surrounding the vegetables.

10.4 Aeroponics system

The aeroponics system consists of vegetables without a growing medium that are suspended in the air. The system uses a timer that sprays the nutrient solution on the roots of the vegetables, the timing of which is based on environmental factors. (4 × 3) (12)

11. Discuss the methods used to control thrips.

Thrip is controlled by applying horticultural oils. Natural pyrethrin or insecticidal soaps can be applied to the underside of the infected leaves. It may be necessary to repeat the process for severe infestation. Blasts of water to the underside of leaves can remove the pests. A soap solution can be sprayed onto leaves. Neem oil can also be sprayed onto plants. Neem oil is a natural pesticide made from the neem tree. Neem oil impacts the insects' hormones, making them stop eating and breeding. Plants can also be sprayed with pyrethrim, which is a natural pesticide made from chrysanthemums. This should be applied twice with a four-day gap between applications. (4)

12. Describe where the following diseases occur and which crops they affect:

12.1 Powdery mildew

It is a powdery growth on the leaves and shoots. Roses, gooseberries, squash and cucumbers are most susceptible to this disease.

12.2 Blight

This fungal disease can affect the leaves, flowers, fruit or the entire plant. Tomatoes, potatoes and related plants are affected by blight.

12.3 Crown rot

The stalks and heads of grain-producing crops are affected by crown rot. (3 × 3) (9)

13. Discuss the differences between the following harvesting methods: by hand, using hand tools and mechanical harvesting.

Harvesting by hand

Harvesting by hand involves harvesting without using any tools. The harvester usually has a container in which the harvested crops are placed and depending on the crop, the fruit is gently pulled off the plant, dug out using only the harvester's hands or snapped off at the base of the fruit.

Harvesting by hand is the most labour-intensive harvesting method, but it also gives the farmer better control over how the crop is handled. For delicate crops that bruise easily, this is the preferred harvesting method.

Harvesting using hand tools

Harvesting using hand tools is another form of harvesting by hand, but in this case the harvester uses a hand tool such as a fork, sickle, pruning shears or a sharp knife. The harvester usually has a container in which the harvested crops are placed, before being moved to a bigger container for transport to the storage facility.

Harvesting using hand tools is a labour-intensive harvesting method, but it gives the farmer better control over how the crop is handled. For delicate crops that bruise easily but with tougher stems, this is the preferred harvesting method. Some small-scale operations also harvest crops such as onions and garlic using hand tools.

It is very important to sanitise hand tools between uses. If any crops that have been harvested had diseases, sanitising the hand tool will ensure that the diseases are not transferred to the next crops that are harvested. It is also advisable to oil the mechanisms of tools such as shears to ensure that they are in good working order.

Mechanical harvesting
Many different types of mechanical harvesting machinery exist, each of which is suited to certain types of crops. Some mechanical harvesting machinery harvests crops in full, while other harvesting machinery is the first step in the harvesting process; crops could go for washing, trimming or curing directly from the harvester. (6)

14. All crops need specific conditions post-harvest to keep them fresh while they are transported to the market. Describe the post-harvest storage methods of the following vegetables:

14.1 Onion
Store in a cool, dry environment while turning the bulbs often
Store up to six months
Ensure adequate ventilation during storage

14.2 Garlic
Cold storage at 0 °C and relative humidity at 60%
Store up to six months
Ensure adequate ventilation during storage

14.3 Pumpkin
Store at 10 °C and 60–70% relative humidity
Store up to three months
Ensure adequate ventilation during storage

14.4 Spinach
Cold storage after harvest of 4 °C and relative humidity > 85%
Store up to seven days
After seven days quality goes down

14.5 Beetroot
Cold storage after harvest of 4–5 °C and relative humidity > 90%
Can be stored up to six months at 1–2 °C and relative humidity > 90%

(5 × 2) (10)
TOTAL: 77

Module 3
Animal production

After students have completed this module, they should be able to:

- explain the structure and functioning of the digestive systems in farm animals;
- identify and describe poultry breeds, types and houses using appropriate examples;
- identify and describe types of feeds in terms of their properties, advantages and disadvantages;
- identify and control diseases and parasites affecting poultry according to workplace procedures;
- demonstrate an ability to handle poultry at all stages of rearing and production;
- identify and describe the goat and sheep types and breeds in terms of their suitability to environmental conditions;
- describe and demonstrate the feeding of goats and sheep in relation to their stages of growth and production;
- identify symptoms and control diseases and parasites affecting goats according to workplace procedures; and
- demonstrate an ability to handle goats and sheep.

This module will take about five weeks to cover and will count ±65 marks in the examination.

Introduction

Well-managed farming will assist in growing the South African economy and providing employment opportunities. Animal production is an important part of the South African economy. This module covers the farming of chickens, goats and sheep in South Africa and how effective management of animal production will lead to food production to support communities, contribute to employment opportunities and promote economic growth.

The physical characteristics and appropriate care of farm animals will be discussed as well as the different breeds that are best suited for the South African environment.

Introductory activity SB page 126

The introductory activities are designed to test students' baseline knowledge of plant and animal production. There are no right or wrong answers, and students need to compare their answers with the new knowledge they have gained after completing the module. The aim of this activity is to encourage class discussion and to build on existing knowledge.

Activity 3.1 SB page 138

Draw a table comparing different breeds of chickens used for different production outcomes (i.e. eggs or meat). Compare at least THREE breeds of chicken.

Students must be encouraged to make summary notes to support them when revising. This activity is aimed at ensuring that the student engages with the content and looks at content in a critical and analytical manner.

Students should include any THREE breeds of chickens from the table below and complete the required information.

Chicken breed	Best for eggs or meat	Weight at maturity	Other characteristics
Boschveld	Good egg-laying potential	Roosters 2,6 kg Hens 1,7 kg	Light red-brown feathers with white feathers for camouflage
Naked Neck	Good for meat production	Roosters 3,5 kg Hens 3 kg	No feathers on the neck, helps them to regulate body temperature
Potchesfstroom Koekoek	Suitable for egg and meat production	Roosters 4,5 kg Hens 3,5 kg	Cross-breed Hens lay brown-shelled eggs
Venda	Good for egg production	Roosters 3,6 kg Hens 3 kg	First identified in Venda region with multicoloured soft feathers

Practical activity 3.1: Research and discussion SB page 140

Visit your local supermarket and compare the price per kilogram of free-range chicken with that of other chicken. Do the same exercise for free-range eggs compared to other eggs.

What can you deduce from this? Discuss your conclusions with a partner. Do you have a similar conclusion as your partner? How will this affect the type of system that a farmer will use for egg production? Your lecturer will provide you with a self-assessment rubric to help you complete the activity in detail.

Students are expected to visit a supermarket and compare prices of free-range chickens with that of other chicken. The same comparisons must be done for eggs. The student should record this information in a notebook.

Note to lecturer: In general, free-range eggs and free-range chicken are more expensive due to the higher production costs linked to cage-free production.

The information that the students collect must be used to discuss their findings and recommendations. The self-assessment rubric in Addendum A can be given to students to assist them in ensuring that they have conducted sufficient research and have discussed the outcomes with a partner.

Case study SB page 143

Read the article below adapted from *Farmer's Weekly*, 19 August 2022, and answer the questions that follow.

1. **Why is there pressure to move away from cages for laying hens?**
2. **What implications will this have for the South African egg industry?**
3. **Which organisation started this campaign in 2019?**
4. **What is the percentage of hens kept in cages or sheds in South Africa?**
5. **What will the cost implications be to convert South African poultry farming to a cage-free system?**
6. **How will this impact consumers when purchasing eggs?**
7. **What is the feeling of the South African Poultry Association expressed in this article? Explain in detail.**
8. **Will this decision affect small producers negatively? Provide a reason for your answer.**
9. **If you had to give advice on the move to free-range, what would your advice be?**

Use your discretion when marking these questions. If a student gives a clear motivation, consider the answer.

1. Pressure from various organisations regarding the welfare of chickens. The thinking is that there is a negative impact on chickens in a cage system, as they are not able to move around. Free-range chickens are considered less stressed due to their ability to move around freely.
2. The implications of this will have a negative effect on the South African egg industry. It will result in an increase in the price of free-range eggs.
3. The World Health Organization for Animal Health started a campaign in 2019.
4. In South Africa, 94% of layers are being housed in a cage system and only 5% as free-range and 1% in chicken sheds.
5. It will cost more than R5 billion.

6. The price of eggs will increase by R6 per dozen.
7. The South African Poultry Association has indicated that there was a case for promotion of a cage-free system, but it was not going to be possible to move the entire system to a cage-free system. If there is an increase in the demand for free-range eggs, there could be a greater shift to this system. This means that the entire egg production system cannot be a free-range system.
8. It will affect small producers, as they will not be able to afford the necessary production setup and costs related to free-range chickens. The system requires a large amount of flock management.
9. Use discretion for this answer. Students must give a reason and motivate from the contents of the article.

Case study SB page 151

Read the article below, adapted from *Farmer's Weekly*, 19 August 2022, and answer the questions that follow.

1. **What is necrotic enteritis in chickens? Do research on this disease. Name the symptoms.**
2. **How can necrotic enteritis normally be treated?**
3. **What does the article suggest for the treatment of necrotic enteritis?**
4. **What does the abbreviation *AGP* stand for?**
5. **Why have some producers banned AGPs?**
6. **What does the article suggest the benefits of AGPs are?**
7. **What is the alternative treatment suggested by the article and what are the ingredients of this treatment?**
8. **How will feed efficiency assist the farmer in his or her financial planning?**
9. **Is accelerated growth in chickens a favourable outcome? Motivate your answer.**
10. **What was the outcome of the research?**
11. **How will this be of benefit to a chicken farmer?**

Use your discretion when marking these questions. If the student gives a clear motivation, consider the answer.

1. Necrotic enteritis is a disease where there are patches of dead tissue on the intestinal epithelium, and it causes high mortality. Symptoms are dehydration, diarrhoea, ruffled feathers and reduced intake of food and water.

   Note to lecturer: This answer requires the student to do some research. The answer is not in the text. Use discretion when marking the answer

2. Treatment is put into the drinking water.
3. Antimicrobial growth promoters (AGPs) can treat necrotic enteritis.
4. Antimicrobial growth promotors
5. Chickens have built up a resistance, so this means that they do not respond to the AGPs and still get infected.
6. Benefits include accelerated growth of chickens and good feed efficiency.
7. The alternative is an organic mixture of a blend of essential oils and organic acids. The alternative treatment contains carvacrol, thyme, hexanoic, benzoic and butyric acid.
8. Feed efficiency means that there is no wastage of food. Animals reach the desired weight with a measured amount of food. This will save the farmer money in feed costs.

9. Accelerated growth can be of benefit, as the chickens reach maximum weight in a shorter period. A balance is needed so that chickens do not grow too quickly, as this can impact on the quality of the meat.
10. The research showed that the use of the organic mixture gave the same results in terms of growth of the chickens and feed efficiency.
11. Farmers will be able to protect animals from necrotic enteritis using an organic mixture that will still provide good growth and feed efficiency.

Practical activity 3.2: Interview and report writing SB page 152

Visit an animal feed producer and gather information about the different feed options that are available for different types of birds.

Interview a person at the feed producer and ask them FIVE questions about the composition of chicken feed.

List your questions in advance and record the answers you receive while conducting your interview.

Present your findings in a written report.

Your lecturer will provide you with a marking rubric that will be used to assess this activity.

Students must conduct an interview and ask FIVE questions. Guide students as to the kinds of question that they could ask. Tell students to prepare the questions in advance so that they can record the answers to the questions while conducting the interview.

Guide students in the kinds of questions they can ask. Some suggestions are listed below:
- Do you have different feeds available for various stages of growth?
- Which kind of feeds are more popular (e.g. mash, crumble or pellets)?
- Do you sell additional supplements that farmer can add to their feed?
- Who are you customers? Are they large producers or smaller subsistence farmers?
- What specific vitamins and minerals do you add to your feed and why?

Provide the students with some tips on good interviewing skills. An eLINK has been provided below to guide students on how to approach the interview.

eLINK

Visit this link to learn more about how to be a good interviewer: futman.pub/GoodInterview

Students must present a written report. A rubric for marking this assessment is provided in Addendum A.

Practical activity 3.3: Demonstration on how to treat infected poultry

SB page 159

In this pair activity, students and a partner will need to:

- **be dressed appropriately for the activity; and**
- **have clean hands to protect the health of the chicken.**

You will need to conduct this practical on a working farm or at the college practical farm site. You and a partner will be required to catch and hold a chicken. One of you will hold the chicken while the other administers an eye-drop vaccination. You will then swop roles. Your lecturer will observe you and mark you according to a rubric. Your lecturer will share the rubric with you before the practical activity.

Practical activity 3.4: Handling and holding poultry

SB page 161

You will need to conduct this practical on a working farm or at the college practical farm site. In groups of four, you will be asked to catch, hold and inspect a chicken. Your lecturer will guide you as to how you will be assessed. You will need to follow a checklist and rubric provided in Addendum A.

Note to lecturer: Practical activities 3.3 and 3.4 can be done at the same time to use a visit to a practical facility to maximum benefit. The practical can be conducted at a college practical facility using a college flock or arrangements can be made with chicken farmers in the area.

For Practical activity 3.4, students must be encouraged to comment on the process as they are busy with the practical. Students must write their responses in the relevant column on the checklist. Once the students have completed the practical and written in their responses, the lecturer can complete the rating.

Lecturers must encourage students to discuss the process that they are following during the practical activity. The aim is for students to demonstrate their ability to handle the chicken as well as explain what they are doing.

Practical activity 3.5: Research

SB page 162

Visit the SAPA website at www.sapoultry.co.za and download the following document:

The South African Poultry Association Abridged Code of Practice in Relation to the Transportation of Poultry, Live Bird Sales and Biosecurity on Poultry Operations.

1. **Make a list of 10 important aspects to be considered when transporting Poultry.**
2. **Explain the process of biosecurity in relation to the people aspect of transporting poultry. List 5 important factors to consider.**

Students will need access to the internet to access the document indicated above. Students can work individually or in pairs or groups. Use your discretion in how to manage this assessment. The document is quite extensive and covers a number of issues. Students must be guided on selecting responses to the questions that best suit their particular context.

Responses are not limited to the list below. Download the document for reference purposes.

1. Important aspects to be considered when transporting poultry:
   - The driver of the vehicle must have a valid driver's licence and be trained in animal welfare.
   - The driver must have all relevant contact details.
   - Containers must be stacked to allow for airflow.
   - Containers must move smoothly to avoid stress to chickens.
   - When travel is international, relevant documents must be in place.
   - Animals must be protected against weather conditions.
   - Crates must be clean.
   - Crates must not be overcrowded.
   - Travel should not take place for more than 24 hours.
   - Vaccination and health records must be available.
   - Load during the cooler part of the day.
   - Sufficient food and water must be available.
   - Do not tie legs.

2. The process of biosecurity in relation to the people aspect when transporting poultry:
   - Restricted admission to production facilities
   - Private clothing changed for farm clothing
   - Shower facilities
   - Vehicles disinfected
   - Visit one farm a day if possible
   - Don't visit another site if an infected site is visited
   - Footwear disinfection.

Activity 3.2 SB page 170

1. Do research on the various breeds of sheep and goats discussed in this module. Choose any THREE breeds. Ensure that you list the sources or references that you used to do your research.
2. Capture your research in the table. (Keep this as a summary for study purposes.)
3. Decide on a particular breed that you may want to keep on your farm.
4. Motivate why you have chosen this breed. Ensure that you motivate your answer in detail.
5. Present your answer in a written report.
6. Source pictures of the breed that you have chosen to report on.
7. Your lecturer will guide you on how this report will be assessed.

Goat breed	Best suited for milk, meat, wool or other	Sheep breed	Best suited for
Boer	Meat	Merino	Meat and wool
Anglo-Nubian	Dual purpose	Dormer	Meat – specifically lamb
Savanna	Meat	Damara	Dual purpose
Kalahari Red	Meat	Namaqua Afrikaner	Meat
Angora	Hair and wool	Zulu	Meat
Indigenous Veld	Dual purpose	Bapedi	Meat
		Karakul	Multipurpose for milk, meat, wool and skins

Note to lecturer:

- Students must complete a number of subtasks in this activity.
- You can choose to break up the different components or give it to students as one consolidated task.
- Students must complete the table (suggestions have been provided in the table above).
- Students must then produce a written report selecting a particular breed for their farm. Students must also clearly motivate why they have chosen that breed. They should refer to adaptability to climate, dual purpose of the animal, etc.
- Encourage the students to find relevant pictures that they can include in their activity.
- The assessment of the activity can be done using a rubric. An example that can be used is provided in Addendum A.

Students must be encouraged to make summary notes to support them when revising. This activity is aimed at ensuring that the student engages with the content and looks at content in a critical and analytical manner. Students must be encouraged to think about how they would approach a farming operation.

An alternative to the use of a rubric could be the checklist found in Addendum A.

Keep the checklist and written report with your notes.

Case study

SB page 171

Read the article adapted from *Farmer's Weekly*, 19 August 2022, below.

In groups of three to four, discuss this article and the suggestions regarding the use of cassava for subsistence farmers. Refer to the costs and benefits that this could provide for subsistence farmers. Why would the use of cassava be effective for subsistence farmers and not for large-scale farmers? Also discuss the advantages in terms of the cultivation of cassava for subsistence farmers.

Your group must develop a PowerPoint presentation to explain the benefit for subsistence farmers. Refer to the article for information to support your presentation. Your group will present your power point presentation to the rest of the class.

Note to lecturer:

- Divide the students into groups of various levels of ability. This will allow for peer learning.
- Make sure that students are familiar with PowerPoint.
- Allow them to work in class and discuss the article. Move from group to group during the discussions to lead students towards a line of thought.
- Provide relevant resources to allow students to access additional information. This can include books, magazines or the internet.
- Use discretion, as students will have different opinions. Ensure that students motivate their answer with content from the article or from the textbook.

Practical activity 3.6: Apply grazing systems in a workplace setting SB page 173

Do the following to prepare for this practical activity:

- **Spend time observing the goats or sheep and make notes on the grazing system used.**
- **Ask the farmer questions about the feed**
- **Conduct research on feed requirements. Visit a farm to observe a herd of goat or sheep grazing. This can be done at a commercial farm, the college practical farm or a subsistence farm.**

Write a report and include information on the following aspects of grazing that you observe.

1. **Can you identify the type of grazing system used? Motivate your answer in detail.**
2. **What types of feed are the animals consuming?**
3. **Identify the benefits of the type of feed that the animals are consuming.**
4. **Are there any supplementary feeds that you can observe? Explain what you see in this practical setting.**
5. **What advice would you give the farmer on any alternative methods of grazing? Give at least TWO suggestions.**

Suggestions for lecturer:

- As students will be observing a practical setting, there may be different options that they observe.
- Students must make comment on the following (use discretion)
  - Identify grazing options
  - Explain why this grazing option is used
  - Benefit of this grazing option
  - What kind of feed is being given to animals
  - What are the benefits of this kind of feed
  - Are the animals receiving any additional/supplementary feed
  - Why would this additional/supplementary feed be necessary
  - Advice to the farmer
  - Recommendations on improvements
- Students must incorporate all of the information that they observe in a written report.
- Ensure that the written report includes a response to each question and has a clear introduction, main body of the written report and a conclusion.
  - Students must include their own opinion and motivation.

Case study SB page 174

Read the question posed by a farmer to the *Farmer's Weekly* (19 August 2022) and the response given.

Conduct some research on feedlots and answer the following questions:

1. **What is a feedlot and is feedlot farming profitable for sheep farmers? Motivate your answer.**
2. **What additional advice and information would you give to the farmer?**

Discuss your answers in class or with a partner.

Note to lecturer:
- Students are expected to conduct some research and to participate in a class discussion or a discussion with a partner.
- This activity can be used to stimulate conversation and have students express their opinions on important topics.
- The activity will not be formally assessed, but will be used to generate class participation in discussions.

Practical activity 3.7: Demonstrate the treatment and procedures of treating infected goats and sheep SB page 181

You will need to visit a farm where livestock is kept and interview the farmer to get as many of the answers as possible. Make sure that you arrange this in advance so that the farmer is prepared for your visit. You will need to observe what the processes and procedures are on the farm. You can work with a partner or alone. Your lecturer will guide you on how you will be assessed.

Look at the list of questions in the checklist below. Provide an answer for each of the questions. If you did not observe this process or procedure, indicate *Not observed*.

Note to lecturer:
- Students will have to visit a practical facility or farm to complete this activity.
- Students must be given the checklist in advance in order to know what processes they need to observe and what they need to take note of.
- It is suggested that students move in groups around the facility to ensure a smooth flow.
- The lecturer must arrange this visit and take students in groups, depending on the ability of the facility to accommodate the number of students.
- Students are expected to observe, make notes and ask questions during the visit.
- It is suggested that the farmer or facility staff receive a list of the questions in advance in order to pre-empt the questions from the students and to be able to demonstrate some of the processes indicated in the checklist.
- A completed checklist is essential for students to gain exposure to practical activities.
- Students can keep the completed checklist with their notes in order to have it as a reference resource.

Practical activity 3.8: Discuss and demonstrate the treatment of infected goats SB page 182

Scenario: **Goats on your farm are showing signs of worm infestation. Explain in detail how you would treat the goats. You will need to present you process and treatment plan to your class as an oral presentation.**

Include the following:
- **What symptoms are you observing?**
- **What specific infestation is there and how do you know what parasite is causing the infestation?**
- **What will your plan of action be? Explain in detail, including the type of treatment, the process and any additional comments.**
- **What programme of action will you put in place to prevent reinfection?**

Your lecturer will guide you on how this oral presentation will be assessed.

Practical activity 3.9: Demonstrate the treatment of infected goats SB page 184

You have to demonstrate how to dip or dose a goat. This practical activity will take place in a practical farm setting. Your lecturer will guide you as to how this will be assessed. You will be given a checklist against which you will be marked.

Ensure that you are properly dressed and ready to engage with the animals.

Note to lecturer:

- Students will need to engage with animals in a practical setting.
- You will need to engage with the farmer to see what options are available for dipping and or dosing.
- Students must be observed engaging with the animals in a confident manner.
- Each situation and what the student will be exposed to will depend on the facility that you visit.
- The checklist has been kept very generic, as it may need to be adapted.
- If dipping or dosing is not an option for students to participate in, any other practical handling of an animal may be used. (Example: loading an animal into a chute and doing a health check.)
- Lecturers will have to use discretion to ensure the ability to observe a student in a practical setting in handling a goat.

Practical activity 3.10: Handling goats in different circumstances SB page 189

This practical activity will take place in a farm setting. You will be expected to milk a goat. While milking the goat, you will have to explain the process to your lecturer. Your lecturer will guide you as to how this activity will be assessed.

Summative assessment: Module 3 SB page 191

1. **After visiting the eLINK, draw a mind map on the various breeds of chicken that are most common in South Africa. Include physical characteristics, most effective use of the bird and any other important information.**
   Use the mind map to supplement your study notes.

Note to lecturer:

- Ensure that the process of drawing a mind map is explained in class
- A link has been provided in the student book to guide students on how to draw a mind map and the value of mind maps
- There are a number of different websites and videos on You Tube that can be used as a resource
- Encourage students to use the process of mind mapping for other aspects of the curriculum
- Mind mapping is a good study tool for students who present as visual learners

2. Answer the following multiple-choice questions. Write down the number of the question and the relevant letter that corresponds to the correct answer.

2.1 The digestive system in humans is referred to as a ... system.

A ruminant
B monogastric
C dual
D omasum

2.2 The process of chewing food, swallowing and regurgitating later is called ...

A digestion.
B production.
C rumination.
D consumption.

2.3 In ruminant animals, the first part of digestion that takes place in the foregut is called ...

A regurgitation.
B chewing.
C swallowing.
D fermentation.

2.4 The following animals have three-chambered stomachs:

A Sheep and lambs
B Sheep and goats
C Camels and llamas
D Camels and goats

2.5 The digestive system in chickens is referred to as the ... system.

A avian
B ruminant
C monogastric
D pancreatic

2.6 Strong muscles in the ... of a chicken assist in breaking down the food.

A bladder
B pancreas
C gizzard
D crop

2.7 Waste in chickens is expelled through the ...

A caeca.
B pancreas.
C crop.
D liver.

2.8 The small intestine in ruminant animals consists of the ...

A gall bladder and salivary glands.
B duodenum, jejunum and ileum.
C cecum, colon and rectum.
D rumen, reticulum and omasum.

2.9 Food in the mouth of a goat forms a ball called a ... before it is swallowed.

A cud
B bolus
C rumen
D saliva

2.10 Acids and enzymes that aid in digestion are secreted from the ...

A bladder.
B pancreas.
C intestines.
D abomasum.

2.11 The digestive system of ruminants is designed to process ...

A fibrous plant feed.
B thorny trees.
C grass and hay.
D maize and protein.

2.12 'Rumen Bugs' are critical for breaking down plant matter in the system of a ruminant. These include:

A microorganisms.
B salivary lipids.
C protozoa, bacteria and fungi.
D none of the above.

2.13 This breed of chicken was developed in Limpopo by cross-breeding the Venda, Ovambo and Matabele chicken breeds:

A Boschveld chicken
B Naked Neck chicken
C Black Australorp
D White Leghorn

2.14 Intensive chicken housing systems can also be called ...

A battery systems.
B deep litter systems.
C housed chicken systems.
D all of the above.

2.15 Birds that are allowed to wander freely are called ...

A intensive systems.
B semi-intensive systems.
C free-range systems.
D caged systems.

2.16 Adult chickens should have a body temperature of ...

A 40,6 °C to 41,7 °C.
B 37,2 °C to 39 °C.
C 29 °C to 33 °C.
D 31 °C to 33,5 °C.

2.17 What is suggested to be in place at the entrance to every chicken house?

A Door
B Hand basin
C Foot bath
D Storage containers

2.18 Chickens that are produced for meat are called ...

A layers.
B broilers.
C hens.
D roosters.

2.19 The rearing of day-old chicks is called ...

A brooding.
B breeding.
C bonding.
D dosing.

2.20 The amount of feed given to a bird and divided by the weight of the bird is called ...

A egg yield.
B feed conversion.
C effective body weight.
D economic point of production.

2.21 The feed given to day-old chicks is referred to as ...

A post-finisher feed.
B finisher feed.
C starter feed.
D day-old feed.

2.22 Chickens that present with necks twisted backwards, could be infected with ...

A salmonellosis.
B botulism.
C fowl pox.
D newcastle disease.

2.23 An example of an internal parasite is ...

A roundworm.
B tapeworm.
C threadworm.
D all of the above.

2.24 A male goat is called a ...

A ram.
B ewe.
C foundling.
D bull.

2.25 A castrated male goat is called a ...

A buck.
B billy.
C buckling.
D wether.

2.26 The process of removing the testicles in a male animal is referred to as ...

A dosing.
B docking.
C cauterisation.
D castration.

2.27 The best meat-producing breed of goat in South Africa, is the ...

A Angora goat.
B Boer goat.
C Zulu goat.
D Bapedi goat.

2.28 Mohair is a product of a ...

A Angora goat.
B Boer goat.
C Zulu goat.
D Bapedi goat.

2.29 The following breed of sheep originated in Spain:

A Dormer
B Merino
C Dorma
D Zulu

2.30 This sheep breed is born black, but fades as the animal gets older:

A Dormer
B Bapedi
C Karakul
D Darmer

2.31 An area used for an animal to graze in is called a ...

A forage.
B fodder.
C pasture.
D paddock.

2.32 When animals move from different fields, giving the previous field a chance to regrow, this is called ...

A continuous grazing.
B rotational grazing.
C field grazing.
D regrowth grazing.

2.33 When producing an animal for meat production, the leaner the meat ...

A the higher the price.
B the lower the price.
C the more profitable the meat is.
D the less profitable the meat is.

2.34 A bacterial disease that results in the likely death of an animal is ...

A roundworm.
B anthrax.
C liver flukes.
D mastitis.

2.35 A disease that is the result of a cut or injury that becomes infected, is called ...

A mastitis.
B foot-and-mouth disease.
C tetanus.
D heartwater.

2.36 Sheep and goats can easily be managed by using a ...

A pasture.
B paddock.
C chute.
D rope.

2.37 A form of castration is ...

A banding.
B bonding.
C docking.
D dosing.

2.38 The process of removing the woollen fleece of a sheep is called ...

A docking.
B trimming.
C shearing.
D castration.

2.39 Meat from an adult sheep is called ...

A cabrito.
B mutton.
C beef.
D chevon.

2.40 Meat from an adult goat is called ...

A cabrito.
B mutton.
C beef.
D chevon.

(40 × 2) (80)
TOTAL: 100

Addendum A

Practical activity 1.1: Checklist

Rating score: 4 = excellent; 3 = good; 2 = average; 1 = poor

	Question	Student's response (Students to give verbal feedback and record their responses in this column and explain their actions during each step of the process.)	Comments and additional information and feedback from the lecturer on observation of the student	Rating 1–4
1.	Did the student collect enough soil samples and place them in different containers?			
2.	Was the student able to mix the samples correctly and take pH tests with litmus paper?			
3.	Did the student capture the pH correctly?			
4.	Did the student add the correct additive to the correct sample?			
5.	Was the student able to correctly identify the change in pH for each of the three samples?			

TOTAL MARKS	Maximum marks obtainable 5 × 4 = 20 marks	Student's marks

Feedback from student on the practical activity	
Feedback from lecturer	

Practical activity 1.2: Checklist

Rating score: 4 = excellent; 3 = good; 2 = average; 1 = poor

	Question	Student's response (Students to give verbal feedback and record their responses in this column and explain their actions during each step of the process.)	Comments and additional information and feedback from the lecturer on observation of the student	Rating 1–4
1.	Did the student collect enough soil samples and place them in different containers?			
2.	Did the student mark the jars correctly?			
3.	Did the student mix the samples with water correctly?			
4.	Was the student able to accurately measure and calculate the different percentages?			
5.	Was the student able to identify the floating debris?			

TOTAL MARKS	Maximum marks obtainable 5 × 4 = 20 marks	Student's marks

Feedback from student on the practical activity	
Feedback from lecturer	

Activity 2.10: Oral rubric

Name of student	
Date of assessment	

SCORE	DESCRIPTION
5	The student has demonstrated a thorough understanding of the topic. All requirements of the task are included in the response and a level of creativity has been demonstrated in the oral presentation.
4	The student has demonstrated an understanding of the fundamental concepts, ideas or issues of the topic. All requirements of the activity have been covered in the oral presentation.
3	The student's presentation demonstrates considerable (but not a complete) understanding of the basic concepts, ideas or issues of the topic. Most requirements of the activity are included in the oral presentation.
2	The student's presentation demonstrates a partial understanding of the topic. Fewer requirements of the activity are included in the oral presentation.
1	The student's evidence demonstrates little or no understanding of the topic. Many requirements of the activity are not included in the oral presentation.

Maximum mark obtainable = 5 Mark out of 5 × 20 will give a percentage achieved.	%

Practical activity 3.1: Self-assessment rubric

Name of student	
Date of assessment	

Rate each question by ticking the relevant rating code for each question. Any questions where you score yourself a 1 or a 2 should be redone to ensure that you derive the maximum benefit from this assessment.

Rating codes: 1 = poor; 2 = average; 3 = good; 4 = excellent

QUESTIONS	1	2	3	4
Have you visited a local supermarket and done price research?				
Have you compared the price of free-range chicken meat and other chicken meat and written these prices down?				
Have you compared the price of free-range eggs and other eggs and written these prices down?				
Have you reached a conclusion and written this down?				
Can you motivate your conclusion?				
Have you discussed this with a partner?				
Do you have the same conclusions as your partner? If not, have you discussed your different points of view?				
Have you discussed how this will affect the type of system that a farmer may use for egg production?				
Do you feel that you have gathered enough information to motivate your opinion?				

TOTAL MAXIMUM MARKS:
9 QUESTIONS × MAXIMUM OF 4 MARKS = 36 MARKS

STUDENT MARK ACHIEVED OUT OF 36	

Practical activity 3.2: Marking rubric

Name of student	
Date of assessment	

Rating codes: 1 = poor; 2 = average; 3 = good; 4 = excellent

QUESTIONS	1	2	3	4
Has the student prepared FIVE questions relating to chicken feed?				
Has the student arranged to interview a feed producer?				
Has the student recorded the answers to the FIVE questions?				
Has the student captured the data collected in a written report?				
Has the student presented the report in a logical manner?				
Has the student included any additional information in the report?				
The overall impression of the research, interview and written report				

TOTAL MAXIMUM MARKS:
7 QUESTIONS × MAXIMUM OF 4 MARKS = 28 MARKS

STUDENT MARK ACHIEVED OUT OF 28	

Practical activity 3.3: Marking rubric

Name of student	
Date of assessment	

Rating codes: 1 = poor; 2 = average; 3 = good; 4 = excellent

NOTE: Students will be assessed on their ability to hold the chicken while their partner administers the eye drops and then to administer the eye drops while the partner holds the chicken. Each student must be assessed on a separate rubric.

QUESTIONS	1	2	3	4
Did the student catch the chicken and hold the chicken properly?				
Did the student take care to handle the bird with care and safety?				
Did the student administer the eye drops effectively?				
Did the student release the bird taking the safety of the bird and themselves into account?				
Did the student show confidence during the process?				
Overall impression of the student's ability to conduct a practical task (holding chicken and administering eye drops)				

TOTAL MAXIMUM MARKS:
6 QUESTIONS × MAXIMUM OF 4 MARKS = 24 MARKS

STUDENT MARK ACHIEVED OUT OF 24	

Practical activity 3.4: Checklist

Rating score: 4 = excellent; 3 = good; 2 = average; 1 = poor

	Question	Student's response (Students to give verbal feedback and record their responses in this column and explain their actions during each step of the process.)	Comments and additional information and feedback from the lecturer on observation of the student	Rating 1–4
1.	Can the student correctly catch the chicken?			
2.	Does the student display the correct method of holding the chicken?			
3.	Can the student explain the process and reason for correctly holding the chicken?			
4.	Has the student completed an observation of the bird and indicated any normal or abnormal features?			
5.	Has the student displayed calm and effective handling and observation of the bird?			
6.	Has the student released the bird in a safe and secure manner?			

TOTAL MARKS	Maximum marks obtainable 6 × 4 = 24 marks	Student's marks

Feedback from student on the practical task	
Feedback from lecturer	

Activity 3.2: Marking rubric

Name of student	
Date of assessment	

Rating codes: 1 = poor; 2 = average; 3 = good; 4 = excellent

QUESTIONS	1	2	3	4
Has the student completed the table with the details of THREE breeds of goat?				
Has the student selected a particular breed of goat and clearly motivated their choice?				
Has the student captured this choice and motivation in a written report?				
Has the student sourced any additional information in the written report?				
Has the student provided any pictures, graphs, maps, etc. to supplement the written report?				
Overall impression of the completed activity				

TOTAL MAXIMUM MARKS:
6 QUESTIONS × MAXIMUM OF 4 MARKS = 24 MARKS

STUDENT MARK ACHIEVED OUT OF 24	

Activity 3.2: Checklist

Name of student	
Date of assessment	

Question/Criteria	Tick YES	Tick NO
Has the student completed the table in full with a summary of the goats and sheep covered in this module?		
Is the information relevant and can it be used as study notes?		
Has the student presented a written report?		
Has the student indicated a breed that they would like to farm with?		
Has the student provided a strong motivation as to why they have selected this breed?		
Has the student sourced pictures of the breed selected?		
Has the student provided sufficient information and is there evidence of research?		

Maximum mark obtainable = 7	Student mark

Practical activity 3.6: Marking rubric

Name of student	
Date of assessment	

QUESTIONS	Tick YES	Tick NO
Has the student indicated the symptoms that the animal is presenting with?		
How has the student identified the parasite and did they explain how this was identified?		
Has the student indicated a treatment plan of action?		
Has the student explained the process of treating the animal?		
Has the student provided sufficient information and is there evidence of research?		
Has the student prepared well and delivered the oral with confidence?		

Maximum mark obtainable = 6	Student mark

Practical activity 3.9: Checklist

Name of student	
Date of assessment	

QUESTIONS	Tick YES	Tick NO
Is the student appropriately dressed to engage in this practical activity?		
Is the student confident in engaging with the animal (observed)?		
When questioning the student, are they clear on the process that they are going to participate in?		
Does the student show empathy and care for the animals?		
Is the student able to explain the reasons for the process that they are going to participate in?		
Has the student completed the practical activity in a satisfactory manner?		

Maximum mark obtainable = 6	Student mark

Practical activity 3.10: Marking rubric

Name of student	
Date of assessment	

Rating codes: 1 = poor; 2 = average; 3 = good; 4 = excellent

QUESTIONS	1	2	3	4
Is the student able to secure the goat appropriately?				
Has the student cleaned the udder area before starting the milking process?				
Has the student shown care for hygiene (their own hands and the milking area)?				
Is the student able to calmly engage with the goat?				
Does the student use the correct milking technique (gripping the teat from the top between the thumb and finger and then using the other fingers to squeeze the teat)?				
Has the student emptied the udder and shown the appropriate techniques for ensuring that the udder is empty?				
Has the student been able to get sufficient milk from the goat?				
Is the student able to disengage the goat appropriately after the milking process?				
The overall impression of the milking process				

TOTAL MAXIMUM MARKS:
9 QUESTIONS × MAXIMUM OF 4 MARKS = 36 MARKS

STUDENT MARK ACHIEVED OUT OF 36	

Glossary

A

Adhesion – water molecules are attracted to other surfaces

Amino acid – simple organic compounds that combine in long chains to form proteins

Angiosperm – plants that grow flowers and produce seeds from those flowers

Anion – a negatively charged ion with more electrons than protons

Atom – the smallest particle of a chemical element that can exist

B

Basin irrigation – a surface irrigation method where fields are surrounded by high ridges in order to form basins that are flooded with water

Biodiversity – the plant and animal life in a particular habitat and which is important to its sustainability

Border strip irrigation – a surface irrigation method where fields are divided into strips separated by ridges that run down the gradient of the fields

C

Capillary action – liquid flowing through a narrow space

Castration – when a male animal has his testicles removed; done in a non-surgical manner by cutting off the blood supply to the testicles; the reason for castration is to control breeding of a herd and in that way improve the herd and castration also reduces the male hormones and so will reduce aggressive behaviour in the herd

Cation – a positively charged ion with fewer electrons than protons

Centre pivot irrigation – a method of sprinkler irrigation where pipe segments supported by trusses and towers with wheels hold the sprinklers

Chlorophyll – a light-absorbing pigment found in the chloroplast

Chloroplast – plant cell organelles that use photosynthesis to transform light energy into chemical energy

Chlorosis – due to a lack of chlorophyll, leaves turn yellow

Clay – very small particles that are all less than 0,002 mm in size

Cohesion – water molecules are attracted to each other

Compaction – the process during which the density of soil increases

Cotyledon – embryonic leaf in plants that produce seeds; the first leaves to emerge from a sprouting seed

Crop yield – the amount of a crop that can be grown per unit area of land

Cultivation (in terms of weed control) – removing the weeds and loosening the soil to ensure maximum water retention and allow air to flow into the soil

D

Decompose – to break down organic matter into component elements

Desertification – the process during which fertile soil becomes dry and unproductive

Dicotyledon – also known as dicot; flowering plant with an embryo that has two cotyledons

Diffusion – the process in which individual molecules move through a semipermeable membrane from a high concentration to a lower concentration, in order to equalise the concentrations on both sides of the membrane

Digestion – the consumption of food and water; chewing, chemical reaction of

saliva, and swallowing of food; digestion of food and absorption of nutrients; maintaining hydration and electrolytes as well as the evacuation of waste

Drip irrigation – a micro-irrigation method where water is delivered straight to the root zone of plants in droplets

E

Electron – a subatomic particle with a negative charge equal to that of a proton

Elevation – height above sea level

Endocarp – innermost layer of a fruit that surrounds the seed

Erosion – the process during which soil material is worn away and moved by water or wind

Evapotranspiration – a measure of how much water is transferred from the soil to the atmosphere by evaporation and from transpiration from plants

Exocarp – the outer layer of a fruit

F

Fertigation – the application of water-soluble nutrients to plants via an irrigation system

Fodder – food that is added to the diet of grazing animals

Forage – to search widely for food

Furrow irrigation – a surface irrigation method where water is deposited into furrows and allowed to flow through the field by gravity

G

Gamete – a mature male or female cell that is able to unite with another cell of the opposite sex in sexual reproduction

Geographic distribution – the places on Earth where plants can grow

Grazer – an animal that eats grass (e.g. sheep or cow)

H

Humus – organic component of soil that is formed when plant material is broken down by microorganisms

Hydroponics – process of growing plants without soil

I

Inorganic material – substances that are not derived from living things, such as the particles formed when rock breaks down into many smaller pieces

Ion – an atom or molecule with a net electric charge due to the loss or gain of one or more electrons

Irrigation – the process of supplying controlled amounts of water to land or crops to assist in crop production

L

Lawn sprinkler irrigation – a method of sprinkler irrigation that is installed permanently, mostly underground, and uses spray heads or rotors to deliver water

Lenticel – raised pores on the woody stems of plants that facilitate gas exchange between internal tissues and the atmosphere

Light saturation point – the light intensity point at which further increases in light do not increase photosynthesis

Loam – a mixture of sand, silt and clay in different ratios, with particles ranging from 0,002 mm to 2 mm in size

M

Macronutrients – nutrients that plants need in large amounts to maintain optimal growth and development

Mesocarp – the middle fleshy layer of a fruit, found between the exocarp and the endocarp

Micro-irrigation – an irrigation system where water is distributed through a

predetermined pattern of pipes at low pressure

Micronutrients – nutrients that plants need in small amounts to assist in growth and metabolism

Microorganisms – microscopic organisms such as bacteria and fungi

Micro-spray irrigation – a micro-irrigation method where water is delivered under low pressure at a slow rate via sprinklers with very small openings

Mini-bubbler irrigation – permanently installed low- pressure irrigation where water is delivered via a bubbling head

Mitochondrion (plural: mitochondria) – an organelle present in most cells in significant numbers where the metabolic activities of respiration and energy production take place

Monocotyledon – also known as monocot; flowering plant with an embryo that has a single cotyledon

Mulch – material spread around plants to insulate and enrich the soil

N

Neutron – a subatomic particle with the same mass as a proton, but with no charge

Nodule – a small bump of cells

Non-arable – land that is unable to support the growth of a crop due to poor soil and land constraints

Nutritional deficiencies – caused when the food that is being eaten does not give sufficient vitamins and minerals to keep the animal healthy; if the food that animals are being fed does not contain all of the necessary nutrients, they can develop illnesses

O

Organelle – a specialised part of a plant cell

Organic matter – the matter that makes up living things such as plants and animals

Osmosis – the process in which water moves through a semipermeable membrane from a high concentration to a lower concentration, in order to equalise the concentrations on both sides of the membrane

Oxidise – undergo a reaction in which electrons are lost

P

Parasites – organisms that live in or on another or organism or species (host) and derive nutrients from the host to the detriment of the host

Pasture – an area used for forage would normally have a fenced area; can be grown to contain specific foods to suit the particular animal

Pericarp – part of the fruit that is formed from the wall of the ripened ovary

Pests – that which include the infestation of insects, mites, snails or slugs and are noticeable by inspecting the condition of the leaves

pH – a measure of the concentration of hydrogen ions in a sample

Photoperiod – the length of time each day during which a plant receives light

Photosynthesis – the process in which plants capture and transform light energy, water and carbon dioxide into chemical energy and oxygen

Plant morphology – also known as phytomorphology, is the study of the external structure of plants and is useful when visually identifying plants

Plant physiology – the study of the way plants function, including all the processes involved in growth, metabolism, reproduction, defence and communication

Plant production – the growing of crops for food and for use as inputs in the production of other products

Pollination – the transfer of pollen from the male part of the flower (stamen) to the female part of the flower (pistil)

Pollution – the process of introducing harmful or poisonous substances into the environment

Protein – large, intricate molecules that are crucial for the structure, operation and control of tissues

Proton – a subatomic particle with a positive charge equal to that of an electron

Proventriculus – the narrow glandular first region of a bird's stomach between the crop and the gizzard; enzymes are added here to break down food; muscles are also used to break down food

R

Reactant – a substance that undergoes a change or takes part in a reaction

Reaping – to harvest a crop

Representative sample – a sample that reflects the characteristics of the phenomenon that is being studied

Reproductive growth – the growth of flowers and fruit formation

Respiration – the process during which plants use the sugars that were produced during photosynthesis together with oxygen to produce energy that they use to grow

Rumination – the process of chewing food slightly, swallowing and regurgitating it later to chew

S

Salinisation – the process during which high quantities of salts accumulate in the soil

Sand – large rock particles that are between 0,2 mm and 2 mm in size

Selective breeding – when a certain breed is bred over a period by selecting a breed with good genetics and controlling animal reproduction

Semipermeable – allowing some liquids or gases to pass through

Silage – green fodder is compacted and kept in airtight silos for use as winter animal feed

Silt – medium-sized particles that are between 0,002 mm and 0,02 mm in size

Sodium – a mineral that is also one of the chemical elements found in salt

Soil – the loose material on the surface of the earth that covers most of the land

Soil fertility – the ability of soil to sustain plant growth by providing the required nutrients

Soil sampling – the process of taking a representative sample of soil to determine nutrient content

Solar energy – radiant energy emitted by the sun

Subirrigation – a method of irrigation where water is delivered to the root zone of plants

Subsistence farmers – farmers who produce enough to support themselves and their households with any surplus sold to supplement the household finances; subsistence farmers are found mostly in urban areas where there is a lack of other resources easily reached to support their family

Surface irrigation – irrigation method where water is delivered to crops and distributed over the soil by gravity

Sustainable – able to continue without damaging the environment

Sustainable agriculture – ecologically and environmentally friendly methods of farming that allow the production of crops and livestock without damage to the farm as an ecosystem

T

Threshing – to separate a crop (such as grain or maize) from the plant using a revolving mechanism

Tissue – a type of material of which plants or animals are made; consists of specialised cells and cell products

Transpiration – the loss of water through the stomata in the leaves of a plant

V

Vegetative growth – the growth of leaves, stems and roots

W

Weed – any plant that grows in a place where it is not wanted or expected to grow; could also include a plant that is not planned in that specific area, for example, if corn starts to grow in the middle of a strawberry field, this can be considered a weed

Wheel line irrigation – a method of sprinkler irrigation where pipe sections with large wheels fixed to their midpoints and sprinklers installed lengthwise deliver water to crops

Winnowing – blowing air through harvested crops (such as grain or maize) to remove the chaff

X

Xylem – plant tissue that conducts water and nutrients from the roots to the rest of the plant

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