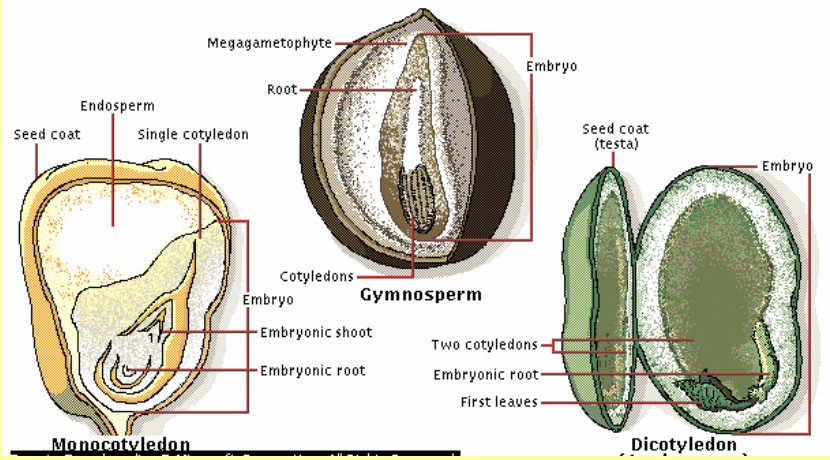
NQF Level: 3 US No: 116272

Assessment Guide

Primary Agriculture

Anatomy and physiology of crop plants



Assessor: . . . . . .

Workplace / Company: . . . . . .

Commodity: . . . . . Date: . . . . . .

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Before we start...

This assessment guide contains all necessary activities and instructions that will enable the assessor and learner to gather evidence of the learner's competence as required by the unit standard. This guide was designed to be used by a trained and accredited assessor whom is registered to assess this specific unit standard as per the requirements of the AgriSETA ETQA.

Prior to the delivery of the program the facilitator and assessor must familiarise themselves with content of this guide, as well as the content of the relevant Learner Workbook.

Please Note:

This Unit Standard **116272** Assessment Guide must be read in conjunction with the generic Assessor Guide as prescribed and published by the AgriSETA.

The assessor, facilitator and learner must plan the assessment process together, in order to offer the learner the maximum support, and the opportunity to reflect competence.

The policies and procedures that are required during the application of this assessment are available on the website of the AgriSETA and should be strictly adhered to. The assessor must familiarise him/herself with this document before proceeding.

This guide provides step-by-step instructions for the assessment process of:

Title:	Demonstrate a basic understanding of the physiological functioning of the anatomical structures of the plant				
US No:	**116272**	**NQF Level:**	3	**Credits:**	4

This unit standard is one of the building blocks in the qualification listed below. Please mark the qualification you are currently assessing, because that will be determined by the context of application:

Title	ID Number	NQF Level	Credits	Mark
National Certificate in Animal Production	49048	3	120	❒
National Certificate in Plant Production	49052	3	120	❒

Please mark the learning program you are enrolled in:

Are you enrolled in a:	Y	N
Learnership?	❒	❒
Skills Program?	❒	❒
Short Course?	❒	❒

Note to Assessor:

If you are assessing this module as part of a full qualification or learnership, please ensure that you have familiarized yourself with the content of the qualification.

Activity Answers

1

SO 1

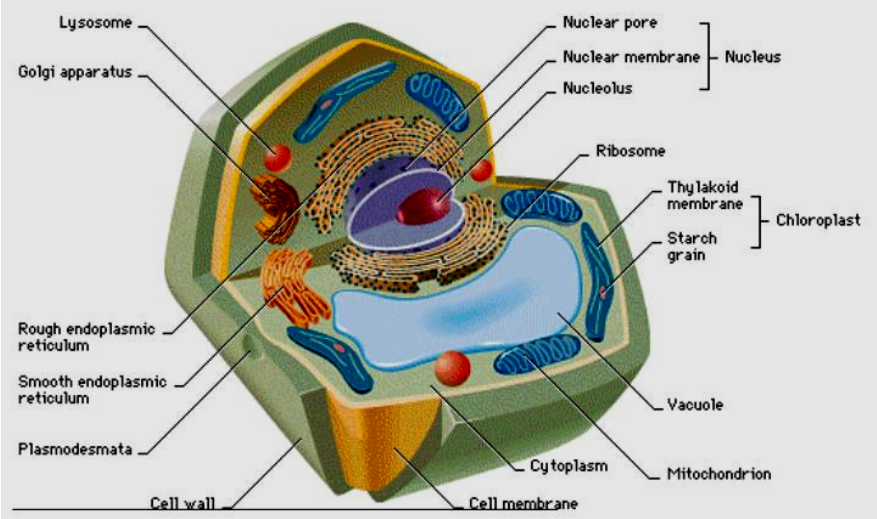
Instructions to learner:

Explore and discuss. Individual Activity

Learner Guide: Page 9 **Facilitator Guide: Page 13**

Draw a diagram of a cross section of a plant cell providing the identity of organelles.

Model Answer(s):



My Notes ...

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Activity Answers

2

SO 1

Instructions to learner:

Explore and discuss. Individual Activity

Learner Guide: Page 12 **Facilitator Guide: Page 13**

In an essay, discuss the function of plant cells within plant tissues and structures.

Model Answer(s):

Plants are compiled of single cells that are organised in compounds of cells that make up organs. The cells are not just aggregated in a group but are connected and coordinated.

The organs are made up of microscopic units know as plant cells. Plants, such as pine trees, tomatoes and even maize all look different from one another, but they are made of similar cells and tissues.

Plant cells are microscopic sized structures that contain various smaller organs known as organelles that ensure the growth processes.

Cells may vary in size, shape, structure and function. Some cells are relatively simple in the way that internal organelles are organised whilst others are more complex. Cells may perform various functions or may be specialised in their function.

Although cells differ is size and function, they are the basic structural units of plant organs. Although cells have different functions and may be part of different organs, they have a common structure consisting of a number of cell organelles (microscopic cell organs).

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Activity Answers

3

SO 1

Instructions to learner:

Explore and discuss. Individual Activity

Learner Guide: Page 12 **Facilitator Guide: Page 13**

Define the function the plant cell organelles.

Model Answer(s):

*The outer protective layer around the cell is know as the **cell wall** which is made of cellulose, giving the wall a rigid structure and acting as a semi-rigid "exoskeleton" of the cell.*

*Beneath the cell wall is the **cell membrane**, which acts as the outer boundary of the cell. Anything that enters or leaving the cell must first pass through the membrane. The cell membrane thus acts to "filter" out harmful products and also ensures that all the necessary product stay inside the cell. This is the most important function of the cell membrane.*

*Within the membrane is the **protoplasm**. The protoplasm is basically the ground substance or living material of a cell. This protoplasm includes the complex colloidal organisation of substances making up a cell's nucleus, cytoplasm, plastids and mitochondria. The term protoplasm has to a great extent been replaced by the term cytoplasm; the latter, however, does not include the cell nucleus.*

*The **nucleus** controls all the functions of the cell by specifying the proteins to be produced. It also stores and passes on genetic information to future generations of cells during cell division. DNA responsible for storage and transfer of this genetic information is found in the chromosomes. The information stored and transferred determines what the plant will look like, as well as which characteristics will be expressed. The chromosomes are enclosed in the nucleus.*

*The next organelle is the **chloroplast**, the plastid where photosynthesis occurs. The chloroplast is enclosed in a double membrane. Chloroplasts contain chlorophyll. They are disc-shaped and about 4 to 6 micrometres in diameter. They are found mostly in the cells of leaves where they can orientate themselves towards light. The light energy trapped by the chlorophyll is converted to compounds, called adenosine triphosphate (ATP), by means of a series of chemical reactions that take place in the grana. The trapped energy is stored temporarily as small starch granules in the chloroplasts.*

*The starch and sugars made during photosynthesis is metabolised by the plant during the night through a process called aerobic respiration. This process occurs in the organelle called the **mitochondrion**. Mitochondria have two membranes; the inner and the outer. The outer serves as an outer boundary of the organelle. The inner membrane contains many proteins with important functions, including those that allow molecules to enter into, or exit from the mitochondrion.*

*A prominent feature of the cell, clear in the figure above, is an irregular three-dimensional network of spaces, enclosed by membranes. This feature is called the **endoplasmic reticulum** (ER). The ER is the site where most cell membrane components as well as materials that are exported from the cell, are produced. When the ER is covered in ribosomes, it is known as rough ER and when ribosomes are absent, it is known as smooth ER.*

***Ribosomes** are factories for protein synthesis. It is here where the so called*

messenger RNA is translated into amino acid sequence (protein building blocks). It is obvious that these organelles must be closely associated with the ER as this is the site for synthesis of cell constituents.

*The **Golgi apparatus** is a miniature cellular inclusion in the cytoplasm. It is made up of a series of smooth, stacked membranous sacs. The function of the Golgi apparatus is to direct newly synthesised proteins to their correct destination in the cell. It is obvious that the Golgi apparatus and ER are closely linked.*

***Vacuoles** are membrane bound cavities (sacks) filled with cell sap, which is made up mostly of water, containing various dissolved sugars, salts, and other chemicals. These could include pigments that provide the colour of flowers.*

My Notes ...

Activity Answers

4

SO 1

Instructions to learner:

Explore and discuss. Activity to be conducted in pairs

Learner Guide: Page 13 **Facilitator Guide: Page 13**

Explain how plant cells are involved in plant growth.

Model Answer(s):

Plants grow by means of cells, duplicating and enlarging. The process of cell division is known as mitosis. Meiosis is the process of division of a living cell nucleus which leads to the production of two daughter cells. These two daughter cells normally carry the same genetic information. Mitosis is the standard way that cells multiply and occurs all the time during plant growth.

Mitosis is -

The lengths of DNA begin to twist and coil, becoming more compacted (chromosomes). Each chromosome consists of a two identical halves know as chromatids. The two halves are attached to one another more or less in the middle. This gives the chromosome an X-like appearance.

During mitosis the chromosomes align across the cell's middle. The nuclear membrane begins to disintegrate. Then the two halves of the chromosome are pulled apart, separating at the connection point. They are then pulled in opposite directions towards the ends. A new nuclear membrane forms around each new set of chromosomes and the chromosomes then uncoil and unravel. At the same time the rest of the cell also divides in a process known as cytokinesis. The cell as a whole eventually splits in two with a new cell wall built across the middle of the parent cell. Once two cells are formed the cell enlarges to the normal size.

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Activity Answers

5

SO 2

Instructions to learner:

Explore and discuss. Individual Activity

Learner Guide: Page 18 **Facilitator Guide: Page 15**

Write an essay, discussing the process of imbibitions and the rupturing of the seed coat.

Model Answer(s):

During germination, water diffuses through the seed coat into the embryo, which has been almost completely dry during the dormancy period. The seed starts swelling, up to the point where the swelling is so large that the seed coat is ruptured. Together with the absorption of oxygen by the seed, energy is made available for growth. The foodstuffs stored in the endosperm or in the cotyledons are broken down by enzymes into simpler substances, which are transported to the areas of growth.

My Notes ...

Activity Answers

6

SO 2

Instructions to learner:

Explore and discuss. Individual Activity

Learner Guide: Page 18 **Facilitator Guide: Page 15**

Develop a presentation on:

- The role that the environment plays on the activation of endogenous hormones during germination.

Use examples relevant to the crops grown at your place of work to highlight the process.

Model Answer(s):

Abscisic Acid

This chemical causes the embryo to remain dormant. This chemical is produced by a plant during the late summer and early autumn, leaving the seed to be come dormant. This means that even if they are dispersed in autumn, they cannot sprout. During the colder winter months enzymes, contained in the seeds, degrade the abscisic acid so that by spring the abscisic acid is gone and the seed germinates.

It is possible to stimulate the seeds to germinate earlier by placing the seed in moist soil and a fridge for about four weeks (a process called stratification). This is usually sufficient time to degrade the abscisic acid.

Plant seeds are then placed in a warm greenhouse. The seeds, assuming that winter is over and spring has come, will now begin to sprout. This process is called vernalization.

Phenolic Compounds

Plants that grow in a dry environment (desert) have a different problem.... a lack of water. These plants use a more potent chemical, called phenolic compounds (which are water-soluble) to keep their seeds dormant until the environmental conditions are ideal for germination.

Deserts typically have very long dry season and a short wet season accompanied by flash floods.

Therefore, when rain does come, the phenolic compounds (which are water soluble) are quickly leached out of the seed allowing it to germinate. In this way the seeds will remain dormant until enough water has been provided through rain to leach the compounds, ensuring they do not germinate during dry periods.

- The potential influence that the environment may have on seed germination.

Use examples relevant to the crops grown at your place of work to highlight the process?

Model Answer(s):

Seed Viability

Seed viability refers to seed being capable of growing into a healthy plant. Some seeds are viable for only a few days after falling from the parent plant. Other seeds (e.g.) remain viable for many years. It is well known that an Oriental lotus can

germinate 3,000 years after dispersal. Different plant species has its specific period of viability; seeds sown after the period of optimum viability may produce weak plants or may not germinate. This is important when you grow crops earmarked for seed. The seed distributor will normally indicate the due date on the packaging after which the seed is no longer expected to be viable.

Seed Dormancy

The lack of viability of seed can be confused with seed dormancy as many seeds need a "resting period" to complete their maturity process after falling from the parent plant and before they are able to germinate into new plants.

In some plants, chemical changes take place during the dormancy period to prepare the seed for germination. In some cases seeds have extremely tough seed coats that must soften or decay before water and oxygen can enter the seed to take part in the growth of the embryo, or before the growing embryo is capable of bursting through the seed coat.

My Notes ...

Activity Answers

7

SO 3

Instructions to learner:

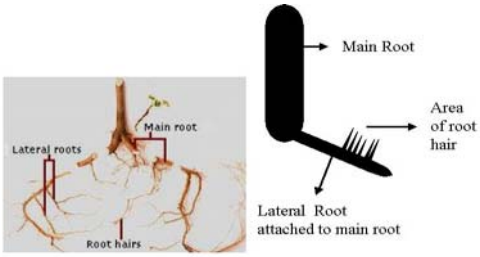
Explore and discuss. Individual Activity

Learner Guide: Page 23 **Facilitator Guide: Page 17**

Making use of detailed diagrams and describe and discuss the basic structure of a plant root.

Model Answer(s):

In general roots have a basic structure consisting of a main root from which lateral roots develop. These spread out over a larger area helping to anchor the plant in the soil. The lateral roots are covered with numerous root hairs which have the sole function of absorbing water and nutrients from the soil.



Adventitious roots are those that develop directly from the stem and act primarily as support for the plant.

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Activity Answers

8

SO 3

Instructions to learner:

Explore and discuss. Group Activity – Groups of 2

Learner Guide: Page 23 **Facilitator Guide: Page 17**

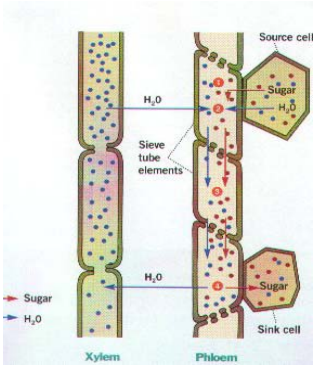
Develop and present a presentation in which you describe how water and nutrients are transported in plants. Ensure that you cover water uptake from soil and the movement to sinks via roots and stems. The presentation should be 20 minutes long and must include a series of diagrams that illustrate the processes. Allow an additional 10 minutes for questions.

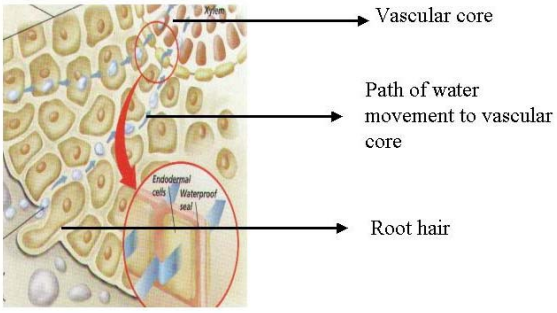
Model Answer(s):

A plant is anchored in the soil by means of tap roots, main roots and lateral roots, preventing it from being physically pushed over by wind or animals. The lateral roots spread out from the stem covering as large an area as possible. The larger the area that is covered the better the plant is anchored.

Attached to the main and lateral roots are root hairs. The root hairs are the only areas on the root where nutrients and water is actively taken up. Any damage to root hairs of a plant results in the reduced uptake of water and nutrient. A cross section of a root reveals that it is made up of a core consisting of vascular cylinders which contains xylem and phloem, which forms a tube through the plant through which water and nutrients are transported. The root hairs are integrated into the cell system of the root.

The transport of organic food by the phloem vessels is explained.





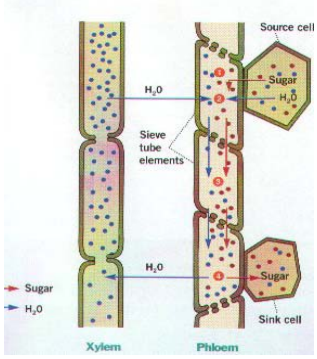
The different plant organs are interlinked by a system of tubes known as the vascular

system. This tube system ensures that water, nutrients and food stuffs can be transported from the source at one end to the area where it is required (sink). The vascular system is differentiated into 2 distinct types of "veins" and they support the leaves. The two systems are the phloem: through which SUGARS are transported from the leaves (source) to where they are stored or used (sink or target), and the Xylem; through which water and mineral Nutrients are transported from the roots to the leaves.

Water is transported from the soil (after root uptake) via the vascular system (Xylem) to the leaves where it is, by means of a metabolic process, converted into vital sugars. These sugars are transported to the roots and other plant part from the leaves via the vascular system (phloem) where it is needed for growth.

The cambium, of a ring of reproductive tissue around the stem produces callus tissue, which is composed of large, undifferentiated cells. Callus tissue differentiates to form Xylem and Phloem and a cambial layer.

The transport of organic food by the phloem vessels is explained.



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Activity Answers

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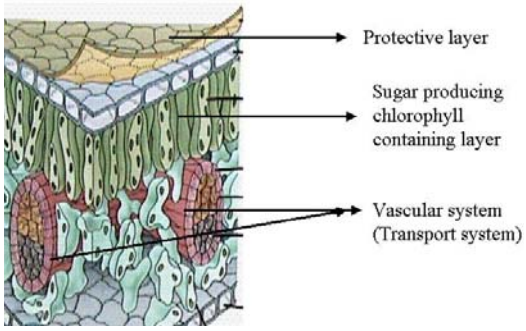
SO 4

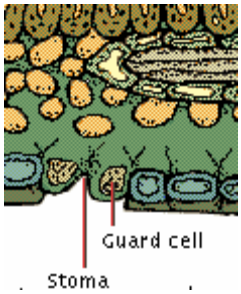
Instructions to learner:

Explore and discuss. Activity to be conducted in pairs.

Learner Guide: Page 28 **Facilitator Guide: Page 19**

Discuss the structure and anatomy of plant leaves using the illustrations provided as reference. Discuss the structure in relation to the physiological processes of transpiration, photosynthesis and respiration.





Model Answer(s):

Leaves have two main characteristics: firstly, leaves are thin and flat and secondly: leaves are green. The primary function of a leaf is to trap sunlight energy and turn it into energy (chemical energy) that the plant can use. If one were to cut a cross section though a leaf blade and look at it under a microscope, one observes that there are distinct layers, as illustrated above.

The outer layer is a protective layer followed by a layer of cells that produce sugars by trapping sunlight. Below these layers are the leaf veins or vascular system that transports water, minerals and sugar to and from the energy producing cells.

Because the leaf surface is flat and the blade is thin, the process of capturing sunlight is optimised, thereby optimising the photosynthesis process. The leaf is green because it contains a pigment called chlorophyll. Chlorophyll is essential in leaves as this is the pigment responsible for capturing the light energy that is later converted into chemical energy.

Leaf surfaces (especially lower surfaces) are covered in tiny openings, known as stomata. The stomata allow the exchange of gases (oxygen and carbon dioxide) and water vapour, required for transpiration.

Plant leaf hairs play important physiological and ecological roles in the plant leaf. Leaf hairs are involved in protecting the leaf from stress, including UV damage, drought tolerance and reduction of radiation, heat and tapping of toxins.

The process of trapping sunlight energy and turning it into chemical energy is known as photosynthesis. During the process of photosynthesis the light energy is captured via the chlorophyll (in the outer leaf layer), the cells then use carbon dioxide (atmospheric gas) and water (from soil) to produce carbohydrates or sugars and oxygen (atmospheric gas).

Activity Answers

10

SO 5

Instructions to learner:

Explore and discuss. Activity to be completed by groups of 2.

Learner Guide: Page 34 **Facilitator Guide: Page 20**

Develop a presentation in which you discuss the purpose of flowers, their structure, pollination and seed development and the link to fruit development.

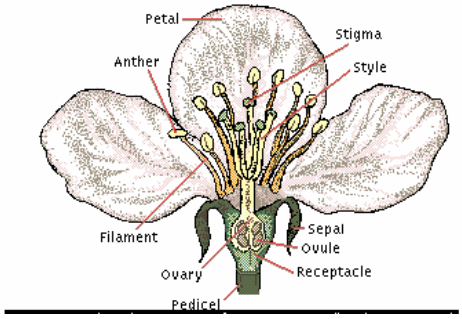
Model Answer(s):

The floral axis bears one to four types of specialised appendages, or modified leaves, usually arranged in whorls in the more advanced flowers and spirally arranged in the more primitive ones. In a typical flower the outermost whorl, the calyx, consists of a number of sepals that protect the flower bud before it blooms.

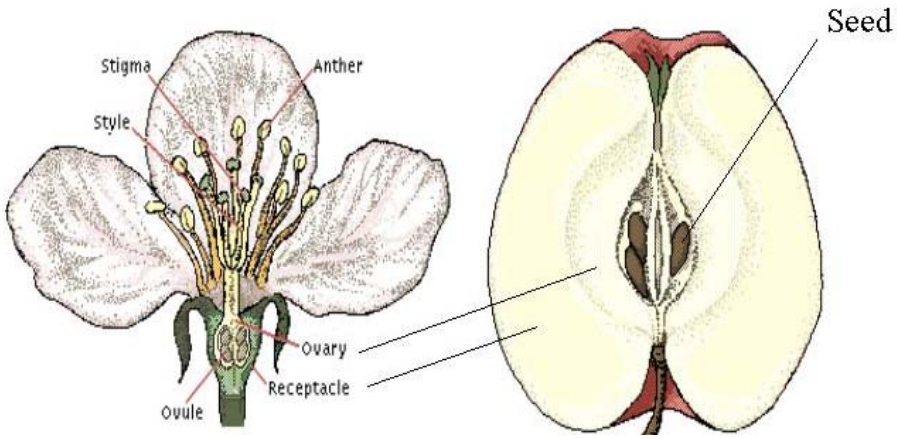
The next whorl on the floral receptacle, the corolla, is composed of a number of petals, often bearing nectar-producing glands that aid in attracting pollinators.

The third whorl, the androecium or male reproductive parts, consists of a number of stamens that produce pollen necessary for reproduction. Two whorls of stamens may be present.

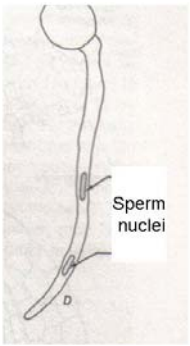
The next, or innermost, whorl of the flower, called the gynaecium, consists of several carpels, frequently fused to form a pistil. Each carpel contains at least one placenta to which is attached ovules or immature seeds. The calyx and corolla are collectively known as the perianth.



The mature ovary in a flower, together with all the other inseparable flower parts, develops to make up the fruit. Commonly the word "fruit" is often restricted to succulent, edible fruits of plants such as melons, tomatoes, apples etc... Fruit is normally produced after ovules are fertilised. The maturation of the ovary leads to the fruit developing. The ovules within fertilised ovaries develop into seeds. The major function of the fruit is to protect the developing seeds. In many plants, fruit may also play a role in the distribution of seed.



Typically, the fruit is simply the ripened ovary, as in the pea pod; but in apples it includes the ovary and receptacle (other fused floral parts); in strawberries it is an aggregation of small individual fruits, called achenes, as a fleshy receptacle; and in pineapples it is a development of an entire infructescence, or cluster of fruits.
The first step in plant fertilisation occurs when the stamen lands on the stigma in the flower. Once this has occurred and environmental conditions are favourable, the pollen will germinate. During the process, the pollen grows down the style (tube) towards the ovary. The pollen tube contains two sperm nuclei.



The germinating pollen tube enters the ovule through a small opening known as the micropyle. The one sperm nuclei contained in the pollen tube unites with the egg cell in the ovule and forms zygote. The zygote develops into the embryo.
In flowering plants the other sperm nucleus unites with two polar nuclei present in the embryo sac and forms an endosperm nucleus. This endosperm nucleus later produces the endosperm tissue around the embryo in the seed.
The tissue composing the main part of the ovule at this stage is later partly digested during the development of the embryo and endosperm tissue.
Surrounding the seed is a hard, tough seed coat; this develops from the outer layer of the ovule and becomes the testa. In flowering plants a second seed coat occurs below the testa; this second coat is a thin membrane and is known as the tegmen.
The micropyle through which the pollen tube entered the ovule tends to remain as a small opening in the seed coat. Close to the micropyle a stalk (funiculus), attaches the seed to the placenta on the inside of the fruit wall. When the seed is removed, a small scar, called the hilum, marks the former attachment of the stalk.

Summative Test and Attitude & Attribute Evaluation

Before the knowledge test is undertaken, the learner must be reminded of what is expected from him / her in terms of summative and reflexive competence. Read and explain to the learner, the **Preparation for Your Final Assessment** section in the learner workbook. Learners and assessor should sign off this section to acknowledge that this step was completed.

Please set up a knowledge test from the questions given as a guideline to learners and supply each learner with a test sheet.

Supply each report with the following heading:

Unit Standard:	116272	**NQF Level:**	3
Learner Name:			

Questions	Model Answers
1. What is a plant cell and what is its role in relation to plant growth?	♦ Plant cells are microscopic sized structures that contain various smaller organs known as organelles that enable growth processes to occur. ♦ Plants are made up of single cells that are organised in of complexes of cells called tissues that make up organs. The cells are not just aggregated in a group but are connected and coordinated. ♦ The tissues in plant organs are made up of microscopic units known as plant cells.
2. What are the two major metabolic processes that occur in plant cells?	♦ Photosynthesis and respiration
3. What are the main environmental factors that may influence germination?	♦ The primary favourable environmental conditions for germination include adequate water, and oxygen as well as suitable temperature.

4. What is a plant root and its main function?	♦ In general plant roots can be described as the plant structures that grow underground. The roots anchor the plant in soil and also absorb and transport water and mineral nutrients from the soil via the stems to reach the leaves where these are used.
5. What is the function of plant leaves?	♦ In general, a leaf is made up of a stalk (also called a petiole) through which it is attached to the stem and an expanded, flattened portion, called a blade (lamina). One of the most obvious characteristics about leaves is that they are thin and flat. The second most obvious characteristic is that leaves are green. Leaves have these two main characteristics because their primary function is to trap sunlight energy and divert it into a chemical energy that is used for the manufacturing of carbohydrates.
6. What is the function of flowers?	♦ Flowers are the sexual reproductive organs of plants from which seed and fruit develops.
7. What is the function of stems?	♦ Stems are divided into segments, which are called internodes. At the end of these internodes the area becomes **thicker**; called the nodes where the leaves attach to the stem. (One or more leaves may attach at each node.) At the point where the leaf attaches to the stem, the stem bears a lateral bud that is capable of developing into a new shoot. Stems have the function of carrying the leaves and flowers as well as to transport water and nutrients between roots and leaves. In addition, stems may also have a storage function.

Assessment Feedback Form

Comments / Remarks	
Feedback to learner on assessment and / or overall recommendations and action plan for competence:	
Feedback from learner to assessor:	
Assessment Judgement You have been found: ❍ Competent ❍ Not yet competent in this unit standard	Actions to follow: ❍ Assessor report to ETQA ❍ Learner results and attendance certification issued
Learner's Signature:	**Date:**
Assessor's Signature:	**Date:**
Moderator's Signature:	**Date:**