Course Name	National Certificate: Plant Production NQF 4 (144 Credits) SAQA ID: 49009
Module Name	Module 3: Establish the Crop Learner Guide
Module Code	20300
Unit Standards	116311, 116316, 119471, 119462,116279,116295
NQF Level	4

Module 3

Learner guide

Establish the Crop

Table of Content

Dear Learner

This Learner Guide contains all the information to acquire all the knowledge and skills leading to the unit standards:

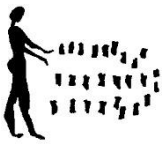
ID:	**Unit standard title:**
116295	Demonstrate a basic understanding of the physiological processes in plant growth and development
116311	Implement soil fertility and plant nutrition practices
116316	Propagate plants in a variety of situations
119471	Use language and communication in occupational learning programmes
119462	Engage in sustained oral communication and evaluate spoken texts
116279	Implement a permaculture site design

You will be assessed during the course of your study. This is called formative assessment. You will also be assessed on completion of this unit standard. This is called summative assessment. Before your assessment, your assessor will discuss the unit standard with you.

It is your responsibility to complete all the exercises in the Assessor Guide. The facilitator will explain the requirements of each exercise with you. You will also be expected to sign a learner contract in your assessor guide. This contract explains responsibility and accountability by both parties.
On the document "Alignment to NQF", you will find information on which qualification this unit standard is linked to if you would like to build towards more credits against this qualification.
Please contact our offices if you would like information with regards to career advising and mentoring services.

Office: 051-4511120
Enjoy the learning experience!

Key to Icons

Key to Icons	Important Information
	
	Quotes
	Personal Reflection
	Individual Formative Exercise
	Group Formative Exercise
	Summative Exercise
	Activity

CIN: 20300 **Version: 001**
Date: 2021/10/26

Alignment to NQF

Element of programme	
1. Name of programme	Establish the Crop
2. Purpose of the programme	Form part of the qualification to equip learners in Plant Production
3. Duration of the programme	5 days of facilitation; 260 notional hours
4. NQF level	4
5. NQF credits	26
6. Specific outcomes	See Unit Standard Guide
7. Assessment criteria	See Unit Standard Guide
8. Critical cross-field outcomes	See Unit Standard Guide
9. Learning assumed to be in place	See Unit Standard Guide
10. Essential embedded knowledge	See Unit Standard Guide
11. Range statement	See Unit Standard Guide
12. Recognition of Prior Learning (RPL)	RPL can be applied in two instances: ✓ Assessment of persons who wish to be accredited with the learning achievements ✓ Assessment of learners to establish their potential to enter onto the learning programme.

CIN: 20300 **Version: 001**
Date: 2021/10/26

13. Learning Materials	Learner Guide, Assessor Guide with Model Answers, Facilitator Guide, Learner PoE Workbook
14. Links of the programme to registered unit standards, skills programmes, or qualifications	Registered qualification: Title: National Certificate: Plant Production ID:49009 NQF: Level 4 Credits:144

Unit 1: Plant Physiology

Unit Standard	
116295	Demonstrate a basic understanding of the physiological processes in plant growth and development
Specific Outcomes	
SO1: Demonstrate an understanding of the processes involved in cell division with relation to growth and development of the plant. SO2: Describe the process of transpiration and its role in water uptake by a plant. SO3: Describe the process of respiration in relation to gaseous exchange in the plant. SO4: Demonstrate an understanding of the process of photosynthesis. SO5: Demonstrate an understanding of the maturity and ripening of fruit.	

CELL DIVISION AND PLANT GROWTH

Cell duplication

Cells duplicate through the process of Mitosis. Mitosis is the process by which a cell duplicates its genetic information (DNA) and in the process generates two, identical daughter cells. Duplication and division of the genetic material in the nucleus is normally followed by cytokinesis. Cytokinesis is the process through which the cytoplasm divides and a new cell wall formed between the two new daughter protoplasts. The result of the process is two identical daughter cells with more or less an equal distribution of organelles originating from the mother cell. The combined phases of mitosis and cytokinesis define the mitotic phase cell cycles. Somatic cells undergo mitosis, while the sexual reproductive cells are formed by a similar process known as meiosis.

Mitosis is a regulated and sequential process consisting of phases.

These main phases of mitosis are:

- Preprophase
- Prophase

- rometaphase
- Metaphase
- Anaphase
- Telophase

Preprophase

In plant cells prophase is preceded by a pre-prophase. The nucleus has to migrate into the center of the cell before mitosis can begin. A pre-prophase band is formed that is a ring like band of microtubules just below the plasma membrane that delimits the equatorial plane of the future mitotic spindle of the cell preparing to divide.

Prophase

In a non-dividing cell the genetic material in the nucleus is ordered in a loosely bundled coil called chromatin. When prophase is initiated the chromatin bundle becomes condensed and forms a highly ordered structure called a chromosome. At this stage the genetic material has already been duplicated and each chromosome has two sister chromatids which are bound together at the so-called centromere. The chromosomes can be seen when using a light microscope at high magnification.

Prometaphase

During prometaphase the nuclear envelope becomes disassembled, and microtubules invade the nuclear space. The chromosomes now form two kinetochores at the centromere, one attached at each chromatid. The kinetochore is a protein ring which forms a moving device. This motor activity, as well as polymerisation and depolymerisation of microtubules, provides the pulling force necessary to later separate the chromosome's two chromatids. The spindle grows to a sufficient length where the kinetochore microtubules begin searching for kinetochores to attach to.

Metaphase

At the same time, as the microtubules find and attach to kinetochores in prometaphase, the centromeres of the chromosomes arrange themselves along the equatorial plane.

Anaphase

When the kinetochores are all attached to microtubules and the chromosomes have lined up along the metaphase plate, the cell proceeds to anaphase. At this stage the proteins that bind sister chromatids together are cleaved, allowing separation. The sister chromatids are then

pulled apart by shortening of the kinetochore microtubules and toward the opposite sides of the cell. The end result of anaphase is the cell that has succeeded in separating identical copies of the genetic material into two distinct populations at opposite sides of the cell.

Telophase

Telophase is in effect a reversal of the events of prophase and prometaphase. The nonkinetochore microtubules lengthen, causing the elongation of the cell. Corresponding sister chromosomes attach at opposite ends of the cell. New nuclear envelopes are formed from fragments of the parent cell nuclear membrane. Both sets of chromosomes, now surrounded by new nuclei, unfold back into chromatin. Mitosis is complete, but cell division is not yet complete.

Cytokinesis

Cytokinesis begins at the same time as telophase. Cell division is driven by vesicles derived from the Golgi apparatus. The vesicles move along the microtubules to the middle of the cell. This structure forms a cell plate at the center of the nuclei and develops into a cell wall. Each of the daughter cells now has a complete copy of the genome of its parent cell as well as more or less equal parts of the cytoplasm. The importance of mitosis is that it ensures that the chromosomes or genetic information in the nuclei of the two resulting daughter cells will be alike.

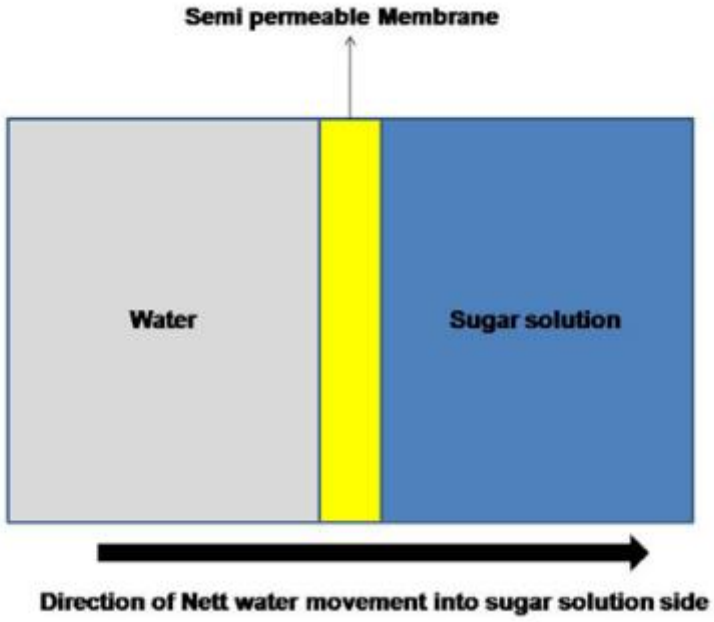
Individual Formative Exercise 1

TRANSPIRATION AND WATER MOVEMENT IN CROP PLANTS

Osmosis

Osmosis is the process through which water moves (diffusion) through a membrane from an area of higher concentration to an area of lower concentration through a partially permeable or selectively permeable membrane. A selectively permeable membrane is a membrane such as the cell membrane that will selectively allow molecules to pass through it. Such a membrane may for example allow water to pass but not proteins. The movement of compounds from a higher to a lower concentration can be compared by the moving down a concentration gradient by diffusion.

In order for osmosis to occur, two solutions must be separated by a membrane that will only let the solvent (water in the case of cells) pass through it. Another prerequisite is that the concentration of the water must be higher in one of the separated solutions. This can be achieved by having a sugar solution as one solution and plain water on the other side. In this way the water molecules will move into the sugar solution down a concentration gradient.



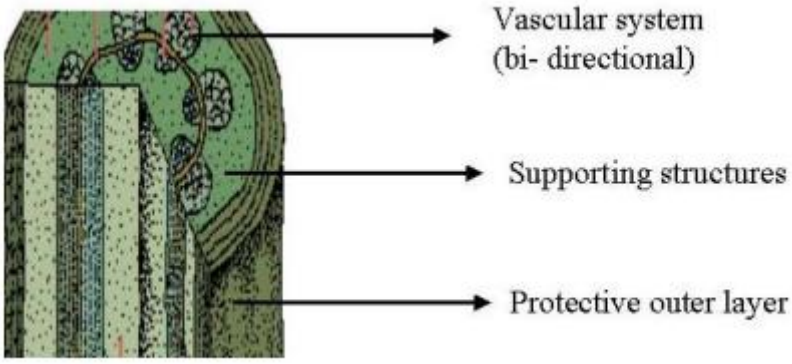
The water will continue to migrate through the membrane until the two solutions are in equilibrium, meaning that the relative concentrations at both sides of the membrane are the

same. In the example the membrane is permeable to only the water, thus only will the water move but the sugar will not migrate, remaining at one side of the membrane.

Selectively or partially permeable membranes are found mostly in living organisms: e.g. Cell membranes and the membrane lining of an egg shell. Osmosis is thus clearly a critical process in living beings. The process controls the constitution of cells and therefore of living tissues. It is important that as little water as possible moves in or out of cells because if too much water enters a cell, it could swell and burst and if too much water exits the cell, the protoplast will shrink and the plasmalemma (outer cell membrane) will pull away from the cell wall (plasmolysis).

Water transport in plants

Plant stems have two major functions. The first is to produce and carry the leaves and "hold' the leaves up to the sunlight and to produce and carry buds and flowers. The second is to hold the vascular system through which sugars and water is transported.



Simplified, a cross and longitudinal section of the stem reveals that a stem is made up of an outer protective tissue layer, ground (filling) tissue and the vascular system.

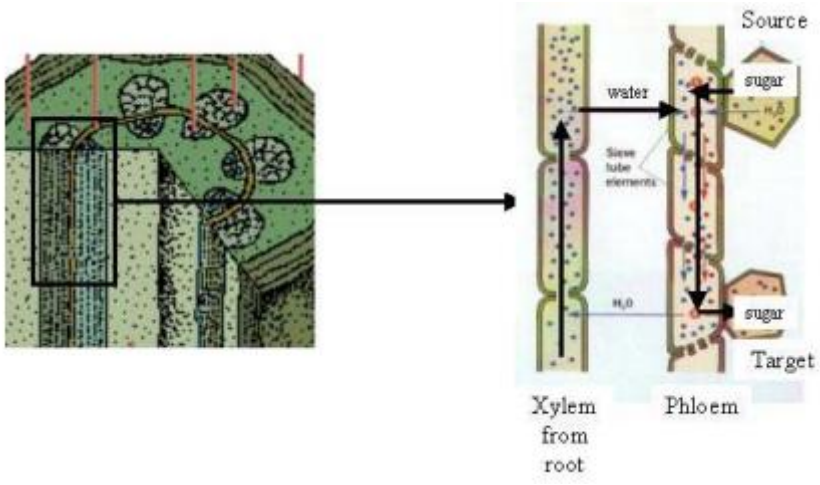
The vascular system consists of two tissue systems ; the phloem through which SUGARS are transported from the leaves (source) to where they are stored or used (sink or target) and the xylem transporingwater and mineral nutrients

Primary tissues deriving from the growing point (apical meristem) of the stem

- The epidermis (Protective tissue). Epidermis in young stems or periderm in older stems

CIN: 20300 **Version: 001**
Date: 2021/10/26

- The ground tissue. (Cotex and pith) Live parenchyma cells, and collenchyma
- Transport system:
- Primary Xylem – consists of strengthening tissue (dead xylem fibres), transporting tissue (dead xylem vessels) and live cells (xylem parenchyma)
- Primary Phloem system – consists of transporting tissue (live sieve elements). Live phloem parenchyma and sometimes strengthening tissue (dead phloem fibres)



Secondary tissues deriving from the vascular cambium and cork cambium

Vascular cambium (only found in Dicots – no secondary thickening growth in most Monocots)

Cylinder of embryonic (dividing) cells producing secondary xylem towards the inside and secondary phloem towards the outside of the stem or root:

- Secondary xylem (secondary xylem vessels, secondary xylem fibres and secondary xylem parenchyma in xylem rays and axial xp
- Secondary phloem (secondary phloem sieve elements or sieve tubes, companion cells, secondary phloem fibres, secondary phloem parenchyma

Cork cambium (phellogen) producing:

- Dead cork tissue (phellem) towards the outside
- Live parenchyma cells (phelloderm) towards the inside
- (Phellem + phellogen + felloderm collectively known as perderm, a very important protective tissue)
- Periderm + secondary phloem commonly known as the bark of a tree, easily breaks off from the wood (secondary xylem) at the vascular cambium when debarking trees

The role of stomata in gas exchange in plant tissues

Stomata are found in the epidermis of leaves, young stems and fruit. Stomata allow gas exchange into and out of the leaf. Water vapour moves out of the leaf and carbon dioxide is

allowed in for photosynthesis. If the stomata are closed, transpiration is reduced and photosynthesis is limited. The plant thus has to constantly balance these two processes ensuring metabolism is optimised.

In most plants the stomata are primarily or solely found on the underside of a leaf's surface but may also b present in young stems and fruit. At times of extreme heat (such as at midday) they will close thereby reducing water loss.

Transpiration and water flow in plants

Transpiration is a biological process in which water evaporates from a plant. The exchange of water vapour from leaves through the stomata is the primary driving force of the process. Transpiration is critical to the metabolic processes in the plant and thus the survival of the plant.

Water flow

All living organisms need water to survive. Plants need water to maintain the internal pressure or turgidity in cells and tissues. Water is also needed to transport dissolved minerals and elements materials from the soil that may be required for metabolic process to continue.

Water, containing dissolved minerals enters the plants roots via root hairs, and is transported via the xylem vessels up the stem to the leaves and actively growing and metabolising part of the plant.

In order to maintain a flow though the xylem system, water evaporates from the leaves via the stomata into the surrounding atmosphere. As the water evaporates from the leaf surface, more water enters the roots to replace the evaporated water. This causes a sucking system allowing water to be drawn from the roots-to-leaves in a continuous stream through the plant. This capillary suction action is known as the transpiration stream or transpiration tension and is similar to the suction effect found in a wick. Much of this water will not enter cells, but will pass by the cells and exit the plant directly.

Wilting

Wilting is the loss of rigidity or turgidity of non-woody plant parts. Plant cells and tissues lose turgidity when the turgor pressure in the cells decreases towards zero. The pressure is

reduced when the volume of water in the cell decreases below the ideal. Permanent wilting leads to plant death.

Decreased cell water content occurs due to:

- Drought, where soil moisture decreases below that which plants can maintain water uptake
- High salinity, which causes water to diffuse out of plant cells
- Saturated soil conditions, where roots are unable to obtain sufficient oxygen or infections that may clog the vascular systems.

Control of transpiration

Because water is not always abundant, most plants must control transpiration in order to prevent excess water loss. The surface of plant leaves are covered in a waxy, semi-waterproof coating called the cuticle. This layer ensures a minimal loss of water (evaporation) though the cuticle of epidermal cells. The stomatal pore is flanked by two specialised bean-shaped guard cells. The guard cells' inner walls are thicker and firmer than their outer walls. When a plant begins to wilt through excess transpiration, the guard cells become flaccid due to the lack of water, straightens and so doing, closes the pore.

When thousands of stomata shut on a leaf, the rate of transpiration is drastically reduced. The plant though, continues to absorb water via the roots, replenishes the plant cells to a point where they swell and become turgid. As the guard cells swell, the thin, outer wall stretches and become curved, resulting in the widening of the stomatal pore between them. More water vapour passes through the open stomata and transpiration increases until the plant begins to wilt again. This self-adjusting system regulates the plant's water loss by means of transpiration. The concentration of the plant hormone, abscisic acid, also increases when the leaves of a plant wilt as it causes the guard cells to close the stomata.

Individual Formative Exercise 2A
Individual Formative Exercise 2B
Individual Formative Exercise 2C
Individual Formative Exercise 2D

CIN: 20300 **Version: 001**
Date: 2021/10/26

PLANT RESPIRATION, GAS EXCHANGE ANF FRUIT RIPENING

Respiration

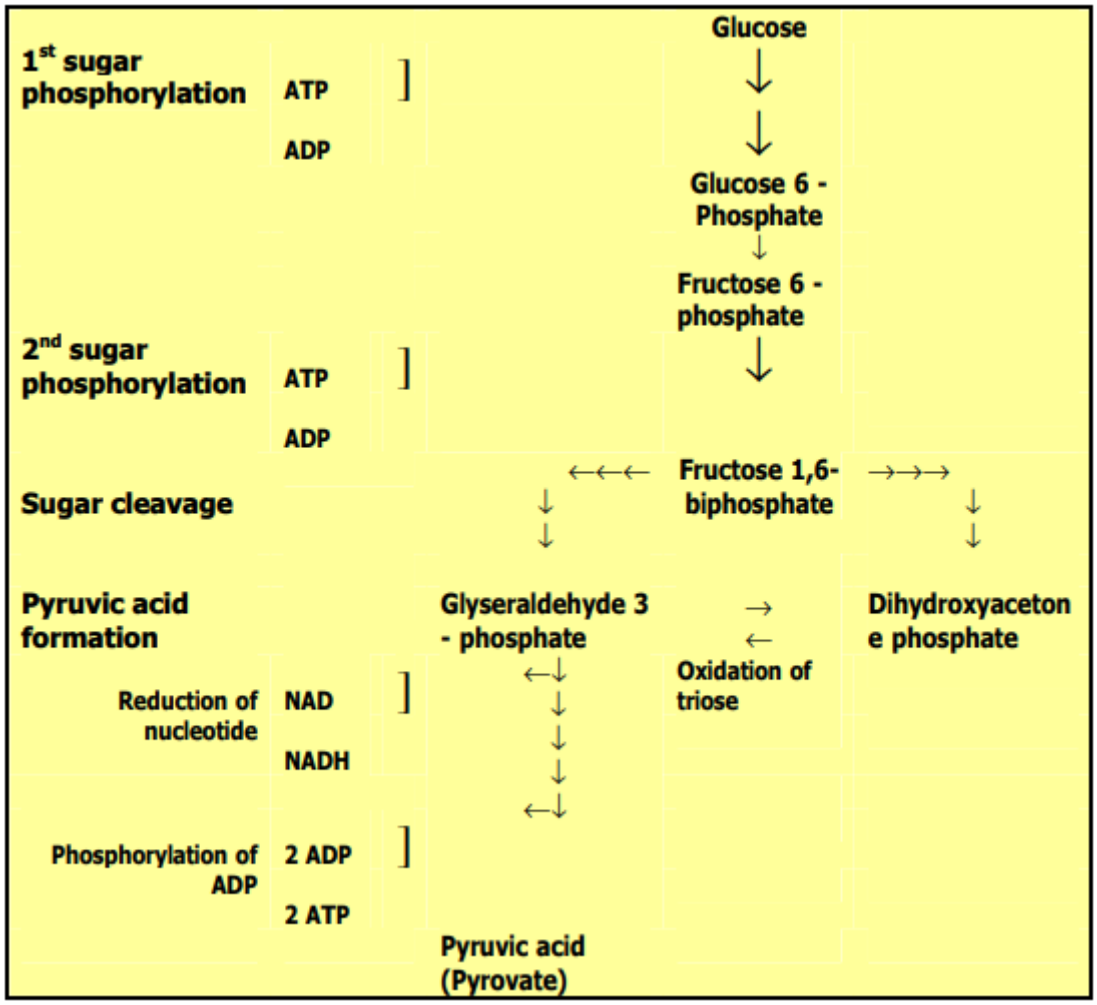
The main energy source of plants for growth is carbohydrates which are formed during photosynthesis (see later). During the respiration the energy trapped in the carbohydrates is released in a usable form for the plant. The process of respiration takes place in the plant cell organelles called Mitochondria.

Mitochondria are sub-cellular compartments that contain enzymes and membrane systems that are required to control the biochemical processes which are involved in converting of sugars (trapped energy) to Adenosine tri phosphate (ATP) (usable energy) during respiration. ATP is the universal energy-carrying molecule in all living organisms (bacteria, fungi, plants, animals). Every plant cell contains hundreds of mitochondria, the equivalent of small power generators feeding into a grid, providing energy for the cell. The sugars that are produced in the leaves during photosynthesis are transported to other organs such as growing shoot tips, roots or fruits. The sugar is supplied to every cell in the plant otherwise these cells will die. The sugars are essential because they are consumed during respiration releasing energy. During a series of biochemical reactions in the mitochondria sugar is combined with oxygen, releasing carbon dioxide, water, and energy. The energy, which is released, is captured in the molecule called ATP. ATP is then in turn used to "drive" a number of other cellular processes aimed at maintenance (e.g., repair), functions (e.g., nutrient uptake and transport) and growth of plant tissues. From the sugar produced during photosynthesis, approximately half is consumed during respiration. The amount of carbohydrates used per day dependents on environmental conditions. Throughout the respiration process, enzymes which are protein catalysts are involved with the reactions.

The respiration process can be summarised as:
Sugar ($C_6H_{12}O_6$) + oxygen ($6O_2$) renders ($\rightarrow$) carbon dioxide ($6CO_2$) +water ($6H_20$) + energy

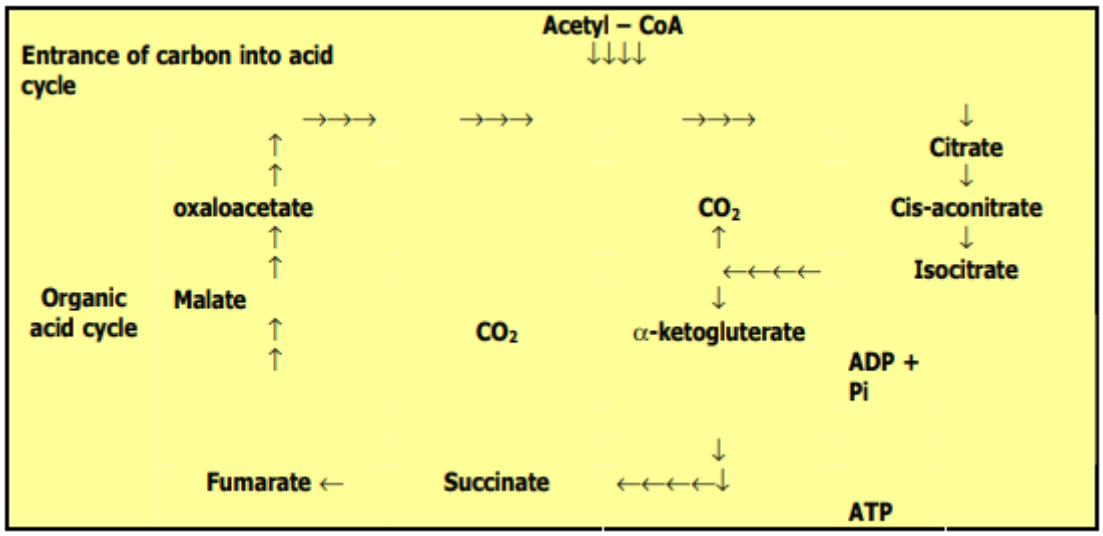
Respiration can be separated into distinct phases. During the first step the sugar glucose (6 carbon carbohydrate) is oxidised (where oxygen is added) to form two molecules of pyruvic

acid (3 carbon organic acids). This process is known as **Glycolysis** ('Glyco' refers to sugar and 'lysis' meaning splitting) and is set out schematically below.

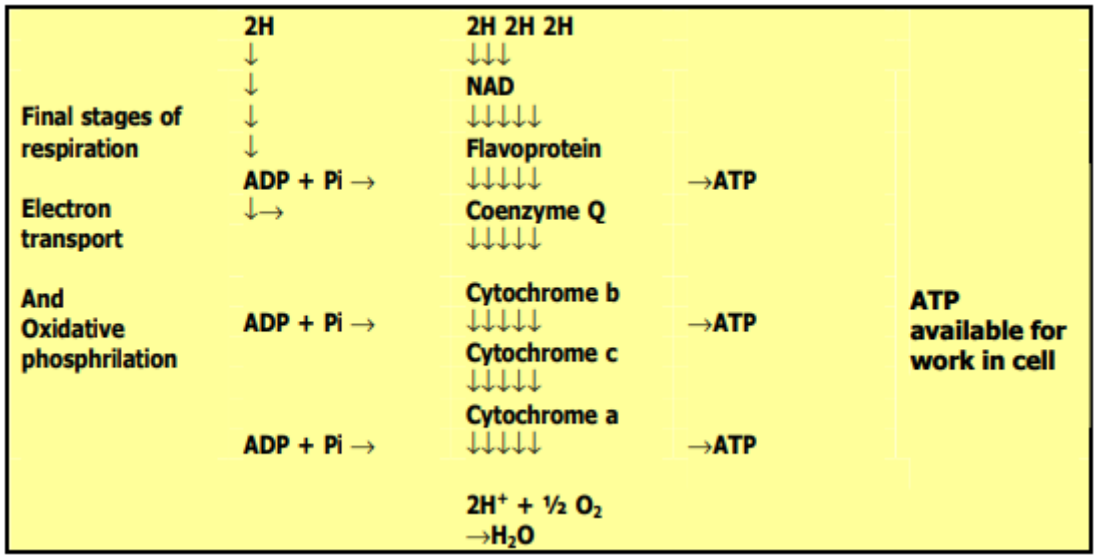


During the first phase no oxygen was involved and is therefore called the anaerobic phase that takes place in the ground substance of the cytoplasm and not in the mitochondria. During the second, **aerobic** phase of respiration taking place inside the mitochondria, the newly formed pyruvic acid is converted into 2 acetaldehyde molecules. These then enter the organic acid cycle of respiration.

One step missing? Pyrovate Acetyl-CoA



Eight hydrogen (H) atoms are liberated; two to from malate conversion to oxaloacetate; two to from succinate conversion to fumarate; two to from ketogluterate conversion to Succinate and two to from isocitrate conversion to ketogluterate



FRUIT GROWTH AND DEVELOPMENT

MATURITY

It is the stage of fully development of tissue of fruit and vegetables only after which it will ripen normally. During the process of maturation, the fruit receives a regular supply of food material from the plant. When mature, the abscission or corky layer which forms at the stern end stops this inflow. Afterwards, the fruit depend on its own reserves, carbohydrates are dehydrated, and sugars accumulate until the sugar acid ratio form. In addition to this, typical flavour and characteristic colour also develop. it has been determined that the stage of maturity at the time of picking influence the storage life and quality of fruit, when picked immature like mango develop white patches or air pockets during ripening and lacking in normal brix acid ratio or sugar acid ratio, taste and flavour on the other hand if the fruits are harvested over mature or full ripe they are easy susceptible to microbial and physiological spoilage and their storage life is considerably reduce. Such fruits persist numerous problems during handling, storage and transportation. Therefore, it is necessary or essential to pick up the fruits or vegetables at correct stage of maturity to facilitate proper ripening, distant transportation and maximum storage life.

Seeds develop inside the ovary wall where various hormones are induced in the fruit for specific growth metabolic processes.

First cytokinins are produced. Cytokinins are released from the seed to stimulate cell division in the ovary wall. This leads to the thickening of the wall of the fruit.

The next hormone produced is gibberellic acid. This hormone is released to the ovary wall where it induces rapid expansion of individual cells. This combination of increased number of cells and the expansion of cells leads to drastic increases in the size of the ovary.

At the same time the mother plant produces the hormone abscisic acid. Abscisic acid causes the embryo inside the developing seeds to become dormant, ensuring that the seed does not sprout whilst inside the warm, moist fruit.

Where seedless fruit types have been developed, a solution of gibberellic acid can be applied to the fruit to ensure that full-sized fruit develops. The number of applications required and

the stage of treatment may differ between cops. Important to note is that without these treatments the fruits will not reach the market sizes required.

Fruit ripening

An unripe fruit is generally hard, green, sour, lacks scent; its starch content is high and therefore has no taste. Fruit will ripen once a "ripening signal" has been received. This signal is a rapid increase or burst in ethylene production which leads to metabolic changes, causing the fruit to ripen. Ethylene is a simple gas CH2 that is produced within the fruit. The gas is discarded into the atmosphere. Often ethylene production is initiated when a fruit is injured e.g. during picking process. As a result of the ethylene burst, enzymes are produced that are essential in the ripening process.

These enzymes may include hydrolases that aid in breaking down specific chemicals in the fruits, amylases that are required to hydrolyse starch into sugar and pectinases that catalyze the degradation of pectin (the substance that glues cells together). The combined action of these enzymes alters the composition characteristics of the fruit.

Responses that occur may include:

- Chlorophyll is broken down
- New pigments are formed that colour the fruit
- Acids are degraded, thus changing the fruit from sour to neutral.
- Starch is degraded to sugar.
- Pectin is degraded, thus separating the cells resulting in a softer fruit.
- Often the degradation of organic compounds occurs, leading to volatile compounds being formed which escape the fruit, leaving an aroma.

As a producer, one can manipulate fruit ripening because of the way the ripening process is initiated. This is extremely important in the case of bananas as they ripen very unevenly and over an extremely long time on the mother plant. In addition, ripe bananas have an extremely short shelf live. Because of this, they are picked and shipped green. Once the consignment arrives at the destination, the crop is treated with ethylene in specialised warehouses. This causes even coordinated ripening, where all bunches will ripen at the same time, making it easier to market the produce.

Citrus, for export purposes, is harvested when still green.

Changes during Fruit Ripening

1. Cell Wall Changes

Cell wall consists of pectic substances and cellulose as the main components alongwith small amounts of hemicellulose and non-cellulosic polysaccharides. In cell wall, the changes particularly in the middle lamella which is rich in pectic polysaccharides are degraded and solubilised during ripening. During this softening, there is a loss of neutral sugars (galactose and arabinose-major components of neutral protein) and acidic pectin (rhamnogalacturonan) of all cell wall. The major enzymes implicated in the softening of fruits are pectine1asterase, polygalacturonase cellulase and β- galactosidase.

2. Starch

During fruit ripening sugar levels within fruit tend to increase due to either increased sugar importation from the plant or to the mobilization of starch reserves within the fruit, depending on the fruit type and whether it is ripened on or off the plant. With the advancement of maturity, the accumulated starch is hydrolysed into sugars (glucose, fructose or sugars) which are known as a characteristic event for fruit ripening. Further breakdown of sucrose into glucose and fructose is probably mediated by the action of invertase. In vegetables like potato and peas on the other hand, the higher sucrose content which remains high at fresh immature stage, converts into starch with the approach of maturity.

3. Organic Acids

With the onset of fruit ripening there is downward trend in the levels of organic acids. The decline in the content of organic acids during fruit ripening might be the result of an increase in membrane permeability which allows acids to be stored in the respiring cells, formation of salts of malic acid, reduction in the amounts of acid translocated from the leaves, reduced ability of fruits to synthesize organic acids with fruit maturity, translocation into sugars and dilution effect due to the increase in the volume of fruit.

4. Colour

With the approach of maturation, themost obvious change which take place is the degradation of chlorophyll and is accompanied by the synthesis of other pigments usually either anthocyanins or carotenoids. They can give rise to a wide range of colours (from red to blue). The chloroplasts in green immature fruit generally lose chlorophyll on ripening and change into chromoplasts which contain carotenoid pigments. Carotenoids are normally synthesized in

CIN: 20300 **Version: 001**
Date: 2021/10/26

green plant tissue a major product being 3-carotene. However, in many fruits additional -carotene and lycopene is synthesized during ripening.

5. Flavouring Compounds

Although fruit flavour depends on the complex interaction of sugars, organic acids, phenolics and volatile compounds but the characteristic flavour of an individual fruit or vegetable is derived from the production of specific flavouring volatile. These compounds are mainly esters, alcohols, aldehydes, acids and ketones. At least 230 and 330 different compounds in apple and orange fruits have been indicated respectively.

6. Ascorbic Acid

L-ascorbic acid (Vitamin C) is the naturally occurring ascorbic acid in fruits. A reduced amount of ascorbic acid is noticed in pome, stone and berry fruits at the time of har vest. An increase in ascorbic acid content with the increase in fruit growth has been and the levels declined with the advancement of maturity and onset of fruit ripening in pear, sweet potatoes, potato, asparagus and okra during the course ofpost-harvest handling.

7. Phenolics

The phenolic content of most fruits declines from high levels during early growth to low levels when the fruit is considered to be physiologically mature and thereafter susceptible to the induction of ripening.

8. Amino Acids and Proteins

Decrease in free amino acid which often reflects an increase in protein synthesis. During senescence the level of free amino acids increases reflecting breakdown enzymes and decreased metabolic activity.

9. Ethylene Production and Respiration

Physiological events responsible to ripening process are as follows:

(1)Ethylene production

(2) Rise in respiration

Ethylene production

In climacteric fruits such as mango, banana, ethylene production increase and causes:

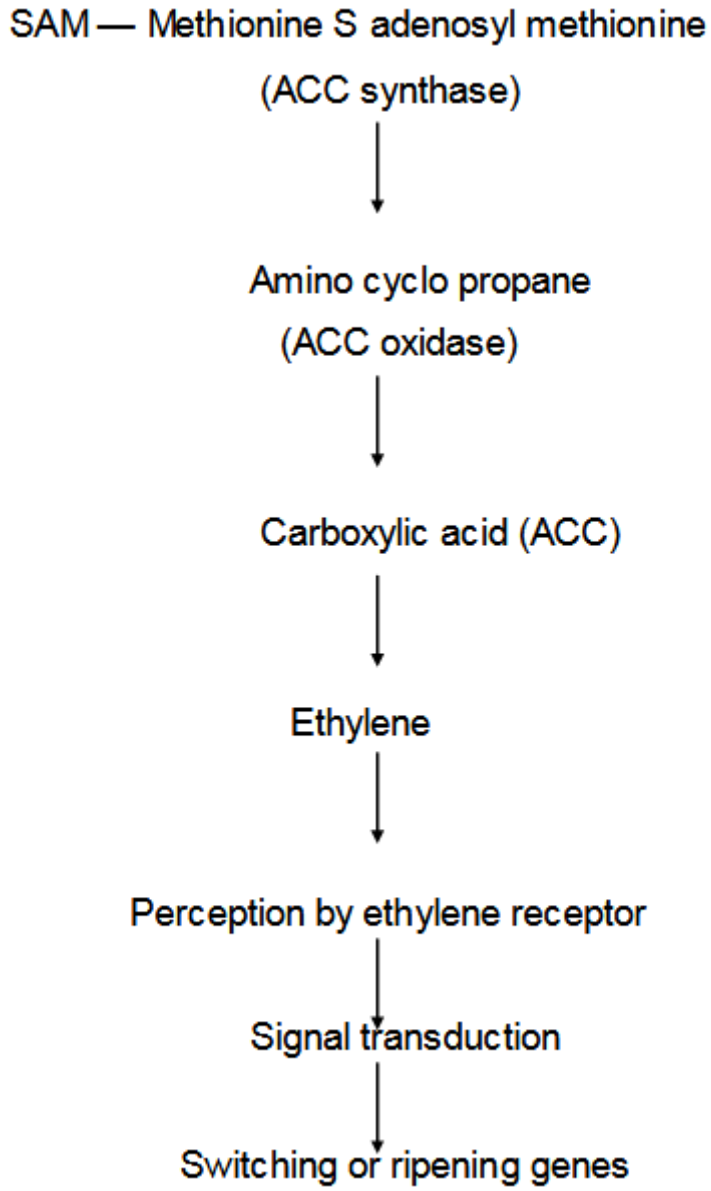
• Rise in respiration

• Rise in temperature

• Rise in activity of hydrolytic enzymes.

Ethylene is produced from an essential amino acid — methionine.

Following the steps as below:



Rise in respiration

Respiration is required for releasing energy and the substrate for synthesis of several organic compounds required in the ripening process. During ripening in climacteric fruits, there is rise in respiration called climacteric. The clirnacteric peak is obtained very fast when temperature is relatively high. Respiration is a most deteriorating process of the harvested fruits and

vegetables which leads to the oxidative breakdown of the complex materials (carbohydrates or acids) of cell into simpler molecules ($CO_2$and water) with the concurrent production of energy required by the cell for the completion of chemical reactions. In brief, the process of respiration can be summed up with the following reaction:

$C_6H_{12}O_6 + 6O_2 \rightarrow CO_2 + 6 H_2O$ + energy

USE OF CHEMICALS FOR INCREASING SHELF LIFE OF FRUITS AND VEGETABLES

(A) Ethylene absorbent

Ethylene is responsible for decreasing shelf life. Putting $KMnO_4$ @ 100 ppm soaked filter paper can minimized ripening and increase shelf life. In Banana this method is very useful.

(B) Antifungal Agents

- SOPP: Sodium orthophenylphenate
- Diphenyl wraps protection against moulds, stem-end rot.
- Dibromoletrachloroethane and esters give better flavour.

(C) Use of Inhibitors

Treatment	Crop	Chemical	Concentration
Post-harvest	Mango	MH	1000-2000 ppm
After fruit formation	Apple	2-Dimethyl-hydrazide	10,000 ppm

(D) Use of Auxins

Also helpful to advance in ripening and may increase shelf life.

Chemical	Concentration	Crop	Stage
2,4-D	5 ppm	Grape	Pre-harvest
2,4,5-T	25 ppm	Fig	Pre-harvest
2,4,5-T	100 ppm	Mango	After harvesting

E) Vegetables can be preserved by lactic acid and may increase the shelf life.

F) Postharvest dipping of papaya fruits either in 100 ppm GA_3or $CaCl_2$al 2% extended shelf life up to 9 days without any decline in quality.

Climacteric and non-climacteric fruit

Climacteric fruit can be picked from the tree at maturity, but before they are fully ripe and can continue the ripening process later. In general, there will be an increase in quality during the picking-to-ripening stage. Ripening is controlled by the fruit producing their own ethylene together with a significant increase in CO2 production.

Non climacteric fruit on the other hand, will maintain the quality they had at harvest without much beneficial change as this fruit produce little or no ethylene with only small changes in CO2 production. Non-climacteric fruit therefore can only be harvested when fully ripe.

Table 1. List of climacteric and non-climacteric fruits

Climacteric fruit	Non-climacteric fruit
Apple	Carambola
Apricot	Cherries
Avocado	Citrus
Banana	Grape
Ber	Litchi
Cherimoya	Loquat
Fig	Olive
Guava	Pineapple
Kiwifruit	Pomegranate
Mango	Strawberry
Melons	
Pear	
Peach	
Plum	
Persimmon	
Papaya	
Tomato	
Sapota	
Passion fruit	

Group Formative Exercise 3A
Group Formative Exercise 3B
Group Formative Exercise 3C

PHOTOSYNTHESIS

Photosynthesis The primary source of energy for all living organisms on earth is the sun, 150 million kilometres from earth. Energy is generated form light and heat. Heat energy cannot be captured directly by either plants or animals, but light energy is captured by green plants. It is this captured energy that is used by animals via plants, to meet all their needs. To obtain this energy, an animal requires food from plants, which can be broken down in the animal's body to provide the necessary energy for the animal's life processes. Only plants can however capture light energy directly and they do this through the process of photosynthesis.

Photosynthesis is the process through which plants trap light energy and converts it into chemical energy which is then released by means of respiration. Life on earth, as we know, cannot exist without the process of photosynthesis.

During photosynthesis plants convert light energy into stored energy. Plants thus have the ability to manufacture their own food. Photosynthesis is possible because plants have an energy-capturing green pigment substance called chlorophyll, which also gives plants their green colour. Photosynthesis also occurs in seaweed and other algae, mosses and not only in vascular plants.

A plant's chlorophyll captures the light energy and uses it to manufacture carbohydrates from the raw materials water (hydrogen and oxygen), carbon dioxide (carbon and oxygen). These raw materials are sourced through the plant's roots and leaves. Water, containing minerals, enters the plants through the roots and is channelled up the stem and into the veins of the leaves in the vascular system, and the carbon dioxide enters the leave trough the stomata.

CIN: 20300 **Version: 001**
Date: 2021/10/26

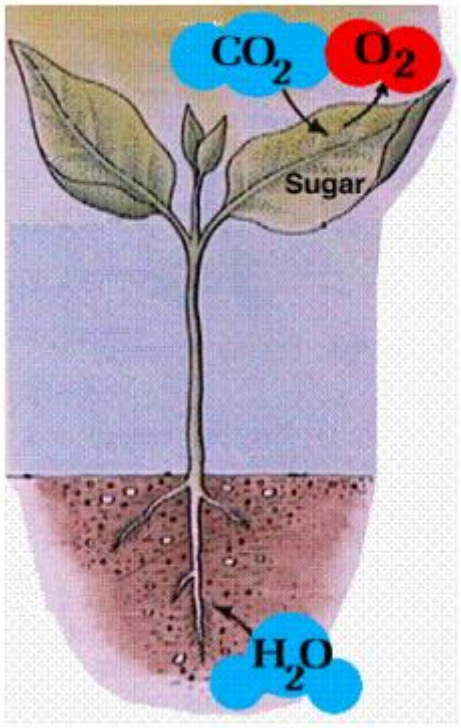


Figure 4.1: Diagram indicating the transport of water through the plant.

Photosynthesis has as its final product carbohydrates. Carbohydrates are compounds composed of carbon, hydrogen and oxygen atoms such as sugar, glucose and fructose (simple carbohydrates). Starch and cellulose are also carbohydrates, but these are complex carbohydrates. A simple carbohydrate is made up of a few carbon, hydrogen and oxygen atoms while complex carbohydrates are made up of many of each of the three basic atoms. Glucose for example consists 6 atoms of carbon, 12 atoms of hydrogen and 6 atoms of oxygen. The formula for glucose is usually written as C6H12O6. The plant uses glucose for the production of more complex carbohydrates.

The photosynthetic process can be summarised as:
Carbon Dioxide + Water + Chlorophyll and Sunlight = Oxygen + Sugar

The sugar produced is mixed with water and sent to other parts of the plant where it is used by the plant as food. The oxygen is released into the air through the stomata. The figure below shows the basic structure of a plant leaf.

CIN: 20300 **Version: 001**
Date: 2021/10/26

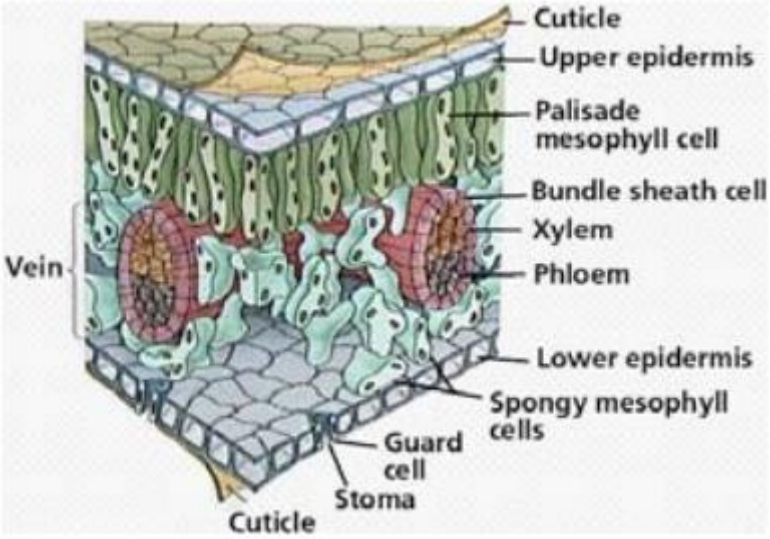


Figure 4.2: A diagram of a cross section of a plant leaf showing its basic structure.

Photosynthesis takes place in the leaf cells containing tiny lens shaped structures called chloroplasts. Each chloroplast consists of green chlorophyll containing grana within the stroma (Figure 4.3).

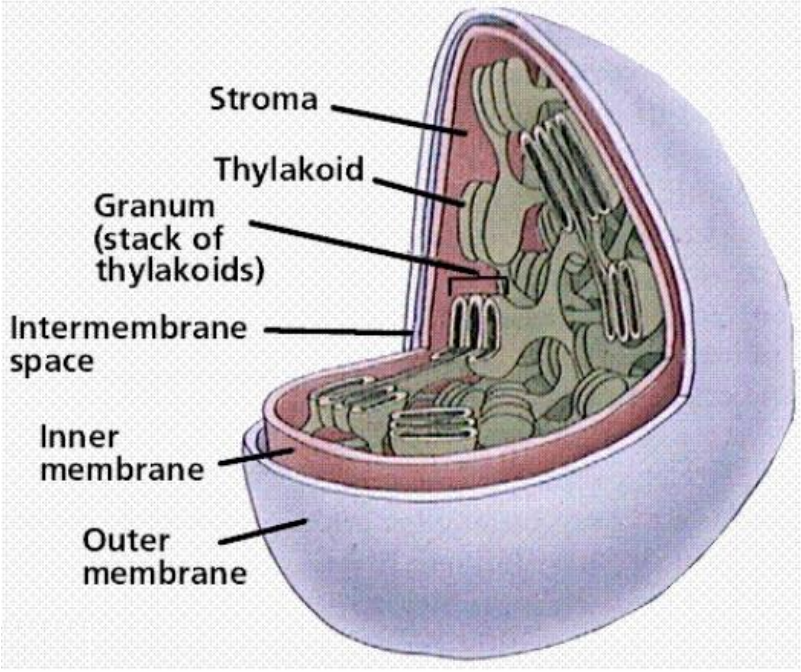
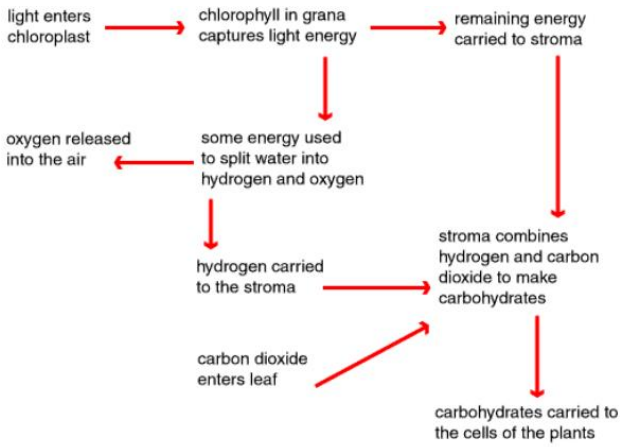


Figure 4.3: A diagram of the basic structure of the chloroplast. The steps as they follow on one another in the photosynthetic path are summarised in the diagram below.

CIN: 20300 **Version: 001**
Date: 2021/10/26



1. Light energy passes into the leaf and reaching the chloroplast inside an individual cell.
2. The chlorophyll inside the grana captures the light energy.
3. Inside the grana some of the energy is used to split water into hydrogen and oxygen,the oxygen is released into the air.
4. The hydrogen is transported to the stroma along with the grana's remaining light energy.
5. Carbon dioxide enters the leaf and passes into the chloroplast.
6. In the stroma the remaining light energy is used to combine hydrogen and carbon dioxide to produce carbohydrates.
7. The energy rich carbohydrates are carried to other plant cells and used by the cells to drive the plant's life processes.

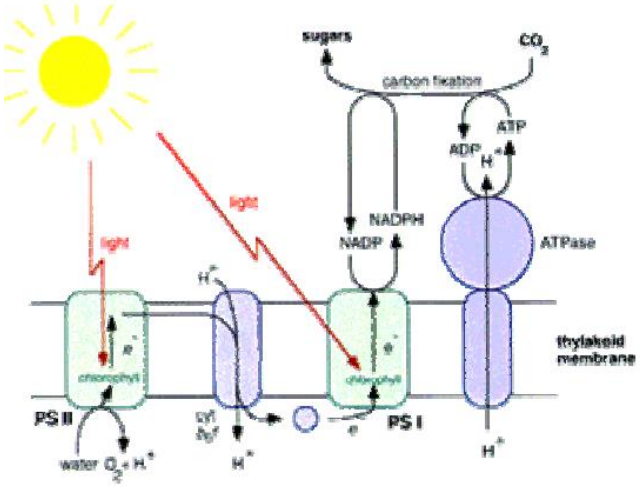


Figure 4.4: A diagram showing the light capturing process within the chloroplasts.

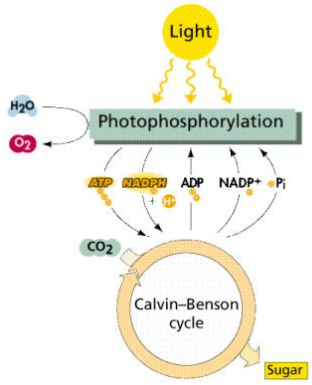
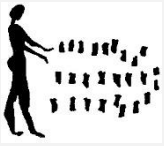


Figure 4.5: A diagram of the photosynthetic splitting of water, carbon dioxide and the fixation and production of sugars. Why is respiration explained in more depth than photosynthesis?

Individual Formative Exercise 4:



Individual Summative 1

Unit 2: Soil Fertility and plant nutrition

Unit Standard	
116311	Implement soil fertility and plant nutrition practices
Specific Outcomes	
SO1: Interpret recommendations and set up a nutritional programme based on recommendations. SO2: Implement soil utilization plan for specified crops. SO3: Identify and interpret symptoms of nutritional deficiencies and make full recommendations. SO4: Manage soil improvement according to soil properties.	

SET UP A NUTRITIONAL PROGRAM

Introduction In the following sections, two nutrient programs are provided as examples. The examples provided are for citrus, representing tree crops and sunflower representing field crops. The programmes provided may be relevant to other, similar crops as the basic principles are the same. However, the values provided in the examples are not definite as these may vary between crops as well as between different farms growing the same crop. This is because soil, climate, crop, cultivars etc. vary. It is for this reason that all good fertilizer programmes are based on recommendations from soil and / or leaf samples for the crop and site.

1.2 Nutritional program for Tree Crops -

Citrus Citrus production, as is the case of all other crops, has a specific schedule for the application of nutrients. Certain nutrients require application at critical times, while others may be applied over a longer and less specific period.

When the fertilizer applications schedule is planned all production practices must be considered. This is especially true for foliar sprays, where the application of crop protection products must be considered. Fertilizer application must be coordinated with other production practices to ensure that the right fertilizer is applied at the right time.

Various institutions will develop fertilization programs for a crop. These may vary from basic, general programs to highly specific programs. General programs may be of little value in a commercial citrus production unit. The ideal programs are formulated for a specific orchard, based on specific data from that orchard. Such specific programs are developed based on leaf and soil analyses data for the current year, as well as historic data. The leaf and soil analytical data is usually supported by information on the previous fertilizer applications (what, how much and when) and information on the previous as well as current crop information such as yields and fruit quality.

All these factors are evaluated in conjunction in order to formulate the best fertilization program. The best fertilization program is one that will result in the best possible fruit volumes and quality, and therefore give the highest economic benefit, without sacrificing sustainability.

A good fertilization program will contain the following information for each orchard:

- Orchard number or reference
- Cultivar and variety
- Details for soil applications:
    - Quantity in grams (g) to be applied per tree
    - Name of fertiliser
    - Time of application
        - Details for foliar applications:
            - Quantity in grams (g) or millilitre (ml) to be mixed per 100l water
            - Name of fertilizer
            - Time of application
        - Additional information or special instructions

Fertilization Program - Citrus			
Orchard:	Orchard 10	**Size:**	3.0ha
Cultivar/Variety:	Delta Valencias	**Trees per ha:**	316
Fertiliser		***Quantity***	***Time of Application***
Soil Applications		**g per tree**	
Limestone Ammonium Nitrate (LAN)		500g	July
LAN		250g	August
LAN		250g	September
Potassium **Chloride** (KCL)		500g	September
Dolomitic Lime		4000g	October
Foliar Sprays		**g per 100l water**	
Low Biuret Urea		1000g	July
Manganese Sulphate		200g	October
Solubor®		150g	October

Remarks: 1. Manganese and Solubor® are compatible. Spread the lime over the entire area allocated per tree.

Once a programme has been provided, the orchard manager need to develop a schedule for the Implementation of the programme provided. The schedule is developed for soil applications as well as foliar sprays so-as to slot into the rest of the production programme. The programme may require adaptation to suit younger trees.

Scheduling a Soil Application Program

The best practice for citrus is to schedule soil applications on a monthly basis. Most fertiliser programmes provide the fertiliser mass or volume per month. The fertilisation programs will recommend rates per tree or per ha.

In order to develop a soil program for the farm as a whole, the applications of all the orchards are summed and presented in one working document or schedule per month. Additional information is added, such as the size of each orchard and the number of trees per hectare. Using the fertilization program in the example above as a starting point, the following **Soil**

Application Schedule can be developed:

Soil Application Program Age of trees

Soil Application Program							
Month:	July 2006						
Product:	Limestone Ammonium Nitrate (LAN)						
Orchard	*Size (ha)*	*Trees per ha*	**Total Trees*	*Recommend (g per tree)*	*****Total Recommend per Orchard (kg)***	***Applied (g per tree)***	***Total Applied per Orchard***
A	3.5	316	1,106	650g	719kg		
B	2.0	316	632	500g	316kg		
C	4.1	556	2,279	250g	570kg		
D	3.2	416	1,331	500g	666kg		
Total					2,271kg		

*Total Trees = size (ha) x trees per ha
** Total required per Orchard (kg) = total trees x recommended g per tree / 1,000
i.e. * 3.5 ha x 316 trees per ha = 1,106 trees
** 1,106 trees x 650 g per tree = 718,900g / 1000 = 719kg

It is important to note those N-containing fertilizers are not applied as a single dose, but rather spread the application as 2 to 4 applications during the month. Nitrogen is highly soluble in water and if 500g LAN per tree is applied as a single dosage, the ammonium nitrate, may scorch the roots and reduce absorption.
The high concentration of ammonium nitrate can also not be absorbed within a short period of time and subsequent irrigation may leach the nitrogen beyond the reach of the roots.

The solubility and salt index of the fertilizers, the clay content of the soil, and the rooting depth of the plants are the major factors that affect the efficiency of a fertilizer application. Leaching is less of a problem in clay than in sandy soils. The buffer capacity of clay soils is better than that of sandy soils and the temporary increase in salinity due to ammonium nitrate is lower. The salt index of fertilizers indicates the necessity of splitting an application. Fertilizers with a high salt index, such as potassium chloride, should be split into multiple

applications. This may not be necessary in the case of calcium nitrate, which has a low salt index.

After the Soil Application Program has been compiled, an application schedule is developed for each month. During such as exercise, it is planned which orchard will receive its application during what time of the month, taking into consideration available manpower and equipment. Please note that if a number of applications are done in the same orchard in consecutive months, care should be taken to ensure that the applications are done on more or less the same day of each consecutive month.
In practise, it is difficult to apply exactly the recommended quantity per tree to all of the trees in orchard. It is therefore necessary to calculate the actual average rate of application once the application has been completed. This is done by dividing the total quantity applied to the orchard by the number of trees per orchard, and thus calculating the average volume per tree. The actual average quantity per tree may vary somewhat from the recommended quantity per tree, but it is important to ensure that this variation is not larger than 10%, i.e. 618-683g per tree in the case of orchard A.

Soil application programs are developed for August, September and October, with two separate programs for the application of LAN and potassium chloride in August and September.

Developing a Foliar Application Program

A foliar application program is developed in a similar manner, although the calculations are somewhat different. The recommended foliar applications are supplied in g or ml per 100l water. The size of the trees will determine the total amount of spray mixture required. Foliar feeds are applied as medium cover sprays. The larger the tree the higher the volume applied per tree and thus the volume per hectare. On average, between 1250 and 2,500 litres of spray mixture is applied per hectare on mature citrus trees using a medium-cover spray.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Foliar Application Program							
Month:	July 2006						
Product:	Low Biuret Urea						
Orchard	***Size (ha)***	***Litres per ha***	****Total Litres***	***Recommend (g per 100l)***	*****Total Recommend per Orchard (kg)***	***Applied (g per ha)***	***Total Applied per Orchard***
A	3.5	2,500	8,750	1,000	88		
B	2.0	2,250	4,500	0	0		
C	4.1	1,250	5,125	0	0		
D	3.2	1,750	5,600	1,000	56		
Total					144		

Total Litres = size (ha) x litres per ha
** Total Recommended per Orchard (kg) = recommended g per 100l / 100 x total litres / 1,000
i.e. * 3.5 ha x 2,500 litres per ha = 8,750 litres
** 1,000 g per 100l / 100 = 10g per litre x 8,750 litres = 87,500g / 1000 = 88kg

The average actual application per hectare is calculated once the application has been done to ensure that the variance between the recommended quantity and the actual applied quantity does not vary by more than 10%. A foliar application program is developed for October as well. Note that it was stated in the fertilization program that the Manganese Sulphate and Solubor® sprays are compatible, and can therefore be sprayed at the same time.

Maintaining Stock Levels and Placing Orders

Ordering of fertilization must be coordinated with the production manager and the administrative staff. Ensure that documentation is provided to the responsible person in good time, and ensure that the manager is aware of all orders that are to be placed.

The fertilization program for the next season (remember that a season is from the beginning of August of one year to July of the next year) is usually prepared during March to June. During this period, leaf and soil samples are analysed and the results used inter alia to formulate the fertilisation program. March to June is also the harvesting period for the early cultivars and a good time to evaluate the yield and quality of the late cultivars. Ordering should start during

CIN: 20300 **Version: 001**
Date: 2021/10/26

May or June to ensure that stocks are on hand when the very important application of nitrogen starts in July or August.

The time required between ordering and delivery depends on the agreement between manager and supplier. Ensure however that the fertilizers will be delivered in time if orders are placed for instance thirty days prior to the application date.

Economic considerations could limit the time between ordering and delivery. If payment is made on delivery, one would not submit an order in March for fertilizer required in July.

Fertilizer Order

Fertilizer Requirements

Product:	Limestone Ammonium Nitrate (LAN)					
Orchard	*Required July*	*Order Date*	*Delivery Date*	*Required August*	*Order Date*	*Delivery Date*
A	719			277		
B	316			158		
C	570			570		
D	666			333		
Total	2,271	03/06/06		1,338	02/07/06	

Requirement reports, such as the one above, are developed for each fertilizer and each month, and are done for the low biuret urea required in July (foliar spray), LAN and potassium chloride required in September, the lime in October and manganese sulphate and Solubor® in October.

Substitution of Recommended Fertilizer

Recommended fertilizers and chemicals for foliar sprays can be substituted with an equivalent elemental base provided that:

- The chemistry of the replacement chemical and its reaction in the soil and on the leaf will not create unwanted side-effects; and
- The recommended mass or volume is adjusted to compensate for variations in concentration of the active ingredient/s.

The person responsible for the formulation of the fertilization program should be consulted before substitutions are made. Fertilizer manufacturers may also be able to assist in this regard.

The rate of application for the replacement fertilizer is calculated as follows:

- The rate of application for recommended product multiplied by % active ingredient in recommended product divided by % active ingredient in replacement product
- Rate of application for replacement product

Fertilizer Substitution

- Borate A, containing 16% B, can substitute Solubor®, containing 20% B. The application rate must be changed accordingly, i.e. if 150g per 100l was recommended, 187.5g Borate A per 100 litre water should be applied, calculated as follows: 150x20/16 = 187.5
- LAN (28% N) can be substituted by ammonium sulphate (21% N) but keep in mind that the acidification of ammonium sulphate is more than twice that of LAN. The calculation in this case is: 500g LAN x 28/21=667g ammonium sulphate
- Double super phosphate (20% P) can be substituted by twice as much single super phosphate (10,5% P)

The application of fertilizers for sunflower and field grown vegetables and other field crops differ in that from citrus, due to the fact that we replant each year. Therefore, most of the fertilizers will be incorporated into the soil during soil preparation, some can be applied with plant and a third part can be applied after the crop is established. In some cases, especially with high value crops or crops with specific needs, a farmer can also apply some elements as a foliar application. Learners are referred to the previous section on citrus for information on timing fertilizer orders and replacement fertilizers.

In this section we investigate:

- Broadcast application of fertilizers to the soil
- Applying fertilizer during ploughing
- Band application of fertilizers with planter
- Fertiliser top dressing after planting
- Foliar feeds

CIN: 20300 **Version: 001**
Date: 2021/10/26

As for citrus, it is important to keep record of what and when fertilizers have been applied. Some of the information to be recorded includes:

- Field number – same number as the one indicated on the soil analysis
- Crop and cultivar
- Details for soil applications:
    - Quantity (kg) to be applied per ha
    - Name of fertilizer
    - Time of application
- Details for band placing:
    - Quantity (kg) to be applied per ha
    - Name of fertilizer
    - Time of application
- Details for top dressing:
    - Quantity (kg) to be applied per ha
    - Name of fertilizer
    - Time of application
- Details for foliar applications:
    - Quantity in grams (g) or millilitre (ml) to be mixed per 100l water
    - Name of fertilizer
    - Time of application
- Additional information or special instructions

Determining the amounts of N, P, K and B to apply.

During the course of this section, the information in tables 1.1 to 1.6 will be used. Table 1.1. is the information we received back after the Laboratory did the soil and plant analysis. This information will be used in conjunction with tables 1.4 and 1.5 to determine the amount of phosphorus and potassium to apply per ha of crop field.

Table 1.2. provides an indication of the yield potential for sunflowers under a certain set of conditions. The higher the yield potential the more nutrients will be required and visa versa.

Table 1.2. will be used in conjunction with tables 1.3 to 1.5, to determine the amount of nitrogen as well as phosphorous and potassium to apply per ha of crop land under sunflower. The information in table 1.6. provided information on the volume of boron required.

Table 1.1. Test results received from the Soil Laboratory for the soil sample we took.

CIN: 20300 **Version: 001**
Date: 2021/10/26

LABORATORY SOIL ANALYSIS								
Field no	Texture class	pH (KCl)	P mg kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}	Na mg kg^{-1}	Ca/Mg mg kg^{-1}
1	Sa	4.9	8	53	228	46	11	3.02
2	LmSa	6.1	12	88	316	73	11	2.64
Extraction method P = Bray 1 Cations = NH_4OAc		Soil Texture classes (% = % clay in soil) Sa = 0 - 10%; SaLm = 10 - 20%; LmSa = 20 - 30%; Clay = > 30%						

Table 1.2. Production potential for sunflowers under dry land conditions at specific soil clay contents and soil depths. (Du Toit et al., 1994)

Rainfall	Clay content	Soil depth (cm)								
(mm)	%	40	50	60	70	80	90	100	110	120
475	0-10	572	715	857	1 001	1 143	1 192	1 192	1 192	1 192
	10-15	728	910	1 091	1 192	1 192	1 192	1 192	1 192	1 192
	15-20	850	1 063	1 192	1 192	1 192	1 192	1 192	1 192	1 192
	20-35	980	1 192	1 192	1 192	1 192	1 192	1 192	1 192	1 192
	35+	970	1 192	1 192	1 192	1 192	1 192	1 192	1 192	1 192
500	0-10	604	755	905	1 207	1 207	1 325	1 325	1 325	1 325
	10-15	768	961	1 153	1 325	1 325	1 325	1 325	1 325	1 325
	15-20	898	1 123	1 325	1 325	1 325	1 325	1 325	1 325	1 325
	20-35	1 035	1 294	1 325	1 325	1 325	1 325	1 325	1 325	1 325
	35+	1 024	1 126	1 126	1 126	1 126	1 126	1 126	1 126	1 126
525	0-10	636	794	953	1 126	1 271	1 430	1 464	1 464	1 464
	10-15	807	1 011	1 213	1 416	1 416	1 416	1 416	1 416	1 416
	15-20	945	1 181	1 417	1 464	1 464	1 464	1 464	1 464	1 464
	20-35	1 090	1 362	1 464	1 464	1 464	1 464	1 464	1 464	1 464
	35+	1 078	1 245	1 245	1 245	1 245	1 245	1 245	1 245	1 245
550	0-10	668	834	1 001	1 168	1 334	1 501	1 611	1 611	1 611
	10-15	849	1 062	1 274	1 487	1 611	1 611	1 611	1 611	1 611
	15-20	933	1 241	1 489	1 611	1 611	1 611	1 611	1 611	1 611
	20-35	1 144	1 430	1 611	1 611	1 611	1 611	1 611	1 611	1 611
	35+	1 132	1 370	1 370	1 370	1 370	1 370	1 370	1 370	1 370
575	0-10	700	874	1 049	1 223	1 399	1 573	1 748	1 765	1 765
	10-15	890	1 113	1 335	1 558	1 765	1 765	1 765	1 765	1 765
	15-20	1 040	1 300	1 560	1 765	1 765	1 765	1 765	1 765	1 765
	20-35	1 198	1 498	1 765	1 765	1 765	1 765	1 765	1 765	1 765
	35+	1 186	1 482	1 500	1 500	1 500	1 500	1 500	1 500	1 500

Table 1.3. Nitrogen recommendations for sunflower according to yield potential (FSSA, 2000).

Potential, t ha^{-1}	1.5	2	2.5
N, kg ha^{-1}	22	54	87

Table 1.4. Phosphorus recommendations for sunflower according to soil analysis and yield potential (FSSA, 2000).

Soil P (Bray 1)	P application for yield potential t ha^{-1}		
	1,5	2	2,5
mg kg^{-1}	kg ha^{-1}		
5	14	32	50
10	11	22	35
15	9	16	26
20*	7	13	20
25*	6	10	16
30*	5	9	13

Table 1.5. Potassium recommendation for sunflower according to soil analysis and yield potential (FSSA, 2000).

Soil K (Bray 1)	K application for yield potential t ha^{-1}				
	1	1,5	2,0	2,5	3,0
mg kg^{-1}	kg ha^{-1}				
20	16	21	27	33	39
40	10	15	20	25	30
60	7	10	14	18	22
80	0	8	11	14	17
100	0	0	9	11	14
120	0	0	0	0	0

CIN: 20300 **Version: 001**
Date: 2021/10/26

Table 1.6. Boron recommendation (kg ha-1) for sunflower

Product	Clay percentage		
	0-15	16-30	31+
Borax (11.3% B)	9	18	27
Boric acid (17.5% B)	6	11	17
Sodium oktaborate (20.5% B)	5	10	15

Determining yield potential (Table 1.2.)

To determine the yield potential for sunflower we use the information provided in Table 1.2. The first step is to identify the field. Once the field in know, gather information on the soil depth and long-term average rainfall.

Let us assume the field of interest has a soil depth of 0.9 m, the average rainfall is 550 mm for the growing season and the clay content between 0 and 10%. Using this information and applying it to the data provided in table 1.2., the sunflower yield potential for the field number is 1.501 ton ha-1.

- Determining the amount of nitrogen (N) needed per ha (Table 1.3.)
  To determine the N required, the yield potential must be known. If we use the data in example 1.3.1., we assume a yield potential of 1.501-ton ha-1, table 1.3 indicates a nitrogen requirement of 22 kg ha-1.
- Determining the amount of phosphorus (P) required (Table 1.4.)
  To determine the P requirement, we need to know the yield potential for the crop as well as the amount of available P in the soil.

  If we again use the data in example 1.3.1., we require a yield of 1.501-ton ha-1. If we assume an available P status of 8 mg kg-1, the P requirement can be determined. Table 1.4 indicates that for a yield of 1.5 ton per hectare with a P status of 8 mg/kg, we will require 11 kg P ha-1. We thus need to apply 11 kg P per ha of sunflower.

- Determining the amount of potassium (K) needed per ha for field number one (Table 1.5.)
  To determine the K requirement, we need to know the yield potential and the available K in the soil. If we assume the K status of soil is 53 mh/kg and a yield of 1.501-ton ha-1, the corresponding value in table 1.5. is 10 kg K ha-1. We thus need to apply 10 kg K for every ha of sunflower we are going to plant in field number one.

- Determining the amount of boron (B) needed per ha for field number one (Table 1.6.)
  To determine the B requirement, we need to know the clay percentage. If we assume

clay content of 0 to 10%, the B requirement is given as (Table 1.6) 9 kg Borax or 6 kg Boric acid or 5 kg Sodium oktaborate per ha.

Compiling a fertilization program

The information in the previous section can now be incorporated into a fertilization program. Below is an example of such a program for sunflower.

Fertilizer application – Planting in November					
Orchard:	Field 1	Irrigation or dry land	Dry	Size:	100 ha
Crop:	Sunflower	Cultivar:	Sunbird 5	Plants per ha:	30 000
Fertiliser				*Quantity* kg ha^{-1}	*Time of Application*
Broadcast application – before plant					
Calcitic or Dolomitic lime				1 000	Augustus
2:3:2 (22%)				117	October
1:0:1 (36%)				14	October
Bandplacing – with plant				kg ha^{-1}	
Limestone ammonium nitrate (LAN)				15	November
Top dressing – after plant				kg ha^{-1}	
Limestone ammonium nitrate (LAN)				28	January
Foliar application – after plant				g per litre per ha	
Sodium oktaborate (Solubor®)				750	When B deficiency is noted
Remarks:					
• Solubor are compatible with most herbicides. • If beans are in rotation with sunflower, be careful not to apply too much B, as it can be toxic to the bean crop. • Solubor can also be applied to the soil before plant, if the field is known for its lack in boron. • Calcitic or Dolomitic lime can be used. The price and transport of each will determine which to use. • The amount of fertilizer placed in the band is restricted to prevent burning of the seed. The amount should never exceed 15 kg N fertilizer per ha.					

Compiling a fertilizer plan for all crop fields allows that the correct type of fertilizer is stocked and available at the relevant time. Keep in mind that you are not the only farmer who is going to need the fertilizers. Place your fertilizer order well in advance time to ensure that the fertilizer will be delivered at least a month before you will need it.

Fertilizers application strategies and timing of application

In this section the reasons for applying certain fertilizers at a specific time will be explained.

- Broadcast application of fertilizers to soil
  Broadcasting refers to the even distribution of lime and fertilizer before it is incorporate into the soil. Broadcasting is efficient and often the method of choice in areas with perennial plants. Lime has to be incorporated in the soil, at least two months before planting. This will allow the lime to rectify a pH problem, as the lime has a long reaction period.

  Phosphorus containing products have to be applied to the soil before or with plant, as phosphorus do not easily move in the soil. It can therefore not be applied as topdressing later on, as it will not wash into the soil easily as in the case of nitrogen.

  Broadcasting can be done with a tractor pulling the fertilizer spreader or by hand (Fig 1.1.). Most of the spreaders can also be used to spread other dry formula chemicals (insecticides, fungicides etc.) or even broadcasting seed. After the fertilizer has been broadcasted, it is ploughed into the soil. The two actions can also be combined into one, whereby the tractor's spreader and plough are attached at the same time.

Figure 1.1. Tractor drawn fertilizer spreader on the left and a hand operated version on the right.

- Placing fertilizer in the soil while ploughing
  With this application the fertilizer is placed in a continuous band into the furrow during the process of ploughing. Each band is covered as the next band is turned over. No attempt is usually made to sow the crop in any particular location with regard to the plough sole bands, as is the case with band placing of fertilizers.

  This method has been recommended in areas where the soil becomes quite dry up to a few centimetres below the soil surface during the growing season, and especially with soils having a heavy clay pan a little below the plough sole. By this method, fertilizer is placed in moist soil where it can become more available to growing plants during dry seasons.

  This is an alternative to broadcasting. The application of lime is always done by broadcasting, while application of fertilizers containing N, P, K and other elements are mostly done in this way.
  An exception on broadcasting of lime is when the subsoil is quite acidic. Then lime will be placed deep into the soil while the soil is being ripped with a heavy tooth implement, which penetrates the soil (Fig 1.2.) to a depth of 20 to 50 cm.

Figure 1.2. A hand-held ripper on the left and a mechanical drawn ripper on the right.

- Band placement of fertilizers at plant
  This method refers to the application of fertilizers into the soil close to the seed or plant. Localized placement is usually employed when relatively small quantities of fertilizers are to be applied, otherwise it can burn the seed leading to low germination and poor stands. Localized placement reduces fixation of phosphorus and potassium in

the soil. Localized placement is done with specialized planters and the fertilizer is placed to the side and often below the seed during the seeding operation.

This practice is done to give the young seedling a boost. The fertilizer is placed close to where its roots will grow. The seedling's roots need not search for the fertilizer which has been mixed with the soil during tillage.

- Top dressing of fertilizers after planting
  Nitrogenous fertilizers containing nitrates, like sodium nitrate, calcium ammonium nitrate etc. is applied as top dressing to closely spaced crops. In addition, urea is also top dressed. This helps in supplying nitrogen in readily available form to growing plants. Top dressing can be done with fertilizer broadcasters.

- Foliar feeding
  This refers to the spraying of suitable fertilizing solutions on leaves of growing plants. These solutions may be prepared in a low concentration to supply a plant with a single nutrient or a combination of nutrients.

  It has been well established that all plant nutrients are absorbed through the leaves of plants and this absorption is remarkably rapid for some nutrients.
  Foliar application does not result in a great saving of fertilizer, but it may be preferred under the following conditions.

- When visual symptoms of nutrient deficiencies are observed during early stages of deficiency.
- When unfavourable conditions (physical and chemical) which reduces the efficiency (FUE) of fertilizers occurs.
- During a drought period where soil application could not be conducted. (soil moisture insufficient)

There are certain difficulties associated with the foliar application of nutrients:

- Marginal leaf scorching may occur if concentrations of solutions are too high.
- As solutions of low concentrations (usually three to six per cent) are to be used, only small quantities of nutrients can be applied during a single spray.
- Several applications are needed for moderate to high fertilizer rates, and hence
- Foliar spraying of fertilizers is costly compared to soil application, unless combined with other spraying operations taken up for insect or disease control.

Group Formative Exercise 1A

Group Formative Exercise 1B

SOIL UTILIZATION PLAN

Selecting the Appropriate Soil

A permanent crop like citrus, which may remain in the same soil for more than fifty years, proper selection of the soil, is essential. One is, however, limited to the soil types that occur on the farm, but have to select the best from what is available. Tree crops are often not planted on ideal soils and the subsequent horticultural practises need to be developed to compensate for the deficiencies of the soil.

In evaluating soils for crop production, one strives to get as close to the optimum soil characteristics as possible. This is a fairly specialised activity and should ideally be done by an experienced pedologist.

This process of soil surveys on a farm should culminate in the creation of a soil map indicating positions of the various orchards overlaid onto the map produced by the soil survey. Once this is done, soil preparation and the irrigation layout can be planned.

Slope – Orchard crops requires the use of fairly heavy machinery, such as spraycarts and picking trailers. During soil preparation, the tractors and implements used to prepare the soil must also be able to drive safely. The slope must therefore not be so severe that workers and equipment are put in danger. A flat surface with a slope of less than 2 degrees is however also not suitable, as surface drainage of rainwater will then be too slow. These recommendations also hold true for other crops.

In crop production, other than tree crops, slopes are often contoured (Fig 2.1.) to reduce the flow of water (runoff) across the land surface, thus reducing erosion.

Figure 2.1. Contour ploughing to restrict runoff in a crop field (http://www.thamesweb.com/page.php?page_id=27&topic_id=16).

Apart from the influence of the slope of the site on safety and ease of vehicle movement in the fields, it is also important for row orientation, surface drainage and erosion. Planting on contours is no longer done and if the slope poses any potential problems with surface drainage and/or erosion, orchard layout should be adapted accordingly. The orchard roads and vehicle paths between rows are usually protected by grass-cover. If the orchard layout facilitates water movement at a moderate speed, erosion can be avoided. Row orientation is more important in the southern parts than in the northern parts of Southern Africa and can be changed to facilitate surface drainage. Also remember that in South Africa, northern slopes are warmer than southern slopes. The crop selection should therefore be done in accordance, namely crops with a lower tolerance to heat on the southern slopes and those crops which growth is encourage by more heat on the northern slopes.

Some of the benefits of contour ploughing are:

- Soil erosion can be reduced by as much as 50%
- Increased water infiltration promotes better water quality.
- Increased soil retention encourages root development, binding the soil and preventing erosion.
- Limits the release of nutrients/particulates into nearby river systems or lakes, minimizing harmful effects such as eutrophication.
- Can disrupt wind currents, therefore reducing wind erosion.

Soil Depth

In general tree crops will require a minimum soil depth of 30cm to 40cm if micro-jet irrigation is used, and 40cm to 50cm where drip irrigation is used. It is important that the layer below this potential rooting zone does not restrict drainage.

The ideal soil depth varies between crops. In the case of crops like onion and cabbage, they have a shallow root system that will be restricted to the top 15 cm soil layer. Such crops can therefore be planted on shallow soils. Deep rooted crops such as tree crops require an effective soil depth of at least 60 to 90 cm, with no restriction layers present. In the case of shallow rooted crops an effective soil depth of 20 to 30 cm is required. In all cases, the soil requires effective drainage to prevent water logging.
Where the potential effective rooting depth is limited, it can be improved by ridging. This creates a thicker layer of soil where the crop will be planted.

Ridging also demarcate the path for vehicles to drive in, avoiding re-compaction of the soil after planting. Ridging lowers the preparation cost. Energy required in soil preparation increases the quadratic equation with depth; hence, costs will also increase. Where large quantities of lime are required, ridging can reduce the quantity required. As example, where 10 tonnes of lime has to be mixed in with the top 50 cm of soil, it can be more easily and cheaply done by mixing 5 tonnes into the top 25 cm, and then ridge the field.

Keep in mind that ridging makes harvesting more difficult in tree crops. Due to the undulating surface, the pickers have to walk more.

Ridging improves drainage in areas with such problems and is often used in irrigation or high rainfall areas. Tomatoes, potatoes and tobacco are some of the crops which are often ridged.

Ridging reduces the soil temperature around seed tubers. The deeper one goes into the soil, the cooler it becomes. If seed tubers are to be planted in the summer in very hot soils (> 30°C), they may rot. To prevent high soil temperatures, the soil is ridged to a height of 15 – 20 cm which effectively cools the soil temperature to 20°C around the seed tubers.

Soil Clay Content

The optimum clay content varies between crops. In the case of citrus optimum clay content is between 5% to 20% for micro-jet irrigation and 5% to 35% for drip irrigation.

In general, the ideal soil type for most crops is sandy loam soils, with a clay content of 10 to 20%. Most crops will adapt to soils with higher clay content provided that no other growing factors are limiting. The use of non-ideal soils may require additional production practices, which could lead to additional costs. One should therefore ideally use a recommended soil type as far as possible.

Some crops, such as potatoes and peanuts that bear their produce under the soil surface, may be more sensitive to soil clay content. With these crops, clay soils may affect the crop in reducing the value of the crop by discolouring the crop or make it difficult to harvest. These crops are also more prone to diseases as the soil tends to remain wet for longer periods.

Under dry land production crops soils with higher clay content (>25%) are often preferred, as the heavier clay soils have a better water holding capacity than sandy soils.

The clay content of soil influences its water holding capacity, (volume of easily available water), its cation exchange capacity and its aeration. These are all factors that will influence the crop.

The water holding capacity influences the irrigation scheduling, yield and fruit size.

The cation exchange capacity influences the frequency of fertilizer application, leaching of nutrient cations and utilisation of potassium.

Poor aeration affects the root system negatively. Under anaerobic conditions, roots cannot function properly and diseases like *Phytophthora proliferate.*

As one cannot increase or decrease the clay percentage in the soil in the field, one has to adapt to the conditions or try to improve the soil conditions. Adapting implies the use of adapted crops and applicable irrigation systems and good irrigation scheduling. Improvement may include the incorporation of organic matter to improve aeration, or installing a drainage system to improve drainage.

Soil Stratification

During soil preparation, all forms of stratification must be removed, i.e. layers in the soil are broken up and mixed. The type and depth of these layers will determine the implements that may be required. The fewer layers present in a soil, the lower the preparation cost, as soil with little or no stratification can merely be loosened.

Stratification, or layering, restricts water movement and root development, resulting in soil volumes with few roots. These volumes become waterlogged and create pockets in the soil where root-rot starts. These unoccupied volumes also contain water and nutrients that are unavailable to the plant due to a lack of roots. During soil preparation, all forms of layering must be eliminated. This can be done by deep ripping the soil. Special implements (Fig 1.2.) are needed, but are worthwhile in using as they promote root growth and development.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Soil Salts Content

Salts may accumulate in a soil for various reasons. If salt accumulation is due to poor drainage and high levels concentrations of sodium are also encountered, such sites should be avoided. It is difficult and expensive to remove salts from soil because the causes of accumulation also require removal.

If high salt content is caused by the lack of leaching, the site may be reclaimed. Consult a specialist to determine the reclamation process, cost and impact. Calcium carbonates accumulate in the subsoil due to limited leaching. Depending on the depth of accumulation, the soil can still be utilised successfully.

Soils with accumulated salt anywhere in the top 60cm to 100cm should however be dealt with caution. The measurement of resistance or EC of the soil may aid in identifying accumulated salts. Clay soils that provide resistance readings below 250 ohm should be investigated intensively before preparation. The same applies to lighter soils where resistance readings are below to 500 ohm. If such soils are identified, it is best to consult an expert.

While accumulated salts also include nutrients, it usually contains high concentrations of sodium, calcium, chlorides, sulphates and carbonates. The chemical conditions in the layers where the salts accumulated restrict root development and function.

Where sodium is the dominant cation, the conditions damage the structure of the soil and hence the physical properties required for proper root functions.

Where calcium and carbonate are dominant, the pH will reduce the availability of many nutrients such as Fe, Mn, Cu, Zn, P and K.

Where chloride and sodium are the dominant ions, the osmotic pressure of the water in that zone will restrict utilisation of water by the crop plants.

Managing soils with high salt concentrations are extremely difficult and expert advice should be called upon to prevent further degradation of the soil. Managing tools can vary from planting salt tolerant crops (example Oldman Saltbush), to adapting the irrigation scheduling to the application of soil amendments.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Group Formative Exercise 2

SYMPTOMS OF NUTRITIONAL DEFICIENCIES

Introduction

The identification of nutrient deficiency symptoms in plants is a very powerful diagnostic tool for evaluating the nutrient status of crops. However, identification of a specific single visual symptom is seldom sufficient to make a definite diagnosis of plant nutrient status. Many of the classic deficiency symptoms such as leaf tip scorch, chlorosis and necrosis are characteristically associated with more than a single mineral deficiency. In addition, other stress factors may also cause similar symptoms. Identification remains a most useful tool.

Deficiency symptoms develop as a result of specific physiological process cannot be completed. In general, the deficiency symptoms appear about six weeks after the deficiency develops. In crop production, the development of deficiencies must be avoided, and strategies should be in place to monitor the nutritional status of the plants, especially in the case of trees, continuously.

One such strategy is annual leaf and soil analyses. It is however possible for the concentration of certain nutrient elements to decline below the threshold for the crop. Supplemental to leaf and soil analyses, the plants in the field must be monitored for these hidden deficiencies. Observations must be reported when supplying information to the person preparing the fertilization program.

Symptoms of some Nutrient Deficiencies

Stress factors such as soil salinity, pathogens, and air pollution induce characteristic symptoms. Often, these symptoms resemble those of nutrient deficiency conditions.

Pathogens often produce interveinal chlorosis, whereas many air pollution and salinity stresses may cause tip scorching. Although, at first these symptoms might seem similar in their

CIN: 20300 **Version: 001**
Date: 2021/10/26

appearance to those of nutrient deficiencies, they do differ in detail and/or in their overall developmental pattern.

Pathological symptoms can often be separated from nutritional symptoms by their distribution in the crop. If the plants are under a nutrient stress, all plants of a given type and age in the same fields tend to develop the same symptoms at the same time. If the stress is the result of a pathogen, symptom development will have a tendency to vary between plants until the pathogen is relatively advanced.

At first glance, it would appear as if the distinction between deficiency symptoms for the 13 known essential mineral nutrients should be relatively simple. But such an assumption is incorrect. The deficiency symptoms are however quite complex because each nutrient has a number of different biological functions, and each function may have an independent set of interactions. In addition, the expression of these symptoms varies depending on how acute or chronic deficiency conditions have developed. Acute deficiency occurs when a nutrient is suddenly no longer available to a rapidly growing plant. Chronic deficiency occurs when there is a limited but continuous supply of a nutrient, at a rate that is insufficient to meet the growth demands of the plant.

Most of the classic deficiency symptoms described in textbooks is characteristic of acute deficiencies. The most common symptoms of low-grade, chronic deficiencies are a tendency towards darker green leaves and stunted or slow growth. Typically, most published descriptions of deficiency symptoms arise from experiments conducted in greenhouses or growth chambers where the plants are grown in hydroponics or in media where the nutrients are fully available. In these conditions, nutrients are readily available while present, but when a nutrient is depleted, the plant suddenly faces an acute deficiency.

The interaction between nutrient mobility in the plant, and plant growth rate can be a major factor influencing the type and location of deficiency symptoms that develop. Mobile nutrients such as nitrogen and potassium, deficiency symptoms develop predominantly in the older and mature leaves. This is a result of these nutrients being preferentially mobilized during times of nutrient stress from the older leaves to the newer leaves near the growing regions of the plant. Additionally, mobile nutrients newly acquired by the roots are also preferentially translocated to new leaves and the actively growing areas. Thus, old and mature leaves

become depleted of mobile nutrients during times of stress while the new leaves are maintained at a more favourable nutrient status.

The typical presence for deficiency symptoms of very fewer mobile nutrients such as calcium, boron, and iron initially develop in the growing regions and new leaves. In plants growing slowly for reasons other than nutrition (such as low light), lower levels of nutrients may be sufficient for the plant to slowly develop, maybe even without symptoms. This type of development is likely to occur in the case of weakly mobile nutrients because excess nutrients in the older leaves will eventually be mobilized to supply newly developing tissues. In contrast, a plant with a similar supply that is growing rapidly will develop severe deficiencies in the actively growing tissue such as leaf edges and the growing region of the plant. A classic example of this is calcium deficiency in vegetables such as lettuce. In lettuce calcium deficits symptoms develop on the leaf margins (leaf margin tip scorch) and the growing region near the meristems. The maximal growth rate of lettuce is often limited by the internal translocation rate of calcium to the growing tissue rather than from a limited nutrient supply in the.

When moderately mobile nutrients such as sulphur and magnesium are the limiting nutrients in the system, deficiency symptoms are normally seen on the entire plant. If the nutrient supply is marginal compared to the growth rate, symptoms will appear on the older tissue, but if the nutrient supply is low compared to the growth rate, or the nutrient is totally depleted, the younger tissue will become deficient first.

Prominent nutrient elements that develop hidden deficiency symptoms are nitrogen, magnesium, copper and iron.

In the following section, the deficiency symptoms expected in citrus and tomatoes are provided as examples.

Nitrogen

- Citrus
  Nitrogen is a mobile nutrient in plants and is translocated to areas where it is required the most. The nitrogen in older leaves is moved to new leaves shortly before leaf drop. This is a natural process, which starts when the leaves are about twenty-four months old.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Leaves of under the age of twenty-four months can however be dropped prematurely when the tree experiences a nitrogen deficit. The leaves receiving the translocated nitrogen will contain elevated levels, but at the cost of the older leaves. If the leaves with elevated nitrogen concentration are picked during sampling, the leaf analysis will present an incorrect reflection of the nitrogen status of the trees.

The symptoms of this process are:

- the entire tree is a slightly lighter green than normal;
- the oldest leaves turn deep yellow in colour and drop;
- Twigs have leaves at the tips and few or none at the middle or base;
- The tree is sparsely foliated with only one or two generations of leaves;
- Excessive leaf drop occur a week before and during a vegetative flush.

The nitrogen concentration in the leaves decreases but stabilises at a level in the "below normal" range, not indicating that this status is sustained by relocated nitrogen from leaves dropped prematurely. The leaves on the tree have a reasonable nitrogen status but this "fairly good" status is applicable to much fewer leaves.

Information:

Nitrogen Relocation.

- To explain what happens during the relocation of nitrogen and premature leaf drop, the following calculation is helpful:
- When the leaf analysis indicates a nitrogen content of 2.00%, the unsaid assumption is made that the trees have a normal leaf-cover. However, if N was relocated from 20% of the leaves to the leaves sampled, this 2.00% N at an 80% leaf-cover actually would have been 1.60% N if no leaf drop occurred.
- Therefore, although the leaf analysis indicates a "below normal" nitrogen status, the actual status is actually "deficient".

Additional information is required to interpret the analytical data if the trees are growing under abnormal conditions or showing abnormal symptoms such as sparse foliation.

- Tomato

  Figure 3.1 provided a photograph of chlorosis (yellowing) developing due to nitrogen deficiency. A light red discolouration can also be seen on the veins and petioles. Under nitrogen deficiency, the older mature leaves gradually change from their normal

characteristic green appearance to a much paler green. As the deficiency progresses these older leaves become uniformly yellow (chlorotic). Leaves approach a yellowish white colour under extreme deficiency. The young leaves at the top of the plant maintain a green, but paler colour, and tend to become smaller in size. Branching is reduced in nitrogen deficient plants resulting in short, spindly plants. The yellowing in nitrogen deficiency is uniform over the entire leaf including the veins. However in some instances, an interveinal necrosis (between veins) replaces the chlorosis commonly found in many plants. In some plants the underside of the leaves and/or the petioles and midribs develop traces of a reddish or purple colour. In some plants this colouration can be quite bright. As the deficiency progresses, the older leaves also show more of a tendency to wilt under mild water stress and become senescent much earlier than usual. Recovery of deficient plants to applied nitrogen is immediate (days) and spectacular.

Figure 3.1. Nitrogen deficiency symptoms in tomato. (Epstein and Bloom 2004)

Magnesium

- Citrus
  Magnesium is a mobile nutrient and the same process as with nitrogen occurs when the supply of magnesium is too low. Magnesium deficiency symptoms are more prominent on seeded cultivars.

  The symptoms are:
- No change in the green appearance of the entire tree;
- The oldest leaves develop yellowing from the margins and tip towards the petiole, leaving a unique inverted V-shaped green area with its broadest side at the petiole;
- Twigs have leaves at the tips and few or none at the middle or base;

CIN: 20300 **Version: 001**
Date: 2021/10/26

- The tree is sparsely foliated with only one or two generations of leaves;
- Excessive leaf-drop occurs during the onset of spring and/or during a vegetative flush;
- Excessive leaf-drop can also occur after a foliar application of potassium. Applications of potassium will aggravate the hidden magnesium deficiency.

The magnesium concentration in the leaf decreases but stabilises at a level in the "below normal" range, not indicating that this status is sustained by relocated magnesium from leaves dropped prematurely.

- Tomato
  Figure 3.2 provided a photograph of Mg-deficits in tomato leaves indicating advanced interveinal chlorosis, with necrosis (browning dying leaf tissue) developing in the highly chlorotic tissue. In its advanced form, magnesium deficiency may superficially resemble potassium deficiency. In the case of magnesium deficiency, the symptoms generally start with mottled chlorotic areas developing in the interveinal tissue. The interveinal leaf tissue tends to expand proportionately more than the other leaf tissues, producing a raised puckered surface, with the top of the puckers progressively going from chlorotic to necrotic tissue. In some plants such as the Brassica or mustard family, which includes vegetables such as broccoli, Brussels sprouts, cabbage, cauliflower, collards, kale, kohlrabi, mustard, rape, rutabaga and turnip, tints of orange, yellow, and purple may also develop.

Figure 3.2. Symptoms of Magnesium deficiency on a tomato plant. (Epstein and Bloom 2004)

Copper

- Citrus
  Copper moves slowly through plants. When a strong vegetative flush develops, the supply of copper to the leaves formed on new shoots might be too low and copper

deficiency symptoms develop. The symptom will be more pronounced on the lower leaves on a shoot and becomes less obvious towards the tip of the shoot.

The typical leaf symptom of copper deficiency is abnormally large leaves. The leaves at the base of a shoot are two to four times the normal size and are sometimes the shape of a boat.

When copper deficiency symptoms appear on leaves of a twig exceeding 50 cm in length, it can be attributed to a natural slow supply of copper. However, if symptoms appear on shorter twigs, the copper supply must be supplemented.

Gumming is often connected to a copper deficiency, but gumming is a natural response of the tree to many adverse conditions and not only a copper deficiency.

- Tomato

  Figure 3.3. provides a photograph of typical copper-deficiency symptoms in tomato leaves. The leaves are curled, and petioles bent downward. Copper deficiency may be expressed as a light overall chlorosis along with a permanent loss of turgor (wilting) in young leaves. Recently matured leaves show netted, green veining with areas bleaching to a whitish grey. Some leaves develop sunken necrotic spots and have a tendency to bend downward. Trees under chronic copper deficiency develop a rosette form of growth. Leaves are small and chlorotic with spotty necrosis.

Figure 3.3. Copper deficiency symptoms in tomato. (Epstein and Bloom 2004)

Iron

- Citrus

  Iron is present in leaves as both physiologically active and inactive forms. Traditionally leaf analyses do not distinguish between these forms and will only indicate the total iron content.

  The availability of iron depends on external factors such as soil pH and the concentration of bicarbonates in the soil, the water and the plant. When the soil pH is high, less iron is available to be taken up by the plant. Once taken up, the iron can be inactivated by bicarbonates. Bicarbonates are present in the irrigation water, but also in the cell-sap in the plant. Inactive iron accumulates in the leaves and forms part of the iron concentration detected during analysis. A plant can therefore suffer an iron deficiency although the leaf analysis indicates normal, high or excess concentrations of iron. Leaf analyses are only useful when the results indicate a low to deficient iron concentration.

  Iron is not relocated in the plant and deficiency symptoms develop on the newly formed leaves. The symptoms are more prominent during winter and at the lower shaded part of the canopy.

- Tomato

  Figure 3.4 provides a photograph of iron-deficient leaves showing severe chlorosis at the base of the leaves with some green netting. The most common symptom of iron deficiency starts out as interveinal chlorosis of the youngest leaves, which develops into overall chlorosis. These areas often develop into necrotic spots. Up until the time where leaves become almost completely white, they will recover if supplemental iron is provided. In the recovery phase the veins are the first to recover as indicated by their bright green colour. This distinct venial re-greening observed during iron deficit recovery is probably the most recognizable symptom in all of classical plant nutrition. Because iron has a low mobility, iron deficiency symptoms appear first on the youngest leaves. Iron deficiency is strongly associated with calcareous soils and anaerobic conditions, and it is often induced by an excess of heavy metals.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Figure 3.4. Iron deficiency symptoms in tomato. (Epstein and Bloom 2004)

Common deficiency symptoms on tomatoes and other vegetable crops.

- Phosphorus
  Figure 3.5 provides a photograph of phosphorus-deficient leaves, showing necrotic spots. As a rule, phosphorus deficiency symptoms are not very distinct and thus difficult to identify. A major visual symptom is that the plants are dwarfed or stunted. Phosphorus deficient plants develop very slowly in relation to other plants growing under similar environmental conditions but without phosphorus deficiency. Phosphorus deficient plants are often mistaken for unstressed but much younger plants. Some species such as tomato, lettuce, corn and the brassicas develop a distinct purpling of the stem, petiole and the under sides of the leaves. Under severe deficiency conditions there is also a tendency for leaves to develop a blue-grey lustre (shine). In older leaves under very severe deficiency conditions a brown netted veining of the leaves may develop.

Figure 3.5. Phosphorus deficiency symptoms in tomato. (Epstein and Bloom 2004)

- Potassium
  Figure 3.6 provides a photograph of potassium deficiency in tomato plants showing marginal necrosis (tip scorch). Advanced potassium deficiency is seen as chlorosis of the interveinal spaces between the main veins as well as with interveinal necrosis. This group of symptoms is very characteristic of K deficiency

Figure 3.6. Potassium deficiency symptoms in tomato. (Epstein and Bloom 2004)

- Calcium
  Figure 3.7 provides a photograph of calcium-deficient leaves showing necrosis at the base of the leaves. The low mobility of calcium is a major factor in determining the expression of calcium deficiency symptoms. Classic symptoms of calcium deficiency include blossom-end rot in tomato (browning or rotting of blossom end of tomato fruit), leaf tip scorch in lettuce, blackheart in celery and death of the growing regions in many plants. All these symptoms show soft dead necrotic tissue at rapidly growing areas, which is generally related to poor translocation of calcium to the tissue rather than a low external supply of calcium. Very slow growing plants with a deficient supply of calcium may withdraw sufficient calcium from older leaves to maintain growth with only a marginal chlorosis of the leaves. This ultimately results in the margins of the leaves growing more slowly than the rest of the leaf, causing the leaf to cup downward. This symptom often progresses to the point where the petioles develop but the leaves do not, leaving only a dark bit of necrotic tissue at the top of each petiole. Plants under chronic calcium deficiency have a much greater tendency to wilt than non-stressed plants.

Figure 3.7. Calcium deficiency symptoms in tomato. (Epstein and Bloom 2004)

- Boron

  Figure 3.8 provides a photograph of boron-deficient leaves showing a light general chlorosis. The tolerance of plants to boron varies greatly between species. Boron requirements necessary for one crop may be toxic to other boron sensitive crops. Boron is poorly transported in the phloem of most plants. In plants with poor boron mobility, boron deficiency results in necrosis of meristematic tissues in the growing regions, leading to loss of apical dominance and the development of a rosette condition. These deficiency symptoms are similar to those caused by calcium deficiency. In plants in which boron is readily transported in the phloem, the deficiency symptoms localize in the mature tissues, similar to those of nitrogen and potassium. Both the pith and the epidermis of stems may be affected, often resulting in hollow or roughened stems along with necrotic spots on the fruit. The leaf blades develop a pronounced crinkling and there is a darkening and crackling of the petioles often with exudation of syrupy material from the leaf blade. The leaves are unusually brittle and tend to break easily. Also, there is often a wilting of the younger leaves even under an adequate water supply, pointing to a disruption of water transport caused by boron deficiency.

  Boron also plays an important role in reproduction of plants. Boron deficiency sunflower will show poor seed set and in severe cases of B deficiency it may lead to misshapen sunflower heads and even snapping of the stem directly below the sunflower head. It is therefore very important to monitor the B status of the soil and plants when sunflower is cultivated, as B deficiencies can cause severe yield losses.

Figure 3.8. Boron deficiency symptoms in tomato. (Epstein and Bloom 2004)

- Sulphur
  Figure 3.9 provides a photograph sulphur deficient leaves, showing a general overall chlorosis while still retaining some green colour. The veins and petioles show a distinct reddish colour. The visual symptoms of sulphur deficiency are very similar to the chlorosis found due to nitrogen deficiency. However, in sulphur deficiency the yellowing is much more uniform over the entire plant including young leaves. The reddish colour often found on the underside of the leaves and the petioles has a more pinkish tone and is much less vivid than that found in nitrogen deficiency. With advanced sulphur deficiency, brown lesions and/or necrotic spots often develop along the petiole, and the leaves tend to become more erect and often twisted and brittle

Figure 3.9. Sulphur deficiency symptoms in tomato. (Epstein and Bloom 2004)

- Zinc
  Figure 3.10. provides a photograph of a zinc deficient leaf showing an advanced state of interveinal necrosis. In the early stages of zinc deficiency, the younger leaves become yellow and pitting develops in the interveinal upper surfaces of the mature leaves. As the deficiency progress these symptoms develop into an intense interveinal necrosis

but the main veins remain green, as in the symptoms of recovering iron deficiency. In many plants, especially trees, the leaves become very small and the internodes shorten, producing a rosette like appearance.

Figure 3.10. Zinc deficiency symptoms in tomato. (Epstein and Bloom 2004)

Recommendations for Rectifying Nutrient Deficiencies

Deficiency symptoms should never be the basis on which fertilization programs are developed.

The symptoms described above should be used in conjunction with leaf and soil analyses and should form part of the process that culminates in the formulation of a fertilization management plan.

The best policy is to prevent deficiencies by applying the necessary elements before or at plant. As growing conditions are, however, not always ideal, the plant may experience deficiencies in certain elements. Deficiencies often occur during fast/active growth and during the reproduction phase of a plant. Applying the necessary element to the soil at the stage of deficiency will often not resolve the problem as it takes a relatively long time for the plant roots to take up the nutrients and relocating of the nutrients in the plant where it is needed may also take some time (up to a week or more). Therefore, the deficient element(s) are most often applied by foliar application, as the plant will react on the element within 24 to 48 hours after application.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Nitrogen

Nitrogen can be supplemented as soil applications and/or foliar sprays depending on the time of the year and severity of the deficiency.

When a hidden nitrogen deficiency is detected in a crop, it should be reported and rectified as part of the overall nitrogen application schedule. Nitrogen cannot be applied to the crop at any time of the year and all corrections should be made during the timeframe for nitrogen applications for the specific crop.

In tree crops, where serious deficiencies are identified, one must consider the potential adverse effects on the current and next crop before deciding on a nitrogen application. In vegetable crops and field crops, N will be applied as soon as the deficiency occurs, as one cannot wait as these are annual crops. Applying N too late will reduce the uptake of N as the leaves have started their natural senescence and the produce has started to mature. Before applying N as a foliar application, you should consult with your nutrient supplier if it will still have an economical beneficial effect on the crop or not.

Magnesium

Magnesium is supplemented by soil applications and/or foliar sprays depending on the time of the year and severity of the deficiency.

A magnesium deficiency in citrus can be corrected at any time of the year, as long as the correct carrier is used. Do not apply magnesium nitrate during August to 100% blossom or during March to June. Other sources of magnesium have fewer constrictions unless they contain plant available nitrogen.

In annual crops, Mg sprays will only be applied if it is to the financial benefit of the crop. It will thus be restricted to high value vegetable crops.

Copper

Copper is applied as a foliar spray. When applied to small citrus fruit, the sap from damaged cells react, causing a darker blemish. This accentuated blemish grows with the fruit and such fruit cannot be exported and are culled at picking. Copper products, especially copper suspensions, should therefore not be applied on small and green fruit.

In annual crops, Cu sprays will only be provided if it is to the financial benefit of the crop. It will thus be restricted to high value vegetable crops.

Iron

Iron deficiency in citrus is best rectified by an application of an appropriate chelate to the soil, preferably during August. Iron chelates are expensive and an application is only economically justifiable when more than 20% of the canopy shows iron deficiency symptoms. Where drip irrigation systems are used, much less chelates is applied and the cost can be justified even as a maintenance application.

When the irrigation water or nutrient solution is not acidified, use a chelate that is stable in an alkaline environment. On alkaline soils, the preferred chelates is EDDHA (ethylene di-amine, di-hydroxy tetra acetic acid), which is applied at a rate of 30g per m2 at not more than 300g per tree.

In annual crops, Fe sprays will only be provided if it is to the financial benefit of the crop. It will thus be restricted to high value vegetable crops.

Other deficiencies

Where annually crops are grown, it may be late to rectify a deficit if it is identified towards the end of the growing season. Exceptions are where Ca deficiencies are detected in crops like tomato, peppers, lettuce etc. as well as B deficiencies in sunflower. If the plants are, however, still in the seedling stage, then applying applicable foliar or soil-based fertilizers might be of value.

Soil and Leaf Samples

Although soil samples can be taken at any time, except after an application of fertilizers, it has little value in diagnosing or confirming a nutrient deficiency symptom. In commercial citrus production for instance, fertilizers are applied from July to December and, in certain cases, as late as February. Soil sampling is therefore only reliable between February and June, which is the time to take soil samples to formulate the fertilization program for the coming season.

In annual crops, the timing of soil sampling depends on whether double cropping is practiced or not. Double cropping implies the cultivation of one crop in the autumn/winter and one in spring/summer in succession to each other on the same field. In this case soil sampling can only be done after the previous crop has been harvested. The time before planting the next crop is often less than two months and sampling the soil in good time is of essence. If only one crop is being produced on the field, then there is more time, but soil sampling should commence shortly after the existing crop has been harvested, in preparation for the following crop.

There are specific prescriptions for leaf sampling for individual crops. Consult with a fertilizer consultant and the analytical laboratory on the procedure for the specific crop you are working with. A specific example is that of leaf sampling in sunflower to detect a B deficiency. According to the guidelines, the upper most mature leaf, without the petiole, has to be taken. If the leaf sample was taken a month after plant, is should contain at least 60 ppm B, while a sample taken at the onset of flowering should contain at least 40 ppm B.

Norms to evaluate the results of leaf analyses are developed for a specific leaf type, at a specific position on the plant, taken at a specific physiological stage. This is called the diagnostic leaf. Deficiency symptoms seldom develop on these leaves. Deficiency symptoms mostly develop on young or old leaves and reference norms are usually not available for the symptomatic leaves. Leaf analyses therefore sometimes fail to detect the deficiency and taking leaf samples have limited value. Other factors such as total biomass produced can complicate the interpretation of the results.

Individual Formative Exercise 3

SOIL IMPROVEMENT

Appropriate Soil Preparation Methods

Soil preparation methods are dictated by the properties of the soil profile, being stratification, texture, pH and salinity. Before soil preparation can be done effectively, a soil survey is required. Some basic soil preparations include:

- Primary cultivation
- Secondary cultivation
- Ridging
- Levelling and Contouring

Vegetable and field crops may require seedbed preparation as the most important step in the soil preparation process. A good seedbed is characterized as being fine, firm and level. This is to ensure good contact between the seed and the moist soil in order to facilitate germination and rapid adaptation to field conditions.

To obtain a fine, firm and level seedbed, primary and secondary cultivation is used. Primary cultivation is the first ground-breaking of the season which cuts and shatter the soil with relatively deep penetrating tools (15 to 30 cm). The primary cultivation leaves a rough surface texture. Ploughs (mould board or shear ploughs); listers, bedders and rotary tillers are used to mix the soil with plant rests which may still be on the soil surface, lime and other chemicals which need to be applied before plant.

Primary cultivation and ripping

Sometimes, repetitive primary tillage can cause compaction layers (15 to 30 cm below soil surface), which prevents root penetration, encourages runoff and water logging. To break up such a compaction layers, rippers are used. It loosens the soil by the lifting of the soil and letting it down without any mixing, in an up-and-down motion.

These implements can penetrate the soil to a depth of up to 90 cm. The principle of this method is to loosen the soil without changing the downwards sequence, or layering. The best loosening is achieved by ripping the soil in two directions, of which the deepest is down-slope. The angle between the two directions should be 60°. To improve the lifting action, wings are

attached to the ripper-tine at an angle of 30° with the horizontal at operating depth. This preparation method is also suitable for soils with clayey, acid, saline or carbonate-rich subsoil. Under these conditions, the subsoil must never be brought to the surface. Due to the cost involved when the soil is ripped, other primary cultivation actions will often not be done after ripping.

Secondary cultivation

Secondary cultivation follows on primary cultivation or ripping. This involves operations, which pulverize level and firm the top 5 to 15 cm of soil. It leaves the soil with a crumbly top layer of soil 2 to 3 cm on top of a firm, but not "hard panned," subsoil. The loose top layer is necessary for oxygen supply and temperature regulation for the seed germination and root growth as explained earlier. Implements used during secondary cultivation include disk harrows, cultivators and rotary tillers.

Ridging the Soil

Inter-row Spacing

The spacing between cropped rows differs between crops. In the case of citrus trees inter-row spacing may vary from 5 to 7 metres. The space required for spray machines and other orchard vehicles is 2.5 metres.

- Citrus
  When the depth of suitable soil is limited, the soil from the inter-row spaces can be moved to the area where the trees will be planted, thus excavating the vehicle paths and filling the planting area with more suitable soil. This creates ridges of suitable soil.

  The purpose and advantages of ridging are:
- Improvement in surface drainage;
- Increase in soil temperature in the upper layers;
- Increase in the depth of suitable soil;
- Savings in fertilizer and energy cost;
- Facilitation of the mixing of fertilizers; and
- Control of vehicle movement in the orchard. Ridges clearly indicate the inter-row paths and re-compaction of the soil is limited.

Before ridging, the required lime, gypsum or phosphates are mixed with the top 20 to 30 cm soil layer. The ridges are then built with soil containing the right amounts of nutrients. The

mixing process is more effective and cheaper when this method is used, while also saving on fertilizer cost.
The height of the ridge is determined by the thickness of the suitable layer of soil. If this layer is less than 20 cm thick, ridging will not improve the potential of the soil sufficiently, although it also depends on the layer below this suitable layer.

The disadvantages of ridging are:

- Higher soil temperature, which can be up to 5°C higher compared to a flat soil surface;
- Increased evaporation of water;
- Limitation in irrigation design, as only drip and micro-jets can be used; and
- The undulating surface which makes picking more difficult.

Other crops

Ridges are often used in the production of vegetables and field crops to improve drainage and aeration. To ensure the benefits of ridging, the ridges should be at least 30 cm above the normal soil surface. The width of the ridges will depend on the number of rows planted per ridge and the amount of space needed by individual plants, and can therefore be as wide as 1 meter, as but seldom more than that.

In most crops, the soil is only ridged once during the life span of the crop. In potatoes, however, it is often done twice. First before plant and the second time after the plants have reached a height of 30 to 50 cm. The bottom 20 cm of the plant is then covered with soil coming from between the rows. In this case ridging (also called earth up) is done to cover the tubers, and protect the tubers against attacks from the potato tuber moth and some tuber diseases. By covering the tubers with soil, it also prevents sunlight from coming in contact with the tubers. If tubers are left in direct sunlight, it will turn green. Green tubers do not taste nice, and if one consumes too much green tubers at one go, you may become ill. Additional benefits of ridging at this stage are reducing the soil temperature around the developing tubers and physically controlling of weeds growing between the rows. Special ridge- making implements are available for use in potatoes and one should enquire about this from your local implement dealer.

Levelling and Contouring

This involves the shaping of the soil surface within a field to improve surface drainage and eliminates areas where water may pond. The activity requires the use of cultivation and land

CIN: 20300 **Version: 001**
Date: 2021/10/26

levelling equipment such as scrapers and heavy tractors. Land grading is generally used to improve drainage but can be used to change the aspect of a site, remove bumps and hollows or provide improved erosion control. See Session 1 of this unit standard for more information on sloping and the handling thereof.

Mulching

In areas where water (erosion and losses) are problematic, a layer of plant rests (mulch) are often placed on the soil surface. This layer prevents excessive water losses through evaporation and runoff. Mulching is one type of conservation tillage and the requirement for this is that at least 30% of the soil surface been covered by mulch. The mulch can be from in situ plant rests or applied to the field from another sources.

Mulching can, however, not be recommended where there is a problem with soil borne diseases. The mulch will in this case provide a habitat for the diseases to flourish in and this will be detrimental to the crop.

Minimum and zero tillage

Minimum and zero tillage are also forms of conservation tillage. These types of tillage practices imply that there will be minimum or no soil disturbance.

With minimum tillage only that part of the soil which will be planted to the crop will be disturbed. The disruption of the soil often includes a loosing of the topsoil in the planter furrow, followed by sowing of the seed in the cultivated furrow. The previous season's plant rest is often disked into smaller units to form a mulch layer on the soil surface (Fig 4.1.).

Figure 4.1. Seed drilling (sowing) in minimum tilled soil, covered in wheat mulch.

In zero tillage practices, the soil will only be disturbed by the drilling of a hole in which the seedling or seed is then placed. The plant rests of the previous season will often still be in place on the field (Fig 4.2.). It is therefore not incorporated into the soil, nor disked into smaller units.

Figure 4.2. Seed drilling (sowing) in a zero tilled soil, covered by the stubble of the previous season's wheat.

Appropriate Soil Maintenance Methods

Maintenance of the soil after establishing the crop includes:

- Protecting the surface against erosion;
- Minimizing compaction;

CIN: 20300 **Version: 001**
Date: 2021/10/26

- Guarding against salinisation; and
- Limiting acidification.

Protection Against Erosion

The best method to protect an orchard-floor against erosion is to use a natural grass cover or cover crop.

The orchard floor should not be kept completely free of weeds. The area underneath and between the trees should be weed-free, forming a strip one metre wider than the diameter of the tree canopies. On the rest of the orchard-floor, including the paths between the rows, a natural grass cover must be established as quickly as possible. This is not always possible in low rainfall areas because the paths between the rows are not irrigated.

The width of the grass-strip will decrease as the trees grow and must never reach underneath the canopy. The grass must be mowed frequently, and the cuttings blown underneath the canopy. These strips of grass also harbour beneficial insects and play a major role in pest control.

As explained in the previous section, by using surface mulch, water infiltration into the soil is improved and it also reduces runoff. If mulch is not or cannot be used, erosion can still be controlled by making sure the soil surface have a crumb structure rather than a smooth structure.

Minimising Compaction and the formation of surface crusts.

Compaction of the soil after soil preparation is inevitable, but must be minimised as much as possible. Practises that accelerate compaction are vehicle traffic, high precipitation rates and salinisation.

Vehicle traffic has the severest impact. All vehicles should be restricted to the 2.5m middle section in the inter-row paths and must never drive closer to the trees than that. In vegetable and field crops, vehicle traffic should be restricted to fixed pathways (called tram lines) in the field. This will still lead to compaction, but only in certain parts of the field and not the whole crop area.

When water is applied at a rate exceeding the infiltration rate of the soil, the soil particles floats and, on drying out, will settle in a more compacted state. This reduces the infiltration rate even more, with the consequences of more surface compaction. This is also referred to as crusting.

Salinity, and especially an increase in the SAR of the soil, accelerates crusting. Soil analyses will help detect the development of crusting, but the first symptom is runoff halfway through the irrigation cycle.

Guarding Against Salinisation

Apart from crusting, which is the first symptom of salinisation, accumulation of sodium or reduction of calcium deeper in the profile should be monitored continuously. For this purpose, regular soil analyses are required. Although the ratio of the cations is a good indicator of developing salinity, the subsoil should also be sampled from time to time. The intervals will be determined by the conditions prior to planting when the profile was analysed.

As indicators of developing salinity, the calcium to total cation ratio should be 70% to 75% and the sodium <3.00%.

Limiting Acidification

Acidification is more active in the sub- than the topsoil. Subsoil sampling is therefore, more important to monitor the pH.

The ammonium form of nitrogen is the cheapest nitrogen source but also one of the greatest sources of acidification. Even in fertilizers like LAN, acidification can be a potential hazard for subsoil pH levels. Liming the subsoil alone is not possible and the pH of the sub-soils must be monitored granularly. The frequency of sampling can only be determined by historic data.

Record Keeping

During a soil survey, many soil properties are evaluated, analysed, described and recorded. Many of these properties are stable and will not change. These records are therefore valuable

for replanting and for future developments, and should not have to be redone. The stable properties include:

- Slope;
- Aspect;
- Soil depth;
- Clay content;
- Structure;
- Water-holding capacity; and
- Cation exchange capacity

The variable properties of soil are:

- pH;
- Nutrient content; and
- Resistance

It is in this regard that soil and leaf analyses, especially historical data from routine leaf and soil analyses, have its value. This data indicates the direction in which the nutritional status of the soil and trees are moving. Records of the variable data should be kept in an easily accessible format for at least three years.

The format may vary, but should enable the reader to compare year-on-year figures with ease.

Historical Data on Nutritional Status

NUTRITIONAL STATUS REPORT

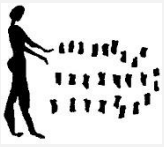
Orchard:	Orchard 10		Cultivar:	Delta Valencias	
Element	*2002*	*2003*	*2004*	*2005*	*2006*
N	2,11	2,45	2,50	2,01	1,87
P	0,11	0,14	0,11	0,12	0,10
K	1,56	1,32	1,09	0,94	0,88
Ca	3,65	3,62	4,06	4.11	3,83
Mg	0,31	0,37	0,41	0,38	0,37
S	0,22	0,19	0,25	0,27	0,23
Cl	0,04	0,01	0,19	0,33	0,47
Na	21	39	117	582	498
Cu	7	21	18	54	21
Fe	74	118	131	163	211
Mn	132	85	46	40	28
Zn	36	29	54	21	14
B	85	107	152	162	228
Mo	1,34	0.42	0.78	0.31	0.55

From the historic data a number of valuable tendencies can be identified, namely:

- The sharp drop in the N status for two consecutive seasons indicates possible problems with root-health.
- The potassium level is decreasing and requires serious attention. There is a danger that the level may drop to the point where fruit-size will be negatively affected.
- Chloride and sodium are accumulating in the soil-water-tree-system and could be indicative of salinity.
- The decrease in the manganese content points to increasing alkaline conditions in which manganese is less available.
- The increase in iron and boron concentration confirms to some extent the increase in salinity

Group Formative Exercise 4A

Group Formative Exercise 4B



Individual Summative 2

Unit 3: Propagate Plants

Unit Standard	
116316	Propagate plants in a variety of situations
Specific Outcomes	
SO1: Recognise and use propagation structures, facilities and materials under supervision and do problem solving on his / her own in relation to processes and maintenance. SO2: Propagate a variety of plant types using different asexual methods. SO3: Experiment with different types of propagation media and environment. SO4: Establish a process for the post propagation activities.	

WHAT IS PLANT PROPAGATION?

Definition: Propagation of plant is defined as production of new individuals from a selected plant having all the characters of the original one.

Importance of plant propagation:

1. Multiply the different species in large number.
2. Protect the plant species which are endangered.
3. Improve the characteristics and quality of the plants.
4. Produce quality and healthy plants on commercial base.

THE STUDY OF PLANT PROPAGATION

Propagating new plants is both a science and an art. The study of it can provide a lifetime of challenges and opportunities to learn more about this fascinating craft, or a basic knowledge of it can provide the farmer with the skills and techniques to keep their farm well stocked with new plants. Plant propagation is the multiplication of plants by both sexual and asexual means. From the home gardener starting a few tomato plants from seed on the kitchen windowsill, to the conservationist growing endangered species of orchids in test tubes, to the nurseries that grow the millions of annuals, perennials, bulbs, shrubs, and trees sold ever year, a working knowledge of plant propagation makes all of these endeavours possible.

Propagation Methods

There are probably as many methods of propagating plants as there are reasons for wanting to do so, but there are basically two types of propagation — **sexual** and **asexual**. Nearly all plants in nature have the ability to reproduce sexually, that is, by **seed**. Along with producing seed they have developed many modifications that aid in the dispersal of that seed. Such modifications include:

- Seeds being enclosed in colourful fruits that are attractive to animals that eat the fruits and deposit the seeds elsewhere.
- Seeds with wing-like or tufted appendages that enable the seed to be carried by the wind.
- Seeds that are hooked or barbed that are easily attached to the coats of animals or out clothing and carried away.
- Seeds that can float thousands of miles away to wash up on a tropical island (such as a coconut).

Many types of plants in nature have also evolved means by which they can reproduce asexually. Some such means include strawberry runners, potato tubers, and Johnsongrass rhizomes. Along with all the natural modifications, people have developed many ways to propagate plants more efficiently and ways that meet the needs of both the agricultural communities and the horticultural trade. Seeds can be treated in various ways to achieve better and more uniform germination rates. Cuttings of various plants can be rooted in greenhouses when the parent plants are under three feet of snow. The highly specialized techniques involved in micropropagation allow growers to produce thousands of genetically identical plants, tissues (thus the term tissue culture), or cells. Learning about these procedures and many others

makes plant propagation a tremendous way to expand one's knowledge of plants and gardening, and can lead to an interesting and rewarding profession.

Methods of propagating plants, with typical examples

Propagation	Propagation by		Typical examples
Sexual	Seed		Annual (maize), biennial (cabbage) and many perennial plants like tomatoes
Asexual (Vegetative)	Cuttings	Stem cuttings	Hardwood – fig, grape, rose Semi-hardwood – lemon, camellia Softwood – lilac, pyracantha, weigela Herbaceous – begonia, sugar cane, chrysanthemum
		Leaf cuttings	*Begonia rex*, sansevieria, African violet
		Leaf-bud cuttings	Blackberry, hydrangea
		Root Cuttings	Phlox, daphne, horseradish
	Grafting	Root grafting	Apple, pear
		Crown grafting	Persian walnut, camellia, grape
		Top grafting	Various fruit trees
	Budding	T-budding	Stone and pome fruit trees, rose
		Patch budding	Walnut, pecan
	Layering	Tip	Trailing blackberry, black raspberry
		Simple	Honeysuckle, spirea, grape
		Mound or stool	Apple rootstock, gooseberry
		Air	Litchi, Indian rubber plant
	Runners		Strawberry
	Suckers		Red raspberry, blackberry
	Separation	Bulbs	Hyacinth, lily, tulip
		Corms	Gladiolus, freesia
	Division	Stem tubers	White potato
		Tuberous roots	Sweet potato, dahlia
		Rhizomes	Iris, cannas
	Micro-propagation	Shoot-tip culture	Orchid, carnation, asparagus, chrysanthemum
		Tissue culture	Rhododendron

Sexual Plant Propagation

Sexual propagation of flowering plants, as opposed to ferns and mosses, begins with flowering, followed by pollination, fertilization and seed production. Seeds are used in large-scale agriculture and forestry operations for growing wheat, corn, alfalfa and tree seedlings for reforestation projects. Propagation by seeds is also critical to many aspects of horticulture including the establishment of many turfgrasses, bedding plants, and a wide range of trees and shrubs, although propagation of many of these types of plants is not restricted to sexual propagation. Sexual propagation has several advantages when compared with asexual methods.

- It is generally the cheapest method.
- It generally requires the fewest skills, specialized equipment or facilities, and is thus the easiest method.
- Seed can be easily stored, often for several years, and still successfully germinated.
- Seeds are cheaply and easily shipped or transported around the world.
- If properly cleaned and stored, seeds are less likely to carry diseases.

Seedlings are likely to be genetically different from the parent plant – this may be desirable for research, breeding, plant selection and conservation work, but may be undesirable in regard to other interests.

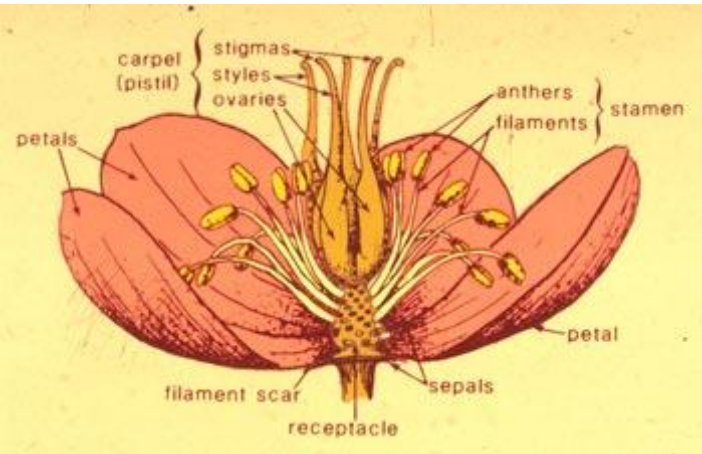
Some disadvantages of using this method include:

- Some plants don't produce live, (viable), seeds, and thus cannot be grown this way.
- Seeds may take a long time to grow into mature plants.
- Seedlings are likely to be genetically different from parent plant, and may not have the same desirable characteristics.

The genetically difference is often especially true for many cultivars and hybrids.

Development of Seeds

The basic function of flowers is to be pollinated so seeds can develop, grow and perpetuate the species. It is obvious just by casual observation that all flowers are not created equal, but flower types can be grouped in terms of their structure and how it relates to pollination and seed production.



Perfect flowers are individual flowers that have both male and female parts. The male part of a flower is known as the **stamen** and is made up of the **anther** and the **filament**. The female part of the flower is known as the **pistil** and is composed of the **stigma**, **style** and **ovary**. Perfect flowers may have one or many stamens and pistils in each flower. **Imperfect flowers** lack one or more of the parts that make up the stamen or pistil.

Some flowers contain only male or only female parts. When a plant develops separate male flowers, (**staminate flowers**), and separate female flowers, (**pistillate flowers**), and both occur on the same plant, the plant is referred to as**monoecious**. Examples of monoecious plants include corn, walnuts and many conifers. With corn, the tassels at the top of the plant are the male flowers, and the silks and young ear represent the female flowers.

Dioecious plants have separate pistillate and staminate flowers, but they are **always on separate plants**, thus you will have plants with **only female flowers** and others with **only male flowers**. Dioecious plants include hollies, date palm, asparagus and Ginkgo biloba. Male plants will never produce seeds or fruit. Females will only set fruit if a compatible male plant is nearby, neither male nor female plants will die if they are not close to each other however.

Pollination involves the transfer of pollen grains from the anther to the stigma. A variety of bees, butterflies, moths and birds are responsible for pollinating a wide range of plants. Flowers often attract pollinators by various characteristics such as color and color patterns, shape, fragrance, offer of food, or, in the case of many orchids, resembling a potential mate for the would-be pollinator. Other plants rely on wind to carry the pollen grains. Conifers and grasses, including many of our grain crops, are wind pollinated.

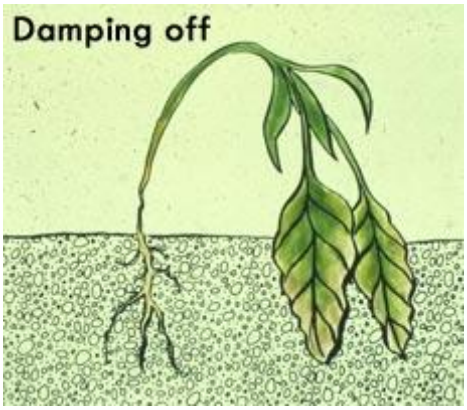
CIN: 20300 **Version: 001**
Date: 2021/10/26

Once the pollen grain lands on a receptive stigma a **pollen tube** begins to grow downward through the style to the ovary where fertilization occurs. Often there are many ovules (eggs) within the ovary. The ovary will develop into the fruit and each **ovule** will develop into a seed.

Growing Plants from Seed

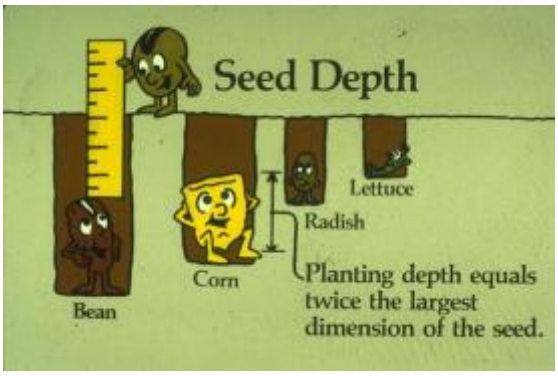
The success achieved when growing plants from seed is dependent on several factors including the seed itself, the medium and the conditions to which the seed and seedlings are subjected. The seed used should be of high quality and, usually, the newer the seed, the better the germination and subsequent seedling growth will be.

The **medium** refers to the soil into or onto which the seeds are sown. Whatever seed sowing mix is used, it should be free of weed seeds, harmful insects and pathogens that may prevent germination or kill the young seedlings.



A disease known as **damping-off** is one of the most troublesome problems encountered if soil and sowing containers are contaminated. The mix should also be free-draining and should not remain soggy after watering. There are several ingredients that can be used to create a suitable medium. Common components include peat moss, vermiculite (a mineral), perlite (a

material of volcanic origin – often mistakenly identified as Styrofoam in soil mixes), sand, fine milled bark, compost and milled sphagnum moss. Fortunately, there are several very good, bagged mixes available in garden centers, but as you experiment with growing various types of plants from seed you may prefer to mix your own special blend.
The most common bagged mixes contain peat moss and vermiculite, and often a small amount of fertilizer to get the seedlings off to a strong start. Whatever seed mix is used, it need not be particularly rich in nutrients. It is much more important to have a mix with proper physical qualities. Once the seedlings are growing, attention can then be shifted to proper feeding with a dilute, water soluble fertilizer if necessary.

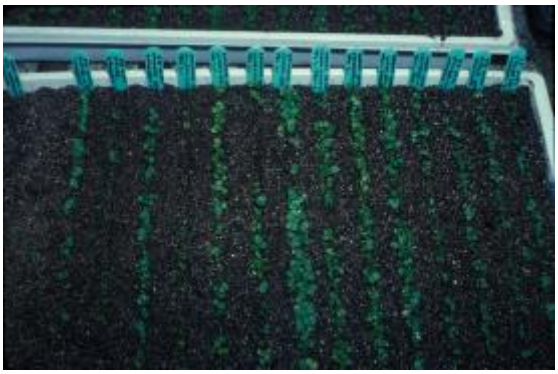


Seeds can be sown into almost any type of container, but of course, clay or plastic pots or flats are logical choices. The pots or flats should be sterilized before use (a dilute solution of bleach and water works well), and there must be drainage holes to allow excess water to drain away. When sowing the seed, the surface of the media should be even, firm (but not compacted), and slightly moistened. The depth of planting will vary with the type of plant being grown.

A general rule is to **plant seed at a depth of one to four times the thickness of the seed**. There are, however, some seeds that require light for germination and should be left uncovered, and just to keep you on your toes, there are others for which light can inhibit germination! This is one reason why it is wise to do a little background check on the seed you are about to sow, or at the very least, read the seed packet that often has much useful information.

Once sown, it is essential that the medium remains moist but not overly wet. Maintain the correct moisture level by placing seed pots in a plastic bag or a propagating case (creating an enclosed environment for high humidity) but keep a close eye on the temperature within. The

widest range of the most commonly grown annual and biennial flowers, and vegetable plants germinate best between 65-75°F.



Depending on the seeds, germination will often occur within one to three weeks, but there are others that will take longer. Once the seedlings emerge, it is important that they receive good light, otherwise seedlings will be spindly, weak and quite difficult to transplant. It is often a good idea to lower the temperature by 5-10°F which will slow growth but will help to keep the plants stocky.

Seeds of many plants, especially woody plants and perennials, have physical or chemical inhibitors within the seed that prevent the seed from germinating even if the proper medium, temperature and moisture levels are present. The good propagator has several techniques that will effectively overcome these natural barriers to germination. One such method is called **stratification**. This involves giving the seeds a moist, cool treatment. Frequently seeds are mixed with moist peat moss, vermiculite or sand, put in a plastic bag and placed in the refrigerator, (35-40°F), for a certain length of time – 90 days is a common duration.

The process of soaking up water is known as **imbibition** and is the first step in germination. Certain seeds have hard, impervious seed coats that prevent water from being absorbed thus

CIN: 20300 **Version: 001**
Date: 2021/10/26

delaying germination. **Scarification** is a method often used to overcome this problem. Scarification involves wearing away at the seed coat to allow water in to the embryo. This can be done mechanically with a file, piece of sandpaper, or by carefully nicking the seed coat with a knife. Some propagators dealing with large numbers of seed will use various acids to eat away at the seed coat, but this is a very refined technique in which great attention must be paid to the concentration of acid, and to the duration for which the seeds are soaked.

There are many other techniques and "tricks" that propagators employ to get certain seeds to germinate. Many plants that have adapted to habitats prone to fire have developed seeds that rely on fire as a precondition to germinating. Other seeds germinate only when a certain microorganism is present in the soil, or when a particular plant is already growing. With many South African plants, exposing the seed to smoke is beneficial or necessary to germination. As much as we know about seeds and how to grow them, there is still much that we do not fully understand. Until we have all the "recipes" for germinating seeds down to an exact science, a good basic knowledge of the techniques along with personal experience will go a long way in bringing success to your seed sowing efforts.

Ferns from Spores

Ferns are one of the first groups of plants to be trendy. They were all the rage in Victorian times but have since quietly gone out of favor. That is, up until recently when there has been renewed interest in this diverse group of plants, largely from native plant enthusiasts. Ferns belong to a group of plants known as Pteridophytes which also includes mosses and others. In terms of plant classification, they are amongst the most primitive members of the plant kingdom. As a group, the pteridophytes are often referred to as the lower plants with flowering plants being known as higher plants. Ferns do not flower and thus do not produce seeds, but rather produce spores. Because of this, ferns have a distinctly different life cycle. Ferns typically produce a great abundance of spores that makes it possible to grow thousands of plants from a single, mature fern plant if the conditions are suitable.

To propagate ferns from spores, the spores must be ripe (just as with seed). The medium onto which spores should be sown can be the same as that used for seed sowing, although it is critical that it be sterile. Spores are dust-like, therefore sow them very sparsely, as it is very easy to sow too many! The pot containing the spores should go in a plastic bag and then be placed in a warm, bright spot, but not in direct sun. The humidity within the bag should remain high. The speed at which fern spores germinate varies greatly depending on the species. Check

CIN: 20300 **Version: 001**
Date: 2021/10/26

the bag frequently to make sure the pot doesn't dry out. The first signs of life will be a green film developing on the surface of the medium. When this appears, mist the surface often. Gradually, young fern plants will begin to develop. When the young plants are large enough to handle easily, they can be transplanted to individual pots.

Many ferns can also be propagated using various asexual methods including division, bulblets, plantlets and micropropagation.

Asexual Plant Propagations

Asexual propagation is the production of plants using the vegetative parts of a plant. Vegetative parts include stems, leaves, roots, bulbs, corms, tubers, tuberous roots, rhizomes, and undifferentiated tissue often used in micropropagation. Propagation by division, cuttings, layering, and grafting are all forms of asexual propagation. Although many plants can be propagated by at least one asexual method, there are some that for one reason or another cannot. When compared to sexual methods, asexual methods have certain advantages.

- Plants are genetically identical to the parents so plants with desirable characteristics can be reliably cloned.
- It allows propagation of plants that do not produce seed, produce little seed, or are difficult or impossible to grow from seed.
- A grower can get a saleable or mature plant more quickly for many plants.

Some disadvantages include:

- Asexual methods are generally more expensive.
- Many asexual methods require greater skill, and/or special equipment or facilities.
- There is an increased likelihood of spreading or perpetuating certain diseases.
- Clones can become weakened and lose vigour after years of asexual production, although this is by no means a general rule.

Division

Dividing plants is probably the simplest form of asexual propagation. This method is regularly used in the propagation of a wide range of herbaceous perennials such as daylilies, Siberian iris, bee balm and ornamental grasses. It essentially involves splitting a single large plant with many crowns or growing points into several individual smaller plants. It is labor intensive, and for that reason is a last option for commercial nurseries when there is no other viable method of propagating a particular plant.

Cuttings

Cuttings can be taken from a variety of plant parts – stems, leaves, roots, buds – but not all plants can be propagated by cuttings and certainly few, if any, can be grown from all types mentioned. The plant from which the cuttings are taken is referred to as the stock plant or parent plant. There are many factors that affect the type of cutting used as well as the success achieved with a certain type of cutting, and include:

- The type of plant being considered for propagation,
- The age and health of the stock plant,
- The time of year, and
- The facilities, equipment and material available for propagation.

When taking any type of cutting, keep in mind that by removing the cutting from the parent plant, it is cut off from its supply of moisture and is instantly under stress. This is a particularly important consideration when dealing with leafy cuttings such as herbaceous, softwood and semi hardwood cuttings. To reduce stress on the cuttings, take cuttings on cool, cloudy days; place cuttings in a plastic bag along with a damp paper towel until they can be inserted in the rooting medium; and prepare cuttings quickly. Also, make sure that cuttings are labeled with

the plant name, the date taken, and any special treatment given the cuttings, such as a particular hormone used. This can help you learn more about a plant and may be useful if you want to take cuttings again next year.

The **rooting medium** used can vary greatly from grower to grower and may vary depending on the type of plant being propagated. The medium must provide support for the cutting to keep it upright. It must also hold an adequate amount of moisture and allow for oxygen to reach the root zone. Although rooting media are like seed sowing mixes, they are generally coarser. A mix of half peat moss and half perlite is commonly used, but many mixes exist to meet the needs of different plants, or simply produce good results for the nursery or gardener using them.

Water is the most critical aspect in the rooting process – too much and the cuttings are deprived of oxygen and the likelihood of disease is greatly increased, too little and the cuttings suffer, wilt and will root slowly, if at all. Professional growers and nurseries use mist or fog systems to maintain ideal moisture and humidity levels. These systems are controlled by a humidistat, timer, or a unit called an electronic leaf.

Light is also an important factor, at least for stem cuttings with leaves and leaf cuttings. Light is necessary for these types, so the plant can continue to photosynthesize and produce carbohydrates needed for the development of roots. Too much sunlight, however, is to be avoided as this can cause the cuttings to dry out too quickly. The **temperature** can also influence root formation. Good success can be achieved with an air temperature of around 65°F for a wide range of cuttings. Often, roots will form even more quickly if bottom heat maintains the rooting media about 10°F warmer.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Auxins are one class of **plant hormones** that occur naturally in plants. **Rooting hormones** used by propagators are synthetic versions of these compounds. Used correctly, these types of hormones can hasten rooting, lead to denser root systems, and help avoid certain disease problems. They are available as liquids or powders and vary in their concentrations of active ingredient. The bases of stem cuttings are dipped into the material and then inserted in the medium. Two common rooting hormones are **napthaleneacetic acid**, (NAA), and **indolebutyric acid**, (IBA). Care should be taken when using hormones as certain cuttings can be damaged by the incorrect strength. These materials break down quite quickly in light, so they should be stored in an appropriate manner.

Types of Cuttings

Stem cuttings are certainly the most important type of cuttings in regard to commercial plant production. They can be divided into four groups based on the nature and maturity of the piece of stem used – hardwood, semi-hardwood, softwood and herbaceous. With the exception of hardwood cuttings which are often longer, cuttings of approximately three to five inches are ideal, although cuttings taken from certain dwarf plants will necessarily be shorter.

CIN: 20300 **Version: 001**
Date: 2021/10/26

When taking cuttings work with a clean, sharp, knife or hand pruners. Cuts should generally be made just below a node, (the point at which a leaf joins the stem, and the point at which roots form most readily), and the leaves on the lower one-third to one-half of the stem should be removed prior to insertion into the media. The basic cutting is referred to as a **simple** or **straight cutting**. **Heal cuttings** are made by breaking a small, young shoot from the side of a branch. This will keep a small portion of the stem attached to the cutting. **Mallet cuttings** are similar but have a complete cross section of the main stem. Some evergreens root better when heal or mallet cuttings are used.

Wounding the base of cuttings of certain plants such as rhododendrons, hollies, magnolias and others can promote root production. Wounds are generally made by stripping lower leaves and some bark from the cutting or by cutting off a thin slice of bark from the lower third of the cutting.

Leaf cuttings and **leaf bud cuttings** are useful for propagating plants such as African violets, snakeplant, piggy-back plant and some begonias. A section of leaf, the entire leaf or the leaf and associated bud are inserted into a typical cutting media. In all cases, the cutting does not become a permanent part of the plant, but gradually disintegrates after the new, young plant is established.

A fairly wide range of plants can be propagated by **root cuttings**. Oriental poppies, certain species of phlox and roses, blackberries, raspberries, Japanese flowering quince among others are all likely candidates for this method. The biggest drawback to this technique is that it involves digging the parent plant out of the ground, or at the very least, severing much of the root system to get at the necessary root pieces. Root pieces can be from 1-6 inches long depending on how coarse the roots are – the finer the roots the shorter the segments. If root cuttings are inserted into media vertically it is essential that they avoid being put in upside down, thus maintaining correct **polarity**. In other words, the end of the root closest to the crown of the plant should be up and the farthest point should be down. Root cuttings of some plants can be laid horizontally, side stepping this problem altogether.

Bulbs are specialized organs with a growing point surrounded by thick fleshy scales. Tulips, onions, lilies and daffodils are all bulbous plants. Techniques for propagating bulbous plants include scaling, basal cutting, offsets and micropropagation.

Layering is yet another form of asexual propagation and is a method that encourages the development of roots on a stem while it is still attached to the parent plant. Tip layering involves bending a branch to the ground, wounding the branch where it touches the ground and covering it with some soil. Roots develop and soon send out new shoots. At this point the new plant can be cut off from the stock plant, lifted from the ground and transplanted. Black and purple raspberries, forsythia, spirea and many other common shrubs can be grown from tip layers.

Air layering is a similar technique but is a bit more involved and is used when a branch cannot be bent to the ground. This technique can be used to propagate several tropical and sub-tropical trees and shrubs such as croton, rubber trees, and philodendron. The stem is wounded, and the wound is covered with a generous amount of long fibered sphagnum moss.

The moss is then wrapped in a sheet of plastic that is tied off above and below the wound. The new plant can be cut off and planted once roots are visible through the plastic.

Underground Structures

Many plants produce specialized structures beneath the soil that are generally used as food storage organs on which the plant relies during adverse growing conditions. Bulbs, corms, tuberous roots, tuberous stems, tubers, rhizomes and pseudobulbs are all such organs. Frequently, though technically incorrect, all or several of these structures are referred to as "bulbs." To the propagator they are often convenient means of producing plants that have developed these sorts of structures.

A **corm** is made up of the swollen base of a stem surrounded by dry, scaly leaves. Crocus and gladiolus grow from corms. Corms are propagated by inducing the natural reproduction of new corms and by the cultivation of cormels, which are also naturally produced during the plants life cycle.

A **rhizome** is a specialized stem structure that grows at or just below ground level such as in bearded Iris, lily of the valley, sugar cane and many grasses. Typically, they are easily propagated by simple division or by a special type of cutting.

A **tuber** is a swollen stem structure that serves as an underground storage organ with nodes, often called eyes, from which shoots emerge. The potato, Jerusalem artichoke and caladiums are all tuber-producing plans. Tubers are easily propagated by dividing them into sections, with each section containing at least one eye.

Pseudobulbs, (meaning, "false bulb"), are typical storage structure of members of the orchid family. Pseudobulbs are readily separated from the parent plant as a means of propagation.

Grafting and Budding

Grafting and budding are both forms of asexual plant propagation. They both consist of connecting two pieces of living plant tissue in a way that allows the parts to unite and subsequently grow and develop as a single plant.

In any form of grafting, a piece of stem or shoot with dormant buds is the part that will grow and develop with branches. This part is known as the **scion**. In budding, the scion is reduced to a single bud with an attached pad of bark and cambium. The part of the graft that will develop into the root system is known as the **stock**, **rootstock** or **understock**. The stock can be comprised of a root system, a sapling or, for the purposes of top working, a mature tree that has been reduced to a trunk and main scaffold branches. Fruits and nuts, as well as roses, lilacs, dwarf conifers and many ornamentals with unique habits are examples of plants that are frequently grafted.

There are several different types of grafts – splice, whip, cleft, approach, wedge, and others are all variations that have different applications for different situations and reasons for wanting to graft in the first place.

The reasons for grafting are quite varied and, among others, include:

- To perpetuate clones that cannot be propagated or are not easily done so by other methods.
- To obtain the benefits of certain root stocks, such as to control height, habit or vigour, or to impart disease resistance.
- To change the cultivar of established plants through a technique known as topworking.
- To obtain special growth habits or forms.
- To repair damaged parts of trees.

There are, however, certain disadvantages:

- It is frequently more expensive.
- Grafting and budding are fairly specialized skills, thus require great experience to be able to make grafts.
- Diseases are readily transmitted.
- Rootstock suckers can be troublesome and can weaken the growth of the scion.

Not just any scion and stock can be grafted successfully. The two parts must be from closely related plants. Plants from different families are incompatible and this is frequently true for plants in different genera within the same family. A scion and stock that can be successfully grafted are said to be **compatible**. A pairing that is incompatible will simply not grow or will grow but never form a successful graft union leading to failure sometimes years from the time when the graft was first made. The time of year can also play a role in the success or failure of a graft. One technique that is sometimes employed to overcome the problem of incompatibility is to use an inter-stock. An inter-stock is a piece of stem inserted between the scion and stock that forms graft unions with both. An inter-stock is also useful, in some cases, for imparting hardiness or a growth regulating property.

When it comes to the actual act of grafting, the most critical point is that the cambium layers in the scion and stock be in close contact. The cambium is a layer of cells between the bark and the heartwood. This layer of cells is capable of dividing and forming new cells, forming callus in the process, that are necessary in order for the graft to be successful. It is important that the cambium layers do not dry out during the grafting process. The graft union is where the scion and stock are joined.

Micropropagation

Micropropagation, or tissue **culture** as it is also called, is the most cutting-edge means of propagating plants. It involves propagating plants from small plant parts, tissues or cells in specialized conditions in which the growing environment and nutrition are strictly controlled.

The basic principles of tissue culture have been known for about 100 years and such theories were suggested as long ago as the early 1800's. By 1939 scientists in the United States and

CIN: 20300 **Version: 001**
Date: 2021/10/26

France had made significant discoveries. Within another ten years, researchers had laid a solid foundation for today's large-scale tissue culture laboratories, propagation facilities, and further advances through ongoing research. It was not until recent decades that micropropagation became a feasible means of producing plants for the nursery industry. Today, many plants are propagated in this way. In catalogs, the names of plants that have been propagated by tissue culture methods are often followed by "TC" in parentheses. With every passing year more and more advances are made, and an increasingly wide range of plants find their way into the many tissue culture facilities which are appearing at an equally rapid pace.

Tissue culture makes use of an in vitro system. In vitro is from the Latin for "in glass," that is in reference to the fact that plant tissues are developed in test tubes and flasks under laboratory conditions. The multiplication of plants in vitro does not create a new process within the plant, it simply directs and enhances the plants natural potential to put forth new growth and multiply in a highly efficient and predictable way.

There are several advantages to micropropagation when compared with traditional asexual methods of propagation.

- Plants can be mass-produced rapidly.
- A new plant can generally be introduced to the nursery industry more quickly.
- Tissue cultured plants are free of insect and disease pests when removed from test tubes.
- The growth of in vitro cultures requires little care on a day-to-day basis, apart from casual surveillance.

There are also several disadvantages.

- More expensive. The start-up costs for a commercial micropropagation facility are high.
- The techniques used require greater skill and training.
- Not all plants can be produced through tissue culture.
- Mutations may occur during the culturing process resulting in plants different from the parent. This can be disastrous if not noticed at an early stage.

The success of tissue culture for reproducing new plants is based on the ability of small plant parts, tissues or cells to undergo rapid cell multiplication under the proper chemical and

physical conditions, and then to differentiate into the various parts that make up an entire plant. The plant part, tissue or cell type that is removed from a stock plant for purposes of being cultured is known as the explant. The explant can be a shoot tip, root tip, leaf tissue, pollen grain, seedling tissue, bulb scales and others.

There exist a number of factors that will affect the success of generating new plants by micropropagation. Sterility is of the utmost importance at all stages. Lab conditions are essential and much of the great expense is attributable to the need for such facilities. All surfaces with which the explant may come in contact, including countertops, tools and human hands, need to be sterile. The growth medium and glassware in which the new plants will be cultured must also be sterile. Apart from sterility, the explant itself and the culture conditions (light, medium, temperature) all play significant roles in the success.

The type of explant taken from a parent plant will also affect the generation of new cell growth and the subsequent new plants. Certain explant types work better for certain plants.
The medium used in tissue culture is unlike that used in any other type of plant propagation. A semi-solid, gelatinous material called agar is used. This provides support for the culture, but by itself is essentially inert. What is mixed in with the agar is what stimulates new growth. These ingredients will vary depending on the plant being cultured, as will the concentrations have used. Ingredients include inorganic salts of many essential plant nutrients and organic compounds like carbohydrates, vitamins, various hormones, and growth regulators.

The four sequential stages in all tissue culture systems are:

1. Establishment

2. Multiplication

3. Pre-transplant

4. Transplant

The purpose of the **establishment stage** is to establish a sterile explant in culture. The initial explants from the first stage have developed a mass of shoots that are separated into individual propagules and transferred to a fresh medium culture. This second medium is frequently the

CIN: 20300 **Version: 001**
Date: 2021/10/26

same or similar to that used in Stage 1, but the concentrations of certain ingredients may be altered.

The **pre-transplant stage** is necessary to prepare the grown propagules, now known as plantlets, for the shift from the rigidly controlled in vitro environment to that of a more typical plant growth environment, usually in a greenhouse. The pre-transplant stage also offers an opportunity to cull mutated propagules or ones that somehow became infected with a disease.

The **transplant stage** is the point at which the plantlets are moved to a pasteurized soil mix essentially as seedlings would be transplanted. At this point the plantlets are very tender and dry air and/or bright sunlight can easily burn them. Gradually, humidity levels can be reduced, and more sunlight provided to the young plants at which point they should be established and growing under standard conditions.

Propagation Tools

The following tools are used in the propagation methods described above.

- **Budding Knife** – A razor sharp knife used to make cuts on the seedlings and to cut off the bud-eye. The knife must always be sharp and in a good working condition to prevent tissue damage to the plant when cutting through it. If tissue damage occurs, the graft will most likely fail.
- **Budding Tape** – Clear polyethylene strips, used to maximize contact between the bud and the rootstock until the union and the healing is complete. It also prevents drying and excess water from getting in and rotting the bud.
- **Pruning Shears** – Bud-wood is cut using pruning shears. Pruning shears are also used where cuttings are used for propagation.
- **Sharpening Stone** – All blades become blunt with use and require periodic sharpening. A sharpening stone, or wet stone, and honing oil are required.
- **Sterilization Liquid** – Knives and shears must be periodically cleaned and **sterilized properly with a solution of 10% bleach (Jik).**

PROCESS FOR THE POSTPROPAGATION ACTIVITIES

Introduction

Propagating plants requires the understanding of different physiological stages that the plant faces before it goes into production. The propagator must be able to match the growth stage to the appropriate environment of propagation to achieve the best results.

Readiness for Transfer to Next Phase

There are different stages at which propagated plants can be transferred or transplanted as seedlings. The population density, per surface area, decreases from the seed germination stage to polyethylene bags in shade-houses, including the seedling tray stage.

Transplant readiness in woody perennial plants is determined by the seedling development phase, seedling age, seedling size and climatic conditions. Transplant readiness differs between crops and between propagation methods. In citrus production, for example, propagators will transplant only when the weather is favourable i.e. warmer season after winter. In citrus production, the first transplant is done only according to the development stage while climatic conditions are overlooked as the first transplants are kept in a greenhouse.

Transplants from the greenhouse to the field takes place at stages as determined by the requirements of the specific crop. Transplants into the field are crop specific and have to be made to crop specific procedures. In addition, each type of propagation product is treated differently, and these should also be done by following specific procedures.

Pests and diseases

Pest- and disease control follows the same procedures as for mature crops. Although some major pest and diseases are mentioned below, specific pest and disease management practices are implemented for specific crops and production areas which should be followed.

Foliar Damaging Pests

Foliage damaging pests, including those that cause encrustations on foliage and leaf eaters, are our major pest problems. A reduction in the leaf effective area will reduce the potential of the transplants for development.

Some important crop pests include:

- Red scale
- Mealy bug
- Aphids
- Citrus psylla
- Mites
- Thrips
- Loopers
- Slugs
- Red scale: Red scale discolours the leaf and can turn it yellow, thus reducing the vitality of the plant. The surface area for photosynthesis is affected as little chlorophyll is synthesised. Severe infestations lead to leaf drop and twig die-back.
- Mealy bug: Mealy bug is an oval, pale yellow insect covered in a powdery white wax. Adults are slow moving and secrete honeydew and black sooty mould. Heavy infestations cause leaf drop and reduced the photosynthesis rate.
- Aphids: Aphids are either winged\wingless black and brown insects that secrete honeydew. Infected leaves are covered with sooty mould which in turn reduces the transpiration and photosynthesis rate. Leaf malformation is also been associated with aphid damage. In most cases the damage associated with aphids is not the direct damage but that associated with the viruses carried and transmitted by the aphids.
- Mites: Red mites are oval-shaped. They feed on leaves and green bark of citrus plants. They prefer the upper surface of leaves which end up grey, silver or yellow. This affects photosynthesis and transpiration rates. Silver mites also have an ovalshape but are flat, straw coloured and translucent. They damage the leaves which become crinkled and may produce corky brown patches on the undersurface.

- Thrips: Thrips are translucent orange-yellow in colour and wingless at immature stages, with adults having two pairs of narrow wings. The damage caused to citrus trees is found on young tender shoots and leaves that are malformed and result into stunted growth. Thrips extract chlorophyll from the infested plant parts, which then become pale.
- Loopers: Loopers feed on leaves, starting at the margins of leaves. Both young and mature leaves are consumed by looper worms. Immature larvae have a different feeding pattern in that they first feed on the upper and lower epidermis and only then eat holes in the leaves.
- Slugs: Slugs mainly eat holes in the crop's leaves.

Wood Damaging Pests

Rodents feed on the bark of young trees and shrubs in the nursery. Severe infestations may lead to the trees drying down. When feeding on smaller seedlings, rodents can cut off the stem.

Root Damaging Pests and Diseases

Nematodes feed on roots which then appear darker in colour. Rootlets become stunted, swollen and irregular in shape and appearance. Infested trees cannot tolerate stress or drought conditions.

Common root diseases of concern include root and stem rot caused by Phytophtora and dumping off caused by fungi including Rhizoctonia.

Root and stem rot, as well as dumping off start in the nursery and are generally expressed in the nursery before trees are planted in the fields. If the plant is infected at the end of the nursery cycle, the disease might not be detected in the nursery and only be expressed in the field.

Dumping off is a seedling disease. It only occurs in the seedling stage of propagation; from the germination until after the first transplanting.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Phases of Propagation

In most cases propagation occurs under controlled environments. At a predetermined development stage, the plants is transplanted either to containers or planted in the field.

Each development phase requires specific environmental conditions for optimal growth. During the germination phase, light intensity, light quality, moisture, aeration, temperature and humidity are the most crucial factors. Once the seed has germinated, the physiological needs of the seedling require enough humidity to perform optimum transpiration.

Respiration and transpiration rates of the seedling determine the level of carbohydrates in the plant that can be used for growth. The more carbohydrates are used in the transpiration process, the less there is available to the plant for growth. Roots develop to ensure that the plant can sustain itself, absorb water and nutrients as well as anchoring the seedling in the medium. During the initial growing phase, humidity and temperature is controlled and humidity kept high. Should the plant then be transferred to a shade house, both humidity and temperature is reduced. The plant is thus subjected to lower humidity and light intensity. The thermal sheets or shade-cloth protect the plant from harsher environmental conditions of the immediate outdoor.

From one phase to the next the propagator must ensure that the transfer is done under optimum environmental conditions to avoid transfer shock.

Hardening-Off

Before the seedlings are transferred to shade-houses from greenhouses, seedlings are subjected to an acclimatisation process to minimise the transplant shock impact.

The seedlings are kept in a facility, for a minimum of a week, where the humidity is lower than in the greenhouse and light intensity is adjusted to resemble those of the ambient surroundings more closely. This leads to an accumulation of carbohydrates, increasing the ability of the plant to withstand its new environment and prevailing conditions.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Where cuttings are used, hardening off begins in the propagation area. The humidity is gradually reduced, and the rooted cuttings become more hardened to function in physiological activities such as water and nutrient absorption, photosynthesis, and leaf development.

Possible problems with Hardening-Off

Disease infested plants will not survive the hardening off period because of their reduced ability to survive.

Plants with poorly developed root systems will display an inability to survive under harsher conditions during the hardening off process.

Reducing light intensity may lead to the development of spindly and elongated plants. In some cases, hardening off is done in structures covered in specialised netting such as aluminium coated netting, which diffuses light evenly in the structure. This aids in preventing the development of spindly plants.

Reduced humidity may lead to excessive water loss by the plant. If this problem is not corrected, plants will starve a pant (breathe with difficulty) death. It is thus crucial that irrigation programmes are adapted to suit the environment under which the plants are grown. In most cases a plant will require a 14-day period to adapt to an altered environment. This should be kept in mind when moving a plant from one environment to the next.

Individual Formative Exercise 1
Individual Formative Exercise 2
Individual Formative Exercise 3
Individual Formative Exercise 4

Individual Summative 3

UNIT 4: PERMACULTURE

Unit Standard	
116279	Implement a permaculture site design
Specific Outcomes	
SO1: Implement the integration of site elements and resources as outlined in a Permaculture Design. SO2: Apply the use of local biological and other available resources according to a Permaculture Site Design. SO3: Apply ecological processes and cycles according to plans outlined in a Permaculture Design. SO4: Apply sustainable living practices as outlined in a Permaculture site design.	

OVERVIEW

Permaculture is a system based on natural ecosystem processes: through consciously combining plant, animal, built environment and energy systems, it endeavours to create sustainable human habitats, settlements and agriculturally productive systems. The intention is to design productive systems that ultimately generate more energy than they consume, with no negative impact on the natural or social environment.

- Permaculture is a systems design response to the downward spiral into unsustainability that the world has been involved in for the last 150 years (at least). The name Permaculture is derived from "permanent", "agriculture" and "culture". Australian professor Bill Mollisson and his student Dave Holmgren coined this phrase in 1978, to describe their design framework for sustainable development.
- There are tens of thousands of Permaculturalists the world over who have implemented this design strategy, in a huge range of climates and contexts. The UN has recognised Permaculture as a useful intervention in areas that have experienced natural disasters, or post-war situations.

- Because it is a multidisciplinary approach, many techniques like Organics, Biodynamics and other agricultural practices are incorporated within its framework.
- Permaculture systems do not use economic performance as the only measure of success. The "Ethics and principles" heading will explain this further.

ETHICS AND PRINCIPLES

ETHICS

Permaculture is rooted in a set of ethics, which guide decisions that designers, agriculturalists and builders use in their daily activities. These ethics evolved out of the need to create behavioural and implementation patterns that would be beneficial to both the human and natural environment. Underpinning all of the ethics is the fundamental realisation that we are dependent on a planet that has limited, and damaged resources, and that we must work within this reality.

- **Earth Care** – all activities maintain the integrity of the natural resource base.
- **People Care** – all activities are aimed at empowering ourselves and other human beings, bearing Earth Care in mind
- **Surplus Share** – all extra resources are utilised to improve earth and People care.
- **Set Limits To Consumption.**

PRINCIPLES

Permaculture has basic design principles that one works from, in any context. One could call these sustainability guidelines. They are simple, practical and achievable.

1. Work with rather than against Nature
2. Relative location
3. Efficient energy planning
4. Every element must be multifunctional
5. Every function should be served by many elements
6. Use biological resources rather than non-renewables
7. Create energy cycles
8. Create diversity
9. Patterns

10. Increase the use of edge
11. Make use of succession
12. Intensity

Work with rather than against Nature

Working with nature means: observe and understand your context, as well as the larger factors which affect you. This is done through mapping, research into local ecologies, weather, investigation and talking to locals! Secondly, aim to enhance the resources you discover by working with the forces you encounter, and turning problems into solutions.

Relative location

Place elements in your system where they are most effective (elements are any component in your design: a house, a barn, cattle, gardens, extensive crops etc). By placing the elements where they are most needed, you reduce the amount of work and energy you must expend. This principle also leads to creating relationships between design elements to enhance productivity and efficiency. A good example is using water from aquaculture ponds to irrigate food production areas.

Efficient energy planning

Every element in a Permaculture system should be placed where it functions most efficiently. This is known as Zone, Sector and Slope Planning.

ZONE PLANNING

Elements are placed in zones according to how many times you need to use and visit them, as well as the number of inputs they require. Areas that need visiting every day for harvesting and maintenance (such as annual vegetable gardens, the nursery, chickens, recycling area, etc) must be placed near the house to facilitate easy access so that these systems are well observed and maintained. Places and systems visited less frequently are placed further away from the main centre of activity (orchards, staple food systems, woodlots, animal systems, etc) because these places require less attention and are harvested less frequently. The design is thus divided into Zones radiating outwards from the centre of activity.

- Zone 0 – House or business

- Zone 1 – Intensive vegetable gardens, nursery and small animal systems
- Zone 2 – An orchard or mixed food forest (perennial species); and staple food systems (grains and tubers).
- Zone 3 – This can incorporate large-scale semi-managed systems such as woodlots; large animal fodder systems and aquaculture.
- Zone 4 – Semi managed wild system of mainly indigenous species harvested for medicines, indigenous fruits and firewood.
- Zone 5 – Unmanaged wild systems of indigenous species that act as a refuge for wildlife and is a place we go to observe nature.

SLOPE PLANNING

Slope planning involves looking at your site in profile, bearing in mind slope angles and elevation. This leads us to place dams, water storage tanks, roads and tracks, drains and flow diversions in the right place, so we might most effectively use slope on our land to our advantage. For example, we place dams and water catchment above the house and garden so we may use gravity to create water flow instead of a mechanical pump. Slope planning means also that we use contours to garden on, to minimise erosion and maximise water retention.

SECTOR PLANNING

Plan your site to make maximum use of energy moving through the site or to deflect those energies. Sector planning deals with "wild energies" that move onto the property from the outside. This means that our designs take into account fire danger; strong or damaging winds; screening of unwanted views; winter and summer sun angles; flood-prone areas etc. This leads to placement of homes, windbreaks, firebreaks, swales and water systems. Sectors also modify zonal placement.

Every element must be multifunctional

Every element selected should provide at least 3 functions: for example, windbreaks are pest predator refuges, a source of wild food and contain an herbaceous layer which also provides pest management.

Every function should be served by many elements

Pest control, soil fertility, water catchment and irrigation, mulch and food provision, etc. … should be served by more than one element. This means if one element fails in its task to provide a service (pest control chickens get eaten by a dog), then there must be back up by at least three other elements to ensure sustainability (plants, ducks and wild birds control pests). Observe this principle and the basic needs of your cultivated ecology will be met consistently from within the system.

Use biological resources rather than non-renewables

Use natural resources to do the work. Plants and animals are used wherever possible to provide nutrients, shelter, and fuel, insect and weed control, nutrient recycling, habitat enhancement, soil building, fire and erosion control, etc.

For example, you can use chickens and small animals to work the soil and compost it; plant legumes to enrich the soil; encourage birds and use silky chickens for insect control; plant diverse systems to enhance nutrient reticulation in the soil and to keep disease and pests in balance; use deep rooting plants to loosen the soil instead of ploughing etc.

Create energy cycles

Any of the natural forces that enter a site must be put to work. If you have rain, ensure that it is not only caught on the roof for domestic consumption, but is re-used in the house, and enters a home garden as greywater to produce food. Overland flow needs to be captured in swales (contour ditches) so that it can slowly percolate into the soil, and eventually make its way to streams or rivers, rather than just rushing overland to the river. The same attitude is applied to any resources used on site to ensure that nothing is wasted, and no pollution is created.

Create diversity

Diversity brings choice and stability. Permaculture is about creating diversity, more so than in nature and it is through diversity that we have stability, choice and sustainability. Diversity not only ensures a wide range of plant species to use, it also means we get away from dependence on one crop for our livelihood (monoculture) into a system whereby a diverse range of plants

CIN: 20300 **Version: 001**
Date: 2021/10/26

and animals provide balance and fertility. Diversity means that a family/farm can satisfy many of its nutritional needs with the available fruits, vegetables, proteins, and minerals. Economically this means there is a wider variety of crops and products available at different times of the year, which protects the family/farm from market downturns, and the failure of one crop. But stability only occurs among co-operative species. Do not simply place as many varieties of plant and animal in your system, because they may compete with each other. It is the number of functional connections between these plants and animals that creates stability and fertility.

Patterns

When talking about patterns we refer to utilising forms like contour lines, spirals, branching patterns etc that occur in nature. This is not as esoteric as it sounds, but highly practical when correctly used.

Nature exists and grows through patterns. Use natural patterns that allow the parts of the design (animals, worms, birds, insects, soils, sun, water, etc.) to flow and work in beneficial relationships. Contours are an obvious form of patterning that can be effectively used on any scale of agriculture. Obviously, these patterns become more simplified when used on a larger scale, but the principle still applies. Use the same patterning principles in your design when shaping beds, watercourses, building structures etc. The use of natural patterns in a garden will enhance the growth and vitality of the system and appear more interesting, original and beautiful.

Increase the use of edge

Edge is where two or more environments meet (for example land and water) and where the resources and energy of two or more systems available for us to use. Edge increases the surface interface in your gardens between different systems (pond/wetlands with veggie gardens) and there will be a high-energy movement between them and thus more opportunities in space and time. Also create as much surface interface for plants and animals to use (wavy shaped beds as opposed to straight ones), which will allow a greater amount of species to be placed into a smaller area effectively. Create more edge in your gardens and the energy in the ecology will flow with ease and vitality, ultimately creating a more productive system.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Make use of succession

Succession is a concept derived from ecology. It describes the evolution of plant and animal communities over time. Generally, when a site is disturbed, it is colonised by hardy weeds, which are short-lived, but provide a microclimate for other less hardy species to develop in. Left alone, these communities will increase in species diversity and longevity. With the increase in plant diversity, animal and insect communities also increase. Ultimately the system developes into a climax (stable) ecology suited to local conditions. In some areas this may be a forest ecology, in others a fynbos ecology. We utilise this successional phenomenon in Permaculture systems to create permanent agriculture systems. However, we will interfere by enhancing the system through using hardy pioneer shrubs and trees (especially legumes), thereby accelerating the development of a microclimate that will support productive crops.

Intensity

A primary consideration in Permaculture is that we need to minimise our impact. This then leads us to design intensive and productive systems that utilise the least space possible. This approach is implemented using 3 dimensional designs. In other words, we use vertical space – walls, trellises, espaliers etc. to maximise production. Stacking productive plants into their appropriate niches and using plant guilds are tools that aid intensified design. This also applies to broadscale Permaculture: large animal systems are not necessarily just grazing but incorporate large leguminous trees for grazing and nitrogen-fixing. Large crop production areas can also look at 3-dimensional design though the use of alley cropping etc.

SCOPE AND APPLICATIONS

Agriculture

As a sustainable agriculture framework, Permaculture provides the designs and tools to create small to large-scale farms that are resilient in the face of disasters like floods, droughts, fires etc. Through careful planning based on local factors such as ecological processes, landforms, wind and water movement, farmers can to some extent buffer their farms in times of crisis. With the emphasis on reintegrating indigenous tree and shrub species into the agricultural

CIN: 20300 **Version: 001**
Date: 2021/10/26

framework, the links to conservation are much strengthened and agricultural enterprises become more stable.

- **Windbreaks and pest management zones** are implemented using species indigenous to or tolerant of local conditions. The planting of trees as an integral part of agriculture also assists with carbon sequestration, which is vital to our continued survival. In addition, we cannot emphasise enough the role that substantial tree planting can play in "creating" rainfall, as well as improved microclimates.
- It is a useful tool especially in arid zones (most of South Africa), where drought mitigation is of utmost importance. Good design and good species selection as well as macro scale water flow management, and the sinking of water into the subsoil through earthworks, are critical to maintaining **good soil hydration** and replenishing dwindling borehole waters. In areas where soil or water is saline, Permaculture has had some profound effects.
- Another important factor in agricultural design is **diversity**: the reintroduction of multipurpose indigenous, and other useful plants or trees, already move the farmer towards more diverse production; coupled with this is the need to diversify agricultural crops so that one can weather a certain amount of crop failure, and still have yields to send to the marketplace.
- **Animals are integrated into food production systems** and are not seen as a separate enterprise from crop cultivation. Chickens and pigs especially have been very successfully used to weed, dig and fertilise crop production areas. Often these animals are rotated around designated, fenced areas, with crops following them as they move on. Cattle and sheep are managed in a low density agro-forestry context, with fenced trees for browsing, nitrogen-fixing for pasture and shade. Bees are also a vital component – pollinating all crops and generating honey. Our local honey supply is low, and a good niche market exists for this product in South Africa.

Construction

There has been a marked resurgence in peoples' interest in sustainable construction methodologies. You may ask what relevance this has to agriculture. Ranging from low cost to luxury housing, it has a profound impact on local resources and finances, as well as health. Most dwellings consume materials that are non-renewable, if not toxic in nature. Poor housing design adds to energy consumption bills, and poor settlement layout has both disastrous social,

CIN: 20300 **Version: 001**
Date: 2021/10/26

environmental, and consequently economic impacts. Also, most agricultural enterprises have ample natural materials to use in construction.

Sustainable construction minimises the impact that housing provision has on the local and far-flung environment. These criteria are:

- Building materials are acquired from a radius of no more than 50km, wherever possible – cutting down on petrol consumed, and enhancing the local aesthetics of buildings.
- Materials are as unprocessed as possible – alleviating the toxic burden on rivers, soils, atmosphere, humans and wildlife.
- Houses are designed for maximum energy efficiency, with green technology and water-saving strategies built in. This includes extensive water storage for domestic consumption from roofs.
- The siting of dwellings in a landscape, whether urban or rural is critical. Passive solar design of houses reduces heating and cooling bills. Good design also impacts on peoples' mental health.
- Construction of homes is labour intensive, and does not necessarily require highly skilled builders, which can add greatly to job creation in South Africa.

Energy and technology

Green technology is another important component in Permaculture designs. Our individual and collective impacts on the planet are having a profoundly negative effect. Simple technologies like solar heating and electricity can take pressure off our South African energy generation requirements – which is largely produced through the mining and burning of coal. This particular activity has extremely negative effects on people living near these mines and stations as well as contributing to greenhouse gas emissions. Water and sewage management can also be made more effective by using appropriate technologies like composting toilets, biogas digestors, greywater purification and re-use. All of these technologies also take the pressure off fresh water supply for wasteful uses.

Methane gas digestors are also of interest to farmers who are working with livestock, and who generate excess biomass that cannot otherwise be utilised. Digestors can be built on farms to generate cooking gas or electricity, depending on the scale. The digestors also eliminate the smelly sewage problem!

Social structures

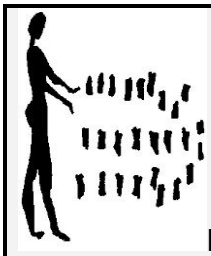
Permaculture is in many was concerned with empowering people from all walks of life. Consequently, it has also investigated social structures and alternative economic systems. Co-ops, Green investment, and revolving loan schemes are some of the ideas you may encounter. Green city design, co-housing schemes and allotment gardens are some of the social restructurings you would find in urban Permaculture contexts. The ethical stance that Permaculture requires leads naturally to a more just social and economic structure.

Urban and peri-urban permaculture

There is both the need for urban agricultural spaces, and the need to "green" our cities. Urban centres consume, and waste, huge amounts of resources. Much of what we consider waste can be fruitfully re-used to create more sustainable cities – green technologies are very useful tools here. Another critical feature of urban ecological agriculture is the reintroduction of biodiversity into these spaces – making every city garden a conservation zone.

With the growing pressure on urban centers to provide work and housing, Permaculture can offer a lifeline to many people. It offers good tools for redefining and redesigning our use of space and resources in cities. The principles outlined above give us a good idea of some approaches.

Individual Formative Exercise 1



Individual Summative Exercise 4

Learning Unit 5: Communication Skills

Unit Standard	
119471	Use language and communication in occupational learning programmes
Specific Outcomes	
SO 1: Access, use and manage suitable learning resources. SO 2: Formulate and use learning strategies. SO 3: Manage occupational learning materials. SO 4: Conduct basic research, and analyse and present findings. SO 5: Lead and function in a team. SO 6: Reflect on how characteristics of the workplace and occupational context affect learning.	
Learning Outcomes	
Identifying	Science
Organising	Communicating
Demonstrating	Contributing
Collecting	Working

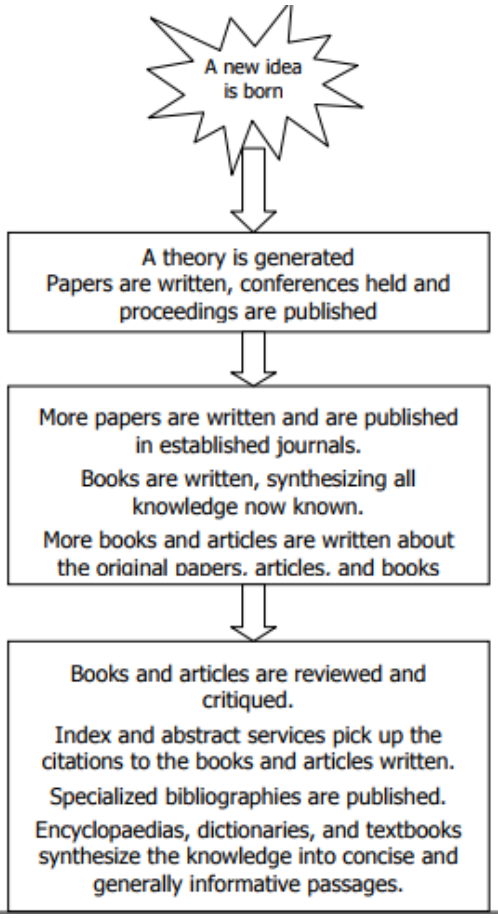
LEARNING RESOURCES AND STRATEGIES

How Literature is structured

Libraries contain information in bibliographies, guides, indexes, abstracts, databases, almanacs, catalogues, newspapers, dictionaries, directories, encyclopaedias, and journals. Although a relationship between these sources may not be apparent to the untrained eye, these different information sources are published systematically to meet the specific information needs of an academic discipline. Researchers using library materials, can benefit from having an understanding of the inherent structure of published literature. Once they see the order in the wealth of materials on the library's shelves, retrieving the information successfully from a discipline's literature becomes a matter of backtracking through its development stages.

The structure of literature

When we talk about the structure of literature, we are describing the physical manifestation of the growth of an academic discipline. As the field matures, the amount and type of literature that become available increase. The literature produced can be divided into three distinct developmental levels.



At the primary level, an idea, sometimes a whole discipline is in its infancy. Great thinkers or pioneering intellectuals discuss new ideas with friends and colleagues, conduct research and postulate new theories.

They disseminate their findings beyond personal contacts by writing and publishing papers and presenting them at conferences.

The secondary level is marked by the increased number of scholars reading, researching, and writing on the original ideas and theories.

The number of articles proliferate and books appear on the topic.

Still other scholars interpret and assess what the first generation of researchers accomplished and publish still more articles and books.

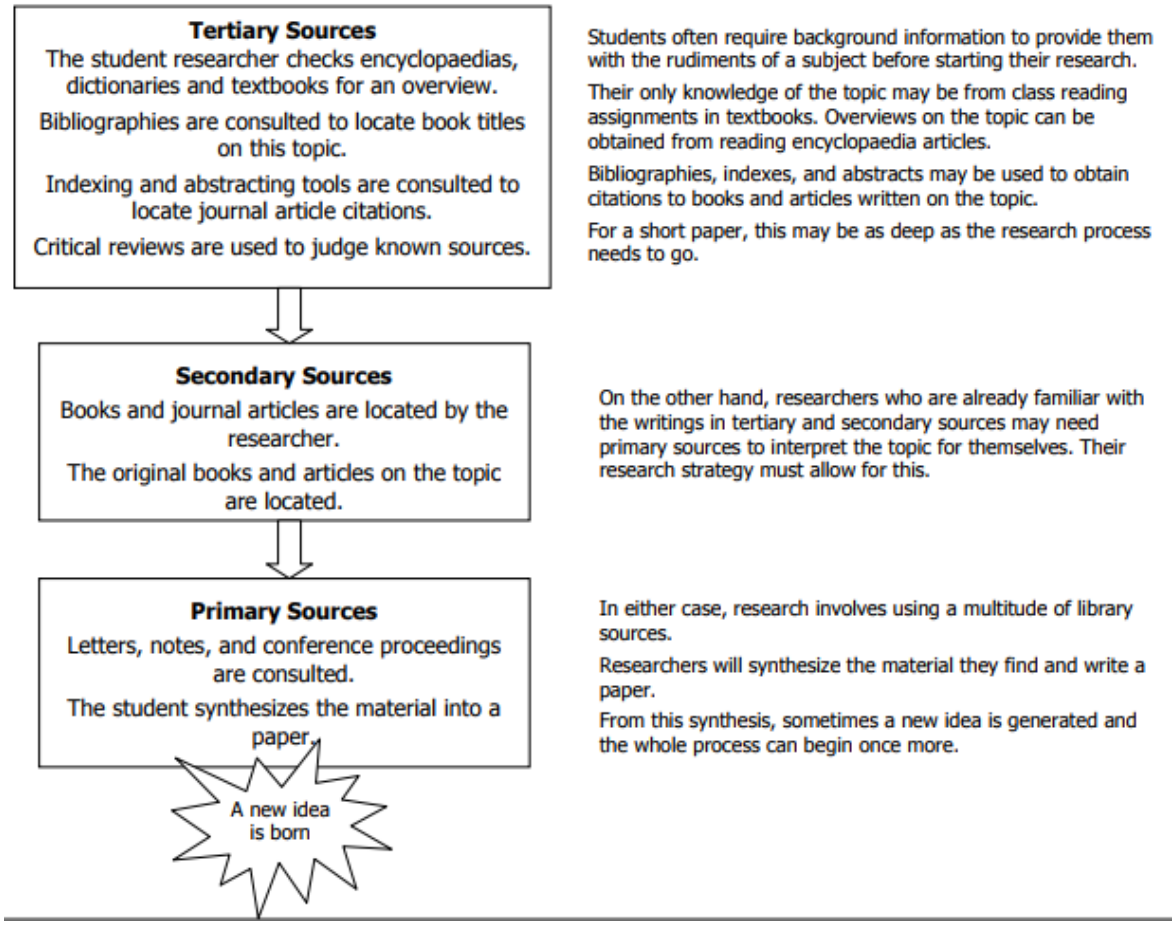
At the tertiary level, the idea becomes widely accepted or a new discipline becomes established.

Curricula are developed, and tertiary sources are published to meet the demand for discipline related reference books and textbooks.

CIN: 20300 **Version: 001**
Date: 2021/10/26

The search strategy

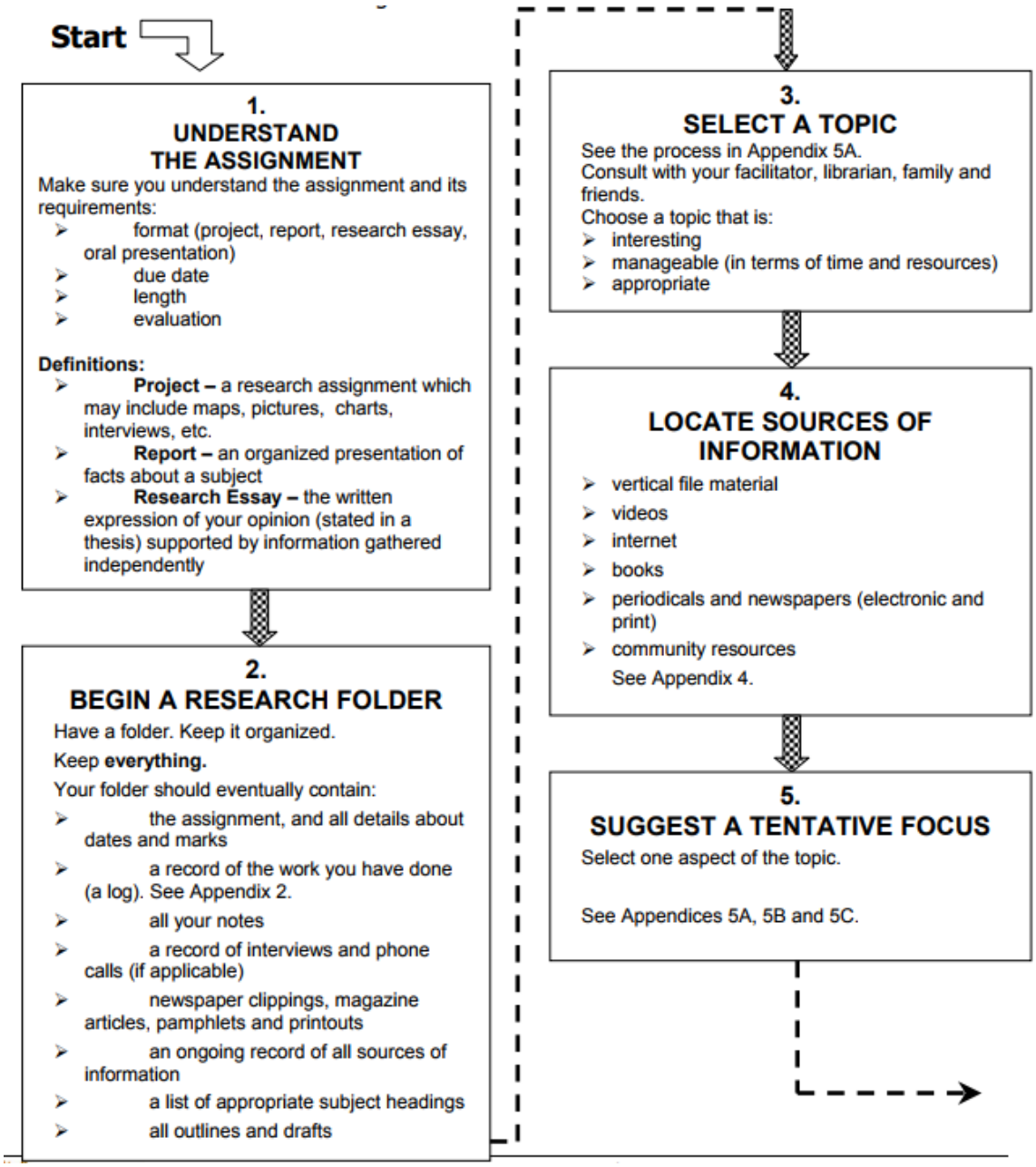
The search strategy is a logical process used by a researcher to locate information that will fill an information need. Where the researcher begins, the literature search will depend on the depth of information required and the researcher's knowledge of the discipline.



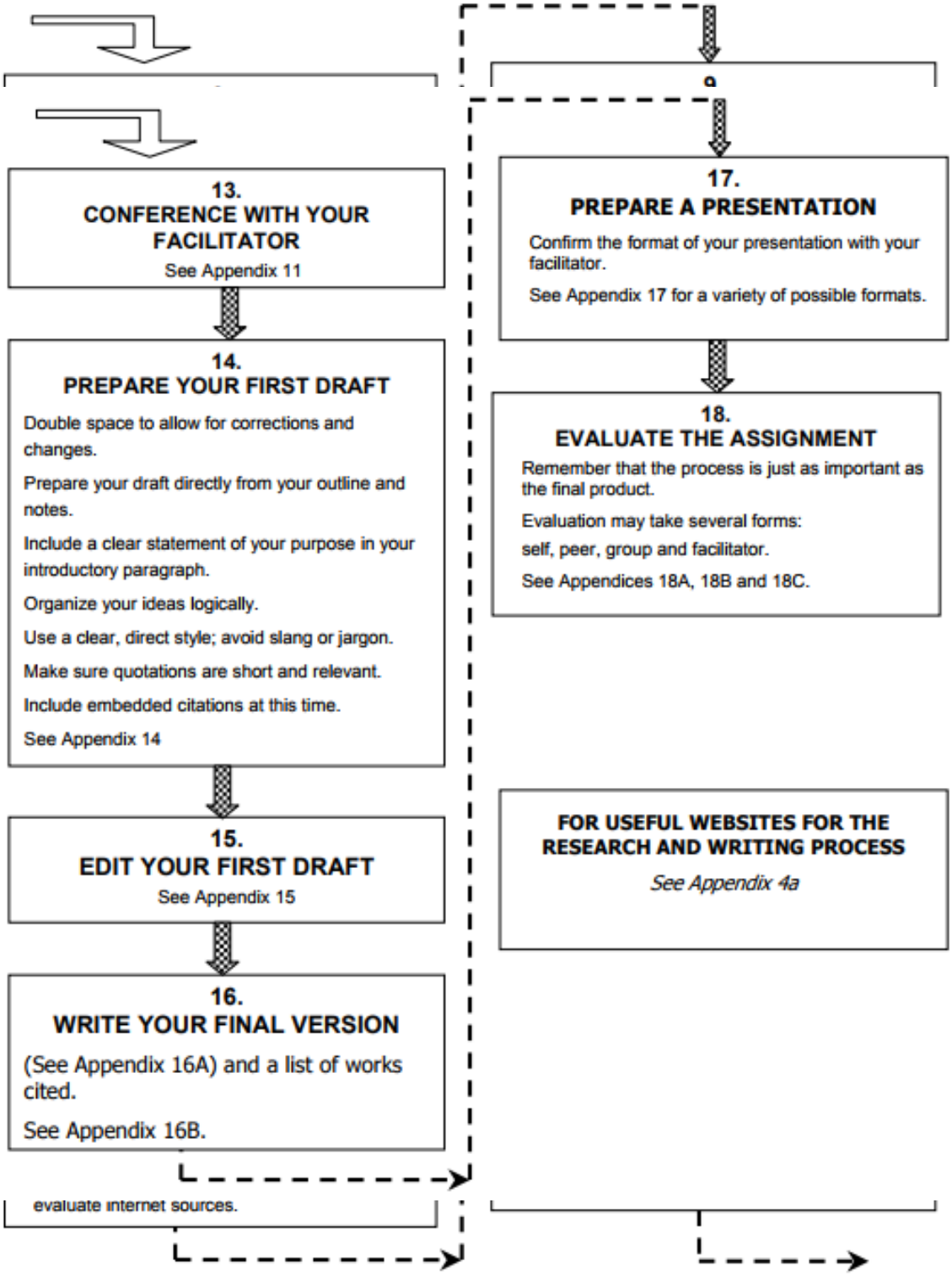
Steps in the Independent Study Research Process

1. Understand the assignment
2. Begin a research folder
3. Select a topic
4. Locate sources of information
5. Suggest a tentative focus
6. Develop tentative thesis if it is required
7. Check/consult with your facilitator

8. Analyse resources and select appropriate information
9. Make notes and record information for works cited list
10. Develop a final thesis
11. Conference with your facilitator
12. Prepare a tentative outline, organize information under main ideas and supporting points
13. Conference with your facilitator
14. Write a first draft
15. Edit the first draft
16. Write the final version
17. Prepare a presentation
18. Evaluate the assignment



CIN: 20300 **Version: 001**
Date: 2021/10/26


13.
CONFERENCE WITH YOUR FACILITATOR
See Appendix 11
14.
PREPARE YOUR FIRST DRAFT
Double space to allow for corrections and changes.
Prepare your draft directly from your outline and notes.
Include a clear statement of your purpose in your introductory paragraph.
Organize your ideas logically.
Use a clear, direct style; avoid slang or jargon.
Make sure quotations are short and relevant.
Include embedded citations at this time.
See Appendix 14
15.
EDIT YOUR FIRST DRAFT
See Appendix 15
16.
WRITE YOUR FINAL VERSION
(See Appendix 16A) and a list of works cited.
See Appendix 16B.
evaluate internet sources.
17.
PREPARE A PRESENTATION
Confirm the format of your presentation with your facilitator.
See Appendix 17 for a variety of possible formats.
18.
EVALUATE THE ASSIGNMENT
Remember that the process is just as important as the final product.
Evaluation may take several forms:
self, peer, group and facilitator.
See Appendices 18A, 18B and 18C.
FOR USEFUL WEBSITES FOR THE RESEARCH AND WRITING PROCESS
See Appendix 4a

Work Log **Appendix 2**

WORK LOG

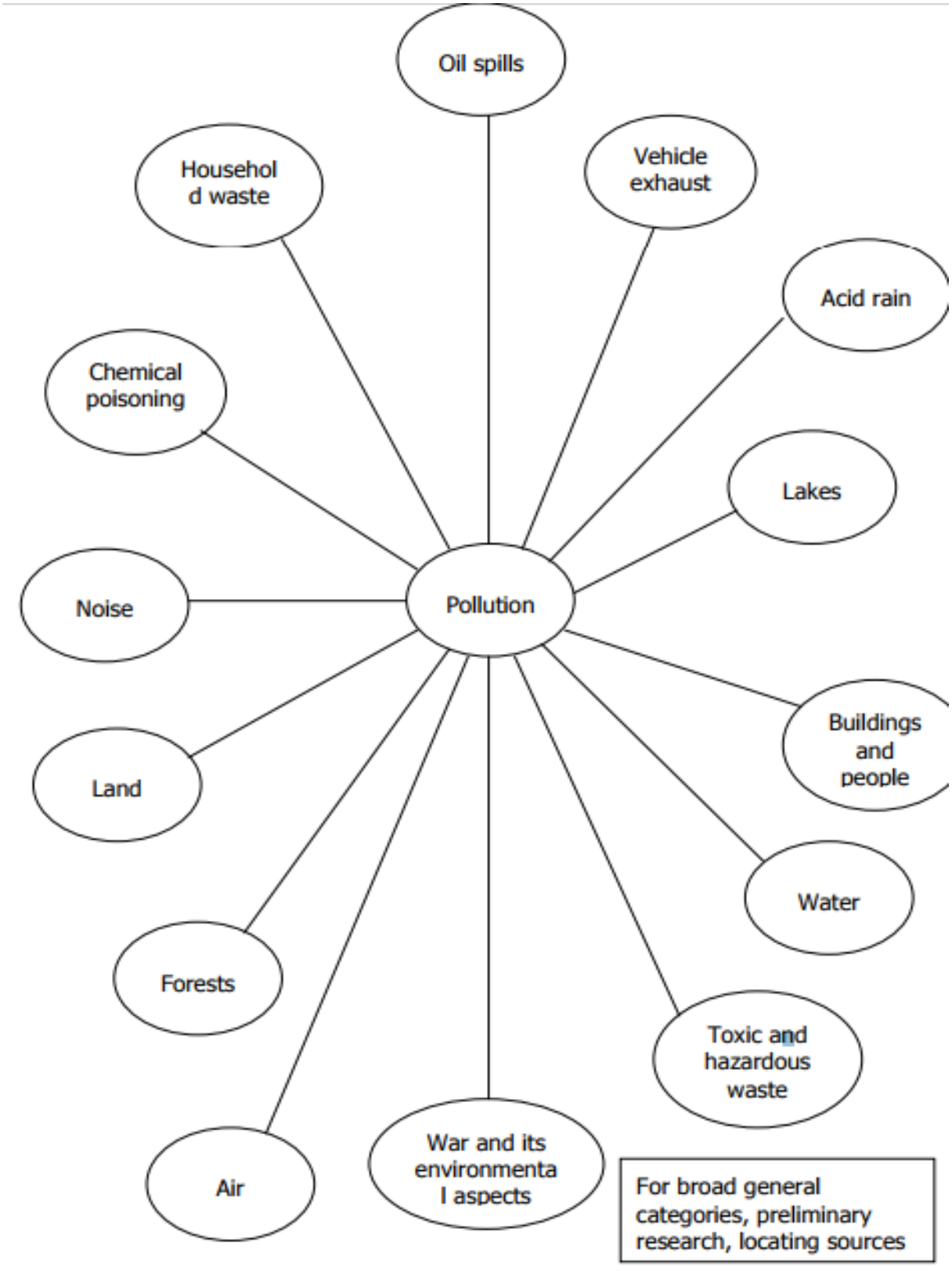
Name: _____ Assignment: _____

Date: _____ **Time Spent:** _____ **hour(s)** _____
Work done: _____
_____
_____
_____
Resources used: _____
_____

Date: _____ **Time Spent:** _____ **hour(s)** _____
Work done: _____
_____
_____
_____
Resources used: _____
_____

Date: _____ **Time Spent:** _____ **hour(s)** _____
Work done: _____
_____
_____
_____
Resources used: _____
_____

Brainstorming the topic – "Pollution"



SOURCES OF INFORMATION:	HOW and WHERE TO LOCATE:
Reference Materials	
• general encyclopedias	• reference section
• subject specific encyclopedias, dictionaries, handbooks and Encyclopedia, indexes (e.g. McGraw-Hill Encyclopedia of Science and Technology)	• Internet • CD-ROM (e.g. Canadian World Book)
• print (e.g. World Book, Britannica) Britannica, World	• on-line via www: Grolier, Book, Galenet
• dictionaries	
• yearbooks, almanacs, directories	
• atlases	
Books:	
• electronic catalogue	
Periodicals and Newspapers:	
• Guide to Periodicals and Newspapers in the Public Libraries	
• on-line access via the Internet (Electric Library, EBSCO, SIRS, CPIQ, NEWSCAN)	
• Internet	
Other resources	
• videos	
• film and video catalogues are available	online
• films	
• television programs	• SABC videos are available
• audio tapes	
• slides	

USEFUL WEBSITES FOR THE RESEARCH AND WRITING PROCESS
Resources for Writers: http://owl.english.purdue.edu/writers/by-topic.html
Writing at the University of Toronto:
http://utl2.library.utoronto.ca/www/writing/index.html
Research and Argument: http://karn.ohiolink.edu/~sg-ysu/
Infozone: http://www.mbnet.mb.ca/~mstimson/
A+ Research & Writing: http://www.ipl.org/teen/aplus/
Researchpaper.com: http://www.researchpaper.com/

Search Strategy Sheet **Appendix 4B**

- Describe Your Topic:

_____

_____

_____

- Identify the Main concepts:

Concept # 1	Concept # 2	Concept # 3

- Find Synonyms:

Use the appropriate thesaurus to identify synonyms. Synonyms, related terms and alternate spellings should be placed in the same CONCEPT column.

Concept # 1	and	Concept # 2	and	Concept # 3
_____		_____		_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____
or_____		or_____		or_____
_____		_____		_____

Search Strategy Sheet Example **Appendix 4C**

- Describe Your Topic:

What are the effects on children of violence in the mass media?

_____

_____

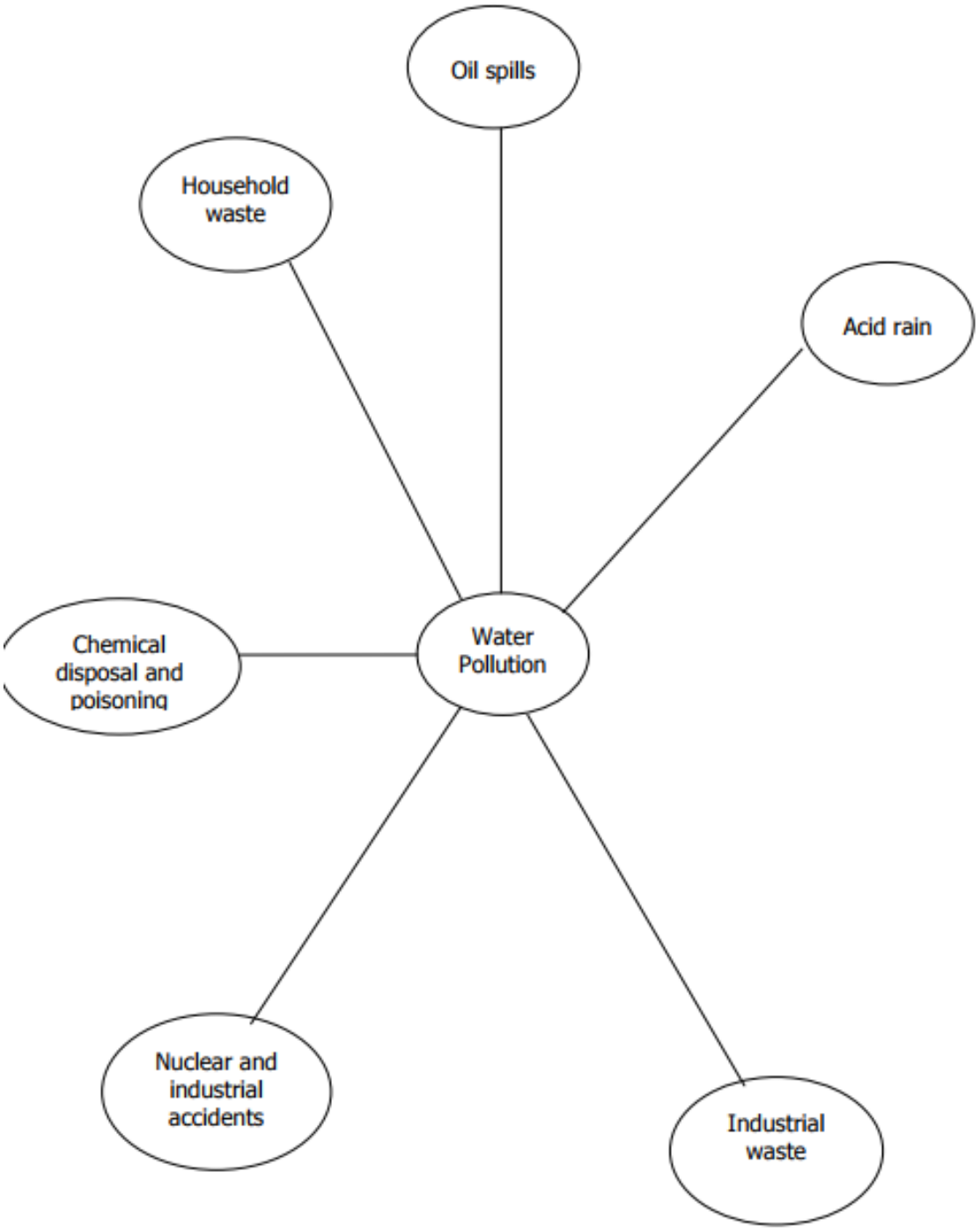
- Identify the Main concepts:

Concept # 1	Concept # 2	Concept # 3
Violence	*Mass media*	*children*

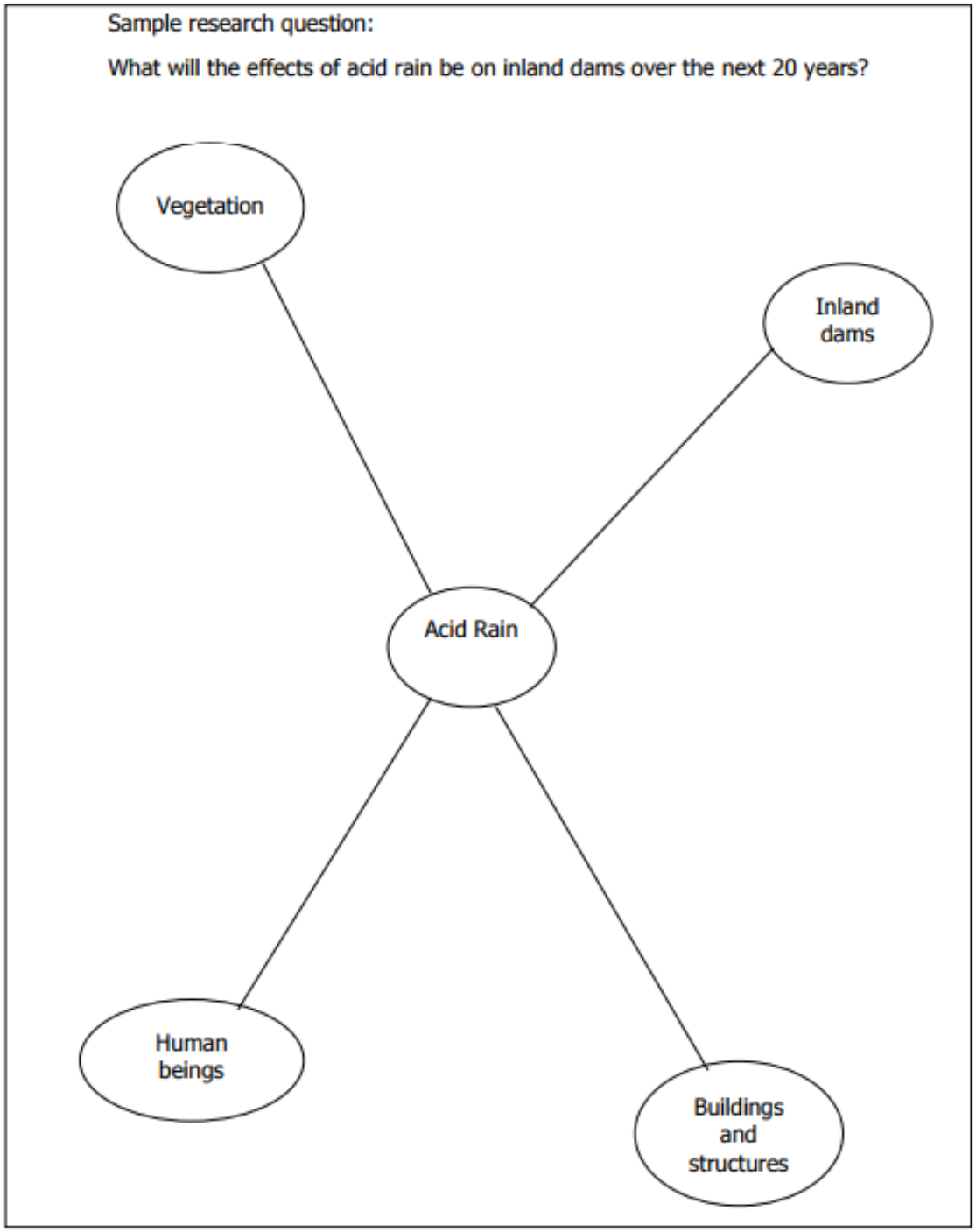
- Find Synonyms:
Use the appropriate thesaurus to identify synonyms. Synonyms, related terms and alternate spellings should be placed in the same CONCEPT column.

Concept # 1		Concept # 2		Concept # 3
Violence	**and**	*Mass media*	**and**	*children*
or *aggression*		or *television*		or *childhood*
or *anger*		or *films*		or
or		or *computer games*		or
or		or		or
or		or		or
or		or		or
or		or		or

Selecting One Aspect of the Topic "Pollution" Appendix 5A



Focusing on One Aspect of the Topic "Water Pollution" **Appendix 5B**



Developing a Thesis **Appendix 6**

A thesis is the expression of your opinion on a topic.

- Select a topic:

  My topic: Capital Punishment

- Get an overview from a variety of sources
- Formulate a question from which your thesis statement can develop.

  Question: Does the death penalty prevent crime?

- Formulate a thesis statement that:
  - takes a stand
  - is arguable
  - can be researched
- Tentative Thesis: Capital Punishment does not deter murder
- Check your Thesis Statements against the models

Thesis	Comment	
1) Capital punishment.	This is topic, not a thesis.	
2) Does the death penalty prevent crime?	This is a good question that leads to a thesis, but this is not a thesis.	
3) The murder rate is a concern.	A statement of fact is a weak thesis. Take a stand that is arguable.	
4) Something must be done about the murder rate.	Weak thesis. What must be done? Take a stand that is arguable.	
5) Capital punishment prevents crime.	Good thesis	Both take stands and are arguable.
6) Capital punishment does not deter murder.	Good thesis	

- Can your Thesis be researched?

  Either #5 or #6 above can be researched because there are many resources on capital punishment, both pro and con, in your institution's library and in the community at large.

Skimming **Appendix 8A**

- How to skim a book
  - Flip through the book from cover to cover. This gives you a general impression. Is the print easily read? Are there illustrations?
  - Flip through a second time. Look for chapter headings, summaries, questions, vocabulary lists, indexes, etc.
  - Look at the book jacket. Is there a summary of the contents? Is there biographical information about the author? Look at the title page front and back. What is the date of publication? Is the book out of date?
  - Look at the preface. Does the author express a particular point of view or bias? What other useful information is contained here?
  - Skim the table of contents for relevant sections.
  - Read opening and closing paragraphs of selected chapters. They often contain summaries of the chapters.
  - Check the index for specific references to your topic.
- How to skim an article or chapter
  - Glance quickly through the article to get an overall impression of length and organization.
  - Read the title, headings, captions, words in heavy print, italicized words, etc.
  - Look closely at illustrations, charts, graphs, maps, etc.
  - Read first and last paragraphs.
  - Read the first sentence (usually the topic sentence) of other paragraphs.
  - Read any questions at the end of the chapter or article.

Scanning

Scanning involves running your eyes down the page looking for specific facts or key words and phrases. Think about what FORM the information will take: Is it a number? Is the word in capitals? How does it start?

- VISUALISE what the word or number looks like
- Use numerical order
- Do NOT read every word/number
- Read FAST and when you find the information you want then you slow down and examine it closely

When you locate a new term, try to find its definition. If you are not able to figure out the meaning, then look it up in the glossary or dictionary. Secondly, scanning is useful in locating statements, definitions, formulas, etc. which you must remember completely and precisely.

Evaluating Internet Resources **Appendix 8 B**

Because we live in an information age, the quantity of information on any given topic is huge. However not all of this information is useful or trustworthy. Therefore judging the accuracy of information is an important skill, which is needed all the time.

When researching a topic you will also be evaluating sources as you search for information. You can have some confidence in the information contained in books, newspapers, and magazines since these sources are edited before they are published. You need to judge whether these sources are useful in terms of coverage of the topic, whether the information contained in the source is up to date, and whether the author presents a biased viewpoint.

Evaluating Internet sources can be a problem because anyone can put anything up on the Internet. Many Internet sources are self-published by the author, have not been edited by others and are not monitored. Use the following checklist to judge the Internet sites you find. Articles found in online databases such as encyclopaedias, periodical articles databases, and newspaper databases can be treated as reliable sources because they have been edited in their original publication form. Remember, as well, that you should always use a variety of resources as part of the research process.

Useful Internet Sites for Evaluating Sources

- Kathy Schrock's Guide for Educators: Critical Evaluation Tools

  http://www.discoveryschool.com/schrockguide/eval.html
- Evaluating Sources of Information

  http://owl.english.purdue.edu/Files/131/a-start.html
- Evaluating Internet Sources

  http://members.aol.com/xxmindyxx/evaluate/question.htm
- Evaluating Web Resources

  http://www2.1widener/Wolfgram-Memorial-Library/webeval.htm

Checklist for Evaluating an Internet Site **Appendix 8C**

Title: _____ URL: _____

- Authority
  - Is the author of the page clearly indicated? (If yes, identify) YES/NO
  - What are the author's qualifications and reputation in the subject? If they are not listed, can you find out?

    _____
  - Has the site been rated by a reputable rating group? (If yes, identify) YES/NO

    _____
  - Has it won any awards? (If yes, identify) YES/NO

    _____
- Bias
  - What does the domain address tell you about the site?

    -edu: indicates an educational site (usually a university or college)
    -gov: indicates a government site
    -org: indicates an organization or advocacy group
    -com: indicates a business or commercial organization
    -co: indicates a business or commercial organization
    -za: indicates a South African site
    -uk: indicates a British site
    -~: indicates a personal web page
  - What is the purpose of the site: to inform, to persuade?

    _____
  - Is there an organization sponsoring the page? YES/NO
  - Who are they? What does this tell you about the page's purpose?

    _____
  - Who is the intended audience of the site?

    _____
- Content and Accuracy
  - Is the material covered adequately? YES/NO

    Explain:

    _____

- How does the site compare with others on the same topic?

_____

- How can you tell if it was well researched? YES/NO

  Explain:

  _____

- Is there documentation to indicate the sources of the information presented? YES/NO

  Explain:

  _____

- Does the site have links to other reliable sites on the topic? YES/NO
- Do they work or are they out of date?
- Did you reach this site from a reputable link? YES/NO

♦ Currency

- What is the date of posting of the site?
- Have there been revisions since then? _____ YES/NO
- Is the information current or out of date? _____

♦ Technical Aspects

- Is the site easy to load? YES/NO

  Comment:

  _____

- Is the site easy to navigate? YES/NO

  Comment:

  _____

- Do graphics, pictures and the layout add to the value of the site? YES/NO

  Comment:

  _____

♦ Overall Evaluation

After looking at all the criteria above, circle a general rating for the site:

• Excellent • Good • Average • Borderline Acceptable • Unacceptable

Comments:_____

CIN: 20300 **Version: 001**

Date: 2021/10/26

Appendix 9A

Tips for Note Taking and Avoiding Plagiarism

You must take accurate, informative, point-form notes before writing the rough draft of your essay or report.

As you read and take notes, you analyse and organize the information in your sources. Using a system for taking notes helps simplify the process and later makes writing your essay easier. Generally, you will be making three kinds of notes:

Summarising

When you summarize you condense ideas, details, and supporting arguments in point form using your own words. Summarizing is useful for recording facts, statistics, and background material.

Paraphrasing

When you paraphrase, you take the author's idea, select what is pertinent, and restate it in your own words and sentence structure. Make sure you keep the author's meaning.

Direct quotations

When you use a direct quotation, you copy the material directly from your source because it is important to use the author's words directly. Make sure you copy the material carefully.

Avoiding Plagiarism

Plagiarism, which comes from the Latin word for "kidnapper", is the act of using or passing off someone else's ideas or words as your own. It is a serious and punishable offence. Students who plagiarize may expect a mark of zero and individual schools may also impose other serious consequences. It is important for students to realize that researched information, which is paraphrased or quoted directly, must be acknowledged in the essay.

Factual material such as statistics must also be acknowledged even if you have summarized rather than paraphrased or quoted. Common knowledge such as dates, simple definitions, or commonly known observations do not need to be acknowledged.

Using embedded citations along with a Works Cited List, allowing the reader to easily determine from where material has been taken, does crediting your sources. If you are not sure whether or not material needs to be acknowledged, always ask for clarification from your facilitator or librarian.

Systems for taking notes

Using a system for taking notes helps simplify the research process, helps avoid plagiarism, and later makes writing the essay easier. There are a number of methods that can be used. Choose the method that works best for you.

Handwritten Notes on Note Making Sheets

- Use the sheets shown in this booklet. The upper portion identifies information that must be recorded for citation information. Make sure you fill in this part!
- Use chapter headings, topic headings and subheadings to separate information.
- Summarize information in point form, using your own words whenever possible.
- Be sure to include page numbers, and to put quotation marks around direct quotations.

Handwritten Notes on Index Cards

- Initially, prepare an index card for each source, identifying the title, author, publisher, date, city of publication and any other pertinent information.
- Assign this card a number, or use the author's name when making up the note cards from that particular resource.
- As you read each book or article, record each point of information on a separate index card, grouping the cards together according to topic. Be sure to include page numbers, and to put quotation marks around direct quotations. Put the author's name or the assigned number in the corner of each card for citation purposes.
- As you work you can assign a brief heading to each note card to help you organize your notes.

Handwritten Notes Using the "5 R Method"

- Use the sheet titled "5R Page for Recording Information". Fill in the upper portion, which is necessary for completing your Works Cited List.

CIN: 20300 **Version: 001**
Date: 2021/10/26

- As you read each book or article, make point form notes of the important ideas and write them in the "Record" column. Use your own words whenever possible, include page numbers, and put quotation marks around direct quotations.
- While recording information, also jot down in the "Relate" column any connected ideas or information that you already know about this topic.
- Think of movies, TV programs, personal experience, books read or people that are related to the topic. This is one way of enriching and personalizing your work.
- At the end of recording your notes, reduce the information to three to five main ideas and write them in the "Reduce" column. These ideas may eventually become the paragraph or section headings of your essay.
- Finally, think about the theme or thesis of the book or article and write it down in your own words in the "Reflect" column. This may become the main thesis of your final product or one of the main arguments to support your thesis.

Notes Word Processed on a Computer

- Type the title, author, publisher, date, city of publication and any other pertinent information for each resource.
- Record information in point form just as you would write it. by hand including page numbers and quotation marks. Leave several lines between facts or points so that you can easily move

USEFUL WEBSITES FOR MAKING NOTES AND AVOIDING PLAGIARISM

How Not to Plagiarize
http://utl2.library.utoronto.ca/www/writing/plagsep.html

Taking Notes from Research Reading
http://utl2t.library.utoronto.ca/www/writingnotes.html

Quoting, Paraphrasing, and Summarizing
http://owl.english.purdue.edu/Files/31..html

Note Making Sheet **Appendix 9B**

Print Reference Material

Name: _____ Course: _____ Date: _____

Topic / Subtopic: _____

_____

Author: _____

Title of the Article: _____

Title of reference material: _____

Format: _____

Place of publication: _____ Publisher: _____

Date of Publication: _____ Volume #: _____ Pages: _____

Type: _____

Page numbers	**Point from notes and quotations**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Note Making Sheet **Appendix 9C**

Book

Name: _____ Course: _____ Date: _____

Topic / Subtopic: _____

_____

Author(s) / Editor(s): _____

Title: _____

Place of publication: _____ Publisher: _____

Date of Publication: _____ Source library: _____

Page numbers	**Point from notes and quotations**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Note Making Sheet **Appendix 9D**

Periodical Article:
Accessed via Print, CD or Internet

Name: _____ Course: _____ Date: _____

Topic / Subtopic: _____

Topic / Subtopic: _____

Author(s): _____

Title of article: _____

Title of periodical: _____

How was it accessed: _____

Date of Publication: _____ Pages: _____ Website add: _____

Page numbers	**Point from notes and quotations**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

CIN: 20300 **Version: 001**
Date: 2021/10/26

Note Making Sheet **Appendix 9E**

Other Materials: Audiotape, videos, interviews

Name: _____ Course: _____ Date: _____

Topic / Subtopic: _____

Title: _____

Format: _____

Director: _____

Producer / Distributor: _____

Date: _____ Source: _____

Page numbers	**Point from notes and quotations**

Note Making Sheet Example **Appendix 9F**

Reference Material

Name: _____ Course: _____ Date: _____

Topic / Subtopic: _____

_____

Author: *Lickens, Gene E*

Title of the Article: *Acid Rain*

Title of reference material: *The World Book Encyclopaedia*

Format: _____

Place of publication: *Chicago* Publisher: *World Book*

Date of Publication: *1998* Volume #: *1* Pages: *27*

Source library: *G.S.H.A Library*

Page numbers	Point from notes and quotations
_____	***Summarizing:***
	- article outlines the causes, effects, occurrence and treatment of acid rain
_____	***Paraphrasing:***
	Causes: *cars, factories, power plants give off chemical compounds such as sulphur*
_____	*dioxide & nitrogen oxides into the air to form sulphuric acid & nitric acid*
	- these acids pollute rain, snow , sleet etc. to produce acid rain
_____	*- some acidic gases & particles fall to earth when it is not raining*
	Effects: *- pollution of lakes, rivers, etc. killing fish and wildlife*
_____	*- damage to buildings, vegetation and soil*
	Occurrence: - eastern N. America, northwestern & central Europe, parts of Asia
_____	*- worse since 1950's (taller smoke stacks)*
	Treatment: *- devices are available to remove sulphur & nitrogen compounds from*
_____	*factory smoke*
	- lime may be added to lakes to neutralize the acids (this treatment does not last
_____	*and may have harmful side effects)*
	Quoting: *"Scientists use the term acid deposition to refer to both wet and dry acid*
_____	*pollution that falls to the earth"*

"5 R" for Recording Information **Appendix 9G**

5R 1 - Read 2 - Record 3 - Relate 4 - Reduce 5 - Reflect

1 – Read Title: _____

Author: _____ Pages: _____

Date of publication: _____ Publisher: _____

4 – Reduce to main points maybe possible headings	**2 – Record** Point from notes taken from reference material	**3 – Relate** make connections to your topic and other notes

5 – Reflect

How can the information gained be used? How do you feel about the information?

Independent Study Conference Notes **Appendix 11**

INDEPENDENT STUDY CONFERENCE NOTES

Section A: To be completed by the learner before conferencing.

Name: _____ Date: _____

Topic _____

Thesis (if it is required): _____

_____

Outline of essay or report:

Resources used:

_____

_____

Questions for your facilitator:

_____

_____

Section B: To be completed by the facilitator.

Comments: _____

_____

Section C:

Plans for the future:

_____

_____

Next conference date: _____

Making an Outline **Appendix 12**

Many word processing programs have outlining features to help you

Report:	**Research Essay:**
INTRODUCTION:	**THESIS:**
I Main point	I Main point
A Sub point	A Sub point
B Sub point	B Sub point
C Sub point	C Sub point
II Main point	II Main point
A Sub point	A Sub point
B Sub point	B Sub point
C Sub point	C Sub point
III Main point	III Main point
A Sub point	A Sub point
B Sub point	B Sub point
C Sub point	C Sub point
CONCLUSION:	**CONCLUSION:**

NOTE:

Research Essays and Reports are not limited to three main points

Editing the First Draft **Appendix 15**

WHY?

1. **CHECK THE CONTENT.**
   Ensure that you have met the requirements of the assignment, your thesis (purpose) and your outline.
2. **CHECK THE MECHANICS (PROOFREADING).**
   Ensure proper spelling, grammar, punctuation and style.

HOW?

1. Read your draft at least twice, once aloud.
2. Read your paper into a tape recorder. Listen. Does it make sense?
3. Have another person edit your work, checking co.

WHAT TO LOOK FOR

The draft flows smoothly.
It makes sense.
The introduction includes at least a thesis or clear statement of purpose.
The parts of the draft are in the most effective order.
The first sentence of each important paragraph refers to the thesis in some way.
Each paragraph begins with a link to the previous paragraph.
Use transitional expressions such as "...However, in addition...", etc.
Each paragraph includes a clear topic sentence.
Each paragraph is long enough to develop its topic.
Sentences vary in length and structure.
The draft has a strong conclusion.
Spelling, capitalization, grammar and punctuation are correct.

ADD A TITLE

It should reflect your thesis.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Sample Title Page **Appendix 16A**

The Global Threat of Acid Rain

by

Violet Ntibane

Unit Std 8979

SBV Midrand

16 October 2004

Documentation **Appendix 16B**

Because you are borrowing the words, facts, or ideas of others when you do research, you must tell readers that you borrowed the material and from where you have borrowed it in order to avoid plagiarism.

To make your use of borrowed material honest rather than plagiarized, you must acknowledge this material in **citations** within your essay and with a list of your sources on a separate page at the end.

You must document everything you use in your essay, not only direct quotations and paraphrases, but also opinions and ideas.

Facilitators require special documentation styles or formats in their learner's essays.

In the past, this has meant using either numbered footnotes at the bottom of each page or numbered endnotes at the end of the essay, followed by a bibliography listing all sources.

Footnotes and endnotes have been replaced with the more modern technique of using **embedded citations** within the text of the essay.

These citations are placed at the end of a quotation or paraphrased sentence and are placed in parentheses. An embedded citation serves two purposes.

The citation tells readers that the material is borrowed, and it refers readers to more detailed information about the source so that they can locate it. The older term "Bibliography" has been replaced by "Works Cited" or "References" because sources now usually include electronic and visual material as well as print sources. The two documentation styles which are used most often are:

- **Modern Language Association (MLA)** which is used for English, history, the arts, and foreign languages.

This style gives authors' names and page numbers for citations which are embedded in the essay, and then a **Works Cited List**, containing full bibliographic information at the end of the essay.

- **American Psychological Association (APA)** which is used for science, and mathematics. This style gives authors' names, publication dates, and page numbers for citations which are embedded in the essay, and then a **References** list , which includes full bibliographic information at the end of the essay.

Caution: The MLA style is quite different from that of the APA style. This booklet will use MLA style for examples of embedded citations and for examples to use in setting up a Works Cited List.

If your facilitator wants you to use APA style, consult the print and web resources listed at the end of this section for examples of APA citations and References Lists.

The author's last name and the page number from which the quotation, paraphrase or idea is taken must appear in the text and a complete reference should appear in your Works Cited list. The author's name may appear either in the sentence itself or in parentheses following the quotation, but the page number should always appear in the parentheses.

Example:

Direct Quotation - One Author

Some argue that "a dream is the fulfilment of a wish" (Freud 154).

Freud states that "a dream is the fulfilment of a wish" (154).

Example: Paraphrase of Author's Idea - One Author

The historian, Crane Brinton, believes that the French and Russian revolutions had similar causes, (Brinton 155)

Format: If you are using several books by the same author, add an abbreviation of the title so that the reader knows which source you have used.

Direct Quotation - More Than One Work by the Same Author

"There is room enough in anyone's backbone for too much duplicity. (Laurence, Jest 182)

Format: Place quotations longer than four lines in a block of lines and omit the quotation marks. Start the quotation on a new line, making sure you indent. Your citation should come after the closing punctuation mark.

Example:Long quotation

Ralph and the other boys finally realize the horror of their actions: The tears began to flow and sobs shook him. He gave himself up to the first time on the island; great shuddering spasms of grief began to wrench his whole body. His voice rose under the black smoke before the burning wreckage of the island; and infected by that emotion, the other boys began to shake and sob too. (Golding 186)

Format: When quoting from plays, cite the act, scene, and line numbers for Shakespeare's plays, and the page number, act and scene (if any) for other plays.

Example: Direct Quotation - Play by Shakespeare

Later in King Lear Shakespeare has the disguised Edgar say, "The prince of darkness is a gentleman" (3.4.147)

Example: Direct Quotation - Play

In Death of a Salesman, Linda defends Willie Loman by stating: He's not the finest character that ever lived. But he's a human being, and a terrible thing is happening to him. So, attention must be paid. He's not allowed to fall into his grave like an old dog. Attention, attention must finally be paid to such a person. (Miller 56; act 1)

Preparing Your Works Cited List

This list, placed at the end of your essay, should include all the sources you quoted, paraphrased, or summarized. It provides the information necessary for a reader to locate any sources you cite. Each source you cite in your essay must appear in your Works Cited List.

General Rules:

- Arrange your sources in alphabetical order by the last name of the author.
- List the author by last name, follow it with a comma, and then first name.
- If a source has more than one author, invert only the first author's name, then continue listing other authors.
- If a source has no author, put it in the list by title, but leave out A, The, or An.
- Indent second and third lines.
- Capitalize each word in the titles of books, articles, etc. not including A, An, The or conjunctions

Basic Forms for Sources in Print

Book

Follow the general format shown below and as further illustrated in the more specific examples, which follow.

Format:

Author (s). Title of Book. Place of Publication: Publisher, Year of Publication.

or

Author (s). Title of Book. Place of Publication: Publisher, Year of Publication.

Note: You may choose to underline the title or to use italics. Be consistent by using one form only in your Works Cited List. Both forms are correct. Ask your facilitators which style they prefer.

Examples, which follow, will consistently use italics.

Note: For well-known encyclopaedias, it is not necessary to list the publisher or place of publication. Usually, it is only necessary to list the edition number (if any) and the publication date. See the examples below.

The following serves as an example:

Example: One author

Goleman, Daniel. Emotional Intelligence. New York: Bantam, 1995.

Example: Two authors

Gilbert, Sandra M. The Norton Anthology of Literature by Women: The Tradition in English. New York: Norton, 1985.

Example: More than two authors

Hudson, Joe and others. Justice and the Young Offender in Canada. Toronto: Wall & Thompson, 1988.

Example: No author given

The Dorling Kindersley World Reference Atlas. London: Dorling Kindersley, 1994.

Example: Editor (s)

David, Jack and Robert Lecker, eds. Canadian Poetry: Volume One. Toronto: General Publishing, 1982.

Example: A part of a book, such as an essay in a collection

Anderson, Doris. "Real Women in Fiction, Where Are You?" The Role of Women in Canadian Literature ed. Elizabeth McCullough. Toronto: MacMillan, 1975.

Example: Print Encyclopaedia article with author given

Likens, Gene E. "Acid Rain." World Book. 1998 ed. Example: Print Encyclopaedia article with no author given "Winnipeg." The Canadian Encyclopaedia. 1987 ed.

Example: Government Publication

Canada. National Council of Welfare. Women and Poverty Revisited. Ottawa: Supply and Services Canada, 1990.

Example: Pamphlet

Aids in the "90s: The New Facts of Life. Pamphlet. Health and Welfare Canada, 1996.

Magazine, Newspaper or Journal

Format:

Author(s). "Title of Article." Name of Magazine Day Month Year: Pages

The following serves as an example:

Example: Magazine article with author given

Morrow, Lance. "The Fog of War." Time 4 Feb. 1991: 61-62. E

Example: Newspaper article with author given

Roseman, Eleanor. "Retirement Planning Pays Off." The Star 10 Dec.1997: B3.

Example: Newspaper article with no author given

"Protesters Greet Chretien in Vancouver." Toronto Sun 12 Jan.1998: A11.

Basic Forms for CD-ROM and Computer Disk Sources

Treat sources on CD-ROM or diskette the same as you would for sources in print, with two main additions: the medium ("CD-ROM," "Diskette") without quotation marks, and the distributor of the electronic work, if one is given, as well as the publisher.

The following serves as an example:

Example: Encyclopaedia article on CD-ROM with no author given

"Aardvark." World Book Multimedia Encyclopaedia. CD-ROM. 1998.

Example: Encyclopaedia article on CD-ROM with author given

Sentman, Eugene. "Aardvark." Multimedia Encyclopaedia. CD-ROM. 1997 ed. New York: Grolier, 1997.

Example: CD-ROM Periodical Database

Begley, Sharon. "Odds on the Greenhouse Effect." Newsweek. 1 Dec.1997: Sirs Researcher. CD-ROM.SIRS. Spring 1998.

Example: CD-ROM Newspaper Article Database

Mitchell, Bob. "Peel Sets up Squad to Deal with Abuse" The Star. 24 Mar. 1994: Canadian News Disc. CD-ROM. Toronto: Micromedia, 1995.

Basic Forms for Internet Sources

World Wide Web Pages

Format:

Author (s). Name of Page. Name of Organization (or the term Home Page if it is a personal home page). Date of Posting/Revision (if available). Date of Access.

Note: It is necessary to list your date of access because web postings are information available at one date may not be available later. Be sure to include the complete address for the site, and enclose the address in the angled brackets so that the address is clear.

The following serves as an example:

Example: a personal home page, no date of posting available

Jones, Ellen. Home Page. 1 Jun. 1998.

Example: a professional website with date of posting available

Abilock, Debbie. Research on a Complex Topic. Nueva Library Help. 9 Sept. 1997. Nueva School. 31 Dec. 1998.

Example: a scholarly project which has an editor

Perseus Project. Ed. Gregory R. Crane. 1997. Tufts U. 31 Dec.1997.

Online Encyclopaedias

The following serves as an example:

Example: an article in an online encyclopaedia with no author "Fresco." Britannica Online. Dec. 1998. 14 Dec.1998.

Online Newspaper and Magazine Articles

Database Subscriptions

Format:

Author. "Article Title." Original Source of Article Date of original source: Page Numbers. Product name. Date of access.

The following serves as an example:

Example: A magazine article found in an online subscription database

Lanken, Dane. "When the Earth Moves." Canadian Geographic March-April 1996: 66- 73. Sirs Researcher on the Web. 10 Nov.1998

Example: A newspaper article found in an online subscription database

Angier, Natalie. "Chemists Learn Why Vegetables are Good for You." The Star 13 Apr. 1993. Newscan. 12 Oct. 1998.

Online Magazines and Journals

Format: Author(s). "Title of Article." Title of Journal. Date: Pages. Date of access.

The following serves as an example:

Example:

Abilock, Debbie. "The Gestalt of Online Searching." MultiMedia Schools. Nov.-Dec. 1997. 10 Oct. 1998.

Discussion Lists and Newsgroups

The following serves as an example:

Example: A Usenet Group

Madige, Ellen. "How to Build a Better Mousetrap." 16 Jan. 1998. Online posting. 21 Jan. 1998.

File Transfer (FTP) and Telnet

The following serves as an example:

Example (FTP):

Harding, William. "Shakespeare and his Muse." 1 Aug. 1998

Example (Telnet):

Jackson, Fred. "Statistical Weather Data for Ontario" Jan. 1996. 7 Oct. 1998

E-mail messages

Format: Author(s) name. "Title of message." E-mail to the author. Date.

The following serves as an example:

Example: personal e-mail message Millon, Michele. "Re: Grief Therapy." E-mail to the author. 10 Oct. 1998.

Online Images, Video and Audio Clips

Format: "Description or title of image, video, or audio clip." Date of document (if Date of download.

The following serves as an example:

Example: "Hubble Space Telescope Release in the Space Shuttle's Payload Bay." 23 Oct. 1998.

Other Types of Sources

Video or Film

Format: Title. Director. Producer. Distributor, Date.

The following serves as an example:

Example:

After the Montreal Massacre. Dir. Gerry Rogers. Prod. Nicole Hubert. Videocassette. National Film Board, 1990.

Television or Radio Program

Format: "Episode Title". Name of Program. Name of network. Local station, City. Date.

The following serves as an example:

Example:

"Bali, Masterpiece of the Gods." Television Program. National Geographic. NBC. WPNT, Buffalo, N.Y. 5 Feb.1998.

Audio Recording, Tape or CD

The following serves as an example:

Example:

Bach, Johann Sebastian. Italian Concerto in F Major. Perf. Angela Hewitt. Cond. Claudio Abbado. Berlin Philharmonic.Compact Disc. Deutsche Grammophon, 1985. DigitalStereo 419 218-2 GH.

Slide

The following serves as an example:

Example:

"Parthenon." Slide. Silver Padachey Collection, 1998.

Stage Play or Musical Performance

The following serves as an example:

Example:

A Stage Play Bouchard, Michel Marc. Lilies. Dir. Suzanne Smith. Theatre Passe Muraille, 27 Feb. 1998.

Example:

A Concert Mehta, Zubin, cond. Israel Philharmonic Orch. Concert. Roy Thomson Hall, Toronto. 1 May 1997.

Cartoon

The following serves as an example:

Example:

Reilly, P. Cartoon. New Yorker 28 Jan. 1997: 32.

Interview

The following serves as an example:

Example:

Wong, Jan. Personal Interview. Toronto. 8 Feb. 1998.

Work of art

The following serves as an example:

Example: As Viewed at a Museum or Art Gallery Van Rijn, Rembrandt.

Aristotle Contemplating the Bust of Homer. Metropolitan Museum of Art, New York

Example: As Viewed in a Book

Rembrandt van Rijn. Aristotle Contemplating the Bust of Homer. Metropolitan Art, New York. Masterpieces of the Met. by Donelson F. Hoopes. New York: Prentice Hall, 1987.

Useful Internet Sites for Help with Documentation

MLA Style

http://www.mal.org/main_stl.htm

APA and MLA Citation Styles

http://www.english.uiuc.edu/cws/wworkshop/bibliostyles.htm

MLA Interactive Forms

http://www.nueva.pvt.k12.ca.us/flibrary.html

Documenting Electronic Sources

http://owl.english.purdue.edu/writers/documenting.html

Standard Documentation Formats

http://www.library.utoronto.ca/www/writing/document.htm

Appendix 16C: An Example of How to Include Citations

Homeless Children and Crime

Homelessness among children is leading to an increase in the number of crimes committed by youth. The number of teens living on the streets of major cities has doubled in the last decade and crime rates among young people appear to be rising proportionately (Canada Yearbook 1997, 126). Children, without the security of a stable place to live and secure adult relationships, can easily become disenchanted with society (Stavsky and Thompson 145). It is important however, to look at the reasons why children run away and how their experiences on the street affect their behaviour.

There seems to be disagreement among the experts as to why teens leave their homes and turn to life on the street. "Public and expert opinion offer a hodgepodge of views as to why kids run away from home" (Hynes). It seems that most runaway children are escaping abusive situations at home, and that few leave home just because they have disagreements with parents over little items like curfews and homework. One runaway state,

> *Although my dad had always been a drinker and a gambler, he'd never squandered our rent or savings before. Poverty soon forced us to move to Regent Park (with more than 10,000 residents, the largest public housing complex in Canada). With the heartbreak came more drinking for both of them. Drunk, my dad couldn't work steady anymore, so he'd work on and off. He'd sober up for work and tank up after work. The fights between them became more violent; he'd smack her around and she'd smack me around. (Webber 156)*

According to Dr. Jeffrey Palter, Executive Director of "Homes for Youth", a government agency dealing with homeless teens, there are numerous risk factors that affect a child's decision to leave home and become involved in criminal activity. These include poverty, violence, addictions, neglect, racism, and community apathy. He stresses, however, that "through supporting parents, provided that the support is maintained over the long-term, the effects of poverty, community breakdown and racism on young people are greatly mitigated and delinquency thus largely prevented." (Young Offenders, A Child Welfare Perspective)

Works Cited List

Canada. Statistics Canada. Canada Yearbook 1997. Ottawa: Minister of Industry. 1996.

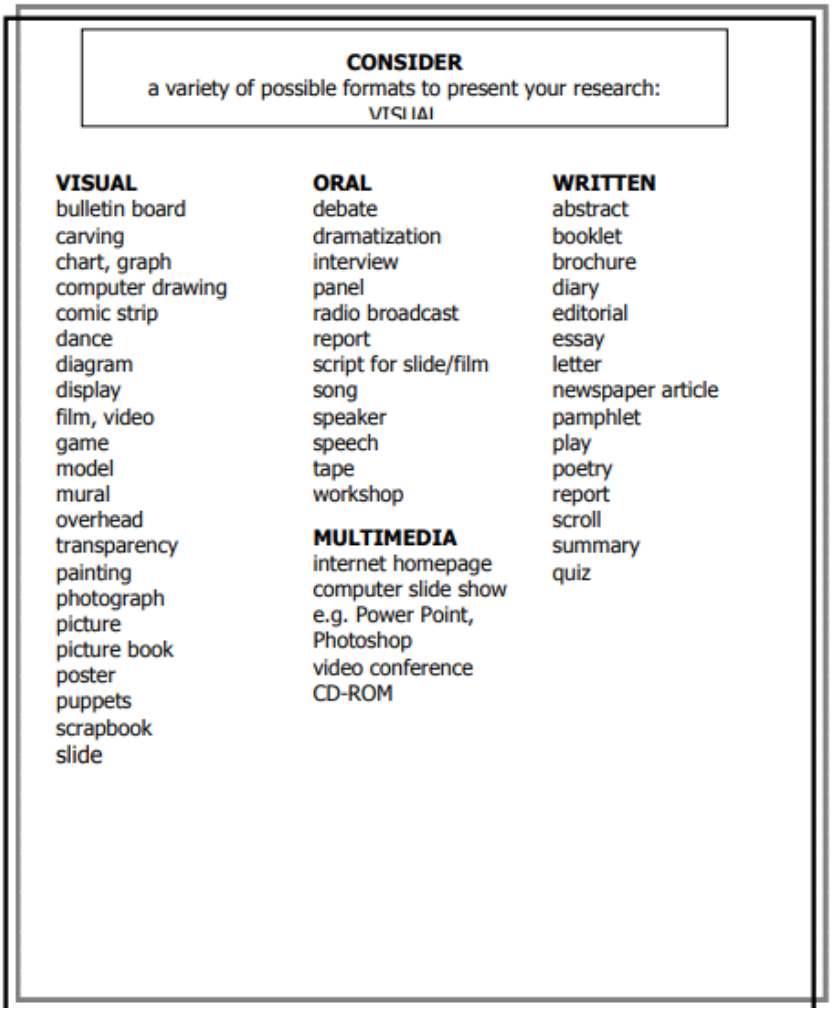
Hynes, Robert. “Street Kids: Behind the Scenes.” Ottawa Citizen 12 November 1997. CD-ROM. Canadian News Disk. Toronto: Micromedia, 1998.

Stavsky, Marcia and David Thompson. The Homeless. San Diego: Greenhaven Press. 1994.

Webber, Marlene. Street Kids: The Tragedy of Canada’s Runaways. Toronto: University of Toronto Press. 1991.

Child Welfare League of Canada. The Young Offenders Act, Its Implementation and Related Services: A Child Welfare Perspective. 1996. 31 May 1998.

Appendix 17 Preparing a presentation



CONSIDER
a variety of possible formats to present your research:

VISUAL
bulletin board
carving
chart, graph
computer drawing
comic strip
dance
diagram
display
film, video
game
model
mural
overhead transparency
painting
photograph
picture
picture book
poster
puppets
scrapbook
slide

ORAL
debate
dramatization
interview
panel
radio broadcast
report
script for slide/film
song
speaker
speech
tape
workshop

MULTIMEDIA
internet homepage
computer slide show e.g. Power Point, Photoshop
video conference
CD-ROM

WRITTEN
abstract
booklet
brochure
diary
editorial
essay
letter
newspaper article
pamphlet
play
poetry
report
scroll
summary
quiz

Evaluating the Project **Appendix 18A**

INDEPENDENT STUDY: EVALUATING THE PROJECT

Topic: _____ Name: _____

HOW WOULD YOU RATE YOUR WORK?

Rate yourself on a 1 to 5 basis

(1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent).

1. Did I use my research time well? (stay on task, make decisions, and work independently)
   1 2 3 4 5
2. Did I work well with others when appropriate? (sharing ideas, asking for help, getting information - classmates, teachers, other contacts)
   1 2 3 4 5
3. Did I prove my thesis / develop my topic?
   1 2 3 4 5
4. Is my information accurate?
   1 2 3 4 5
5. Did I use a variety of sources, print and non-print?
   1 2 3 4 5
6. Is my material well organized? (main ideas, supporting facts, logical arrangement)
   1 2 3 4 5
7. Did I choose the best way to present my results?
   1 2 3 4 5
8. Have I made good use of special effects to make my presentation interesting? (illustrations, charts, slides, costumes, etc.)
   1 2 3 4 5
9. Is my style clear and effective?
   1 2 3 4 5
10. Have I used correct form for my presentation? (spelling, grammar, essay format, oral skills, etc.)
    1 2 3 4 5

Peer Evaluation: Oral Presentations/Speeches **Appendix 18B**

	Very good 3	Satisfactory 2	Poor 1
1. Gave an interesting introduction			
2. Presented clear explanation of topic			
3. Presented information in acceptable order			
4. Used complete sentences			
5. Offered a concluding summary			
6. Spoke clearly, correctly, distinctly and confidently			
7. Maintained eye contact			
8. Maintained acceptable posture			
9. Maintained the interest of the class.			
10. Used visual/audio aids well			
11. Handled questions and comments from the class very well			
Subtotal			
Total			

CIN: 20300 **Version: 001**
Date: 2021/10/26

Group Effectiveness Appraisal **Appendix 18C**

Group Effectiveness Appraisal

Name:_____ Group: _____

Project Title: _____

Audience:_____

Rate your group on a 1 to 5 basis

(1 = poor; 2 = fair; 3 = good; 4 = very good; 5 = excellent).

1. We worked cooperatively with all group members. 1 2 3 4 5
2. We accomplished what we set out to complete. 1 2 3 4 5
3. We were satisfied with our performance of this group task. 1 2 3 4 5
4. We used our group time efficiently without wasting or misusing time. 1 2 3 4 5
5. We all contributed fairly to the completion of this group task. 1 2 3 4 5

Personal assessment and observations:

1. Did you feel satisfied with your own participation in the project? Discuss your feelings honestly. _____

_____

2. Do you think that the project participation was reasonably equal (that is, do you feel others in your group worked well and contributed fairly?) _____

_____

3. Do you think there are some ways your group could have improved and therefore produced a better-finished project? _____

_____

4. Do you like doing a project like this, or do you honestly prefer to work on your own? (Please answer explaining why or why not.) _____

_____

5. Please add any helpful comments you may think of: _____

_____

BRAINSTORMING AND MIND MAPS

Brainstorming

- The following steps are recommended for a brainstorming session:
- Select the topic or problem to be discussed.
- Each group member makes a list of ideas on a piece of paper. This should take no longer than 10 minutes.
- Each person reads one idea at a time from her list of ideas, sequentially, starting at the top of the list. As ideas are read, they should be recorded and displayed by the group leader. Group members continue in this circular reading fashion until all the ideas on everyone's list are read.
- If a member's next idea is duplication, that member goes on to the subsequent idea on his list. x Members are free to pass on each go-round but should be encouraged to add something.
- The leader then requests each group member, in turn, to think of any new ideas she hadn't thought of before. Hearing others' ideas will probably result in related ideas. This is called piggybacking. The leader continues asking each group member, in turn, for new ideas, until they can't think of anymore.
- If the group reaches an impasse, the leader can ask for everyone's, "wildest idea", an unrealistic idea can stimulate a valid one from someone else.

Rules

Certain rules should be observed by the participants to ensure a successful brainstorming session – otherwise, participation may be inhibited.

- Don't criticize, by word or gesture, anyone's ideas.
- Don't discuss any ideas during the session, except for clarification.
- Don't hesitate to suggest an idea because it sounds silly. Many times, a "dumb" idea can lead to the problem solution.
- Each team member should suggest only one idea at a time
- Don't allow the group to be dominated by one or two people.
- Don't let brainstorming become a gripe session.

Aids to Better Brainstorming

A relaxed atmosphere in which people feel free to suggest any kind of idea enhances the brainstorming session. Here are five techniques that may improve brainstorming by giving people ways to come up with new ideas.

- *Modification* is changing some aspect of an existing product or service. An example is lower-priced movie tickets for senior citizens.
- *Magnification* is enlarging a product or service, such as giant economy-size packages.
- *Minification* is altering a product or service so it becomes smaller or less complex. Examples are portable radios and televisions, electronic calculators, and no-frills airline travel.
- *Substitution* is using a certain material or service in place of what has traditionally been employed. Examples are using polyester instead of cotton, plastic in place of metal, and nurse-midwives instead of physicians.
- *Rearrangement* is altering the configuration of basic elements in a product or service-for example, some housing developments use several floor plans, but all homes have the same basic features.

An Example of Brainstorming

Consider a group of six people, one from each department of an organization, who brainstorm about the problem of excessive employee absenteeism. They've already decided on the topic to be discussed, so they can proceed to making their lists of causes. After completing their lists, they read their ideas, sequentially, one at a time. The designated leader records the ideas on a flip chart.

The first person's list of possible causes of excessive employee absenteeism is

- Low morale.
- No penalties for absence.
- Boredom with job.
- Personal problems. The second person's list is
- Dislike of supervisor.
- Drug problems.
- Performance anxiety.
- Anger over pay.
- Work-related accidents.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Other members have similar lists. After everyone have read their lists and the causes have been recorded, the leader requests any new ideas that have emerged. Piggybacking on one of the first person's causes – "personal problems"- might result in another cause, "family problems." Asking for wild ideas might generate a response such as "addiction to video games" or "rundown bathroom facilities."

After all of the ideas have emerged, each group member gets a copy of the list to study. The group meets again and evaluates the ideas. They rank them in order of importance and decide that low morale, drug problems, and boredom with job are the three most critical causes of absenteeism. They are then in the position to develop an action plan to deal with these causes.

Mind Maps

Mind Maps are very important techniques for improving the way you take notes. By using Mind Maps you show the structure of the subject and linkages between points, as well as the raw facts contained in normal notes. Mind Maps hold information in a format that your mind will find easy to remember and quick to review.

Mind Maps abandon the list format of conventional note taking. They do this in favour of a two-dimensional structure. A good Mind Map shows the 'shape' of the subject, the relative importance of individual points and the way in which one fact relates to other. Mind Maps are more compact than conventional notes, often taking up one side of paper. This helps you to make associations easily. If you find out more information after you have drawn the main Mind Map, then you can easily integrate it with little disruption.

Mind Maps are also useful for:

- Summarizing information
- Consolidating information from different research sources
- Thinking through complex problems, and
- Presenting information that shows the overall structure of your subject

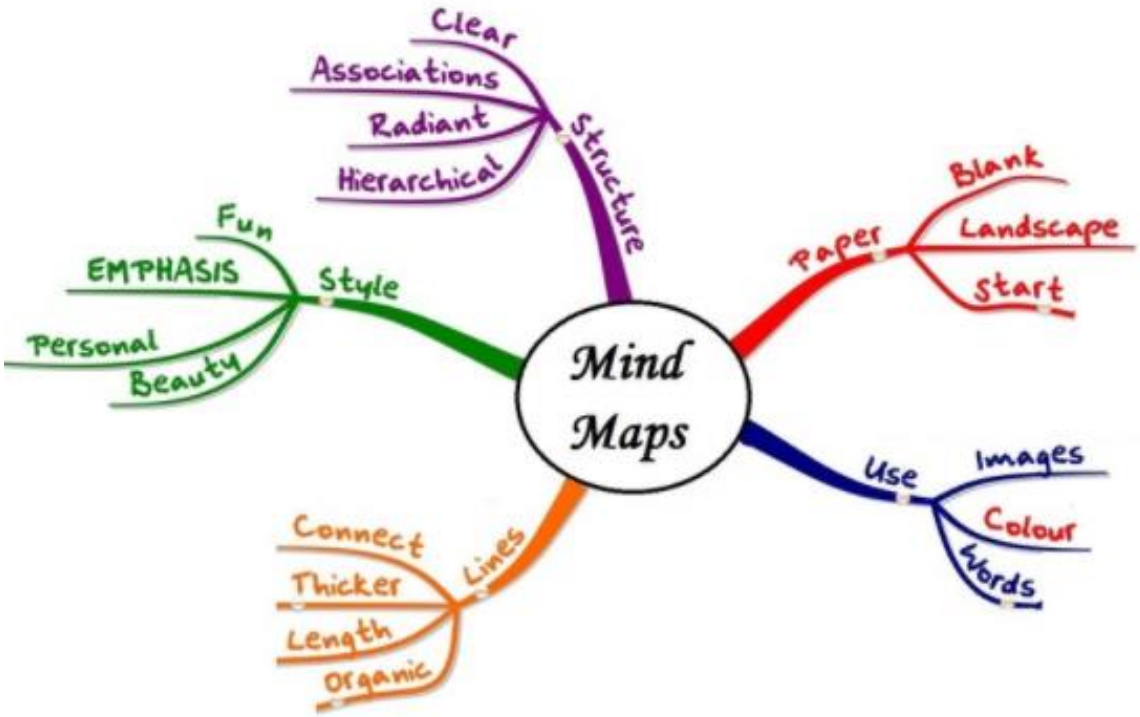
Mind Maps are also very quick to review, as it is easy to refresh information in your mind just by glancing at one.

Mind Maps can also be effective mnemonics. Remembering the shape and structure of a Mind Map can provide the cues necessary to remember the information within it. They engage much more of the brain in the process of assimilating and connecting facts than conventional notes.

Drawing basic Mind Maps

This book was researched and planned using Mind Maps. They are too large to publish here, however part of one is shown below. This shows research into time management skills:

Fig. 1 Example of a mind map



To make notes on a subject using a Mind Map, draw it in the following way:

- Write the title of the subject in the centre of the page, and draw a circle around it. This is shown by the circle marked 1 in the figure 1.
- For the major subject subheadings, draw lines out from this circle. Label these lines with the subheadings. These are shown by the lines marked 2 in figure 1.

CIN: 20300 **Version: 001**
Date: 2021/10/26

- If you have another level of information belonging to the subheadings above, draw these and link them to the subheading lines. These are shown by the lines marked 3 in figure 1.
- Finally, for individual facts or ideas, draw lines out from the appropriate heading line and label them. These are shown by the lines marked 4 in figure 1.

As you come across new information, link it into the Mind Map appropriately.
A complete Mind Map may have main topic lines radiating in all directions from the centre. Sub-topics and facts will branch off these, like branches and twigs from the trunk of a tree. You do not need to worry about the structure produced, as this will evolve of its own accord.

Note that the idea of 'levels' in Figure 1 is only used to help show how the Mind Map was created. All we are showing is that major headings radiate from the centre, with lower-level headings and facts branching off from the higher-level headings.

While drawing Mind Maps by hand is appropriate in many cases, software tools improve the process by helping to you to produce high quality Concept Maps, which can easily be edited and redrafted.

Improving your Mind Maps

Your Mind Maps are your own property: once you understand how to make notes in the Mind Map format, you can develop your own conventions to take them further. The following suggestions may help to increase the effectiveness of your Mind Maps:

- Use single words or simple phrases for information:
  Most words in normal writing are padding, as they ensure that facts are conveyed in the correct context, and in a format that is pleasant to read. In your own Mind Maps, single strong words and meaningful phrases can convey the same meaning more potently. Excess words just clutter the Mind Map.
- Print words: Joined up or indistinct writing can be more difficult to read.
- Use colour to separate different ideas:
  This will help you to separate ideas where necessary. It also helps you to visualize of the Mind Map for recall. Colour also helps to show the organization of the subject.
- Use symbols and images:

CIN: 20300 **Version: 001**
Date: 2021/10/26

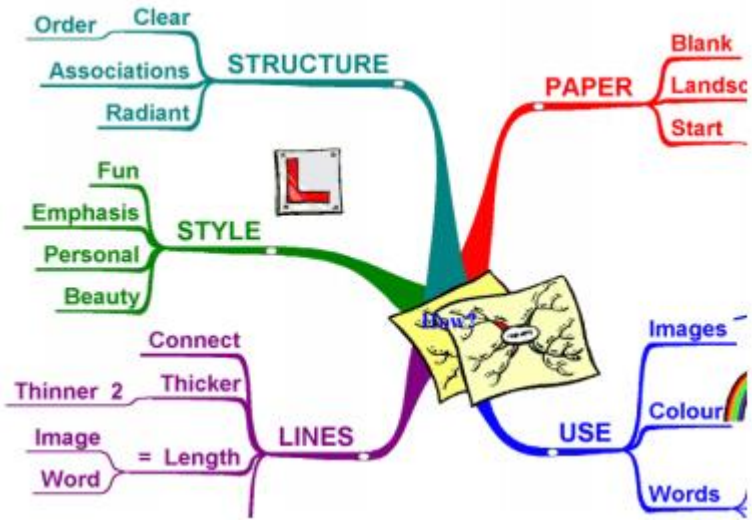
Where a symbol or picture means something to you, use it. Pictures can help you to remember information more effectively than words.

- Using cross-linkages:
  Information in one part of the Mind Map may relate to another part. Here you can draw in lines to show the cross-linkages. This helps you to see how one part of the subject affects another.

Key points:

Mind Maps provide an extremely effective method of taking notes. They show not only facts, but also the overall structure of a subject and the relative importance of individual parts of it. Mind Maps help you to associate ideas and make connections that might not otherwise make.

If you do any form of research or note taking, try experimenting with Mind Maps. You will find them surprisingly effective.



Speed Reading

Speed Reading helps you to read and understand text more quickly. It is an essential skill in any environment where you have to master large volumes of information quickly, as is the norm in fast-moving professional environments.

The Key Insight

The most important trick about speed reading is to know what information you want from a document before you start reading it: if you only want an outline of the issue that the document discusses, then you can skim the document very quickly and extract only the essential facts. If you need to understand the real detail of the document, then you need to read it slowly enough to fully understand it.

You will get the greatest time savings from speed-reading by learning to skim excessively detailed documents.

Technical Issues

Even when you know how to ignore irrelevant detail, there are other technical improvements you can make to your reading style, which will increase your reading speed.

Most people learn to read the way young children read – either letter-by-letter, or word-by-word. For most adults, this is probably not the case – think about how your eye muscles are moving now. You will probably find that you are fixing your eyes on one block of words, then moving your eyes to the next block of words, and so on. You are reading blocks of words at a time, not individual words one-by-one. You may also notice that you do not always go from one block to the next: sometimes you may move back to a previous block if you are unsure about something.

A skilled reader will read many words in each block. He or she will only dwell on each block for an instant, and will then move on. Only rarely will the reader's eyes skip back to a previous block of words. This reduces the amount of work that the reader's eyes have to do. It also increases the volume of information that can be examined in a period of time.

A poor reader will become bogged down, spending a lot of time reading small blocks of words. He or she will skip back often, losing the flow and structure of the text and overall understanding of the subject. This irregular eye movement will make reading tiring. Poor readers tend to dislike reading, and may find it harder to concentrate and understand written information.

Speed-reading aims to improve reading skills by:

- Increasing the number of words read in each block
- Reducing the length of time spent reading each block, and
- Reducing the number of times your eyes skip back to a previous sentence.

These are explained below:

Increasing the number of words in each block:

This needs a conscious effort. Try to expand the number of words that you read at a time. Practice will help you to read faster. You may also find that you can increase the number of words read by holding the text a little further from your eyes. The more words you can read in each block, the faster you will read!

Reducing Fixation Time: The minimum length of time needed to read each block is probably only a quarter of a second. By pushing yourself to reduce the time you take, you will get better at picking up information quickly. Again, this is a matter of practice and confidence.

Reducing Skip-Back: To reduce the number of times that your eyes skip back to a previous sentence, run a pointer along the line as you read. This could be a finger, or a pen or pencil. Your eyes will follow the tip of your pointer, smoothing the flow of your reading. The speed at which you read using this method will largely depend on the speed at which you move the pointer.

You will be able to increase your reading speed a certain amount on your own by applying speed reading techniques. What you don't get out of self-study is the use of specialist reading machines and the confidence gained from successful speedreading – this is where a good one-day course can revolutionize your reading skills.

Key points:

By speed reading you can read information more quickly. You may also get a better understanding of it as you will hold more of it in short term memory.

To improve the speed of your reading, read more words in each block and reduce the length of time spent reading each block. Use a pointer to smooth the way your eyes move and reduce skip-back.

Speed Reading Self-Spacing Methods

Speed-reading is not magic nor is it a big expensive mystery. Professional speed-reading classes simply teach a handful of easy techniques that help a person focus his or her attention better. The eye is drawn to motion. Speed reading techniques put that motion on the page.

Your starting position is important. You should sit up straight, hold the book down with your left hand, and use your right hand to do the pacing.

You should already be a good reader before you attempt to speed read. Speedreading will not help you if you have problems in comprehension and vocabulary. In fact, it may hurt you to try to rush through stuff that you can't comprehend. You should have the basics down already first.
Before you start speed-reading, you should do a survey of the information first to get a general idea of what you will be covering and of the type of writing.

The Hand

The first method is to simply place your right hand on the page and slowly move it straight down the page, drawing your eyes down as you read. Keep an even, slow motion, as if your right hand has its own mind. Your eyes may not be exactly where your hand is, but this simple motion will help you go faster. Don't start, read a little, stop, read a little, start, and read a little. Keep the movement slow and easy. Only do it once per page. If you are "left-handed" use your left hand as the dominant pacing hand.

The Card

The next technique is to use a card or a folded-up piece of paper above the line of print to block the words after you read them. Draw it down the page slowly and evenly and try to read the passage before you cover the words up. This helps break you of the habit of reading and reading a passage over and over again. It makes you pay more attention the first time. Be sure to push the card down faster than you think you can go. Slide the card down once per page.

The Sweep

Another method is to use your hand to help draw your eyes across the page. Slightly cup your right hand. Keep your fingers together. With a very light and smooth motion, sweep your

fingers from left to right, underlining the line with the tip of your tallest finger from about an inch in and an inch out on each line. Use your whole arm to move, balancing on your arm muscle. Imagine that you are dusting off salt from the page.

The Hop

Similar to the "sweep" method is the "hop", but in the "hop" you actually lift your fingers and make two even bounces on each line. Each time you bounce, you are making a fixation, which hopefully catches sets of three or four words. Moving to a "hop" method also makes it easier to keep a steady pace as it is a lot like tapping our fingers on a desk. Balance on your arm muscle; don't just wiggle your wrist.

The Zig-Zag or Loop

The last method is a type of modified scanning technique. In this one you take your hand and cut across the text diagonally about three lines and then slide back to the next line. Now the idea here is not necessarily to see each word, but to scan the entire area, letting your mind pick out the main ideas. I wouldn't recommend this for material that requires very careful reading, but it is a way to help you get the general ideas of easy material.

These methods seem simple and easy, but don't let that fool you. These are very useful methods, which can help a good reader, read faster and better in very little time. But these techniques will not do you any good unless you PRACTICE them. It usually takes about three or four sessions before you get accustomed to a particular technique. As you move along and learn the methods, you may find that one is more suitable for you than the others. Find the one that works for you and use it.

Reading Strategies – Reading Efficiently by Reading Intelligently

Good reading strategies help you to read in a very efficient way. Using them, you aim to get the maximum benefit from your reading with the minimum effort. This section will show you how to use 6 different strategies to read intelligently.

Strategy 1: Knowing what you want to know

The first thing to ask yourself is: Why you are reading the text? Are you reading with a purpose or just for pleasure? What do you want to know after reading it?

Once you know this, you can examine the text to see whether it is going to move you towards this goal. An easy way of doing this is to look at the introduction and the chapter headings. The introduction should let you know whom the book is targeted at, and what it seeks to achieve. Chapter headings will give you an overall view of the structure of the subject.

Ask yourself whether the book meets your needs. Ask yourself if it assumes too much or too little knowledge. If the book isn't ideal, would it be better to find a better one?

Strategy 2: Knowing how deeply to study the material

Where you only need the shallowest knowledge of the subject, you can skim material. Here you read only chapter headings, introductions and summaries.
If you need a moderate level of information on a subject, then you can scan the text. Here you read the chapter introductions and summaries in detail. You may then speed-read the contents of the chapters, picking out and understanding key words and concepts. At this level of looking at the document it is worth paying attention to diagrams and graphs.

Only when you need detailed knowledge of a subject is it worth studying the text. Here it is best to skim the material first to get an overview of the subject. This gives you an understanding of its structure, into which you can fit the detail gained from a full reading of the material. SQ3R is a good technique for getting a deep understanding of a text.

Strategy 3: Active Reading

When you are reading a document in detail, it often helps if you highlight, underline and annotate it as you go on. This emphasizes information in your mind, and helps you to review important points later.

Doing this also helps to keep your mind focused on the material and stops it wandering. This is obviously only something to do if you own the document! If you find that active reading helps, then it may be worth photocopying information in more expensive texts. You can then read and mark the photocopies.

CIN: 20300 **Version: 001**
Date: 2021/10/26

If you are worried about destroying the material, ask yourself how much your investment of time is worth. If the benefit you get by active reading reasonably exceeds the value of the book, then the book is disposable.

Strategy 4: How to study different sorts of material

Different sorts of documents hold information in different places and in different ways. They have different depths and breadths of coverage. By understanding the layout of material you are reading, you can extract useful information much more efficiently.

- Reading Magazines and Newspapers:

  These tend to give a very fragmented coverage of an area. They will typically only concentrate on the most interesting and glamorous parts of a topic - this helps them to sell copies! They will often ignore less interesting information that may be essential to a full understanding of a subject. Typically, areas of useful information are padded out with large amounts of irrelevant waffle or with advertising.

  The most effective way of getting information from magazines is to scan the contents tables or indexes and turn directly to interesting articles. If you find an article useful, then cut it out and file it in a folder specifically covering that sort of information. In this way you will build up sets of related articles that may begin to explain the subject.

  Newspapers tend to be arranged in sections. If you read a paper often, you can learn quickly which sections are useful and which ones you can skip altogether.

- Reading Individual Articles:

  Articles within newspapers and magazines tend to be in three main types:

  - News Articles:

    Here the most important information is presented first, with information being less and less useful as the article progresses. News articles are designed to explain the key points first, and then flesh them out with detail.

  - Opinion Articles:

    Opinion articles present a point of view. Here, the most important information is contained in the introduction and the summary, with the middle of the article containing supporting arguments.

  - Feature Articles:

    These are written to provide entertainment or background on a subject. Typically, the most important information is in the body of the text.

If you know what you want from an article, and recognize its type, you can extract information from it quickly and efficiently.

Strategy 5: Reading 'whole subject' documents

When you are reading an important document, it is easy to accept the writer's structure of thought. This can mean that you may not notice that important information has been omitted or that irrelevant detail has been included. A good way of recognizing this is to compile your own table of contents before you open the document. You can then use this table of contents to read the document in the order that you want. You will be able to spot omissions quickly.

Strategy 6: Using glossaries with technical documents

If you are reading large amounts of difficult technical material, it may be useful to photocopy or compile a glossary. Keep this beside you as you read. It will probably also be useful to note down the key concepts in your own words, and refer to them when necessary.

Usually, it is best to make notes as you go. The most effective way of doing this may be to use Concept Maps.

Key points:

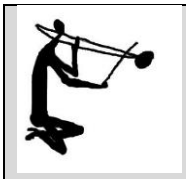
This section shows 6 different strategies and techniques that you can use to read more effectively. These are:

- Knowing what you need to know, and reading appropriately
- Knowing how deeply to read the document: skimming, scanning or studying
- Using active reading techniques to pick out key points and keep your mind focused on the material
- Using the table of contents for reading magazines and newspapers, and clipping useful articles
- Understanding how to extract information from different article types
- Creating your own table of contents for reviewing material
- Using indexes, tables of contents, and glossaries to help you assimilate technical information.

Procedure for the Reading Exercises

So that you will be familiar with the procedure to be followed in reading the practice passages during the course, there follows a short 'trial' exercise for you to attempt. The procedure for reading this and other passages – except where you are given different instructions – is as follows:

- Have your stopwatch, or a watch with a second hand, ready and, at a convenient point, begin timing and begin reading.
- Read the passage through once only as quickly as you can without loss of comprehension and note the time taken.
- Answer Sections A and B of the Comprehension Test.
- Convert the time taken to read the passage into 'words per minute'.
- Deal with Section C of the Comprehension Test.
- Set your watch and begin reading NOW.

	**Individual Activity 1:**

Flexibility and Techniques

Levels of Difficulty

No one would suggest for a moment that, in learning to become faster and better readers, we should allow ourselves to fall into the habit of reading everything we encounter at the same high speed. We must take account not only of our purposes in reading but also of the nature and level of difficulty of the material itself.

There are several factors, which determine the level of difficulty of any particular piece of material for any individual reader, and we must be aware of them if we are to approach our reading in a flexible and efficient manner.

Firstly, there is the effect of vocabulary. If the vocabulary used by a writer is wide and varied or if he uses many highly specialised or technical terms, this can make the material more

difficult to read. The possession of an extensive vocabulary is therefore essential to the really efficient reader if he is to overcome this problem.

Some subjects are inherently more difficult to understand than others, especially those concerned with abstract ideas, so the subject matter must be taken into account. Similarly, some subjects are inherently more interesting than others, especially those dealing with human life and experience, like true-life adventure stories and biographies of famous people. The interest value of the material, then, is the third factor to consider.

As we have already said, our purpose in reading the material can contribute towards making things easier or more difficult to read. There are comparatively few purposes for which perfect comprehension is essential, but where it is required this makes reading more difficult. Moreover, what you hope to obtain from the material should coincide with what the material is offering, otherwise difficulties will arise.

The construction of material is important. A writer must at least be competent in expressing what he has to say, otherwise he creates difficulties for the reader by, for example, poorly organised material or insufficient care in the choice of words. To a significant extent, efficient reading depends upon effective writing, and this is particularly true with difficult subjects.

The layout of material effects the efficiency with which we can read it and here printers and publishers have a responsibility to fulfil. Typographical design, the length of the printed line, the quality and the colour of the paper can all raise or lower the level of difficulty for the reader. Duplicated material can be especially difficult to read because information is frequently crammed on to a sheet of paper in an attempt at economy.

Internal and external distractions at the time of reading, in the form of noise or people moving about, or even one's attention momentarily wandering from the task of reading, can affect one's concentration and thus make the material more difficult to read. Even the individual reader's personality can make material more difficult. Some people are naturally capable of becoming interested in almost everything, others tend to specialise, and the degree of interest on the part of the reader (as opposed to the interest arising out of the material itself) can raise or lower the level of difficulty. Wide and varied reading interests can help to overcome this problem to a large extent.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Before deciding how much time, attention and effort a reading task requires it is therefore necessary to decide whether you expect the material to be easy, of average difficulty or difficult to read. During the coming week you should pay particular attention to this aspect of the reading process in your efforts to select the most suitable technique for each piece of reading matter.

Use of 'Gears' in Reading Speeds

Flexibility involves making a conscious and deliberate choice of the most appropriate reading technique or 'gear' and, in fact, reading matter can be handled in one of four ways. It can be studied, read slowly, read rapidly, or skimmed. Whichever technique is the most appropriate on any particular occasion will depend partly upon your purpose in reading and partly upon the nature and level of difficulty of the material.

Briefly, the four 'gears' in reading speeds may be described as follows:

STUDYING involves reading, re-reading, making notes and considering the full meaning and implications of the material. Quite obviously, this takes time. It is, therefore, a technique to be reserved for those occasions when the content of the material is difficult or unfamiliar and/or the material is sufficiently important for high quality of comprehension to be required. Speeds in study reading will range from a few words per minute (where a short passage is read several times, for example) to a maximum of about 200 w.p.m.

SLOW READING is, for most people who have no reading efficiency training, normal reading and is carried out at speeds ranging from 150 words per minute to 300 words per minute, approximately. The efficient reader uses slow reading where the material is fairly difficult or unfamiliar and/or a higher quality of comprehension than usual is required.

RAPID READING is the technique, or 'gear', which most adult readers are able to use for most purposes after a period of training such as the one provided in this book. It enables average or easy material to be dealt with at a comprehension level of 70-80 per cent, which is quite adequate for most purposes in reading. Speeds range from about 300 to about 800 w.p.m.

SKIMMING involves allowing the eyes to move quickly across and down the page, not reading every group of words or even every line. Effectiveness in skimming is greatly assisted

by a clear sense of purpose, by paying particular attention to headings, sub-headings, the opening and closing sentences of paragraphs and by looking for key words and phrases. It is a suitable technique when a general outline, or 'overview', of the content of the material is required (800-1000 w.p.m.) or when the reader is trying to locate specific facts or ideas (1000+ w.p.m.). You have already begun to practise a form of skimming in your previewing of material before you read it and in your reviewing of material after having read it.

Since you will already be quite familiar with the technique of slow reading and since you are gradually developing the ability to read rapidly in your progress through this book, let us take a closer look at the techniques of skimming and studying.

A Closer Look at Skimming

Skimming, then, is a form of very fast 'reading'. Your eyes move quickly across and down the page, seeking out the important information that the writer is trying to communicate and discarding everything that is of secondary or minor importance. It can be used profitably when you are reading for specific details (we all skim when 'reading' a dictionary or a telephone directory) or are looking for certain key words' and phrases (for example, when skimming a journal article to ascertain the level at which the writer is treating his subject).

Skimming, therefore, is not reading in any normally accepted sense, but it is still a valid reading technique which can be used to obtain information from the printed page. Skilled skimmers find that they have to read in fill only difficult or important material, everything else can be skimmed without appreciable loss in comprehension. You will need to practise a great deal, however, if you are to emulate these natural skimmers. With practice, students have been known to skim at 2000 w.p.m. and even 3000 w.p.m. and still score highly on the kind of comprehension test in this book.

As you practise skimming, look for the main points the writer is making or for the answers to certain questions about the material which may be at the back of your mind. (What is he saying that is useful to me? What evidence does he give to support his statements?) Remember that you are here transferring the techniques that must be used to find information in dictionaries, telephone directories, handbooks and encyclopaedias to other types of material to acquire certain information only.

When you are skimming, make the fullest possible use of the headings and sub-headings provided and be particularly aware of key or 'topic' sentences in paragraphs. When you have

CIN: 20300 **Version: 001**
Date: 2021/10/26

the information you need, move on quickly. Pace yourself against the clock, just as you have been doing on the reading exercises in this book. Check your comprehension by noting down main points and check these afterwards against the material. If you require a more specific comprehension test, then practise skimming on some of the earlier passages in this book that you do not recall so clearly now. You can use newspapers, journals, reports and books for additional practice. You will also find some skimming exercises at the end of this chapter.

As you develop your skill in skimming you will find you are benefiting considerably from the other material the savings in time enable you to read and from not having your attention occupied by unimportant or irrelevant material. At first you may notice some apparent loss in comprehension, but, with a few days' practice, this will correct itself. After all, you are very probably skimming already when you read your daily newspaper (or do you read it all, even the advertisements?) All you are being asked to do here is to realise that there are many more occasions on which you can skim, and, providing you really know your purpose in reading, still understand the material well.

A Closer Look at Studying

We have already defined studying briefly but since it is a fundamental reading technique and since most people are unable to study effectively without instruction we shall now discuss it a little more fully.

As we have already said, studying involves reading and rereading material, making notes and giving careful consideration to the full meaning and implications of the material. It is important to remember that, whilst this process takes time and no little effort it usually results, in the long run, in savings in time. If material is sufficiently important or difficult to require studying, any attempt to find a short cut by being content simply to read the material will invariably result in the necessity for reading it again at a later date. If the material has been studied properly and methodically in the first place, the most you should normally have to do is to refer to your notes.

We all recognise this fact when we are studying for an examination and it is surprising, therefore, that we should fail to recognise that some of our reading at work poses us similar problems to those which the examination student's reading poses. After all, if a report, for example, is to be analysed and evaluated at a meeting, this is very similar to an examination situation. On many such occasions it is we, as well as the material, who are being examined on

our abilities to reach effective decisions and conclusions by our colleagues or our superiors. we cannot afford to treat such a situation lightly.

To read effectively for study purposes, you should first of all skim through the material to obtain an 'overview', or general idea of the contents. Secondly, you should define your purposes in studying and your expectations from the material as clearly as possible. You will be familiar with the nature of both these steps from your work on previous chapters in this book.

The third step is to read the material at an appropriate speed, marking important words, phrases, sentences and paragraphs or noting their substance in a notebook. This is the longest, and to many readers the most irksome, stage of the study process, but it is inevitable if the material is very important or difficult to understand. It is this stage which most readers are tempted to omit in the belief that they can obtain a high level of comprehension without it. Or it may be left out because of laziness. Whatever the reason, its omission invariably leads to having to read the material in full a second time or to suffering the consequences of lack of comprehension of the material.

The fourth step is to check your notes against the material to see that nothing of importance has been missed and to make sure that your notes are an accurate and sufficient summary of the material. This check is most important if you are to have the confidence that when reference is made to the material in future, you need only, on most occasions, refer to your notes and do not have to re-read the material all over again. It is important that each step in the study process is completed conscientiously if the maximum benefit is to be derived from this reading technique.

On many occasions and for many purposes in reading, there will be three further steps which must be incorporated in the processes of studying. Frequently, you will need to revise the notes you have made or the passages you have marked for special attention to ensure that your grasp of the material remains of a high order. If this is so, you will find that the need for revision is reduced if you get into the habit of revising your notes the same day on which you made them. If you are studying in the evening revise your notes early the next day. You will find that this kind of immediate revision is an effective method of fixing the material more permanently in your mind.

CIN: 20300 **Version: 001**
Date: 2021/10/26

You will also be well advised to attempt to relate what you have read and learned to its context in the problem being tackled, the work being done, or the subject being studied and to what has been learned from previous reading and experience. Try to see connections wherever they exist and in this way, you will build up mastery of the subjects you study and establish a firm foundation for your future reading.

With the most important and the most difficult material you have to deal with, you may find it necessary to add a final step in the form of regular revision of your notes. This is particularly true if you are studying material for, say, a high-level policy meeting or some kind of examination. For complete mastery you need to follow revision done immediately after reading and your attempts to relate what you have read to your previous knowledge with continuous and progressive revision until you are thoroughly familiar with the material. Regular revision is another aspect of study reading which is frequently neglected and particular attention should be given to this. You will find that if you have followed all the previous steps in the study process then revision becomes much easier and is carried out quicker. Revision only becomes difficult and time-consuming when you have not carried out the other steps in the process.

Handling Written Materials Systematically

One of the basic inefficiencies of the slower reader is that he tends to read slowly all the time. Flexibility is the key to efficiency in reading. Not every piece of writing is of equal importance, and some require much more time, care and effort than others. You should reserve your energies for more demanding material. To encourage flexibility and the intelligent use of 'gears', ask yourself the following questions:

- Am I spending enough, or too much, time reading this material?
- Am I taking enough, or too much, care over my reading on this occasion?
- Am I making enough, or too much, effort to understand what I am reading?

As a general principle, the efficient reader will read everything as quickly as his purpose, the material and conditions permit. Thus, he is assured that at any time he is reading as efficiently as he is capable of reading. To achieve the kind of systematic flexibility required, you should also ask yourself, every time you read:

- Am I reading as quickly as my purpose, the material and conditions permit?
- Is there anything I should be doing in order to read more efficiently?

CIN: 20300 **Version: 001**
Date: 2021/10/26

- Am I ready to speed up or slow down if the material suddenly becomes easier or more difficult or if my purpose in reading it changes?

You should never be 'just reading', except when you are using reading merely as a time-filler.

By being flexible, you improve your ability to handle written materials systematically and to make the best possible use of the reading techniques or 'gears' open to you. The following table gives an approximate guide to the kind of reading situation in which each of the four 'gears' is usually used by efficient readers.

Purpose	Material		
	Easy	Average	Difficult
Outline only	4	4	3
General Understanding	4	3	2
Detailed Understanding	3	2	1

Key: 1 – Studying
2 – Slow reading
3 – Rapid reading
4 – Skimming

Of course, you are the only person who can make the final decision about how to deal with a particular piece of reading matter. You may find that, for most purposes in reading, the preview-read-review approach is quite adequate.

Developing Flexibility

The passage which now follow will provide you with greater opportunities than the previous exercise for developing your flexibility in approaching reading materials and for doing this systematically along the lines we have discussed in this chapter.

The passage will require you to summarise the content, and this should enable you to avoid trying to 'spot' possible comprehension questions, leaving you free to put the principles of flexible, efficient reading into practice.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Individual Activity 2

Conducting Basic Research, Analysing and Presenting Findings

Identifying and defining scope of topic

Research is nothing more than finding out what you need to know. It can be done in different ways from looking up the meaning of a word to conducting an opinion poll. Depending on what you want to find out, you can ask experts in the field their opinion, do experiments, interview eyewitnesses, analyse photographs, or observe the behaviour of people who are not aware that they are being watched.

Any organised investigation can be referred to as research. Research is important to your writing as you will not always know enough on your own about the subject you will be writing on.

To identify and define the scope of your research project you should consider the following aspects:

- Subject
- Audience
- Voice
- Information and opinion
- Length
- Sources

Subject

Frame your research task in the form of a question that you want your investigation to answer. You may explore any subject that arouses your interest. Before attempting to answer the question, you have to analyse and break it down into its logical segments. Only then will a clear pattern emerge. In other words, you need a plan for your writing. In the process of

CIN: 20300 **Version: 001**
Date: 2021/10/26

identifying a scope you need to decide what will be included in you research project and what will be excluded from it.

The scope statement is a short paragraph that describes in terms as simple as possible the principal deliverables and the limits or boundaries of the project. It should be short and should contain as many active verbs as possible, because it will later serve as a basis for creating the outline of your research.

A good scope statement has three components:

- The principal deliverables of the research project.
- The objectives, which are measures of the success of the research project.
- A justification for the research project. The scope statement captures the goal of the research project and it also defines the limits of the project in very succinct terms. When choosing your subject, you can consider the following:
- Choose a subject that relates to your immediate environment. It will be easier to access information.
- Topical issues are an important source as they are relevant to current situations.
- When you read research articles you will often notice recommendations for further research mentioned at the end of the article.
- You can speak to experts in the field of study as they can come up with ideas that might help.
- Contemporary issues that are debatable can be found in letters that readers write to newspapers and magazines.
- You might find discrepancies between theory and practice.

Avoid a subject that too wide in scope or that is too technical.

Audience

Understanding readers and their needs is a key factor in creating useful research report. Although all elements of audience analysis or identification hinge on some basic stereotypes, and relying entirely on stereotypes for any purpose is dangerous, these four basic elements of audience analysis might, nevertheless, affect how you would write your document:

- Use of information

CIN: 20300 **Version: 001**
Date: 2021/10/26

Most readers read workplace documents to help them perform their jobs and want to know rather quickly how any given document concerns them. Thus, you must determine whether your audience will use your document to make decisions, understand the history of an idea or position within your organization, gain insights about related matters, perform a task, fulfil a requirement, or accommodate a policy. Therefore, job-related factors that determine how the reader will use the information you provide will help you decide what kinds of content to include for your audience.

- Level of education
  Generally, the more education audience members have, the stronger their reasoning skills, the more advanced their vocabulary, the greater their familiarity with metaphors and other comparisons, and the greater their capacity for following complex and even theoretical arguments. Thus, knowing your audience's level of education will allow you to make some decisions about the style of your writing and the appropriate sophistication of your argument or explanation.

Voice

You have to honestly present what you have learned in you research. Remember that your reader's interests have to come first. You are allowed to share ideas and opinions of your own. Whatever point of view you take, should be made clear to your reader from the start.

Length

A typical research paper is six to twelve pages long. The length of your paper should be determined by the nature of your subject.

Sources

Your research should be based on a variety of research methods. You can include secondary sources such as books, periodicals, newspapers, as well as electronic media such as the Internet. It can also include interviews you have had with experts in the field.

Planning and Sequencing your Research Steps

First, think about how much time you can spend on the project. Then, begin as early as possible in order to allow time for Interlibrary Loan, recalling books, and other snags. And, most importantly, choose a topic that is MANAGEABLE. Manageable means that the topic isn't

too broad or too narrow so that you would need more time or so you can't find enough information.

Think about the things listed below BEFORE you start to choose a topic. Although deciding on a topic sounds simple, you'll regret it later if you choose one quickly without doing some looking around first.

Writing a research paper involves a lot of work. You have to:

- choose the topic,
- explore it,
- chase down leads,
- take notes,
- consult different sources,
- think,
- jot down ideas,
- narrow your projects focus,
- write a first draft,
- revise and revise again.

As you can see, a research project cannot be done in a day or two. You need to plan to enable you to have enough time to undertake each step of the process. The following schedule is an example of planning the research process:

Research Project	
Principal Deadlines	**Due Dates**
1. Research scope due, including a statement of my research topic and a working bibliography.	.....
2. Note cards and preliminary outline due.	.....
3. Editing of completed draft.	.....
4. Typed good draft due.	.....
5. Final draft due.	.....

Research Plans Depend on Information You Need and Available Resources

Often, organization members want to know everything about their products, services, programs, etc. Your research plans depend on what information you need to collect in order to make major decisions about a product, service, program, etc. Usually, you're faced with a major decision due to, e.g., ongoing complaints from customers, need to convince funders / bankers to loan money, unmet needs among customers, the need to polish an internal process, etc. The more focused you are about what you want to gain by your research, the more effective and efficient you can be in your research, the shorter the time it will take you and ultimately the less it will cost you (whether in your own time, the time of your employees and/or the time of a consultant).

There are trade-offs, too, in the breadth and depth of information you get. The more breadth you want, usually the less depth you'll get (unless you have a great deal of resources to carry out the research). On the other hand, if you want to examine a certain aspect of a product, service, program, etc., in great detail, you will likely not get as much information about other aspects as well. For those starting out in research or who have very limited resources, they can use various methods to get a good mix of breadth and depth of information. They can understand more about certain areas of their products, services, programs, etc., and not go bankrupt doing so.

Key Considerations to Design Your Research Approach Consider the following key questions when designing your research plan:

- For what purposes is the research being done, i.e., what do you want to be able to decide as a result of the research?
- Who are the audiences for the information from the research, e.g., funders / bankers, upper management, employees, customers, etc.?
- What kinds of information are needed to make the decisions you need to make and/or to enlighten your intended audiences, e.g., do you need information to really understand a process, the customers who buy certain products, strengths and weaknesses of the product or service or program, benefits to customers, how the product or service or program failed some customers and why, etc.?
- From what sources should the information be collected, e.g., employees, customers, groups of employees or customers, certain documentation, etc.?

- How can that information be collected in a reasonable fashion, e.g., questionnaires, interviews, examining documentation, observing staff and/or clients in the program, conducting focus groups among staff and/or clients, etc?
- When is the information needed (so, by when must it be collected)?
- What resources are available to collect the information?

Research techniques

Gathering information

Do some preliminary research to explore the topic you are considering.

- Learn more about your topic by reading about it in encyclopaedias and other general reference sources. If the topic seems appropriate, take notes and see if you can narrow your focus to a specific question.
- See if your topic is researchable by assembling a working bibliography of about a dozen sources that you intend to consult. Use a variety of search tools. Include books, periodicals, newspapers, and electronic media, as appropriate for your topic. If, for example, you are writing about a recent event, newspaper articles will be a significant source of information. On the other hand, if you are writing about an event from ancient history, you may not discover any newspaper sources.
- If adequate sources are not available, see if you can broaden your topic or switch to another one. If you find too many sources, read more about the subject and narrow your paper's focus within more manageable limits.
- Make sure your sources are available. Find out if the library has the periodicals and newspapers you are seeking. Check books out. If necessary, order books from other libraries through Inter-Library Loan. Ask the circulation desk to recall desired books that have been checked out by others. If most of the books are gone, however, someone else is probably writing on your topic, and the sources you need may not become available in time. If so, avoid needless frustration by switching now to another topic.
- Do some quick reading in your sources to learn more about your topic. It might be wise to ask a professor or some other authority on your subject for suggestions about the topic and for further research sources.
- Decide what additional sources can provide valuable information for your project.

- Write letters to request information, if necessary. Arrange interviews in advance by setting up appointments.
- Be sure to record your discoveries, questions, and other experiences with locating sources in your research notebook.

Interviewing

In addition to print sources, interviews with experts can provide valuable material for your paper. Because the people you interview are primary rather than secondary sources, the first-hand information they provide is exclusively yours to present – information that readers will find nowhere else. Therefore, interviewed sources can make a favourable impression, giving readers the sense that they are getting expert testimony directly and reliably.

Your own reliability and credibility may also be enhanced, since you demonstrate the initiative to have extended your search beyond the usual kinds of sources. In your work situation colleagues and subject matter experts are an accessible source of expert information. Being familiar with research in their individual fields, they also can suggest published and unpublished resources you might not have found in your library research. You may also find experts living in your local community. Other valuable sources include participants and eyewitnesses. If you were researching, say, the War in Southwest Africa before it became Namibia, you could interview relatives and neighbours with experience in the military. Be resourceful in considering interviewees who can contribute to your knowledge and understanding. Conducting interviews may not be the first order of business in your research project, but because interviews require advance planning, it is important to set up appointments as early as possible-even before you are ready to conduct them.

Conducting the Interview

Some interviews may consist of a simple question or two, designed to fill specific gaps in your knowledge about your topic. Others may be extended question-and-answer sessions about a variety of topics. The success of your interviewing depends on your preparation, professionalism, and interpersonal skills. The following guidelines should be followed when you conduct an interview.

Before the interview:

Be well prepared. The most important part of the interview takes place before the questions are posed. Become as informed about your subject as you can so that you can ask the right questions. Use your reading notes to prepare questions in advance.

Dress appropriately for the interview. How you dress can influence how the interviewee behaves toward you; people are most comfortable talking with someone who dresses as they do. Business and professional people, for example, are more likely to take you seriously if you are wearing standard business attire. On the other hand, formal attire would be inappropriate when interviewing striking factory workers, who might be reluctant to speak freely with someone who looks like management.

Arrive on time for your appointment. Not only is arriving on time a matter of courtesy, but also it is essential in assuring the interviewee's cooperation.

During the interview:

Take careful and accurate notes. If you intend to quote your source, you must be certain that you have copied the person's words exactly. A tape recorder can give you an accurate transcript of your interviews.

Behave politely and ethically. Be certain you have the interviewee's permission if you tape-record the conversation. If you take notes, offer to let the interviewee check the transcript later to ensure accuracy (doing so may elicit further elaborations and additional statements that you can use).

Be relaxed and friendly. People who are not accustomed to being interviewed are often nervous at first about having their comments recorded. By being friendly and relaxed, you can win their confidence and put them at ease. The most fruitful parts of interviews occur when interviewees become absorbed in what they are saying and forget they are being recorded. Begin with general questions that can be answered with ease and confidence. Later introduce more specific and pointed questions. (For experienced interviewees, these precautions may not be necessary.)

Make your recording as unobtrusive as possible. Many people will not speak freely and naturally when constantly reminded that their comments are being recorded. Place the tape

recorder out of the interviewer's direct line of sight. Do not write constantly during the interview; write down key phrases and facts that will allow you to reconstruct the conversation immediately after the interview.

Be interested in what the interviewee says. People will speak much more freely with you if they sense that you are responsive to their comments. It is a mistake for an interviewer to read one prepared question after another, while barely listening to the interviewee's responses. Such wooden interviewing produces an uncomfortable atmosphere and strained responses.

Stay flexible. Do not be a slave to your prepared questions. Listen with real curiosity to what the person says and ask further questions based on what you learn. Request explanations of what is not clear to you. Ask probing questions when a topic is raised that you would like to learn more about.

Let the interviewee do the talking. Remember that it is the interviewee's ideas that you are interested in, not your own. Avoid the temptation to state your own opinions and experiences or to argue points with the interviewee.

After the interview:

End the interview professionally. Check your notes and questions to determine if any gaps still need to be filled. Thank the interviewee. Ask if the person would like to check your use of statements and information for accuracy, and whether you can call again if you have further questions. Offer to send the interviewee a copy of your paper when it is completed.

Be fair to the source. When you write the paper, be certain that any ideas or statements you attribute to the source are true reflections of the sound and spirit of the person's answers and comments. Be accurate in quoting the person, but eliminate slips of the tongue and distracting phrases like uh and you know.

Send a thank-you note. Whether or not you send a copy of your paper to the interviewee, you should send a note expressing your appreciation for the help that the person provided.

Sifting Information for Relevance

Sifting and sorting is the process of keeping only gathered information that meets the established criteria. When sifting information for relevance you should consider the following elements:

- Currency
- Reliability
- Coverage
- Accuracy
- Objectivity

Currency

How up to date is the information source? Does it cover recent developments? Has it been updated (in the form of a new edition or update) to deal with changes in knowledge or corrections? This is more important in some areas (e.g., the sciences) than others (e.g. literature).

Be aware that dates can be misleading: Books – It can take up to two years for a book to be published, so the information in a 1999 book may already be out of date. Some dates represent the year a book was republished (as a paperback, or after being out of print for some years). Journals – Journal articles are usually printed more quickly than books, but there can still be a delay of over a year (depending on the journal) before you see it, especially considering that many journals are sent to Australia by sea. Web pages – Many are updated constantly, but there is no guarantee that the date given (if given at all) is accurate.

Reliability

Is it clear who is the author? What are the author's credentials? What qualifications do they have for writing the piece? Are they backed by a reputable or traceable organisation? Information that does not conform to these criteria is not necessarily flawed or unreliable, but you should use it with caution. Remember that the web in particular is open to anyone who can write anything they want. Look carefully for evidence of bias, omissions or unsupported statements of "fact".

CIN: 20300 **Version: 001**
Date: 2021/10/26

Coverage

When considering whether an information source is going to be useful you need to look at the range it covers. You also need to consider whether it consists of primary or secondary source material. Primary material contains new information or a new interpretation of previously known information. Secondary material is interpretation and comment on primary material by others. Does it have the detail you need? Does it supplement other sources you have read or merely confirm information you already knew? You may need to cover a variety of different viewpoints.

If your essay is on a broad topic don't try to absorb every detail you can find. Start with an article from an encyclopaedia or find a book that gives a general overview of your topic. When you need detailed information, an academic article is more likely to help you than a general overview.

Accuracy

Can you check the information elsewhere? Are the sources of any facts clearly and correctly listed? Do you have faith in the spelling and other proof-reading aspects of the work? Key dates, facts and other figures should always be verified from alternative sources to ensure that they are correct. Check that they come from the source cited in the work. An incorrect citation may imply that the facts are not correct. While spelling and proof reading may seem trivial, consistent misspellings may mean that facts and figures are also typed or printed incorrectly. They may also imply that the information has not been thoroughly checked for inaccuracies.

Objectivity

This is the most difficult area to judge because virtually all sources are subjective in some way. Good academic work considers all viewpoints and uses material from many sources to show a depth of research and consideration of all aspects of a question. Some tips for recognising bias in information sources:

- Use of emotive or derogatory language
- Omissions in the information presented
- Contradictions to other material you have read
- Viewpoints that seem extreme to you

CIN: 20300 **Version: 001**
Date: 2021/10/26

- You may disagree with some sources, but you need to show your familiarity with them, and demonstrate why you disagree with them.

Further questions to ask yourself:

- Is the article relevant to the current research project? A well-researched, well written, etc. article is not going to be helpful if it does not address the topic at hand.
- Ask, "is this article useful to me?"
- If it is a useful article, does it:
  - support an argument
  - refute an argument
  - give examples (survey results, primary research findings, case studies, incidents)
  - provide "wrong" information that can be challenged or disagreed with productively.

Classifying, Categorizing and Sorting Information

Classifying and Categorising

Questions that help you classify or categorize information:

- How are these ideas alike? How are the ideas different?
- Which ideas belong together?
- How are the ideas related?
- How would you group the facts from the selection?

Classification is an inherent part of creating a document. Every time you write a heading, you are in fact creating a classification. If the document is long (more than 600 words) you should have sub-headings. These are sub-classifications underneath the heading classification.

Good internal classification has three key objectives:

- To organize the document in such a way that maximizes its ability to communicate knowledge.
- To allow the reader to quickly find specific parts of the document.

- To allow the reader to extract specific parts of various documents, and in so doing create a new document. For example, the reader might compile the summaries of ten documents dealing with the South African car industry.

Classification experts tend to focus on organizing complete documents, books, music and other content. They classify for two reasons:

- To organize the content so that it can be found quickly.
- To place the content in context so that it becomes part of a cohesive body of knowledge.

Here are some general rules of classification:

- **Establish clear objectives**. What do you want to use your email software for? Is it for personal use, for business use, or for both? Your objectives will frame the type of classifications you require.
- **Design classification like it will be 'written in stone**.' You don't want to be changing your classification every six months. This will mean a lot of work and will create confusion.
- **Design for the total content environment**. Don't just design for the content you have today. Try to have a long-term perspective. This will result in a much more robust classification.
- **Be practical**. Your classification should be lean and mean. Overdoing classification can be as bad as not doing it at all.
- **Avoid duplication**. Creating two classifications that are essentially the same leads to confusion.
- **Test**. You should do as much testing as possible. Get feedback, particularly where you are creating a classification that you want other people to use.
- **Take your time**. Speed is the enemy of quality classification. Don't rush. Consider each classification carefully. Your efforts will pay handsome dividends in the long-term.

Sorting

One important kind of sorting is arranging items of information in alphabetical sequence according to some pre-defined ordering relation (sort key by each group of lists), e.g., when one sorts the books in a library by title, subject or author (all alphabetically sorted normally in ascending order).

The resulting order may be either ascending or descending, because essentially all sorting is numerical sorting. Now if you sort on different keys, then you get different lists of header information (such as the author's name) with the appended tailing records (such as title or publisher).

The main purpose of sorting information is to optimise its usefulness for specific tasks. In general, there are two ways of grouping information:

- By category e.g., a shopping catalogue where items are compiled together under headings such as 'home', 'sport & leisure', 'women's clothes' etc. and
- By the intensity of some property, such as price, e.g., from the cheapest to most expensive.

This is illustrated by the following story:

Managers are on a course of basic computer terms and they are explained the meaning of sorting. The lecturer comes in and throws hundreds of various nails and screws, new, old, rusty and crooked, of different size and material on the table. S/he then tells them to, sort! The student in no time create a dozen or so heaps each with relatively homogenous members, and with some undecided cases left. The lecturer picks up a straight and strong nail, and hammers it in the wall with his/her shoe sole. "You failed to ask sort what for, or what to sort on" – s/he would tell the puzzled audience.

In the book Information Anxiety by Richard Saul Wurman, he proposes that the most common sorting purposes are Name, by Location and by Time (these are actually special cases of category and hierarchy). Together these give the acronym LATCH (Location, Alphabetical, Time, Category, Hierarchy) and can be used to describe just about every type of ordered information.

Analysing and Presenting Research Findings

Analysis is the process of finding out what your information means and what conclusions it will support. For survey information, item mean scores generally suffice. For behavioural indicators, such as absences and tardiness, frequency counts or percentages will do the job. These analyses are descriptive and comparable. You can use them to measure your progress from year to year.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Analysing quantitative and qualitative data is often the topic of advanced research and evaluation methods courses. However, there are certain basics which can help to make sense of reams of data.

Always start with your research goals

When analysing data (whether from questionnaires, interviews, focus groups, or whatever), always start from review of your research goals, i.e., the reason you undertook the research in the first place. This will help you organize your data and focus your analysis. For example, if you wanted to improve a program by identifying its strengths and weaknesses, you can organize data into program strengths, weaknesses and suggestions to improve the program. If you wanted to fully understand how your program works, you could organize data in the chronological order in which customers or clients go through your program. If you are conducting a performance improvement study, you can categorize data according to each measure associated with each overall performance result, e.g., employee learning, productivity and results.

Basic analysis of "quantitative" information (for information other than commentary, e.g., ratings, rankings, yes's, no's, etc.):

- Make copies of your data and store the master copy away. Use the copy for making edits, cutting and pasting, etc.
- Tabulate the information, i.e., add up the number of ratings, rankings, yes's, and no's for each question.
- For ratings and rankings, consider computing a mean, or average, for each question. For example, "For question #1, the average ranking was 2.4". This is more meaningful than indicating, e.g., how many respondents ranked 1, 2, or 3.
- Consider conveying the range of answers, e.g., 20 people ranked "1", 30 ranked "2", and 20 people ranked "3".

Basic analysis of "qualitative" information (respondents' verbal answers in interviews, focus groups, or written commentary on questionnaires):

- Read through all the data.
- Organize comments into similar categories, e.g., concerns, suggestions, strengths, weaknesses, similar experiences, program inputs, recommendations, outputs, outcome indicators, etc.

- Label the categories or themes, e.g., concerns, suggestions, etc.
- Attempt to identify patterns, or associations and causal relationships in the themes, e.g., all people who attended programs in the evening had similar concerns, most people came from the same geographic area, most people were in the same salary range, what processes or events respondents experience during the program, etc.
- Keep all commentary for several years after completion in case needed for future reference.

Interpreting information

- Attempt to put the information in perspective, e.g., compare results to what you expected, promised results; management or program staff; any common standards for your products or services; original goals (especially if you're conducting a program evaluation); indications or measures of accomplishing outcomes or results (especially if you're conducting an outcomes or performance evaluation); description of the program's experiences, strengths, weaknesses, etc. (especially if you're conducting a process evaluation).
- Consider recommendations to help employees improve the program, product or service; conclusions about program operations or meeting goals, etc.
- Record conclusions and recommendations in a report, and associate interpretations to justify your conclusions or recommendations.

Reporting Results

- The level and scope of content depends on to whom the report is intended, e.g., to funders / bankers, employees, clients, customers, the public, etc.
- Be sure employees had a chance to carefully review and discuss the report. Translate recommendations to action plans, including who is going to do what about the research results and by when.
- Be sure to record the research plans and activities in a research plan which can be referenced when a similar research effort is needed in the future.

Contents of a Research Report -- An Example

Ensure your research plan is documented so that you can regularly and efficiently carry out your research activities. In your plan, record enough information so that someone outside of

the organization can understand what you're researching and how. For example, consider the following format:

- Title Page (name of the organization that is being, or has a product/service/ program that is being researched; date)
- Table of Contents
- Executive Summary (one-page, concise overview of findings and recommendations)
- Purpose of the Report (what type of research was conducted, what decisions are being aided by the findings of the research, who is making the decision, etc.)
- Background About Organization and Product/Service/Program that is being researched
    1. Organization Description/History
    2. Product/Service/Program Description (that is being researched)
        a. Problem Statement (in the case of non-profits, description of the community need that is being met by the product/service/program)
        b. Overall Goal(s) of Product/Service/Program
        c. Outcomes (or client/customer impacts) and Performance Measures (that can be measured as indicators toward the outcomes)
        d. Activities/Technologies of the Product/Service/Program (general description of how the product/service/program is developed and delivered)
        e. Staffing (description of the number of personnel and roles in the organization that are relevant to developing and delivering the product/service/program)
        f. Overall Evaluation Goals (e.g., what questions are being answered by the research)
        g. Methodology
            i. Types of data/information that were collected
            ii. How data/information were collected (what instruments were used, etc.)
            iii. How data/information were analysed
            iv. Limitations of the evaluation (e.g., cautions about findings/conclusions and how to use the findings/conclusions, etc.)
        h. Interpretations and Conclusions (from analysis of the data/ information)
        i. Recommendations (regarding the decisions that must be made about the product/service/program)

Appendices:

Content of the appendices depends on the goals of the research report, e.g.:

- Instruments used to collect data/information
- Data, e.g., in tabular format, etc.
- Testimonials, comments made by users of the product/service/program
- Case studies of users of the product/service/program
- Any related literature

Some Pitfalls to Avoid

- Don't balk at research because it seems far too "scientific." It's not. Usually, the first 20% of effort will generate the first 80% of the plan, and this is far better than nothing.
- There is no "perfect" research design. Don't worry about the research design being perfect. It's far more important to do something than to wait until every last detail has been tested.
- Work hard to include some interviews in your research methods. Questionnaires don't capture "the story," and the story is usually the most powerful depiction of the benefits of your products, services, programs, etc.
- Don't interview just the successes. You'll learn a great deal by understanding its failures, dropouts, etc.
- Don't throw away research results once a report has been generated. Results don't take up much room, and they can provide precious information later when trying to understand changes in the product, service or program.

Conclusions and Recommendations

Although you may have learned in other writing classes that summaries are appropriate conclusions for papers, summaries are typically offered as front matter (prefatory material) in research documents. Therefore, a summary is a weak, redundant ending for a research document. You may, of course, offer a few summary statements to orientate your reader, but effective conclusions do far more than recap information you have already offered in the prefatory material, the introduction, and the discussion of your document.

These endings are all based on the idea that you should draw conclusions, not just conclude. In short, they depend on your explaining “What does this mean for us?” One of the most useful

conclusions for many workplace documents is a section offering recommendations or solutions. Such a conclusion is most typically used for problem/solution reports, but it can also be used for cause/effect, comparison/ contrast, and other organizational schemes. In this section, you may recommend which of several solutions is most likely to solve the problem, is most feasible, or is least disruptive.

Although instincts are important in the workplace, a reader will rarely be satisfied that they are the best grounds on which to base important decisions. Thus, you must explain the criteria on which your recommendations are based. Furthermore, your criteria must match the reader's expectations and needs. Imagine how embarrassing it would be to offer recommendations based on a sense of urgency and moving from immediate-to-remote implementation stages when your readers think your recommendations are based on costs. In other words, you might lose all your credibility if you have proposed an expensive plan because it offers the most immediate relief for the problem, but your readers expect you to offer the most cost-efficient plan.

Your recommendations may correspond to the following criteria:

- Costs or other budget matters
- The mission of the organization
- Space
- Human Resources needs
- Deadlines (legal, business, environmental, or other forms of deadlines)
- Tax structures
- Immediate-to-remote implementation schedules
- Equipment or technological needs
- Materials availability
- Locations

Lead and Function in a Team

Meetings – basic rules

- Plan - use the agenda as a planning tool (see 'POSTAD TV' acronym below)
- Circulate agenda in advance

CIN: 20300 **Version: 001**
Date: 2021/10/26

- Run the meeting - keep control, agree outcomes, actions and responsibilities, take notes
- Write and circulate notes
- Follow up agreed actions and responsibilities

Meetings come in all shapes and sizes, and for lots of purposes. Meeting purposes include:

- Giving information
- Training
- Discussion (leading to an objective)
- Generating ideas • Planning • Workshops
- Consulting and getting feedback
- Finding solutions/solving problems
- Crisis management
- Performance reporting/assessment
- Setting targets and objectives
- Setting tasks and delegating
- Making decisions
- Conveying /clarifying policy issues
- Team building
- Motivating
- Special subjects - guest speakers
- Inter-departmental - process improvement

The acronym POSTAD TV shows you how to plan effective meetings, and particularly how to construct the meeting agenda, and then notify the meeting delegates:
Priorities, Outcomes, Sequence, Timings, Agenda, Date, Time, Venue.

Meeting priorities

What is the meeting's purpose? Always have one; otherwise, don't have a meeting. Decide the issues for inclusion in the meeting and their relative priority: importance and urgency. You can avoid the pressure for 'Any Other Business' at the end of the meeting if you circulate a draft agenda in advance of the meeting, and ask for any other items for consideration. ('Any Other

Business' often creates a free-for-all session that wastes time, and gives rise to new tricky expectations, which if not managed properly then closes the meeting on a negative note.)

Meeting Outcomes

Decide what outcome (i.e., what is the purpose) you seek for each issue, and put this on the agenda alongside the item heading. This is important, as people need to know what is expected of them, and each item will be more productive with a clear aim at the outset. Typical outcomes are:

- Decision
- Discussion
- Information
- Planning (e.g., workshop session)
- Generating ideas
- Getting feedback
- Finding solutions
- Agreeing (targets, budgets, aims, etc.)
- Policy statement
- Team building/motivation
- Guest speaker – information, initiatives, etc

Meeting sequence

Put the less important issues at the top of the agenda, not the bottom. If you put them on the bottom you may never get to them. Ensure any urgent issues are placed up the agenda. Non-urgent items place down the agenda – if you are going to miss any you can more easily afford to miss these. Try to achieve a varied sequence – don't put all the heavy controversial items together – mix it up.

Meeting timings (of agenda items)

Decide the length of the meeting, and allocate a realistic time slot for each item. Do not try to pack too much in – keep it realistic – things generally take longer than you think. Long

CIN: 20300 **Version: 001**
Date: 2021/10/26

meetings involving travel for delegates require pre-meeting refreshments 30 minutes prior to the actual meeting start time.

Put lots of breaks into long meetings. Unless people are participating and fully involved, their concentration begins to drop after just 45 minutes. Breaks don't all need to be 20 minutes for coffee and cigarettes. Five minutes every hour for a quick breath of fresh air and leg-stretch will keep people attentive.

Unless you have a specific reason for arranging one, avoid formal sit-down restaurant lunches – they'll add at least 30 minutes unnecessarily to the lunch break, and the whole thing makes people drowsy. Working lunches are great, but make sure you give people 10-15 minutes to get some fresh air and move about outside the meeting room. If the venue is only able to provide lunch in the restaurant arrange a buffet, or ensure delegates' menu choices are decided well before lunchtime.

Running the meeting

The key to success is keeping control. You do this by sticking to the agenda, managing the relationships and personalities, and concentrating on outcomes. Meetings must have a purpose. Every item must have a purpose. Remind yourself and the group of the required outcomes and steer the proceedings towards making progress, not hot air.

Politely suppress the over-zealous, and encourage the nervous. Take notes as you go, recording the salient points and the agreed actions, with names, measurable outcomes and deadlines. Do not record everything word-for-word, and if you find yourself taking over the chairmanship of a particularly stuffy group which produces reams of notes and very little else, then change things. Concentrate on achieving the outcomes you set the meeting when you drew up the agenda.

Avoid racing away with decisions if your aim was simply discussion and involving people. Avoid hours of discussion if you simply need a decision. Avoid debate if you simply need to convey a policy issue. Policy is policy and that is that. Defer new issues to another time. Practice and use the phrase 'You may have a point, but it's not for this meeting – we'll discuss it another time.' (And then remember to do it.)

If you don't know the answer say so – be honest – don't waffle – say that you'll get back to everyone with the answer, or append it to the meeting notes. If someone persistently moans on about a specific issue that is not on the agenda, quickly translate it into a simple exploratory or investigative project, and bounce it back to them, with a deadline to report back their findings and recommendations to you. Use the rules on delegation to help you manage people and tasks and outcomes through meetings. Always look at how people are behaving in meetings – look for signs of tiredness, exasperation, and confusion, and take necessary action.

As a general rule, don't deviate from the agenda, but if things get very heavy, and the next item is very heavy too, swap it around for something participative coming later on the agenda – a syndicate exercise, or a team game, a quiz, etc.

Negotiation strategy

- Separate the People form the Problem
- Focus on Interests behind positions
- Invent Options for mutual gain
- Insist on using Independent Standards
- Develop your Best Alternative to a Negotiated Agreement (BATNA)

Handling Perception Problems

- Put yourself in their shoes
- Don’t blame
- Help them become involved
- Help them save face 4

Handling Emotions

- Recognize, understand, and make explicit the emotions – yours and theirs.
- Allow the other side to let off steam
- Don’t react to emotional outbursts
- Consider apologizing

Communicating Effectively

- Listen actively
- Speak about yourself, not about them
- Speak for a purpose

Useful phrases for handling people problems

"Let me see if I understand what you just said …"

"I can appreciate why you feel like that..."

"I see it this way … How do you see it?"

"I would like your advice about ...?"

Questions to uncover Interests

"Help me to understand why this is really important to you."

"What concerns do you have?"

"What's the real problem?"

"What would be wrong with …?"

"Why not this …?"

"What are your fears concerning this?"

Successful Inventing

- Invent before you judge.
- Invent a wide range of options.
- Dovetail.
- Use imaginative procedures.

Killer phrases

- A good idea, but …
- Against company policy
- Be practical
- All right in theory, but …
- The boss won't go for it
- Are you serious?

Differences that can be dovetailed

- Different interests
- Same interests, different priorities
- Different values placed on time
- Different forecasts
- Different aversion to risk
- Different beliefs

Independent Standards

A standard is a measuring stick, independent of the will of the other side, for choosing among conflicting options.

Examples of standards

- Consumer Price Index
- Ability to pay
- Equal treatment laws
- Industry standards
- Market value
- Precedent
- Tradition
- Reciprocity
- Costs
- Efficiency

Search for possible independent standards. Be open to reason. Never yield to pressure, only to reason.

Questions to arrive at standards:

- "How did you arrive at that?"
- "What's the theory behind this?"
- "What makes that fair?"

- "How are others handling the same problem?"

Making Offers

- Present offers rather than state positions
- Present offers in terms of gain
- Include specific items that appeal to their interests
- State benefits to them

Negotiation Phases

Entry

- Be soft on the people; hear them out
- Set objective for the meeting
- Inquire as to the other's authority

Exploration

- Focus on Interests behind positions
- Invent Options for mutual gain
- Use independent standards

Bargaining

- Present Offers, not positions
- Caucus
- Sum up areas of agreement and disagreement

Closing

- Make sure agreement is better than your BATNA.
- Make agreement clear and specific, in writing.
- Reaffirm relationship.

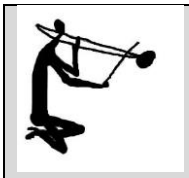
Countering Dirty Tricks

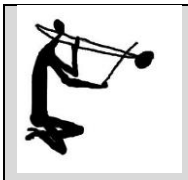
- Recognize the tactic

- Bring it up
- Negotiate
- Walk out – don't be a victim

Common Dirty Tricks

- Lock-ins
- Good guy / bad guy
- No authority
- Threats
- Add-ons
- Phoney acts

	**Individual Activity 3:**

	**Individual Activity 4**

Unit Standard	
119462	Engage in sustained oral communication and evaluate spoken texts
Specific Outcomes	
SO 1: Respond critically yet sensitively as a listener. SO 2: Analyse own responses to spoken texts and adjust as required. SO 3: Use strategies to be an effective speaker in sustained oral interactions. SO 4: Evaluate spoken discourse. SO 5: Lead and function in a team. SO 6: Reflect on how characteristics of the workplace and occupational context affect learning.	
Learning Outcomes	
Identifying	Science
Organising	Communicating
Demonstrating	Contributing
Collecting	Working

CONFLICT MANAGEMENT

Verbal communication

The communication process takes place when information sent by a person (the sender) is received by a second person(s) (the receiver), decoded, and reacted upon.

Importance

Effective communication only takes place when the reaction of the receiving person is positive, according to the expectations of the sender. For example, by altering the intonation of the voice a customer may either receive the message that a waiter is really pleased to see and help him or that he is merely another nuisance to be served. Effective internal and external verbal communication has a direct effect on a company's image and success in the following ways:

- Good, clear, concise communication eliminates time wastage in trying to resolve confusion, errors and conflicts.
- Customers/guests/patrons like feeling important and will return and recommend the establishment to others if they are treated with politeness and helpfulness. This promotes return business.

Staff with positive attitudes, who speak to each other with respect, reflect a positive company image. This gains customer confidence in the establishment.

Types of verbal communication

Internal

Internal verbal communication may be categorised as follows:

- Intra-personal communication is communication with one's self. Talking to one's self is an example.
- Extra-personal communication (as illustrated above) refers to communication to an inanimate object or non-human (plant or animal).

  For example, talking to a cat/dog or saying: "You naughty table!" after a toddler bumps his head on it.

- Interpersonal communication refers to an ordinary conversation on a one-on-one basis, or a very small group. It may also refer to communication between groups of individuals (group discussions or informally in a crowd).

  For example, communication within and between departments in an organisation.

The experience in business has been that, generally, as the size of the organisation increases, communication decreases and morale declines. The ever-increasing size of organisations means that lines of communication are further and further extended. The more communication "centres" (e.g., departments within an organisation) a message has to pass through, the greater the chance of distortion or breakdown.

Instead of trying to improve communication abilities of all employees, there are steps that may be taken to alleviate the situation:

- Open channels for feedback should be established.
- Policy and procedure for communication should be laid down.
- Top management should communicate directly to all staff using the public-address system or public notice.

External

This refers to communication with an audience or people outside of an organisation.

For example: Suppliers, Cleaning Services, and Out-sourced Facilitators conducting lectures in a corporation.

Face-to-face

When communicating face-to-face, body language plays a vital role in conveying the appropriate messages.

Eye Contact

In the business culture, it is imperative to make eye contact if one wishes to make a positive impression with guests and maintain a relationship based on trust. Consider the following:

- Maintain eye contact without staring, as this is arrogant and threatening.
- Avoid blinking too much as this communicates nervousness and can be interpreted as an indication of dishonesty.
- Try to keep eye level on the same level as the guest. Stand if the guest is standing. If the guest is seated, accommodate this by standing back a little.

Facial Expressions

Be aware of facial expressions when speaking to people. Professional service providers who deliver excellent service have alert, lively and appropriate facial expressions. Avoid the following facial expressions:

- An expressionless or deadpan face showing no emotion in response to what guests say makes them feel uncomfortable. This may be interpreted as boredom, rudeness or indifference.
- An arrogant or stern expression creates the impression of being superior to others.
- Grinning continually makes one look stupid. It creates the impression of misunderstanding what is being said or done. It may also create the impression of being deliberately unhelpful.

Gestures

Head and hand movements are common during speech: Smooth and wide gestures with palms facing upwards, are warm and welcoming. People react positively to friendliness and helpfulness. Guests are naturally drawn to people who use calming gestures.

Sharp, short gestures with palms facing downwards, are aggressive and negative. People react by wanting to either dispute or avoid. When upset or if there is a need to discuss problems, gestures should be controlled. Problems are never resolved through aggressive gestures.

Posture

The way the speaker stands, sits or walks, indicates a great deal about the speaker's attitude, mood and self-esteem. A correct posture entails the following:

- Stand upright with arms comfortably at sides
- Keep shoulders dropped and slightly back
- Stand with feet slightly apart to maintain balance
- Walk briskly because it creates a professional impression
- Sit upright with shoulders back. Slouching looks lazy
- When speaking to guests, either face them or turn the body slightly sideways towards them
- Avoid leaning against walls or furniture
- Avoid folded arms – they create the impression of being shy or arrogant
- Standing with hands on hips looks arrogant

- Swinging when speaking to people suggests a lack of self-confidence
- Resting the face on hands while leaning on counters looks lazy.

Personal space

This refers to the space each person has around him/her and into which intrusions are unwelcome. The exact size of the area around each person differs and depends on a variety of factors including, personality, culture, family background and even the type of sport played. Shy people usually need a wider personal space than outgoing people do. People instinctively indicate when their space is invaded - they either move away slightly, look uncomfortable, blink their eyes to show their discomfort, or look behind the speaker to avoid eye contact.

Causes of conflict

Most psychology books suggest that conflicts come from two tendencies: approach and avoidance. To approach is to have a tendency to do something or to move in a direction that will be pleasurable and satisfying. To avoid is to resist doing something, perhaps because it will not be pleasurable or satisfying. These two categories produce three kinds of conflicts:
Approach-Approach Conflict - this is due to the pursuit of desirable but incompatible goals.
Approach-Avoidance Conflict - here is a desire both to do something and not to do it.
Avoidance-Avoidance Conflict - here there are two alternatives, both of which may be unpleasant.

Other causes of conflict are:

- A lack of communication,
- A lack of understanding,
- Ambiguous lines of authority,
- Conflict of interest,
- Disagreement on issues,
- The need for agreement,
- Generational differences, x Religious disagreements,
- Diversity in perspective,
- Majoring in minors,
- Environment and a lack of relationships.

Myths about conflict

Myth #1: Conflict can never lead to anything positive
While confrontation is a risk, it is often a learning experience for those involved.

Myth #2: Conflicts are the result of clashing personalities
Personalities do not conflict, behaviours do! Different people can work together for years without having conflict - until their behaviour conflicts. Differentiating personality from behaviour makes conflict manageable because if conflict is based on personalities, we can do little else but bear it.

Myth #3: Conflict and anger go together
Conflict with people does not mean that there is anger involved. There are whole ranges of emotions that surface in conflict situations.

Defining conflict levels

Conflict can be experienced in three ways
(1) Intra-personal conflict (when a person has internal conflict);
(2) Interpersonal conflict (when personalities clash); and
(3) Substantive conflict (disputes over facts, values, goals and beliefs).

There are four levels of substantive conflict:

Level 1: Facts or Data – This level of conflict occurs when two parties simply have different information. This is the easiest kind of conflict to resolve. To resolve this conflict leaders simply ensure that both parties have the same information.

Level 2: Processes or Methods – This level occurs when there is a difference of opinion over how things should be done. Because the issue here is "how do we get there?" rather than "where should we go?" compromise is usually a realistic option.

Level 3: Goals or Purpose – On this level parties cannot agree on a common goal. Negotiations at this level take patience and skill. Often youth leaders withdraw from this kind of conflict because they are not of the temperament to work through the hard issues and avoid the uncomfortable dialogues that accompany the resolution of conflict at this level.

Level 4: Values – The deepest and most serious conflict relates to values – the parties disagree about basic meanings. Any resolution at this level is almost impossible.

Defining the level of conflict can lead to the selection of appropriate responses to conflict resolution. But often what leaders think is the level is just a screen for a deeper level of conflict. One situation may include several different levels of conflict.

Conflict handling styles

As with leadership styles, different writers present models of conflict handling style and it seems that there is not a best conflict handling styles but a best style for a given situation. A few models will be considered, together with an indication of when the style is most appropriate:

Model 1. Here we can distinguish between five styles

1. The Problem Solver – refuses to deny or flee the conflict, presses for conversation and negotiation of the conflict until a satisfactory conclusion is reached. Most effective with groups that share common goals and whose conflict stems from miscommunication.

2. The Super Helper – they constantly work to help others and give little though to self. This is the 'Messiah' who is often passive in their own conflicts but always assists others to solve their conflicts. This style is to be avoided as one must deal with personal conflicts to effectively help others.

3. The Power Broker – For this person, solutions are more important than relationships. Even if a person leaves the group, as long as a solution was achieved, they are satisfied. It can be used when substantive differences are so contradictory that mutually inclusive goals are not possible.

4. The Facilitator – they adapt to a variety of situations and styles in order to achieve a compromise between competing factions. It is effective for conflicts where differences are attitudinal or emotional.

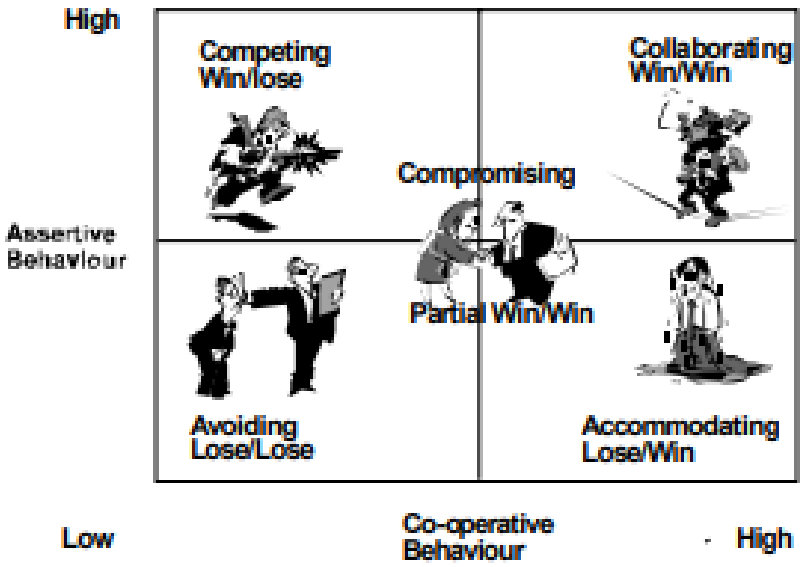
CIN: 20300 **Version: 001**
Date: 2021/10/26

5. The Fearful Loser – this person runs from conflict probably because they are personally insecure. This tends to produce hostility and a weakening of leadership in the group.

B. Speed Leas, in Discover Your Conflict Management Style, mentions six styles

1. Persuading – trying to change another's point of view, way of thinking, feelings or ideas. Techniques used include;e rational approaches; deductive and inductive arguments; and other verbal means. Persuade when there is great trust; when one party is admired; when goals are compatible; and when one party does not have strong opinions on the subject.

2. Compelling – the use of physical or emotional force, authority or pressure to oblige or constrain someone to act in a desired way. Use compelling infrequently; when you are threatened or under attack; when rights are being violated; when you have authority to demand compliance; when there is inadequate time to work through differences; and when all other means have failed.



3. Avoiding – This is actually a category that combines four styles: avoidance (to evade or stay away from conflict); ignoring (act as if the conflict is not going on); fleeing (actively remove oneself from the arena in which conflict might take place); and accommodation (going along with an opposition to keep the relationship). Strategies include: procrastination; saying yes to requests but not acting on them; showing concern for the other without responding to the problem; resigning; and studying the problem with no intention of doing anything about it.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Avoid this style when people are fragile or insecure; when they need space to cool down; when there is conflict on many fronts simultaneously; when differences are trivial; when parties are unable to reconcile differences; and when the relationship is unimportant.

4. Collaborating – This is a process of co-labouring with others to resolve difficulties that are being experienced. It is also called joint or mutual problem solving. Collaborate when people are willing to play by collaboration rules; when there is plenty time for discussion; when the issue lends itself to collaboration; where resources are limited and negotiation would be better; and when conflict and trust levels are not too high.

5. Negotiating – Also called bargaining, this involves collaborating with lower expectations. It is a process where both sides try to get as much as they can, realising there must be give and take. Where collaboration is a "win/win" strategy, negotiation is a "sorta-win/sorta-lose" strategy. Negotiate when there is something that can be divided or traded; when compelling is not acceptable, and collaboration has been tried and failed; when all parties are willing to bargain; when the different parties have equal power; and when trust is high.

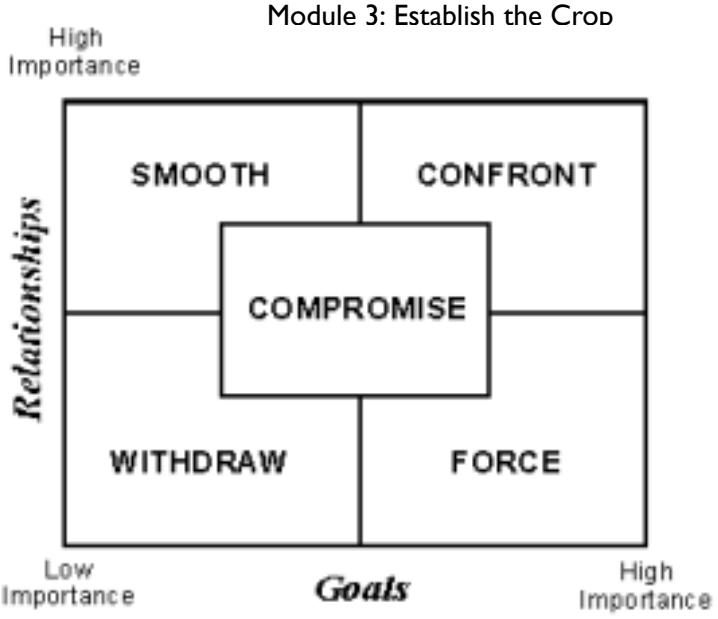
6. Supporting – Here one person will provide a support to the person who is experiencing conflict. It involves strengthening, encouraging or empowering one party so they can handle their difficulties. Support when the problem is the responsibility of someone else; when a party brings problems outside of your relationship with them; and when one party in the conflict is unwilling to deal with issues.

Tension between relationships and goals

A third model focuses on the tension between relationships and goals in conflict handling. When a leader becomes engaged in a conflict there are two major concerns to deal with:
(a) achieving personal goals and
(b) preserving the relationship.

The importance of goals and relationships affect how leaders act in a conflict situation. Given these two concerns the following five styles of managing conflict are found:

CIN: 20300 **Version: 001**
Date: 2021/10/26



1. Withdrawing – people with this style tend to withdraw to avoid conflicts. They give up their personal goals and relationships; stay away from the issues over which the conflict is taking place and from the people they conflict with; and believe it is hopeless to try to resolve conflicts. They believe it is easier to withdraw (physically and psychologically) from a conflict than to face it.

2. Forcing – people in this category try to overpower opponents by forcing them to accept their solution to the conflict. Their goals are highly important, but the relationship is of minor importance. They seek to achieve their goals at all costs; are not concerned with the needs of other people and do not care if other people like or accept them. They assume that one person winning and the other losing settle conflicts. While winning gives them a sense of pride and achievement, losing gives them a sense of weakness, inadequacy, and failure. They try to win by attacking, overpowering, overwhelming, and intimidating other people.

3. Smoothing – for those who fall into this category, the relationship is of great importance, while their own goals are of little importance. They want to be accepted and liked by other people; they think that conflict should be avoided in favour of harmony and believe that conflicts cannot be discussed without damaging relationships. They are afraid that if the conflict continues, someone will get hurt and that would ruin the relationship. They give up their goals to preserve the relationship. They try to smooth over the conflict in fear of harming the relationship.

4. Compromising – people with this style are moderately concerned with their own goals and about their relationships with other people. They seek a compromise. They give up part of

their goals and persuade the other person in a conflict to give up part of their goals. They seek a solution to conflicts where both sides gain something.

5. Confronting – people in this category highly value their own goals and relationships. They view conflicts as problems to be solved and seek a solution that achieves both their own goals and the goals of the other person in the conflict. They believe conflict improves relationships by reducing tension between people. By seeking solutions that satisfy both themselves and the other person they maintain the relationship. They are not satisfied until a solution is found that achieves their own goals and the other person's goals and they want all tensions and negative feelings to be fully resolved.

Conflict handling

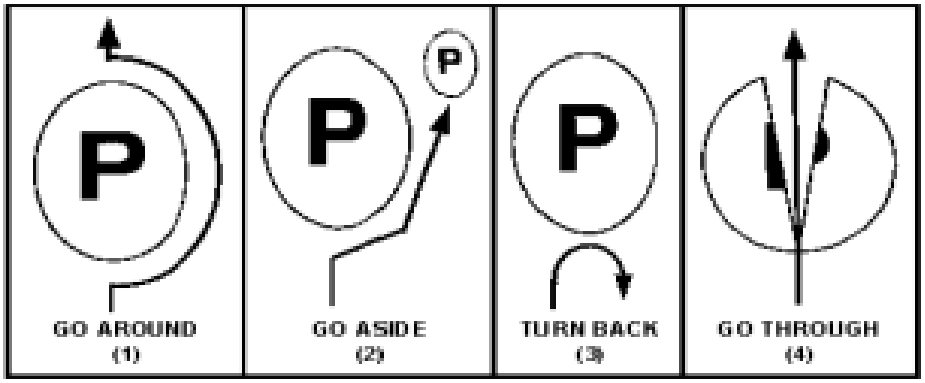
There are two dimensions to handling conflict: prevention and management.

A. **Prevent Conflict**

Applying good management principles in ministry and building quality relationships with people will help to prevent or at least lessen conflict.

B. **Manage Conflict**

In spite of the best efforts at prevention, conflict does arise. The secret is to learn to cope positively with conflict, and not to see it as an enemy to peace, but an opportunity for growth in relationships.



Parties should be asked to describe recent disagreements. What were the issues, who were involved, and how was the conflict handled? What are the differences between conflicts that were handled efficiently and those that were not? Can you see conflict styles evolving? With

answers to questions like these the parties will be ready to work on clarifying goals, reconciling differences, and finding ways to resolve conflicts.

Clarify goals

When people are in conflict they usually share many of the same goals despite their differences. Both sides usually want to see the conflict resolved in a way that will be mutually agreeable, beneficial to both, and inclined to enhance the relationship so that future communication will improve. The youth leader should try to discourage bargaining over positions and work from the basis of the common goals that people are striving for. People should first be reminded of the goals that they share, and then their differences discussed.

Reconcile differences

The guidelines for reconciling differences are:

Step 1: Take the initiative and go to the person who has wronged you This should be done in person and in private. In making this move, it is best if the person goes with a spirit of humility, with a willingness to listen, with a determination to be non-defensive and to forgive.

Step 2: Take witnesses If the person will not listen or change, a return visit with one or two witnesses becomes necessary. These people are to listen, evaluate, determine facts and try to arbitrate and bring a resolution to the dispute.

Resolve conflicts

When individuals or groups are in conflict, they have four main choices about the direction they will take. They may avoid conflict, maintain, escalate, or reduce it. Sometimes people do not want conflict resolution and may decide to go in different directions.

Conflict resolution will involve the youth leader in negotiation and mediation. It is not always wise for leaders to get involved in someone else's conflict even when they are asked to do so, as they will feel pressurised to take sides; be required to make quick analytical decisions; and be responsible for keeping communication open.

When youth leaders do choose to get involved they should try to: show respect for both parties; understand both positions without taking sides; reassure people and give them hope; encourage open communication and mutual listening; focus on things that can be changed; try

to keep the conflict from escalating; summarise the situation and positions frequently; and help the parties find additional help if the mediation is not effective.

We propose that you use the following four-step method in conflict resolution:
Step 1: Separate the people from the problem
This means treating one another with respect, avoiding defensive statements, or character judgments, and giving attention instead to the issues. Each side should be encouraged and helped to understand the other's fears, perceptions, insecurities and desires. Parties should think of themselves as partners in a side-by-side search for a fair agreement, which is advantageous to each side.

Step 2: Focus on the issues, not the positions
When people identify the real issues, and stop trying to defend rigid positions they are on their way to resolve their conflict.

Step 3: Think of various options that might solve the problem
In the beginning there is no attempt to evaluate the options or to arrive at a single solution. Each side makes suggestions in a brainstorming session. After many creative and perhaps new alternatives have been proposed, each option can be evaluated.

Step 4: Insist on objective criteria
Conflict is less likely to occur if both sides agree beforehand on an objective way to reach a solution. If both sides agree to abide by the results of a coin toss, a judge's ruling, or an appraiser's evaluation, the end results may not be equally satisfying to both parties, but everybody agrees on the solution because it was determined by objective, fair and mutually accepted methods.

Identifying and responding to vocal qualities

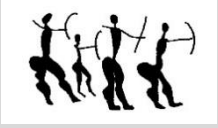
Every time we speak, our voice reveals our gender, age, geographic background, and level of education, native birth, emotional state, and our relationship with the person spoken to. Other people can read these cues accurately. We send important information about ourselves; when we listen to others, we can receive important information about others. In this lesson you will

CIN: 20300 **Version: 001**
Date: 2021/10/26

look at using the qualities of your voice to identify the emotional state or feelings of the speaker and to use your voice to respond appropriately.

	**Group Activity 1**

	**Group Activity 2**

	**Group Activity 3**

FURTHER READING: Forms of communication - Speech and Language

Language helps us to make ourselves understood through using a united system of words. We take our language for granted until we suddenly cannot find the right words to explain ourselves, or when someone asks us to explain what we mean. Have you ever tried explaining yourself to someone who is not a first language speaker of your language? It is much easier to be misunderstood. Even when you are not speaking out loud, you are using language to think and create meaning. We call this intra-personal communication. i.e. interpersonal communication happens between you and others, and intra-personal communication happens within yourself.

Speech and language includes but is not limited to:

- Verbal or spoken communication
- Written communication
- Art, e.g., poetry, music, literature

Non-Verbal

The term "nonverbal communication is used when we refer to communication that is not written or spoken. Researchers have found that when we interact with each other, we interpret more meaning through non-verbal behaviour than through the verbal message. In fact, they claim that as much as 65% of the meaning is understood though non-verbal communication.

Body movement, posture and gestures

Body movements are strong indicators of how you feel. You can tell how your boss is feeling sometimes just by the way she is walking! Some people walk as if they are in a daze (research tell us that those are the ones who are likely to get mugged first – they are communicating: "come and get me!"), others walk with purpose. Sometimes you can see if a person is feeling dejected (sad) by the way they walk.

Your posture can also communicate a lot about your personality, your status, how you are feeling today, your self-image, and your gender. Have you ever noticed how a tall person who is uncomfortable with being tall may slouch their shoulders, whilst some 6-foot models "strut their stuff" on the catwalk? Do you see how this shows a difference in their self-image? But remember, a slouch may just be a temporary indication of a person's emotional state for the day – perhaps they only feel dejected now, and will bounce back when they have overcome their emotional hurdle. We must be careful not to generalise our interpretations. Gestures are movements of hands, arms, legs and feet. Hand gestures commonly describe or emphasise verbal descriptions or communicate attitudes.

Facial Expressions and eye contact

Facial expressions are said to communicate how we are feeling and our reactions to the messages we are receiving. These are generally the real sign to how strongly we feel about the message we have received. Have you ever received unwelcome news, and you did not want to show people your reaction, but your face and eyes gave you away? After all it is said that "the eyes are the mirror of the soul".

The way we use our eyes is also a way of interpreting meaning. Who will be viewed as more confident?

(a) A public speaker who does not look at her audience or

(b) A public speaker who looks up during her speech.

I am sure you answered (b). Sometimes, if someone is not being truthful they cannot look you in the eye. Can you think of other instances when people do not maintain eye contact?

Perhaps you are aware that in some African cultures, it is respectful to drop your head in conversation with a superior. Or did you think of someone who is distracted or bored? They will find it very difficult to maintain eye contact if they are not concentrating on what you are saying or the presentation at hand. Share any additional ideas with your fellow learners.

Use of space

People convey messages about themselves by using space. Consider for example whether a new student decides to sit in the back or front of the class, or if a staff member sits far from the head of a table or at the head of a table during a meeting. Most teachers will tell you that the mischief-makers will sit at the back of the class and the more serious students choose a position near the front

Use of touch

Use of touch can also communicate the nature of the relationship between people.
Beware that touching behaviour is different for people of different cultures, but we also need to be very aware of what makes other people uncomfortable and what is inappropriate. Also find out what touching behaviour could be understood as sexual harassment.

Use of time

People can use other people's use of time to interpret messages. If someone phoned you at three am, you would probably expect it to be bad news. Similarly, if you do not return a client's call within a time frame that he thinks is appropriate, he may interpret your non-verbal behaviour as an indication that you do not care about his business. Time is often a reflection of status, the higher your status, the more control you have over time. For example, the executives in your organisation will control how long you will wait for an appointment. Different cultures and personality types view time differently, often resulting in misunderstandings. Organisations therefore need to have company standards for time keeping that everyone adheres to.

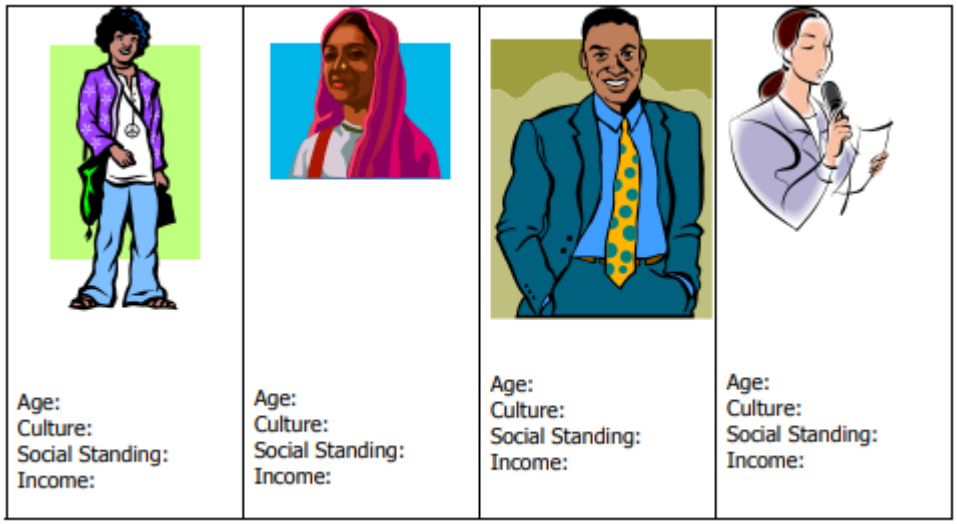
Personal appearance

Personal appearance includes the way you look, including but not limited to:

- the clothes you wear,

- your personal grooming,
- the symbols you wear (badges, tattoos, etc.),
- your sense of style, etc.

It can influence first impressions, job interviews, consumer buying behaviour and even courtroom decisions. Your personal appearance can give away cues about your age gender, identity, personality, attitudes, social standing, and income, to name but a few.
A job seeker looking for a position as a professional in a leading investments company who arrives for an interview wearing jeans and "tekkies", will probably not get the job, even if he has all the right qualifications and experience because the interviewer may interpret that the candidate is not professional. What do the appearances of the people below communicate to you?



"Ones perception is ones reality".

The above saying means that even if someone else's perception of you is incorrect or unfair, it is real to the person who perceives it. Our role is to manage other people's perceptions of ourselves. This can be done very much through taking care of our physical appearance, without compromising our unique individuality.

Vocal qualities

In South Africa we have a variety of accents and ways in which people speak. This adds to the diversity of our nation, and we do not want to make everyone a clone of the other. Only when our vocal qualities lead to miscommunication, do we need to work on refining it. We

CIN: 20300 **Version: 001**
Date: 2021/10/26

need to use or vocal qualities to enhance the meaning of our message. Therefore, we change our vocal qualities according to our situation:

Volume

Some people speak softer or louder than others. We can increase or decrease the volume of our speech to change our meaning.

- A client will use a louder voice to exclaim his dismay at having his call transferred for a third time.
- A soft voice would be used to show sympathy towards a client who has called in to enquire about benefits after her spouse has passed away.
- You have to speak louder when you are interacting with a client if the air conditioning unit is faulty and making a noise.
- Note: Speaking too loudly in inappropriate situations can be irritating, and interfere with meaning. Speaking too softly can make it difficult for listeners to hear and understand you.

Inflection

Inflection is the rise and fall of the voice. People who do not use inflection in their voices have a monotonous "drone". However, overusing inflection can create childlike speech. You would typically use more inflection when you are talking about something exciting.

Pitch

When interpreting emotions from the highness or lowness of the voice, we can typically infer a range of emotions from calmness, cosines, lack of interest through to depression from a low-pitched voice. A high pitch can indicate extreme emotions such as fear or excitement. x Resonance This is the quality and fullness of your voice, or how pleasant or unpleasant your voice sounds to the listener.

Rate

Rate refers to the pace of your speech. Speaking quickly usually indicates excitement, anger, volatility, whilst a slower speech would indicate being relaxed, trying to make a point, depression, lack of interest, etc. Note: Speaking too quickly can cause your listeners not to hear all your words, and speaking too slowly can be monotonous and boring for your listeners.

Clarity

Clarity refers to the clearness of your pronunciation. Your accent is acceptable provided that the listener can understand what you are saying. A final note on vocal qualities: For some of these vocal qualities the emotions indicated are very opposite for the same vocal characteristic.

Listening for information

Introduction

Research has shown that the quality of listening for information is related to our intelligence, motivation, and listening habits. We probably cannot improve interpersonal listening by becoming smarter, but we can make significant improvements in motivation and listening habits.

1. Clarify the purpose for listening: You will not be motivated to listen if you believe that the information given by the other person is unhelpful or irrelevant. You may need to let the person know what your purpose is: "Could you explain X to me?" "I want you to tell me how to X correctly." "I'd like you to describe what happened." If the other person initiates the information, then ask about his or her purpose: "What is your purpose in telling me this?"

2. Maintain active involvement in the interaction: When we feel involved, the process of interacting with others is enjoyable. When we feel uninvolved, the danger of daydreaming and pseudo-listening increases. Involved listening requires giving feedback. Feedback can improve the quality of information, which the other person provides. Nonverbal cues and back-channel comments ("yes," "uh-huh") shows interest, paraphrasing material clarifies understanding, and asking questions to bring out further information. Often it is important for us to make comments about the information and to reveal relevant information of our own.

3. Keep the purpose for listening in mind: The purpose will help focus our attention on what is important. It will also help monitor the direction of the discussion. We can then steer the discussion back on tract and in productive directions: "A few minutes ago you were saying X; I'd like to know a little more about that."

The guidelines above will help maintain motivation for listening and quality of interacting. Motivation itself is a major factor in concentration, and will help listen effectively even under adverse conditions. However, more steps may be taken to increase concentration:

4. Make the environment conducive for listening: The optimal environment feels pleasant, allows us to sit as close as is comfortable to the other person, features few distractions, and places us out of hearing of others who are not part of the interaction. If the selected environment is too distracting, change position, remove the distraction, or suggest a different environment.

5. Look at the other person: An important part of the other person's message is sent through nonverbal communication. Looking at the person helps receive the entire meaning. In addition, it avoids potential outside distractions and signals interest to the other person, as discussed above.

6. Recognize your own concerns and feelings: Outside concerns which we bring to the discussion may compete for our attention. Feelings aroused by the other person may threaten to distort the message. Concerns and feelings will not go away by attempting to ignore them. If the situation is informal and we know the other person well enough, discussing our concerns and feelings is an effective way of managing them. However, just silently recognizing and accepting that they are there is a helpful step toward to listening through them.

7. Make sure to understand the other person's point before evaluating it: Critically analysing ideas and information is important, but not while the person is speaking. Arguing in our minds or preparing responses while the speaker is talking are habits which interfere with our concentration on the message. A critical response will form as we begin our turn to speak.

The preceding suggestions are aimed primarily at improving concentration on the message sent by the other person. Effective informational listening also calls for internal processing to increase the usefulness and retention of the information being received.

8. Relate new information to past knowledge and experience: That does not mean distorting new information to fit prior expectations; in fact, it may mean contrasting it with what we already know. The point is that information is not useful or memorable in a vacuum; we must

CIN: 20300 **Version: 001**
Date: 2021/10/26

tie it to things we already know. When the details are descriptive, visualizing them also helps remember them.

9. Organize the information in a way that makes sense: People often talk in a stream of consciousness. The apparent connections between pieces of information may be understandable at the time, but these connections quickly evaporate from our memories. If the information is reorganized in relation to a familiar pattern, such as time, space, or a learned system of concepts, it will be more useful and memorable and help guide our questions and feedback.

10. Select key words or phrases which pull details together. It's usually a mistake to try to remember everything that another person says. Short-term memory does not hold much; new details tend to push out the ones which came just before. We remember more immediately afterward if we recall key phrases. Trying to keep everything in mind leads to frustration and the possibly of giving up listening.

11. Rehearse silently or jot down key phrases while the person is speaking. In many interpersonal situations, taking notes would appear rude or suspicious. In those situations, silent rehearsal and verbal paraphrase are the best ways to retain the information until you have a chance to write it down. However, even when note taking is acceptable, such as in a formal interview, extensive notes hurt concentration and rapport with the other person.

12. Write out notes as soon after the discussion as possible. No matter how vivid the key phrases are, the associated detail will begin immediately to fade from memory. If the details are important to remember, they must be written down for future reference and study.

	**Individual Activity 4**

Questioning

Having established the initial contact with your client, and listened to their query, your first response will be to question him/her to ensure that you have understood the query correctly and to reach consensus for further action. With relevant, insightful questions you will be able to manage the client interaction and reach a conclusion.

The Ask & Listen stage of the client interaction can be thought of as "examining the patient." If you expect to be respected as a professional, it's a step you can't skip or even gloss over. Take time to learn the different types of questions and practice using them. By developing your questioning skills, you will build credibility with you clients and enhance the client image of your organisation.

Types of questions for client relationships

There are two main dimensions to questions: Openness and Directness. Openness ranges from open questions, where there are unlimited response possibilities, to closed questions where response is limited to yes, no, or a few options. Directness ranges from totally direct where the intent of the question is obvious, to Indirect where intent behind the question is not so apparent. Another factor affecting questions is bias. Biased questions have only one right answer, which exposes to clients that the question is really not a question at all. Instead, it is a manipulative way of getting the client's agreement.

Closed Questions

While open questions have a whole choice of possible responses, closed questions limit the possible responses to a simple one-word answer like yes, or no, a number (policy number, date of birth, etc), or to a few options, like today or Thursday. Closed questions often begin with: Do, Are, Is, Which, Have. "How many," and "How often".

Although closed questions limit possible responses, they have several uses and can be extremely useful in the hands of the right person.

- In the Financial Services environment, we usually use them to verify who the client is and if they are entitled to the policy information.

- E.g., “what is your policy number, your date of birth, identity number, your address”
- It is also used to help focus the client back to business.
- E.g., "This is very interesting, but can I help you resolve your concern?"

Closed probes can also be used to confirm your understanding of a point your client has made or to confirm needs.

You might ask:
"Then, we can assume you will deposit last month’s contribution today, right?"
"If I understand you then, you'd like to take additional medical cover without increasing your contribution, is that accurate?"

When you ask questions to confirm needs, your questions should be asked so that your client can answer with a yes or no response”
"Would you be interested in?"
"Will it be important to you to?"
"Do you want to?"

When you need specific information, closed questions are effective.
"How many times did you try to contact your agent?"
"On what date were you burgled?"
“What is your new address?”

Open questions:
Open questions typically begin with words like: what, how, why, where, who and how. They can also be statements.
"Can you tell me more about?"
"What happened when?"
"How did you hear about?"

You will typically use open probes to explore your client's situations and to identify needs. They are great icebreakers to get people talking. They are especially advantageous, because they are open to a large range of responses, indicating what's on the client's mind.

CIN: 20300 **Version: 001**
Date: 2021/10/26

Open probes can also be used to clarify your understanding of what your client has said. When you clarify, you ask questions to understand what your client has said and why he or she has said it.

Direct vs. Indirect Questions

Questions can also be direct or indirect. Direct questions go straight to the point and their intent is obvious. "Are you the legal owner of the contract?" or "How old are you?" and "How much are you willing to spend?" are direct questions. The problem with them is obvious. They can be off-putting and embarrassing, but their bigger problem is they bluntly expose your intent. They usually produce either incorrect information or none.

A better approach is using indirect questions. With indirect questions, the intent is not so obvious. For example, to determine if someone s the legal owner of the contract: "What is your identity number?" or someone's age: "what is your date of birth?"

Indirect questions are softer and more comfortable for clients to answer. Information gained from them is usually honest and useful. Unfortunately, they may not leap to mind at just the moment you need them. So, plan some indirect questions in advance that will help you learn what you need to know about your clients. Also, raise your sensitivity to when you are asking direct and indirect questions. To help you get started, in the next activity, we will review two lists of sample questions, the first are direct, the second, indirect. Think about what makes them direct or indirect, how they would make you feel as a client, and if they would be useful to add to your own questioning repertoire.

Direct Questions

"Why is that important?"

"Did you make that decision?"

"Do you really want to devalue your policy by taking those loans?"

Open & Indirect Questions

"What do you feel will be most important in the decision?"

"Where would you normally go for help with this type of project?"

"What would you like the outcome of this conversation to be?"

"What are your long-term financial goals?"

"What do you wish you could change?"

Biased / Leading Questions

If you are not careful and conscious of it, your questions may carry bias. Bias is when the wording or tone of your questions indicates what the correct answer should be. "You want me to increase your monthly contributions by R200 then, don't you?" and "You'd have to agree our product is better than our competitors, wouldn't you?"

Bias reduces your credibility and makes clients feel they are being manipulated. And depending on how asked, can be terribly insulting, especially if the client does not share your opinion. Raise your awareness to biased-sounding questions and don't let them creep into your discussions with clients. Here are some additional questions that you should not ask:

"You wouldn't expect our competitor to recommend us, would you?"

"You do care about the environment, don't you?"

"You wouldn't want your children be left destitute, would you?

"Saving money is important to you, isn't it?

	**Group Activity 5**

Additional reading:

The importance of REALLY listening

Are you listening?

Esther Derby

This summer I had a rare-for-me experience. I had the opportunity to be THE CLIENT on a software development effort. I don't mean buying a box of off-the-shelf software - you know, MS Office, Adobe Acrobat, Quicken - I mean a real development project for my Web site. I say opportunity because it never happened. Here's the way my conversation went when I contacted Web site specialist Cecil about the project.

"Hi, Cecil. I'd like to add a search capability to the articles page on my website," I said. Cecil launched: "Well, the thing about search engines is that you have to register with each one and re-submit…"

"Ahem," I interrupted. "Perhaps I wasn't clear. I want people who come to my site to be able to search for articles on my site. I want site visitors to see a list of all the articles and be able to choose one to read—just like I have it now—but I also want them to be able to search for articles on a certain topic." "Oh, well, then what you want is a self-administered database," Cecil said. "I'm not sure I need a database. I've been doing fine uploading the articles with FTP. Plus, there's only one author since it's my site," I said.

"I know I've seen other sites with search capabilities. Can't the visitor's search by topic without the whole database thing?" "You don't understand," Cecil said "We're database gurus! We could convert your entire website to a database and then you could update the content…." "Thanks, Cecil. I'll get back to you," I said. I hung up the phone and sighed. It felt like Cecil hadn't heard much of what I'd said, and wasn't interested in what I needed or wanted. I was frustrated and discouraged. If you notice your clients seem frustrated when you are defining requirements (or worse, after you've delivered the system), consider making a shift in how you go about understanding client needs.

Ask wide open questions to explore
Open-ended and context free questions can help us explore what our clients want:
1. What problem are you hoping to solve?
2. What does a successful solution look like?
3. How will the system be different from what you have now?

These questions may seem sort of wide open … and they are. These are good questions to ask at the beginning a project to understand where the client is coming from and where they want to go.

Manage expectations

Chances are you won't be able to deliver on everything your client wants. But when you have the information, you can begin to manage expectations. I had a client back in the early 80s who wanted to be able to talk to the computer and have it do what he asked it to do. Speech recognition was just coming out of the research labs, and there was no way I could deliver what he wanted with the resources available ($20,000 and a CICS mainframe system with

CIN: 20300 **Version: 001**
Date: 2021/10/26

dumb terminals!). But because I knew that was what he really wanted; we were about to have the conversation about whether that was achievable. He still wanted speech recognition, but because he had been listened to, he accepted that it wasn't possible at that time.

Understand priorities

What is most important to the client? If you can deliver the top 10 items on a 50- item list will the client be satisfied? If you get to the other 40, that's great; if you don't, you've still delivered value. But if you start with item 35 or 49, no matter how nifty it is, the client won't be satisfied. By the way, I still don't have a search capability on my website. I decided Cecil would lead me down a rabbit trail of nifty technology that was more than I needed and not what I wanted. Maybe he'll read this article.

Rephrasing and paraphrasing

As an active listening response, paraphrasing or rephrasing, clarifies understanding of what your client has said. Rephrasing is repeating to the speaker, in your own words, what you heard them say. This may sound basic and like a waste of time. After all, if they just said it, why repeat it? Rephrasing is one of the most powerful listening techniques available to you, and it is one of the easiest to learn. Simply think carefully about what you just heard, put it in your own words, and say it back to them in the form of a question.

Rephrasing shows the other person that you really understand their situation. It also gives the person a chance to repeat and expand upon their concern, which makes them feel better about it and gives you the chance to identify something you can do to make a difference. Keep in mind that a rephrase must be sincere. Artificially posing a rephrase does more damage than good. If you mindlessly repeated their sentence like a parrot, the client would probably get irritated.

Some good ways to begin rephrasing questions are the following:
"As I understand it . . ."
"Do you mean . . ."

CIN: 20300 **Version: 001**
Date: 2021/10/26

Reflecting feelings

Clients also have feelings. They may phone in or visit your offices in a bad mood, or feeling angry, upset, or hurt. Something you may say might irritate them, sometimes company procedures are an irritation to them. Reflecting feelings feeds back the emotion communicated nonverbally by the client. When effective, reflecting feelings means you have grasped the implication of what the client just said. An example is when the client says he has had a busy week, and you say: "You must be glad it is Friday."

When your reflection on the implication is sincere and shows concern, it will be effective in communicating your interest. Use this listening technique with friends and family to gain a comfort level, then try it on clients. Before long, you'll be surprised to find yourself doing it naturally without even thinking about it.

Successful use of reflecting feelings entails focusing attention on the other person and repeating the feelings revealed. Avoid mentally processing how you think the person should be feeling, and use reflecting feelings sparingly. Usually reflecting feelings should be brief and stated in the second person:
"You look relieved,"
"You sound irritated."
"You seem embarrassed."
"You appear angry."

	**Individual Activity 6**

Verbal expression

Use of language

In writing and speaking we can use different types of language. In discussions at work, with clients, strangers, etc. there are unwritten rules that are followed. These unwritten rules are

called "register use". Register use can help you communicate effectively. Incorrect register use can cause problems at work, cause people to ignore you, or, at best, send the wrong message. Of course, correct register use is very difficult for many learners of English. This feature focuses on different situations and the correct register used in the various situations. To begin with, let's look at some example conversations.

Formal

In the business environment it is customary to address your client in a formal register. If you see your client more frequently, the degree of your formality may decrease.

Informal

You use this type of language with people who are familiar to you. You may make good use of this register in verbal communications with clients, but you need to first find out whether your client would not be offended by your use of this register.

Slang

Slang is used by a specific group of people who understand the meaning of the words that are used. Different geographic communities may use words that are only understood in that community. For example, a group of friends may have made up their own words and "group language" which outsiders will not be able to understand. In an organisation, slang is company-specific jargon that is NOT formally accepted. Slang may be appropriate to use in interacting with your colleagues, but is not acceptable for use with clients.

Jargon

Jargon is language that is used by a specific group of people, which is normally not clear to others who are not part of this group. Jargon is useful when speaking to experts and members of the groups as it avoids long-winded explanations. But when dealing with a non-layperson, avoid jargon and use language that explains the concept to them clearly.

Verbal Mannerisms

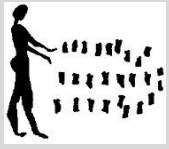
Verbal mannerisms are the unconscious phrases we use such as "uhm", "well", "you know". "er". Sometimes we use these to "buy time, when we are thinking about an appropriate answer, "uhm" or to lead into a subject – "well…". Sometimes we use them if we are nervous.

Beware that they can interfere with meaning, give away a lot about your emotional state and be distracting for your listener.

Plain Language

Don't use convoluted words. See! "Convoluted" is a word that shows off my vocabulary but could cause misunderstanding. To ensure that understanding happens first time around use plain language that is simple to understand. Let's start again. Don't use words that are difficult or complex when a plain word will do. This is not to say that you should not build your own vocabulary, to ensure that you understand people who do not use plain language.
These are common words that we tend to use instead of their plain counterparts.

INSTEAD OF THIS	**USE THIS**
whilst	**while**
terminate	**end**
regarding	**about**
purchase	**buy**
Prior to	**before**
persons	**people**
Per Annum	**a year**
particulars	**details**
In the event of	**if**
In respect of	**for**
In excess of	**more than**
forward	**send**
consequently	**so**
commence	**start**
advise	**tell**
Go to http://www.plainenglish.co.uk/A-Z.html for a free A-Z of "plain English alternatives to the pompous words and phrases that litter official writing".	

	**Summative Activity 5**

BIBLIOGRAPHY / READING LIST

References and Resources

Books

1. David Parmenter, Key Performance Indicators. John Wiley and Sons 2007, ISBN 0-470-095881.
2. Hooley, Graham J.; Saunders, John A.; Piercy, Nigel F. Marketing Strategy and Competitive Positioning. Pearson Education UK in 2004
3. Nell, W.T. & Napier, R.J. Strategic approach to farming success. Published by Wim Nell Agricultural Management Consultants, Bloemfontein. 2006 (second edition).
4. Solomon, Michael; Bamossy, Gary; Askegaard, S.A. Hogg, Margaret K. Consumer Behaviour. Pearson Education
5. Life skills' by Edna Rooth
6. Basic Marketing, E. Jerome McCarthy
7. Cash flow diagram: Adapted from Cotton SA Skills Training Program
8. Christophersen P, Sandved A.O, (1969) An Advanced English grammar, Macmillan Press London. ISBN 0 333 10643 1.
9. Cotton Management Guide (revised 2006); Institute for Industrial Crops – Agricultural Research Council (ARC) printed – Pro-Spec Media
10. Encyclopaedia Britannica – South African Version
11. Erasmus-Kritzinger, L.E, Bowler, A. and Goliath D (2002) Effective Communication: Getting the message across in business, Afritech South Africa. ISBN 1-874940-45
12. Farmers' Weekly Columns, J. P. Hughes, 2005
13. Feldman R.S, (2002) Power Learning: Strategies for Success in College and Life 2nd edition, Mc Graw Hill Higher Education, New Yord. ISBN 0-07-248070-X.
14. Fielding, M. (2003) Effective Communication in Organisations, Juta & Co (Pty) Ltd South Africa. ISBN 0-7021 4236 0.
15. Gray, D.E, 2004. Doing research in the real world. Sage. London.
16. One Hundred Ideas for Managers, 2004. Tony Manning, Consultant in Competitive Strategy and Change Management, P.O. Box 750, Morningside 2057, South Africa.
17. People Farming Workbook – Environmental and Development Agency Trust
18. Pesticide Storage and Stock Control manual of the Food and Agricultural Organization of the United Nations. Manual no GCP/INT/572.NET
19. The 10-Day MBA, Revised Edition, Steven Silbiger, Piatkus Books Limited, 2004
20. The Trade Chain of the South African Citrus Industry, Fresh Produce Exporters' Forum, 2003
21. 17. The Trade Chain of the South African Fresh Fruit Export Industry, 2004. Production

Internet Websites and Articles

1. Pine, B. Joseph II; Gilmore, James (7/1/98), "Welcome to the Experience Economy", Harvard Business Review.
2. A description of performance management, http://www.cpaaustralia.com.au
3. The balanced Scorecard: Translating Strategy into Action, Harvard Business School Press, Boston (1996).
4. Hlavinka, K. (2005). *A Tale of Two Customers*. COLLOQUY, Vol. 13, Issue 1
5. "Great Customer Service For Your Small Business," by Richard F. Gerson, Ph.D.
6. http://www.investopedia.com/
7. http://www.nda.agric.gov
8. www.agrihandbook.co.za
9. Mind Tools: www.mindtools.com
10. Business Management Goal Setting: www.mikeholt.com
11. The Art of Delegation by Gerard M. Blair, www.see.ed.ac.uk