

AGRICULTURAL SCIENCES

WINTER CLASSES

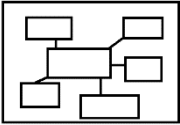



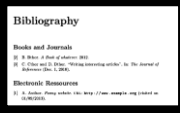
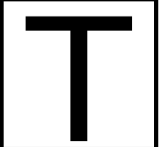
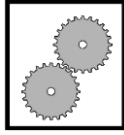

GRADE 12

TERM 2

TEACHER AND LEARNER CONTENT MANUAL



ICON DESCRIPTION

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TOPIC 1: Genetic concepts**EXAMINATION GUIDELINE AND OUTCOME**

**Basic
agricultural
genetics**

**Monohybrid
inheritance**

Dihybrid inheritance

Genetic concepts

- Define basic genetic terminology, like genetics/heredity, genes, chromosomes and alleles (homozygous and heterozygous)
- Distinguish between genotype and phenotype, dominant and recessive genes.
- Indicate a monohybrid inheritance/crosses (Mendel's first law: law of segregation)
- Indicate a dihybrid inheritance/dihybrid cross (Mendel's second law: law of independent assortment)
- Use various methods, such as a Punnett square, genetic diagrams and schematic representations to illustrate the crosses
- Describe Mendel's laws of segregation and independent recombination of characteristics
- Distinguish between qualitative and quantitative characteristics



IMPORTANT TERMS AND DEFINITIONS

T

Genetics is the study of heredity	Genetics
Heredity is the transfer of characteristics from parents to offspring.	Heredity
a section of DNA that contains the information for a specific genetic characteristics	Gene
A specific characteristic of an individual	Traits
A thread-like structure in the cell nucleus that contains DNA and protein	Chromosomes
different forms of the same gene	Alleles
Having identical alleles for a particular gene e.g. BB or bb	Homozygous
Having different alleles of a gene e.g. Bb	Heterozygous
set of genes an organism inherits from its parents	Genotype
the physical, behavioral, and biochemical traits that it expresses in an individual	Phenotype
the version of a gene that is expressed	Dominants
is the version that is masked.	Recessive

1 Genetic terminology

1.1 Genetics and heredity

Genetics is the study of heredity. Heredity is the transfer of characteristics (height, hair colour, ear shape) from parents to offspring.

1.2 Gene

A gene is a section of DNA that contains the information for a specific genetic characteristic (skin color). In the nucleus of plant cell and animal cell we find genes.

1.3 Chromosomes

A thread-like structure in the cell nucleus that contains DNA and protein. Chromosomes are inherited from

parents, and each chromosome contains a specific sequence of genes

1.4 Alleles

Alleles are different forms of the same gene, and each animal has two copies of each gene. One copy is inherited from the mother, and the other from the father.


Homozygous alleles are identical copies of a gene inherited from both parents, while heterozygous alleles are different copies of a gene inherited from both parents. For example, if an animal has two copies of the X chromosome (XX), it is homozygous for X and it is a female. If it has one copy of the X chromosome and one copy of the Y chromosome (XY) it is heterozygous for sex and it is a male.

1.5 Genotype and 1.6 phenotype

Genotype is the set of genes an organism inherits from its parents. It is the organism's unique DNA sequence passed down from one generation to the next. For example, an animal might have a genotype for brown eyes (Bb), meaning they carry one gene for brown eyes and one for blue eyes.

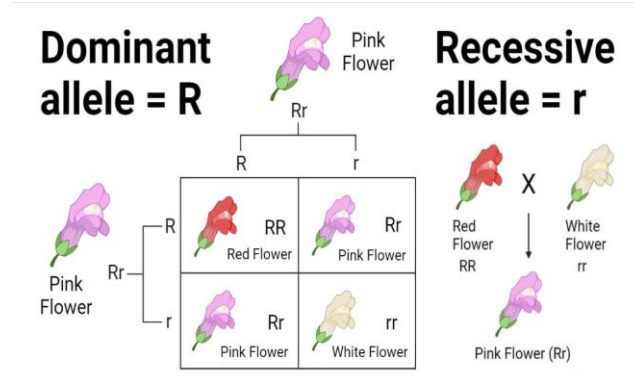
Phenotype is the physical appearance/traits that expressed in an individual. It is the observable expression of an individual influenced by the genotype and environment. For example, an animal would likely have brown fur colour because brown is the dominant trait, making their observable fur color (phenotype) brown.

Genotype vs Phenotype	
GENOTYPE	PHENOTYPE
The genotype is an organism's genetic information.	The phenotype is the set of observable physical traits.
BB homozygous dominant	purple
Bb heterozygous	purple
bb homozygous recessive	white



1.7 Dominant and 1.8 recessive

An individual inherits two different alleles for a gene. A **dominant allele** is the version of a gene that is expressed, while a **recessive allele** is the version that is masked. A recessive allele is only expressed when there is no dominant allele present. This means that the trait associated with the recessive allele will not be visible



2 Monohybrid and dihybrid inheritance

2.1 Monohybrid inheritance studies one trait and follows Mendel's Law of Segregation.

Dihybrid inheritance studies two traits simultaneously and follow both the law of Segregation and the law of Independent Assortment.

Here's a comparison:

Feature	Monohybrid Inheritance	Dihybrid inheritance
Definition	Inheritance of a single trait (one gene with two alleles)	Inheritance of two different traits (two genes, each with two alleles)
Mendel's Law	Follows the Law of Segregation , which state that alleles pairs separate during gamete formation	Follows the Law of Independent Assortment states that alleles of two different genes get sorted into gametes independently of one another during gamete formation
Cross Example	Tall (T) vs Short (t) pea plants	Seed shape (Round-R vs Wrinkled-r) and seed colour (yellow - Y vs Green - y)
Parental Cross (P)	TT x tt (pure tall x pure short)	RRYY x rryy (pure round-yellow x pure wrinkled-green)
Gamates (Meiosis)	T x t	RY x ry
Offsprings (F1)	Tt	RrYy

Self-crossed (P2) /Inbreeding	Tt x Tt (heterozygous tall x heterozygous tall)	RrYy x RrYy (heterozygous round and yellow x heterozygous round and yellow)
Gametes	T; t	RY; Ry; rY; ry
F1 generation phenotype ratio	3:1 (3 dominant: 1 recessive)	9:3:3:1 (9 double dominant, 3 dominant for one trait and recessive for the other, 3 recessives for one trait and dominant for the other, 1 double recessive)
Punnett square size	3 x 3 (9 boxes, including gametes)	5 x 5 (25 boxes, including gametes)
Example in Animals	Fur colour in mice (Black B dominant, white b recessive)	Fur colour and tail length in mice (Black B, White b; Long L, Short l)
Example in plants	Flower colour in pea plants (purple P, white p)	Seed shape and seed colour in pea plants

2.2 Punnett Square for Monohybrid and Dihybrid crosses

Monohybrid cross

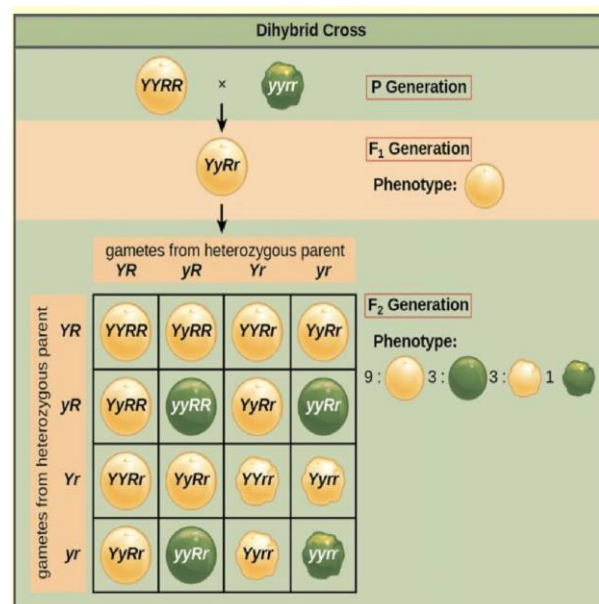
Parental generation: BB x bb

First filial generation, F₁:

Bb

Second filial generation, F₂:

Gametes	B	b
B	BB (purple)	Bb (purple)
b	Bb (purple)	bb (white)



2.3 Schematic representations to illustrate the crosses

Cross of parental generation

Parental phenotype

Parental genotype

Meiosis

Gamete

Fertilization

F₁ genotype

F₁ phenotype

Purple

BB

B

White

bb

b

Bb

All purple flowers.

Self-crossed F₁ generation

F₁ phenotype

F₁ genotype

Meiosis

Gamete

Fertilization

F₂ genotype

F₂ phenotype

Ratio of F₂ genotype

Purple

Bb

B

BB

Purple

b

Bb

Purple

Purple

Bb

B

Bb

Purple

b

bb

White

3 purple

:

1 white



ACTIVITIES

Activity 1

1.1 Mendel studied the characteristics of garden peas and concluded that there are two alleles for each characteristic, which separate from each other during gametogenesis to form the genetic makeup of an individual. Based on the findings, Mendel came up with the laws used by geneticists even today.

1.1.1 Give a term for the underlined words in the paragraph above. (1)

1.1.2 Deduce Mendel's Law of Inheritance illustrated in the paragraph above. (1)

1.1.3 Explain Mendel's Law of Independent Assortment. (2)

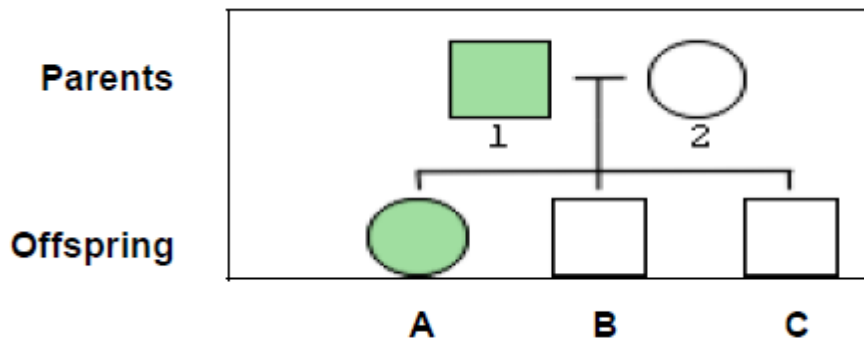
1.2 In pigs, red hair colour (R) is dominant over white colour (r). A white sow was mated with a red boar and all piglets in the F_1 were red.

1.2.1 Use the Punnett square method to determine the genotype of the $1F_1$ -generation. (4)

1.2.2 Calculate the percentage of homozygous red piglets. (2)

Activity 2

The schematic representation below represents the crossing between two parent animals with different traits. The one trait is represented by colour (dark colour or white) and the other by the shape of the diagram (square or circle)



2.1.1 Indicate the percentage of genetic material that each of the offspring receives from each of the parents. (1)

2.1.2 Tabulate the traits (shape and colour) that each of the offspring, indicated by A, B and C in the schematic representation, received from the parent marked (2).

2.1.3 Deduce from the schematic representation and data supplied above the TWO possible traits (shape or colour) that are dominant when the offspring is compared to the parents. (2)

Activity 3

In pea plants, spherical seeds(S) are dominant over desired seeds(s).Two heterozygous plants for seed shape were crossed, as shown in the Punnet square below.

GAMETES	S	s
S	SS	Ss
s	Ss	ss

3.1 1 Indicate the fraction of the offspring that will have dented seeds (1)

3.1.2Calculate the percentage of heterozygous spherical seeds (2)

3.1.3 Determine the phenotypic ratio of the F1 generation(1)

3.1.4Give the number of offspring that will look similar to the parents (1)

- 4.1 Pure-bred Shorthorn cattle may be either red or white. The red colour is the dominant characteristic but when they are crossed, their hybrid offspring are neither red nor white. They are roan, which is a combination of red and white and represents incomplete dominance.
- 4.1.1 R is used to represent the genotype for red colour. Indicate the letter that you would use for the white colour. Motivate your answer. (2)
- Determine the genotype for roan cattle. Explain your answer. (2)
- 4.1.2 Draw a schematic representation of the crossing between a homozygotic red Shorthorn bull and a white Shorthorn cow to predict the possible phenotypes and genotypes of the offspring. (6)
- 4.1.3

TOPIC 2: The pattern of inheritance

EXAMINATION GUIDELINE AND OUTCOME

The patterns of inheritance

- Identify and describe the pattern of inheritance that leads to different phenotypes: incomplete dominance, co-dominance, multiple alleles, polygenic inheritance and epistasis
- Define the concept of prepotency and atavism with relevant examples
- Describe the sex chromosomes and sex-linked characteristics (examples)



IMPORTANT TERMS AND DEFINITIONS



Atavism is the reappearance of ancestral traits in an organism, even if those traits have not been seen in recent generations

Atavism

Occurs when one gene mask the expression of another gene

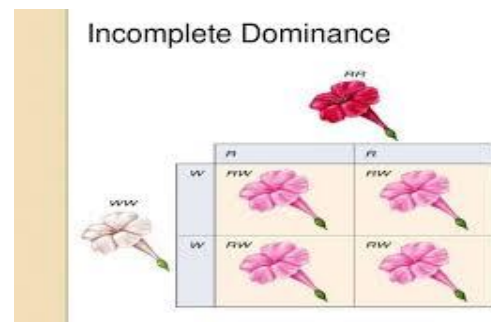
Epistasis

Occurs when a trait is controlled by multiple genes	Polygenic
Prepotency refers to the ability of an individual (usually a parent) to consistently pass on its traits to offspring, often overriding genetic contributions from the other parent	Prepotency

3. The pattern of inheritance

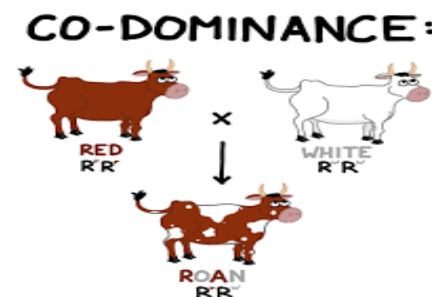
3.1 Incomplete dominance

This occurs when a heterozygous individual displays a phenotype that is intermediate between the two homozygous phenotypes, meaning neither allele is completely dominant, resulting in a "blended" appearance. Example: When a red-flowered plant (RR) is crossed with a white-flowered plant (WW), the offspring (RW) have pink flowers, showing a blend of red and white. In incomplete dominance, the heterozygous phenotype is a blend of the two homozygous phenotypes



3.2 Co-dominance

Both alleles of a gene are expressed equally in the phenotype of a heterozygous individual, showing distinct traits from both alleles simultaneously. For example: A cross between red and white animal will have offspring that is roan. In codominance, both alleles are fully expressed in the heterozygous phenotype



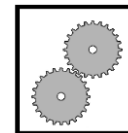
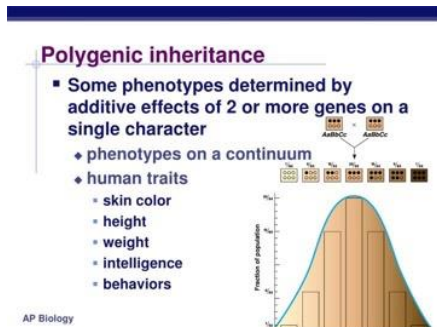
3.3 Multiple alleles

A situation where a gene has more than two different alleles present in a population, leading to a wider variety of possible phenotypes for a trait; example: the human ABO blood group system with A, B, and O alleles. Multiple alleles allow for more than two possible phenotypes for a single trait.

Trait = Blood Type		Alleles = I^A , I^B , i
Phenotypes		Genotypes
• Type A		• $I^A I^A$ or $I^A i$
• Type B		• $I^B I^B$ or $I^B i$
• Type AB		• $I^A I^B$ (co-dominance)
• Type O		

3.4 Polygenic inheritance

Occurs when a trait is controlled by multiple genes, each contributing a small effect, resulting in a continuous range of phenotypes within a population; examples include height and fur color. Polygenic inheritance produces a continuous distribution of phenotypes due to the combined effects of many genes.



Worked example

The height of a tomato plant is controlled by two pairs of genes. The base height of a recessive plant (aabb) is 30cm. Each additive allele contributes 10 cm to the base height.

Calculate the height of the AABB tomato plant(2)

Answer: 30 cm + 10 cm + 10 cm + 10 cm + 10 cm = 70 cm ✓

Name THREE genotypes of a 50 cm tomato plant(3)

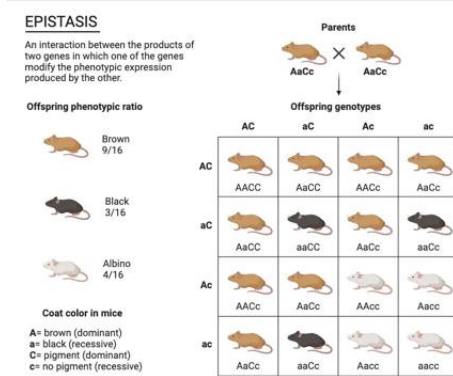
Answer: AAbb ✓

aaBB ✓

AaBb ✓

3.5 Epistasis

Occurs when one gene masks the expression of another gene, meaning the phenotype of one gene is dependent on the genotype of another gene. For example, a gene for albinism can mask the expression of other genes affecting skin color, resulting in a completely white phenotype regardless of other pigment genes. Epistasis involves one gene influencing the expression of another gene.



3.6 Prepotency

Prepotency refers to the ability of an individual (usually a parent) to consistently pass on its traits to offspring, often overriding genetic contributions from the other parent. This is commonly seen in selective breeding, where certain individuals produce offspring that closely resemble them. Examples: A bull with strong prepotency for high milk production in cows will sire daughters that also produce large amounts of milk. A dominant tomato plant with high disease resistance consistently produces offspring with the same resistance, even when crossed with a weaker strain.

3.7 Atavism

Atavism is the reappearance of ancestral traits in an organism after several generations of absence. This occurs due to the expression of dormant genes that were previously suppressed. Example: Horses with extra toes, Modern horses typically have a single toe (hoof), but occasionally, a foal is born with small extra toes, resembling their multi-toed ancestors.

3.8 The sex chromosomes

Sex chromosomes determine an organism's biological sex. In most species, they come in pairs and vary between males and females. Example males have XY chromosomes and female XX chromosomes. The Y chromosome carries genes for male traits.

3.9 Sex-linked characteristics

Sex-linked characteristics are traits controlled by genes located on the sex chromosomes, usually the X chromosome. Since males (XY) have only one X chromosome, they express recessive X-linked traits more frequently than females (XX), who can be carriers. Example: streaked hairlessness is a disorder that results in streaks of missing hair in Holstein cattle caused by a dominant allele located on the X chromosome.

Qualitative vs Quantitative Traits

• Qualitative Traits

- Influenced by a single gene
- Typically follow simple patterns of inheritance
- Phenotypes fall into distinct categories (nominal scale)
- Trait expression is typically unaffected by environment

• Quantitative Traits

- Influenced by multiple genes, perhaps interacting genes
- Do not follow simple patterns of inheritance
- Phenotype is measured on continuous scale (interval scale)
- Trait expression may be affected by environment



ACTIVITIES

Activity 4

4.1 In pea plants, spherical seeds (S) are dominant over dented seeds (s). Two heterozygous plants for seed shape were crossed, as shown in the Punnett square below.

GAMETES	S	s
S	SS	Ss
s	Ss	ss

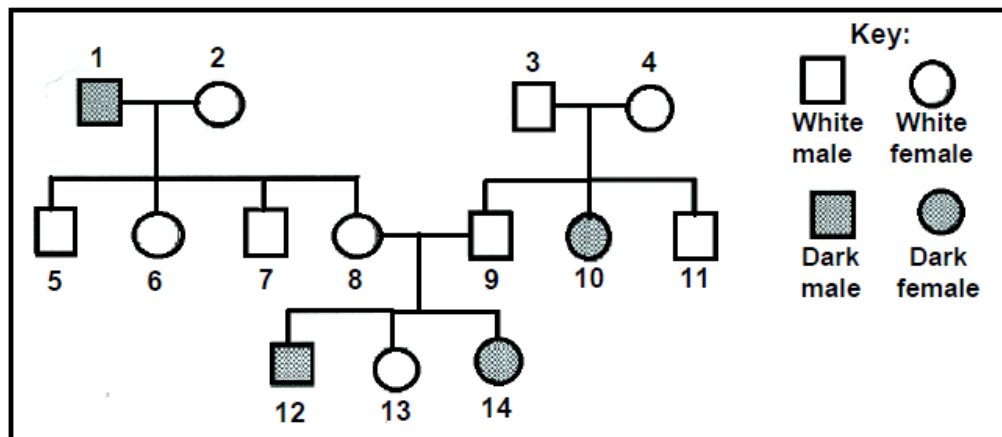
4.1.1 Indicate the fraction of the offspring that will have dented seeds. (1)

4.1.2 Calculate the percentage of heterozygous spherical seeds. (2)

4.1.3 Determine the phenotypic ratio of the F₁-generation. (1)

4.1.4 Give the number of offspring that will look similar to the parents. (1)

5.1 The illustrations below show the crossing of different flowers.



5.1.2 Indicate the phenotype of individuals 5 and 12.

5.1.3. Predict which individual (3 or 10) would be:
(a) Homozygous
(b) Heterozygous

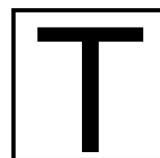
5.1.4 Determine, as a percentage, the probability of having a female offspring by referring to the offspring of the first two sets of parents in the schematic representation above

Variation and Mutation

Define genetic terminology, like variation, mutation and selection

Identify and describe the importance of variation and selection

Discuss the external (environmental) and internal (genetic) causes of variation
Identify the types of mutagenic agents and their effects (changes in chromosome structures)



A change in the DNA sequence of an organism which is the main cause of diversity amongst organisms	Mutation
A change in a small quantity of the hereditary substance in the cell	Gene mutation
Visible changes in the structure or number of chromosomes.	Chromosome mutation
Involves the process of choosing individuals with wanted characteristics to breed offspring that may inherit their wanted characteristics	Selection
The process of choosing individual organisms with certain phenotypic trait values for breeding by humans	Artificial selection
The process by which populations of living organisms adapt and change	Natural selection
The differences in the phenotypes of plants and animals of the same species caused by genetic and environmental factors	Variation

The long-term weather pattern in a regions, typically averaged over thirty years.	Climate
A genetic characteristic giving rise to a range of phenotypes that seem to blend continuously from one extreme to the other and are usually influenced by multiple genes and environmental factors.	Quantitative characteristics

Reres to genetic characteristics that shows continuous variation	Qualitative variation
The degree to which a characteristic/trait is determined by genes	Heritability
This gives an estimate of how much better or worse than an average the offspring of an individual will be for a particular characteristic	Estimated breeding value(EBV)
The study of measurable biological characteristic by using computer technology	Biometrics

Importance of Variation & Selection

Selection and variation work together to drive genetic improvement, whether in natural evolution or controlled breeding programmes. Changes in the DNA of an organism occur because of spontaneous mutations, chromosome defects and sexual reproduction. These changes cause variation in individual organisms. Through a process of selection, variations can result in new breeds and varieties of plants and animals. Both are important for sustaining biodiversity, improving agriculture and ensuring the survival of species.

Variation

Causes of variation

Variation is caused by:

- (a) external, and
- (b) internal factors.

External/ Environmental Causes of variation.

This results from factors associated to the environment of an organism.

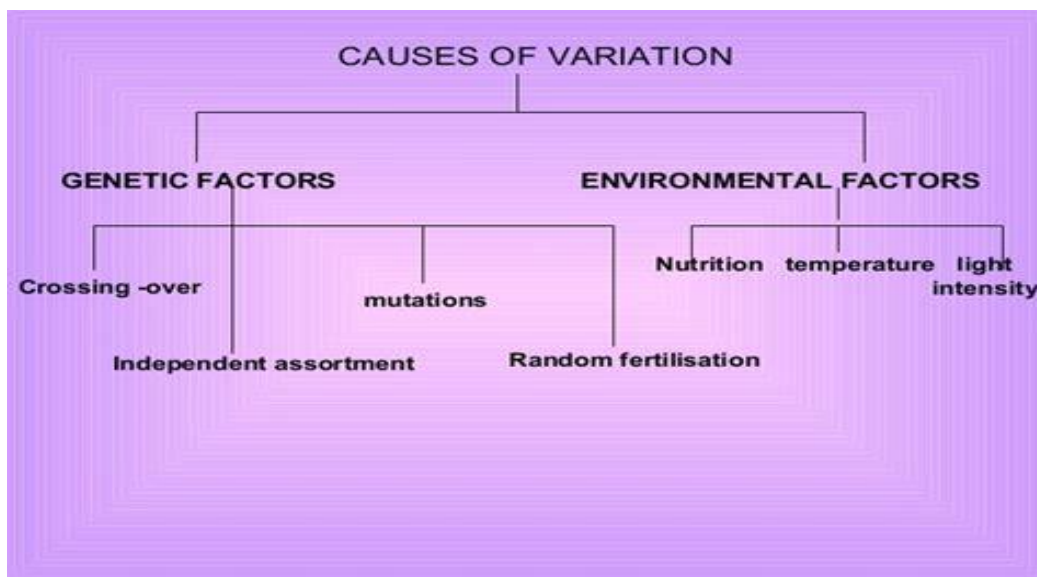
Diseases	Diseases cause variations in organisms by influencing genetic and environmental factors. These variations may arise through mutations, immune responses, and selective pressures leading to differences in traits among individuals in a population
Climate/weather /temperature	Climate plays an important role in causing variations in living organisms by influencing genetic expressions, natural selection and adaptation.
Light Intensity	Animals living in areas at high altitude display colour differences amongst other things

Feeding	Variation will develop between two identically genetic composition that are fed food rations animals differing in quantity and quality.
Topography	Nguni cattle are exceptionally well adapted to cover great distances daily and to climb steep hill.

Internal/Genetic causes of variation

Internal/genetic causes of variation are factors that are linked with the genes and heredity of an organism.

Mutations	It causes changes in the DNA or RNA of an organism which results in creation of new traits or alter existing ones.
Meiosis	Meiosis causes genetic variation through crossing over, independent assortment and random fertilisation.
Fertilization	During fertilisation, genetic variation is increased due to combination of unique genetic material from two parents.



Types of mutations

1. Gene mutations

They are the most common type of mutation affecting organisms.

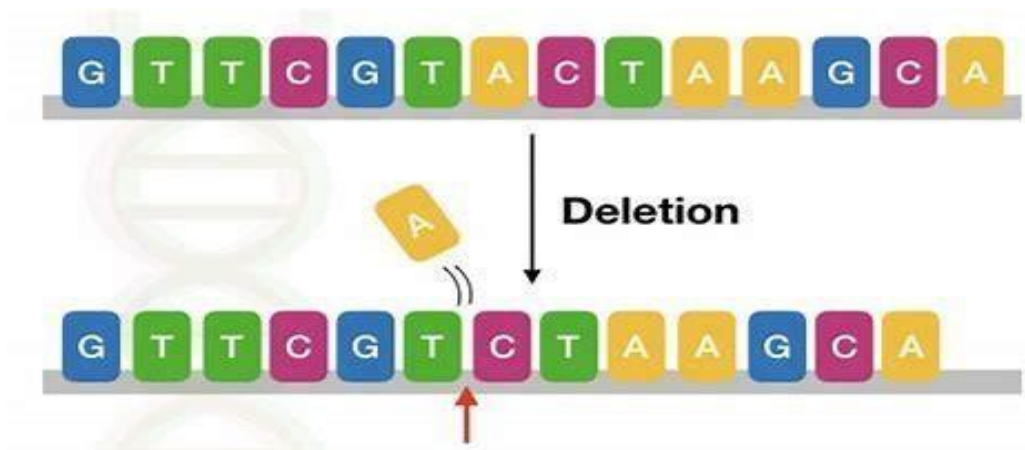
Substitution : one nucleotide base is replaced by different nucleotide base.

insertion : one or more nucleotide bases are added to the into the gene sequence.

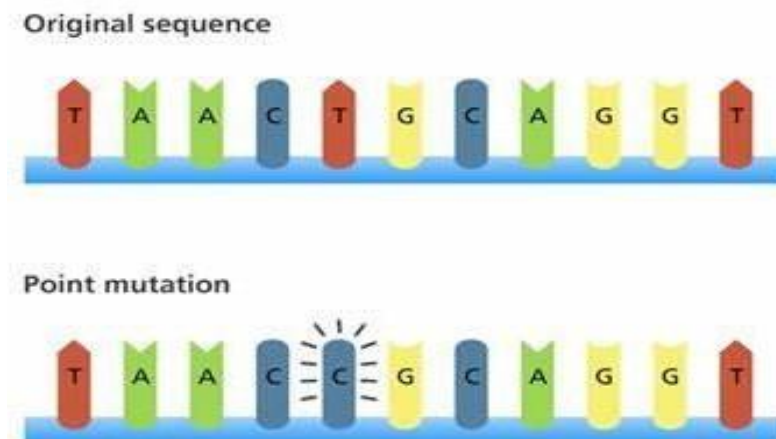
Deletion : one or more nucleotide bases are removed from the gene sequence

Inversion: in this case, the order of two or more nucleotide bases is reversed

1.Deletion- where one or more nucleotide bases are removed from the gene sequence



2.Insertion- one or more nucleotide bases are added into the gene sequence



3.Substitutiuon – one nucleotide base is replaced with a different nucleotidebase

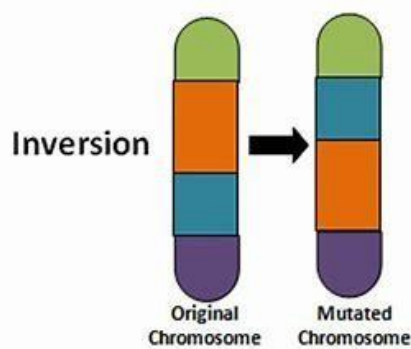
A	C	C	T	G	A	G	T	C
T	G	G	A	C	T	C	A	G



Substitution

A	C	C	T	T	A	G	T	C
T	G	G	A	A	T	C	A	G

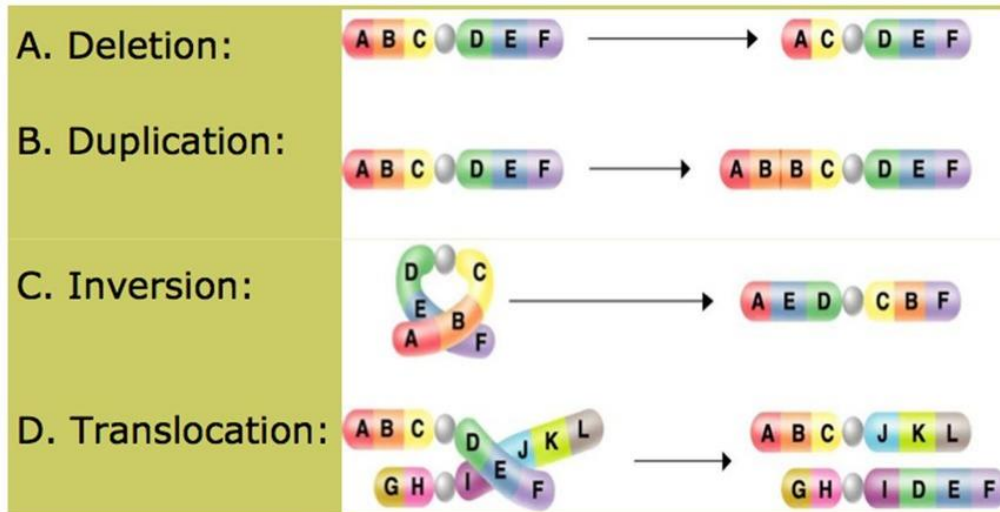
4. Inversion- the order of two or more nucleotide bases is reversed



2.. Chromosome mutations

Chromosome mutations are usually detrimental to the individual organism.

Chromosomal Mutations



Causes of Mutations

Mutations may be caused by **induced /artificial or natural**

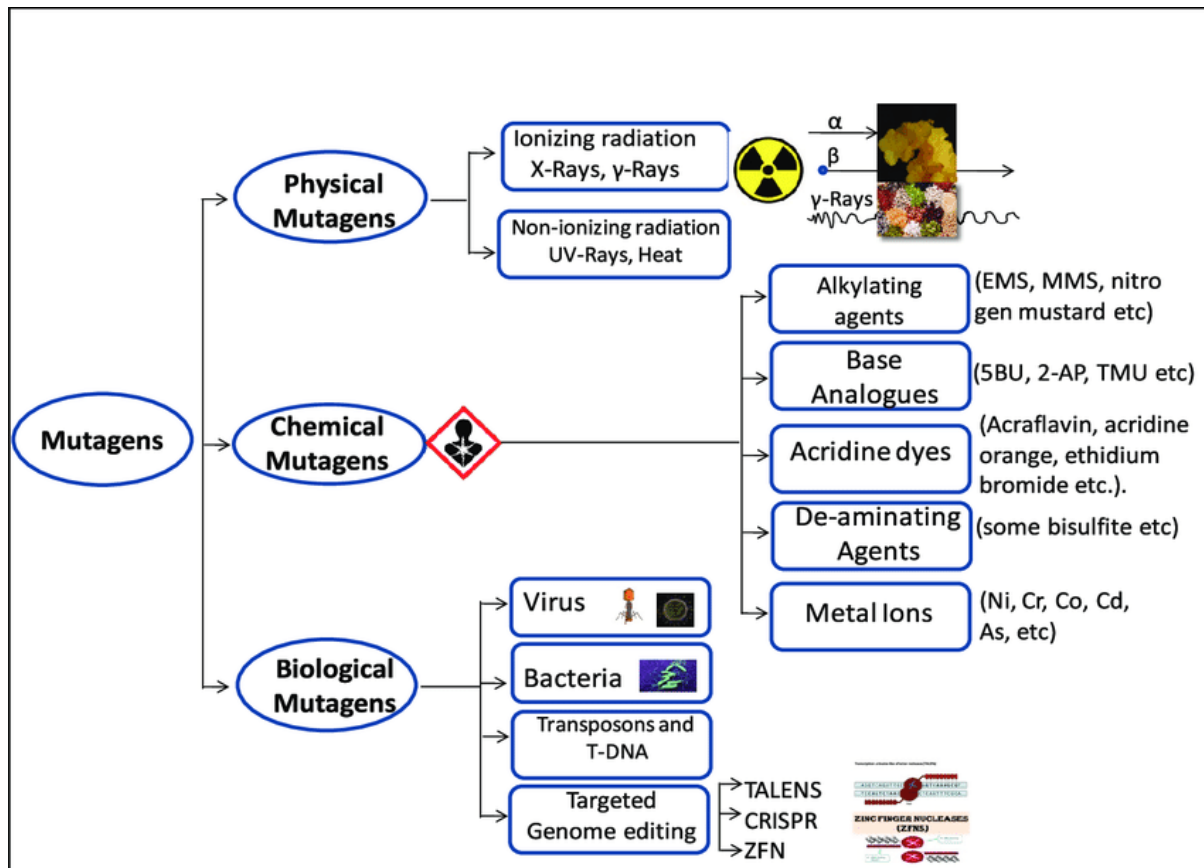
Induced/artificial mutations: these refer to mutations that are caused by artificial means. Mutagenic agents include physical, chemical and biological agents.

Natural mutations : mutations that occur spontaneously in nature due to the normal chemical processes in the cells of organisms.

Importance of mutation

Mutation is a crucial factors in the evolution and improvement of crops and animals by introducing genetic variation which can lead to desirable traits that enhance productivity, resilience and sustainability

Mutagens and their effect



ACTIVITIES

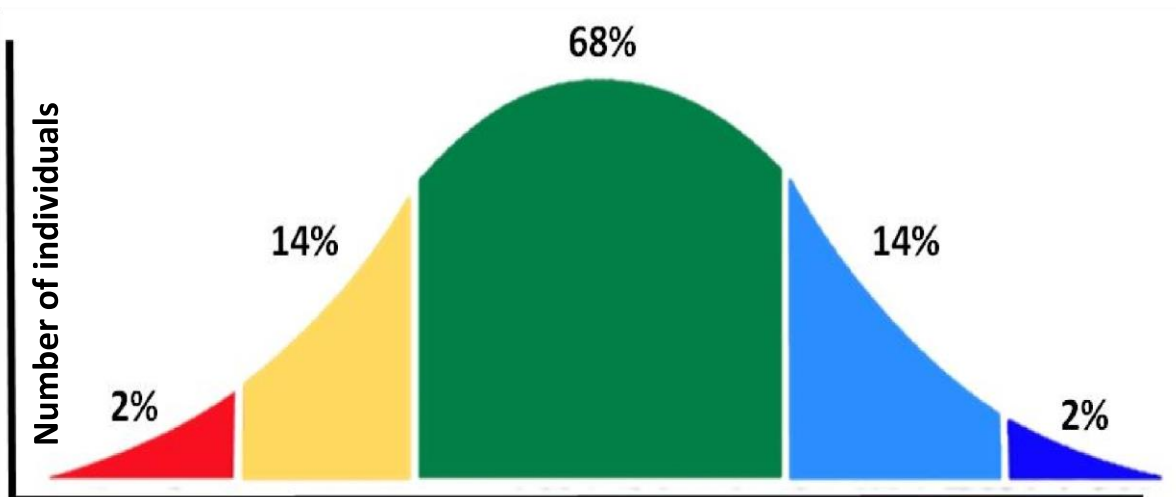
Selection and Breeding



Indicate the general principles of selection, like biometrics, heritability and estimated breeding values (EBVs), and compare natural and artificial selection

Importance of variation in selection

Selection is based on the observable differences between individual of the same species. For example, if offsprings of two parents show a variation in characteristics such as growth rate, resistance to extreme weather condition and egg production, the variation of each of character will have a normal distribution curve(bell-shaped) curve



A greater number of the population falls in the average (individuals meeting the average) whilst lowest numbers are found in the extremes of the curve.

- Characteristics that are caused by genetic factors are passed from parents to offspring.
- Characteristics that are caused by the environment are not passed to offspring
- It is crucial that the farmer identifies characteristics that are **genetically** controlled when choosing individual plants or animals from breeding

Heritability

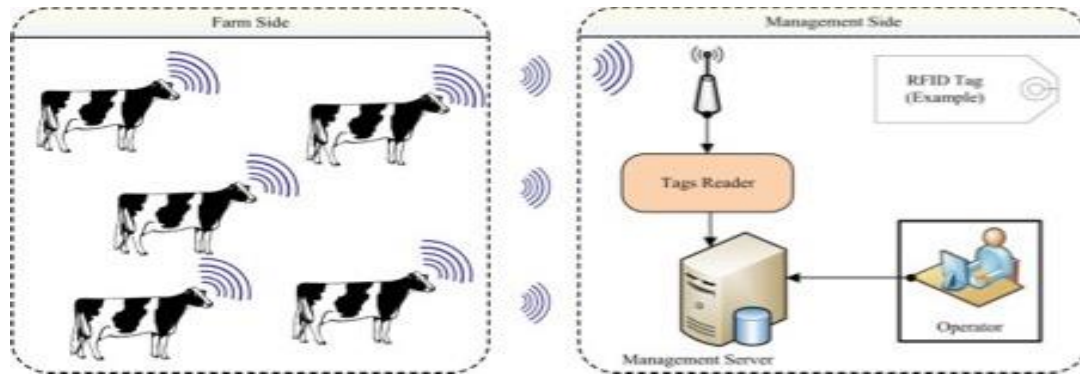
It refers to the degree to which a characteristic is determined by genetics as against environmental factors. It is calculated by comparing the similarity between connected individuals under similar environment conditions. Heritability is expressed on a scale of 1% to 100% or 0 to 1.

Heritability values of over 50% for a particular characteristic is considered high and more influenced by gene rather than by environment.

Estimated Breeding Values (EBVs)

EBV is a concept in animal breeding and genetics and used to predict the genetic potential of an animal as a parent. They help breeders make informed decisions to improve traits in livestock such as milk yield, growth rate, fertility and disease resistance.

In animal breeding, it refers to the application of statistical methods and mathematical models to analyse biological data related to animal traits, genetics and breeding performance. It plays a crucial role in selection breeding programmes, and genetic evaluation.



Factors to consider when selecting breeding stock.

1. Age
2. Level of performance
3. Physical Fitness
4. Health Body Conformation
5. Temperament or Behaviour
6. Quality of products
7. Mothering Ability
8. Adaptability
9. Prolificacy

Selection methods

Selection:

- Natural Selection – as it happens in nature
- Artificial Selection – by human interference

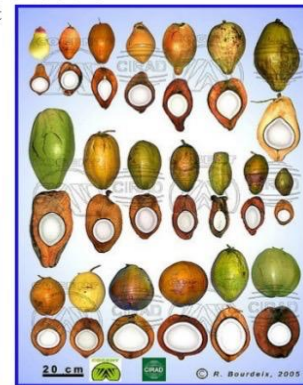
Methods of Selection	
<input type="checkbox"/> Mass selection	- type of selection that is based on the individual's performance on the field
<input type="checkbox"/> Pedigree selection	- type of selection that is based on the quality of the ancestor
<input type="checkbox"/> Family selection	- type of selection that is based on the quality of the relatives of its generation (full/half siblings)
<input type="checkbox"/> Progeny selection	- type of selection that is based on the quality of the offspring

1. Mass selection

It refers to the practice of selecting individuals from a population based on their phenotype (desirable traits). The seeds from these selected plants are mixed and used to grow the next generation. Over successive generations, this process helps to improve the overall performance

Mass Selection

- Gathering the seeds of the biggest and strongest plants.
- These seeds would then be planted the following season and farmers would get big and strong plants.
- Over time this will result in higher yield in the grain crops, such as rice wheat and maize

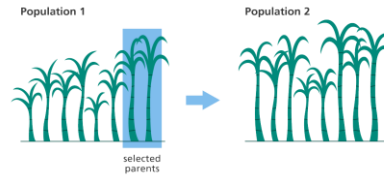


2. Pure line/ Progeny Selection

Plant and animal selection method where selection is based on the performance of the offspring (progeny). Examples include selecting wheat plants that produce offspring with higher grain yields. In animals, an example is selecting cattle whose offspring show superior milk production.

Progeny selection: based on the quality of the offspring.

- If the offspring are good.. Use the parents for breeding purposes!!!

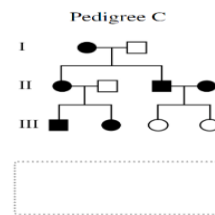
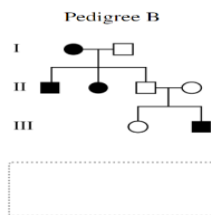
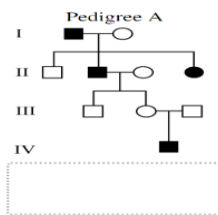


3. Pedigree Selection

Individual plants and animals are selected based on their own performance and the known performance of their ancestors

Pedigree selection: based on the quality of the ancestors:

Determine all the possible modes of inheritance for the pedigrees.



Answer Bank
<input type="checkbox"/> X-linked recessive
<input type="checkbox"/> autosomal dominant
<input type="checkbox"/> autosomal recessive

Family selection

A breeding method where entire families are selected based on the average performance of the family, rather selecting individual plants and animals. Selected individuals could be siblings or half siblings.

Family selection:

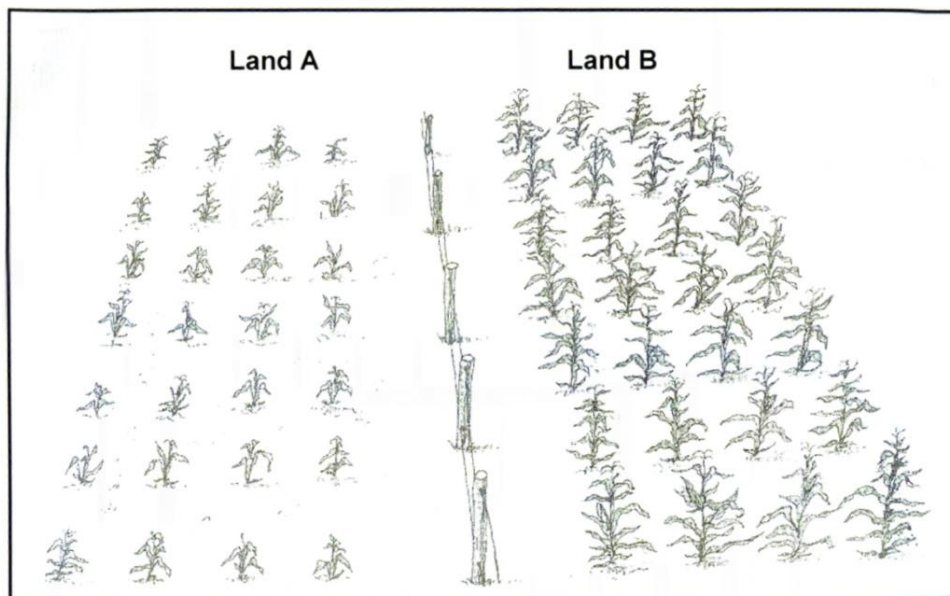
- Based of the quality of the relatives of the same generation (siblings). - Sugar Cane: Most often used in plants that use vegetative propagation



Using Heritability and Estimated Breeding Values(EBVs) in breeding.

- (EBV) is an estimate of how much better or less than average the offspring will be for a particular characteristic.
- Heritability refers to the proportion of variation in the population that is due to genetic influences.

Activity 6



The crops in Field A and Field B both come from the same seed with the same genes for height and were planted at the same time in different areas.

6.1.1 Suggest THREE external factors that might have greatly contributed to the difference in the heights of the plants in the two fields. (3)

6.1.2 Identify ONE dependent variable that the scientists were trying to investigate on these fields.

6.2

Variation is important to farmers because it is the foundation of natural breeding programmes. A farmer would prefer to have animals that are ideally suited to the specific agricultural production environment. Sheep kept in the harsh semi-desert area of the Karoo have been selected by nature through droughts and other harsh environmental factors. Only the more adapted animals and their offspring manage to survive.

6.2.1 Identify the process of selection referred to in the passage above.

6.2.2 Name the TWO most important uses of variation in breeding.

6.2.3 Describe how the heritability of characteristics will influence the success of a breeding programme.

7.1 Name FOUR selection methods used by animal breeders.. (4)

7.2

Traditionally people used a selection and breeding method whereby the best bulls for growth, health and fertility were shared between family and friends. They also cared for their animals by utilising the best available pastures and keeping them away from wet and muddy areas.

7.2.1 Define the concept *selection*. (2)

7.2.2 Determine the method of selection mentioned in the passage above (1).

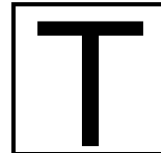
7.2.3 Identify THREE animal production characteristics in the passage that were used for selection by these people. (3)

7.2.4 Indicate how the following aspects were used by the people in the passage above to improve the phenotype of the animals:

- (a) Genetic variation
- (b) Environmental variation



BREEDING SYSTEMS



Process of producing plants or animals by sexual reproduction	Breeding
The crossing of two plants or animals that are closely related	Inbreeding
The breeding of two plants or animals that are not closely related/Mating of two purebreds of different animals	Cross breeding
Breeding of animals that share common ancestors but not closely related	Line breeding
The mating of individual animals of different species	Species crossing
Increase in the performance of the hybrid	Hybrid vigour/Heterosis
Mating of unrelated animals or of animals that are not closely related	Outcrossing
The repeated mating of thoroughbred (purebred) male animals with inferior female animals.	Upgrading

A	_____

B	_____

Breeding systems

Related Breeding is when animals that are related are mated with each other. Examples are inbreeding and line breeding

Inbreeding

- The crossing of two plants or animals that are closely related.
E.g. Father and daughter, mother and son, brother and sister.

Line Breeding

This is a form of selective breeding where animals that are related, but not as closely as inbreeding are mated to preserve desirable traits from a specific ancestor.

An example of line breeding is when a bull is selected to mate with a distant relative (granddaughters) rather than with a close relative (his daughters).

It is commonly used in livestock, pets and sometimes plants to enhance productivity.

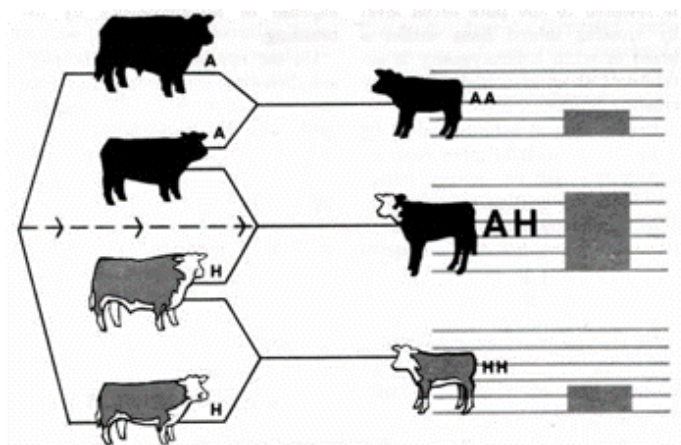
*A **common ancestor** is an individual that appears on both the sire and dam sides of the pedigree*

Unrelated Breeding

Cross Breeding

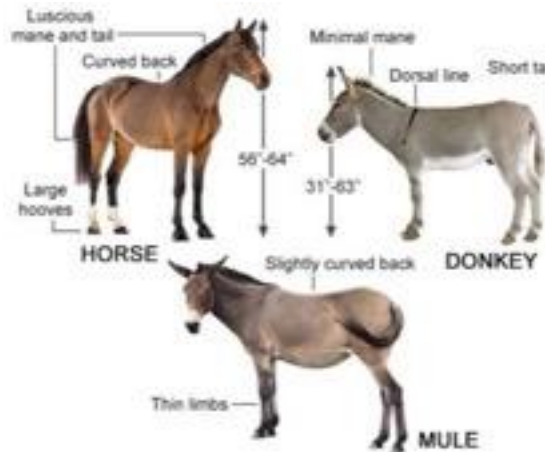
Involves the crossing of two or more different animal breeds or plant varieties. The result is a hybrid animal/plant with enhanced traits from both parents, which is called hybrid vigour or heterosis.

E.g. Afrikaner bull X Aberdeen Angus cow.



Species-crossing

Is the mating of individuals of two different species/the crossing of two different animal species usually producing non-fertile offspring because each species is unique.



e.g. A horse mated with a donkey produces a mule.
or Donkey stallion X horse mare = mule

Uses of the mule

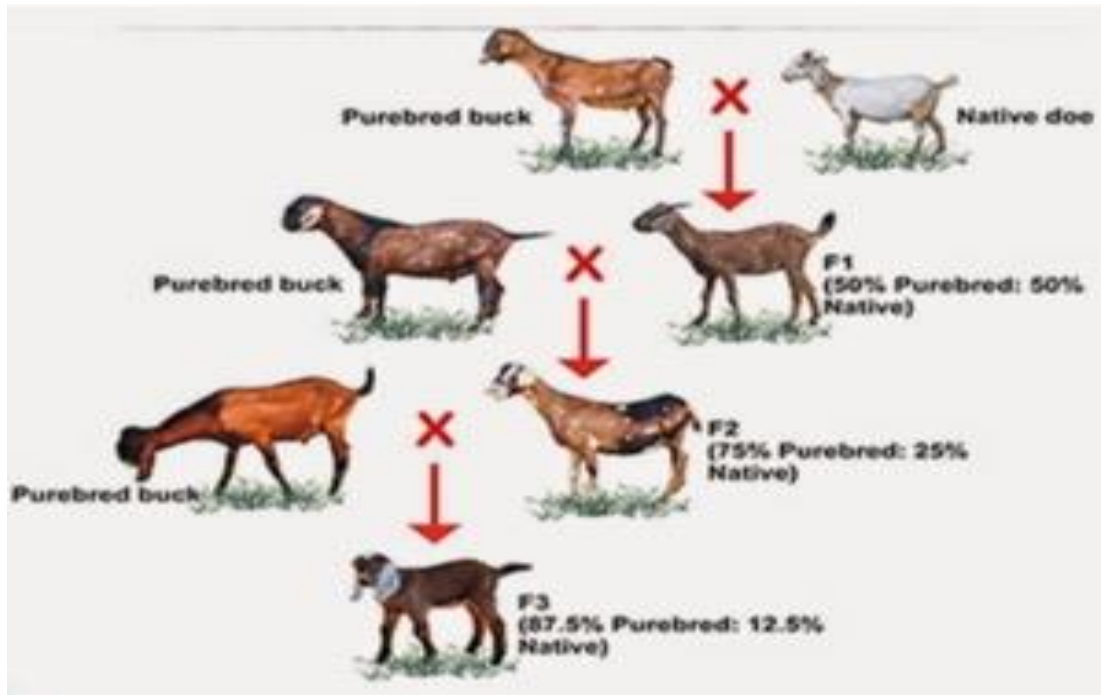
- Used as draught animals for pulling implements/ploughing/working.
- To carry loads/transport of goods

Outcrossing

This method introduces new characteristics to inbred animals. A distantly related relative of the same breed with desirable characteristics is brought in to cross breed with inbred animals.

Upgrading/Grading up

It is the repeated mating of thoroughbred (purebred) male animals with inferior female animals to improve poor quality herd. Excellent pure-bred males of a specific breed are mated generation after generation with females of inferior quality. This is done by mating a good sire with females of inferior quality or using semen of good quality animals to inseminate these females.



Advantages and disadvantages of breeding systems

Breeding system	Advantages	Disadvantages
Inbreeding	<ul style="list-style-type: none"> • Produces uniform animals/plants • Used to create pure lines or strains • Helps in preservation of rare traits within a population 	<ul style="list-style-type: none"> • It lowers the variability of the gene • Reduction in vigour • May give rise to defective animals
Line-breeding	Produces uniform animals and less defects than inbreeding	<ul style="list-style-type: none"> • Less hybrid vigour than cross breeding May give rise to defective animals
Outcrossing	<ul style="list-style-type: none"> • Brings desired characteristics into pure breeds • Increases genetic diversity • Reduced inbreeding depression • Greater adaptability 	<ul style="list-style-type: none"> • Less hybrid vigour than cross breeding • Leads to unpredictable offspring • Loss of desired traits

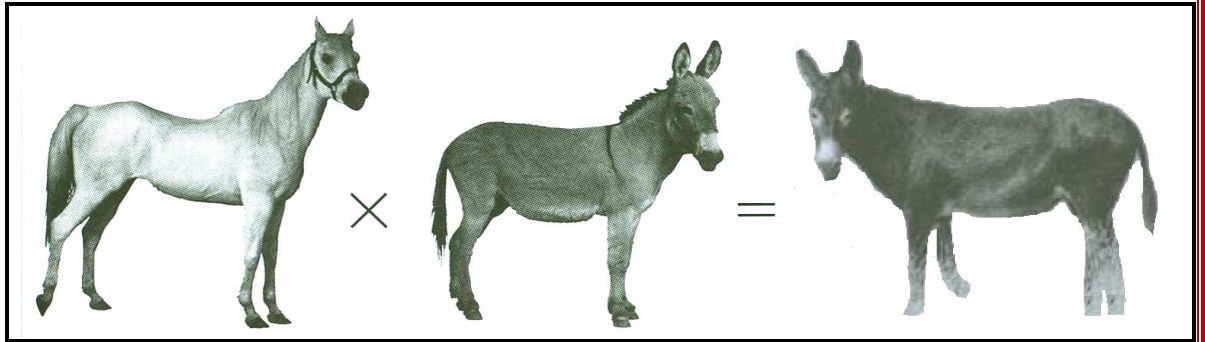
Cross breeding	<ul style="list-style-type: none"> • Gives rise to hybrid vigour/heterosis • Introduces new desirable traits • Offsprings are more fertile 	<ul style="list-style-type: none"> • F1 hybrids have maximum effect after which hybrid vigour declines • Loss of pure-bred traits • May lead to Unpredictable traits
Upgrading	<ul style="list-style-type: none"> • Improves poor quality animals quickly • It improves productivity • It is cost effective 	<ul style="list-style-type: none"> • Effect slows down after a few generations • Leads to loss of indigenous traits • It mainly dependent on exotic breeds
Species-crossing	Produces new plant/animal species	Animal species offspring are infertile

Activities

- 8.1 The crossings A, B and C below represent different breeding systems applied in cattle farming.

A	B	C
Commercial mixed-breed cow	Sussex bull	Afrikaner bull
X	X	X
Holstein stud bull	Sussex cow (bull's daughter)	Shorthorn cows

- 8.1.1 Identify the breeding systems represented by **A**, **B** and **C**.
- 8.1.2 Indicate the breeding system (**A**, **B** or **C**) that promotes heterosis. (1)
- 8.1.3 State TWO disadvantages of the breeding system represented by crossing **B**. (2)
- 8.1.4 Suggest the best method a farmer can use to change the enterprise from a commercial meat production with Brahman to a Bonsmara stud within a period of 20 years. (1)
- 9.1 The diagram below shows a type of breeding system used by some livestock farmers.



- 9.1.1 Identify the type of breeding system illustrated above.
- 9.1.2 Name the type of animal produced by the breeding system in QUESTION 12.1. (1)
- 9.1.3 State TWO uses of the animal produced by this system of breeding in farming. (2)



ACTIVITIES.

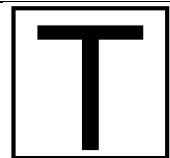
10.1 Assume that four pairs of genes control the height of pepper plants. The base height of a recessive plant (aabbccdd) is 40 cm. Each additive allele contributes 4 cm to the base height.

- 10.1.1 Calculate the height of a plant with an AaBbCcDD genotype. (2)
- 10.1.2 Determine EACH of the following:
- (a) Genotype of a plant with a height of 68 cm (1)
- (b) Phenotype of the shortest plant (1)

GENETICALLY MODIFICATION



Define the concept of genetic modification/ engineering in plants with examples
List the aims of genetic modification of plant and animals
Identify and describe the current uses/ application of genetically modified plants
Describe the techniques used to genetically modify plants/ animals
Describe the potential benefits of genetically modified crops
Name the characteristics of GMOs
Indicate the potential risks of GMOs



TERMINOLOGY

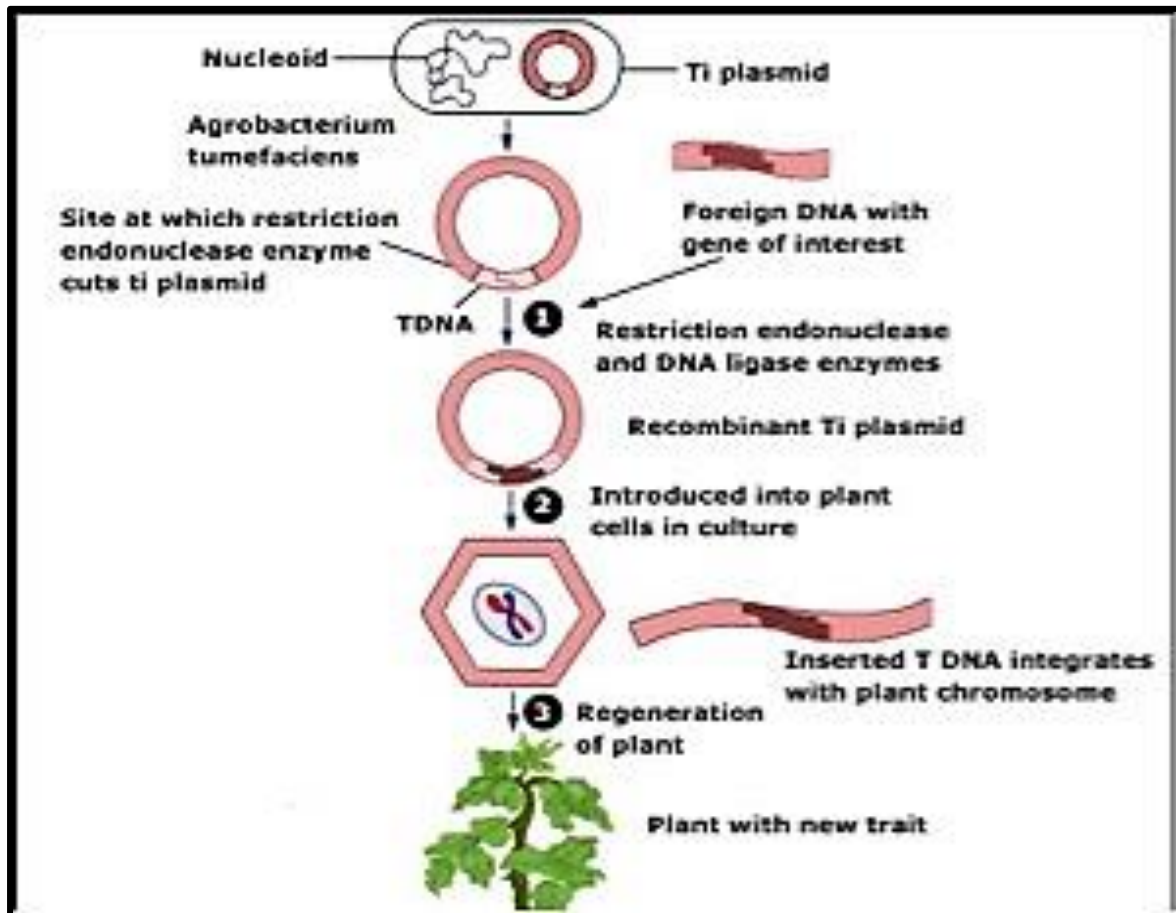
The use of organisms to produce useful substances	Biotechnology
The process of producing plants or animals by sexual reproduction	Breeding
A research activity that creates a copy of some biological entity (a gene/cell/organism)	Cloning
An organism whose genetic characteristics have been changed by inserting gene/s of another organism into its DNA	GMO
The manipulation of the genetic material of an organism to get desired changes.	Genetic modification



Genetic modification/engineering/manipulation

The process of altering the genetic material of an organism to achieve desired traits/characteristics. The process involves taking genes from one organism and inserting them into another organism. The inserted genes are incorporated into the recipient's DNA.

The process includes adding, removing, or changing specific genes within the organism's genome. The genes used in DNA technology are commonly obtained from host cells or organisms called gene laboratories.



The process of genetic modification in maize/corn



Aims of genetic manipulation in plants	Aims of genetic manipulation in animals
<ul style="list-style-type: none"> • Certain crops such as maize and soya beans are genetically modified to be pesticide and herbicide resistant. • Improves crop yields • improving commercial properties such as flavour and shelf life • producing pharmaceutical crops that produce proteins, drugs and vaccines for humans 	<ul style="list-style-type: none"> • Increase the nutritional quality of animal products • Increases yield of animal products such as milk • production characteristics such as growth rate, disease resistance and milk production. • improving food quality • producing medicine producing industrial or consumer products, such as fibre • Breeds more fertile animals to increase production for the growing world population.

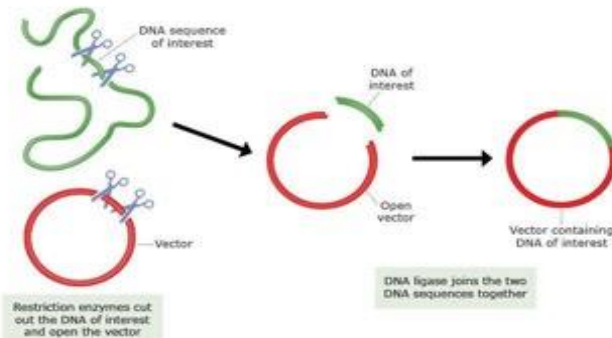

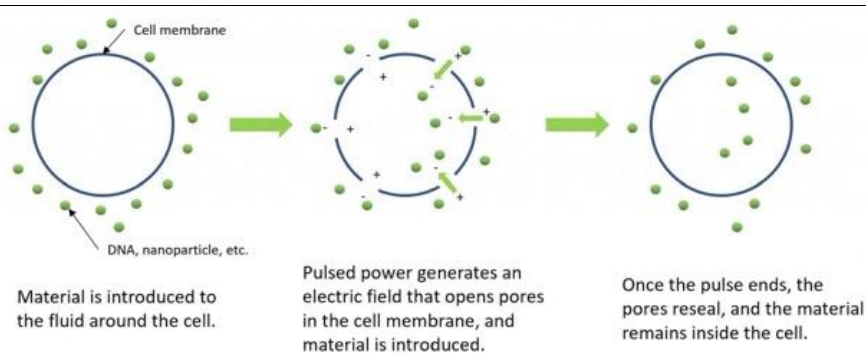
Characteristics of GMOs

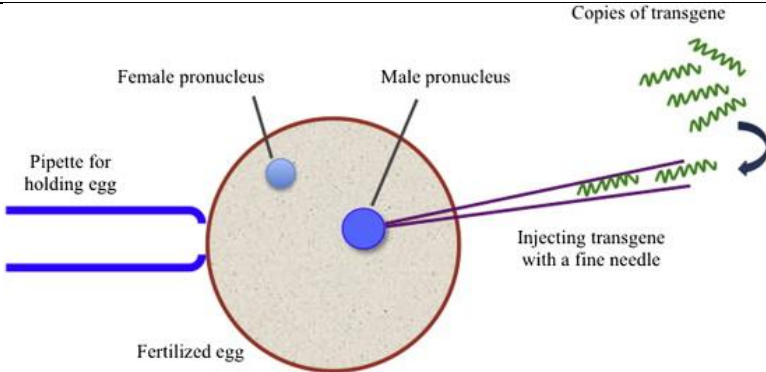
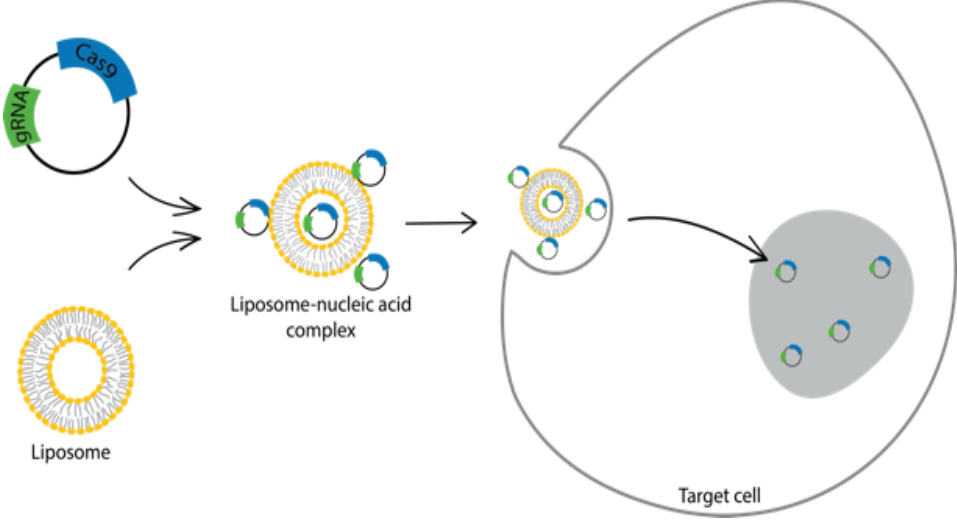
- Crops like Bt corn and Bt cotton are modified to produce *Bacillus thuringiensis* toxin which protects them from insect pests ,reducing the need for chemical pesticide.
- GM crops like drought -tolerant maize and rice are designed to withstand harsh environmental conditions, including salinity, drought and extreme temperatures.
- Improvements such as nutrient enrichment, yield and shelf life. Crops like Golden Rice are enriched with vitamins (e.g. Vitamin A) to combat nutrient deficiencies in populations ying heavily on staple foods.
- Increase resistance to viral diseases such as in the cassava plant.
- Special abilities such as helping to clear pollution and store vaccines
- May be so expensive to acquire that poorer farmers may not be able to afford the seed/material

Advantages of Genetic modification crops over traditional methods

Genetic modification	Traditional methods
<ul style="list-style-type: none"> • Fast because it requires only one generation to complete 	<ul style="list-style-type: none"> • Slow and can take many generations to reach a target
<ul style="list-style-type: none"> • It is very precise 	<ul style="list-style-type: none"> • Not very precise
<ul style="list-style-type: none"> • Not limited to crossing species that can interbred 	<ul style="list-style-type: none"> • Limited to crossing cultivars or breeds of the same species

TECHNIQUES USED IN GENETIC MODIFICATION IN PLANTS

Technique	Illustration
Bacterial carriers(vectors) transfer foreign genetic material into host cells. Plasmids for example are engineered to carry desired genes and replicate within bacterial cells	 <p>The diagram illustrates the process of bacterial transformation. It starts with a linear DNA sequence of interest (green) and a circular plasmid vector (red). Restriction enzymes cut the DNA of interest and open the vector. DNA ligase then joins the two DNA sequences together, creating a recombinant vector containing the DNA of interest.</p> <p>Restriction enzymes cut out the DNA of interest and open the vector</p> <p>DNA ligase joins the two DNA sequences together</p> <p>© Copyright, 2014, University of Waikato. All rights reserved. www.bioedonline.org.nz</p>
Biolistic s/Gene gun. The selected DNA is attached to microscopic particles of the metal gold or tungsten. The DNA particles are shot into the target cells using a burst of gas under pressure, in a similar way to firing a bullet from a gun	 <p>The diagram shows the Gene Gun process. A gene gun barrel is used to fire a particle gun with DNA-coated gold particles. The particles pass through a screen and enter target plant cells. The process is then followed by selection and regeneration of transformed cells.</p> <p>The Gene Gun</p>
Electroporation. An electric field is used to temporarily increase permeability of the cell membrane, allowing genetic material to enter the cell.	 <p>The diagram illustrates the electroporation process. It shows a cell membrane with DNA, nanoparticles, etc. being introduced. Pulsed power generates an electric field that opens pores in the cell membrane, and material is introduced. Once the pulse ends, the pores reseal, and the material remains inside the cell.</p> <p>Cell membrane</p> <p>DNA, nanoparticle, etc.</p> <p>Material is introduced to the fluid around the cell.</p> <p>Pulsed power generates an electric field that opens pores in the cell membrane, and material is introduced.</p> <p>Once the pulse ends, the pores reseal, and the material remains inside the cell.</p>

<p>Microinjection. A precise technique used to directly introduce foreign DNA, RNA, or other molecule into a cell using a fine glass micropipette.</p>	
<p>Lipofection. It involves using small bubbles of fat called liposomes as carriers of selected DNA. The target cells and liposomes are placed into a special solution. The liposomes mix with phospholipids in the cell membrane allowing the DNA entry cells for inclusion into the chromosomes</p>	

Potential benefits and risks of GMOs

Potential benefits	Potential risks
<p>Health benefits. Farmers use fewer pesticides on insect resistant plants , which result in healthier food</p>	<p>Health risks. Allergic reactions. Introducing new genes into an organism could potentially create new allergens. It could also lead to the cause of cancer</p>
<p>Environmental benefit.</p>	<p>Environmental risks</p>

Crops can be engineered to resist pests, diseases and environmental conditions leading to higher productivity.	Overuse of pest resistant GM crops (like Bt cotton) or herbicide resistant crops can lead to evolution of pests and weeds(super weeds) that are resistant to these controls. The toxic effects of insect resistant crops could potentially also kill beneficial insects such as bees
Improved nutritional content. GM technology can enhance the nutritional profile of crops	Economic concerns GM crops are patented and farmers may not afford it. GM seeds have the same genetic composition which makes them vulnerable to infection, which can destroy the entire crop

Benefits and risks of Genetic manipulation

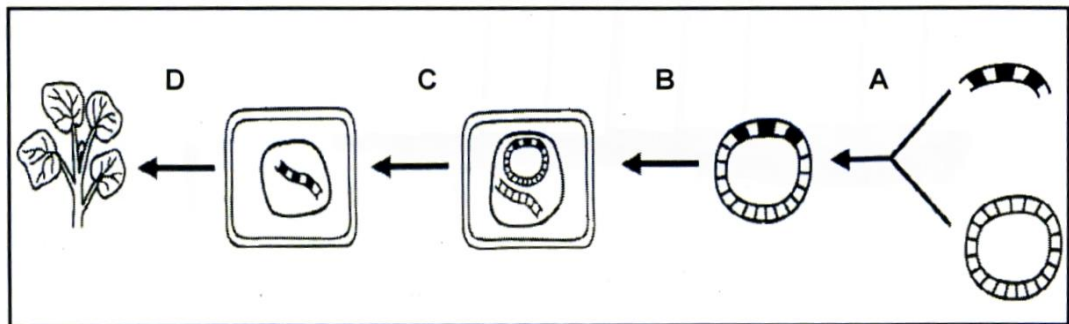
Benefits	Risks
<ul style="list-style-type: none"> It may become possible to grow crops in previously non-arable areas. GM crops may be more productive (produce higher yields), and therefore feed a growing world population at lower cost. Some GM crops are resistant to pests and diseases and therefore reduce the use of chemicals. This is better for the environment. Some GM crops have a longer shelf life and improved properties such as . Better flavour, colour, texture and nutritional value. Use of GM crops can have a positive effect on the economy, especially in less-developed countries. Already, implementation of GM cotton crops has led to economic gains in S.Africa. 	<p>Environmental hazards. Unintended harm to other organisms Reduced biodiversity Reduced effectiveness of pesticides Gene transfer to non-target species The toxic effects of insect-resistant plants could potentially also kill beneficial insects such as bees</p> <p>Human health risks Unknown effects on human life Increased allergies: Be a possible cause of cancer and the loss of an effective immune system GM crops contain genes that offer resistance to antibiotics</p> <p>Economic concerns GM crops are patented and farmers may not retain seed for breeding purposes, which means that they have to buy new seed each year. GM seeds for a particular variety all have the same genetic composition.</p>

- GM crops can **allow people to receive medicines and vaccines** that are difficult to distribute.

This makes them vulnerable to infection, which can destroy the entire crop

ACTIVITY

11.1 The flow chart below illustrates a technique used in plant breeding.



- 11.1.1 Identify the plant breeding process illustrated above (1)
- 11.1.2 State TWO aims of the process illustrated above. (2)
- 11.1.3 Summarise the process illustrated above by referring to labels A to D. (4)
- 11.1.4 State TWO potential environmental benefits of GM crops. (2)
- 11.2 The DNA of a tomato plant was changed through an advanced modification technique.
- 11.2.1 Indicate TWO methods which could be used in this modification process. (2)
- 11.2.2 State TWO disadvantages of using tomatoes with modified DNA. (2)

11.1

IMPROVING SORGHUM THE GENETICALLY MODIFIED (GM) WAY

Africa's scientists are developing a genetically modified (GM) super strain of the staple grain sorghum that they say will be vitamin-packed to help fight malnutrition. The objective of the project is to produce seeds of nutritionally improved cultivars of sorghum, appropriate for planting.

Biotech crops have sparked controversy in Africa, where some countries, despite having trouble growing food, have refused GM food aid or insisted it be milled before distribution to avoid contamination of local seed stocks. Anti-GM activists say GM foods risk destabilising the environment and food production.

[Adapted from *Cape Argus*,]

- 11.1.1 Identify TWO reasons for developing this genetically modified sorghum in Africa. (2)
- 11.1.2 Describe TWO superior abilities that the GM sorghum would have compared to normal sorghum cultivars. (2)
- 11.1.3 Indicate TWO dangers of using GM cultivars. (2)

AGRICULTURAL MANAGEMENT AND MARKETING

AGRICULTURAL MARKETING: EXAMINATION GUIDELINES



- Define market/marketing.
- Distinguish between marketing and selling.
- List, identify and describe the main functions of agricultural marketing
- Terminology: demand and supply
- The Law of demand and the law of supply
- Interpretation of demand and supply curves
- Factors influencing demand and supply of goods
- Price elasticity demand/supply and price inelasticity of demand/supply
- Price determination with and supply and demand
- Explanation of demand/supply schedule/curves/graphs
- Interpretation of Price elasticity of demand and supply
- Free Market(Concept of free marketing, the general advantages and disadvantages)
Farm gate market, fresh produce market, Internet sales, Direct marketing, and internet marketing.
- Co-operative marketing (The concept of agricultural cooperatives, types of agricultural co-operatives, principles, benefits/advantages.

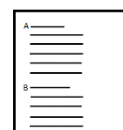
IMPORTANT TERMS AND DEFINITIONS



Market	An entire number of buyers and sellers in an area being considered .
Marketing	All the processes involved including planning promotion, and distribution of goods or ideas to the customers/consumers.
Market equilibrium	A market situation where demand and supply of goods are the same.
Selling	The exchange of goods and services for money

Bartering	Exchange of goods for goods
Buying	Obtain a product or service in exchange for payment.
Processing	The conversion and modification of raw product in order to add value.

Demand	Refers to quantity of goods that consumers are willing and able to buy at different prices and times.
Supply	Quantities of goods that producers are willing and able to sell or produce at different prices and time.
Price Elasticity	Refers to the quantity response to a change in price.
Law of demand	As the price of a good increases, demand for the good or service will decrease./ As the price of a good decrease, more of the good will be bought by consumers.
Law of supply	An increase in price leads to an increase in the quantity of goods supplied./ Lowering prices lead to quantity of good sold being lowered.
Hedging	A market price risk management strategy where the market price is kept constant.
Free marketing	A form of marketing where producers market their produce as they wish
Cooperative marketing	It is when producers pool their products and market them through the cooperative society.
Controlled marketing	It refers to the regulation of goods and services by government/State
A cartel	Refers to a group of producers who join together to control prices.
Price fixing	When group of producers collaborate/collude and set prices artificially.



CONCEPTS OF MARKET & MARKETING

Market refers to the physical or virtual meeting of buyers and sellers to exchange goods.

Marketing refers to all the processes involved including planning promotion, and distribution of goods or ideas to the customers/consumers.

DIFFERENCES BETWEEN SELLING AND MARKETING

The main difference between selling and marketing is that selling involves the procedure where goods or services are traded for money whilst marketing involves in activities and plans that businesses use to promote the selling or buying of a product or service.

Attributes	Selling	Marketing
Orientation	Generating high sales volumes	High profits
Focus	Needs of seller	Needs of buyer
Planning	Short term	Long term
Emphasis	Product	Customer wants.
Price	The cost determines the price	Consumers determine the price

AGRICULTURAL MARKETING FUNCTIONS

Agricultural produce must undergo a series of transfers or trade from one hand to another before it eventually reaches the consumer. This is achieved through four important marketing functions which are :

- 1 Transport,
- 2 Storage,
- 3 Packaging, and
- 4 Processing/value adding.

1.Transport

Agricultural produce must be transported from production point to assembly point and finally to the consumer or market. Different modes of transport can be used based on the nature of produce. These include rail, road, air and sea.

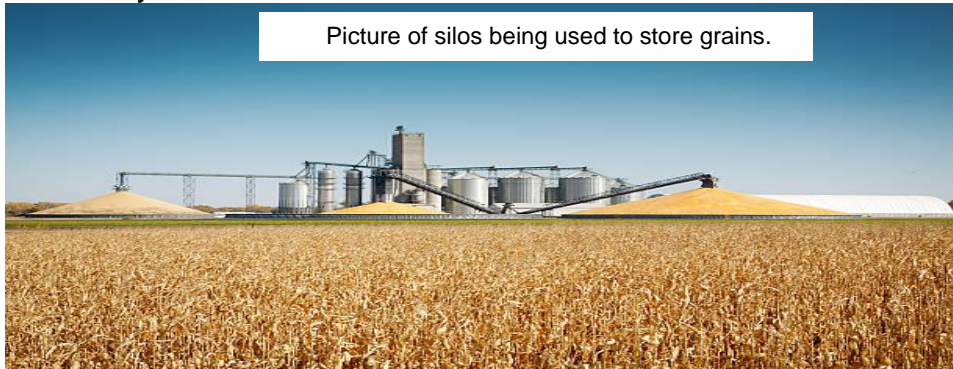
Fresh produce such as vegetables, fresh fruit, meat, and milk may be transported by road and will require refrigerated transport to avoid spoilage in transit. Air transport may be required for cut flower and other highly perishable produce.



A truck transporting agricultural produce

Storage

Some agricultural produce like grapes must be stored before packaging and processing soon after harvesting to prevent spoilage. Farmers may use on-farm storage facilities or use another party such as a processor to keep his produce until ready for the market.



Picture of silos being used to store grains.

Advantages of Storage

- Ensures fresh produce.
- Helps to control prices by keeping them at constant levels.
- Creates jobs.
- Reduces the time between production and purchasing.
- Helps maintain the supply and demand of products.

Packaging

Most agricultural produce is packaged before transporting. The purpose of packaging is to help farmers and packers of fruits and vegetables to choose the optimum packaging for their produce to improve shelf life and quality of the product and reduce loss in the supply chain.



Maize meal



A box of apples

Guidelines for Packaging fresh produce

- The package **must protect produce**
- Use **environmentally friendly** material which must be biodegradable
- The **product should fit** well in the container in which it is packaged.
- It must **identify the product** and appeal to customers.
- The package should **display the brand**.

Advantages of packaging

- It improves shelf life.
- It gives the product strong market appeal.
- It promotes the trademark.

Important aspects of packaging fresh produce

1 Protection

The package must protect produce from mechanical damage and poor environmental conditions during handling and transportation.

2 Identification

Packaging must identify and provide useful information about the produce such as product name, size, quantity producer and brand.

3 Containment

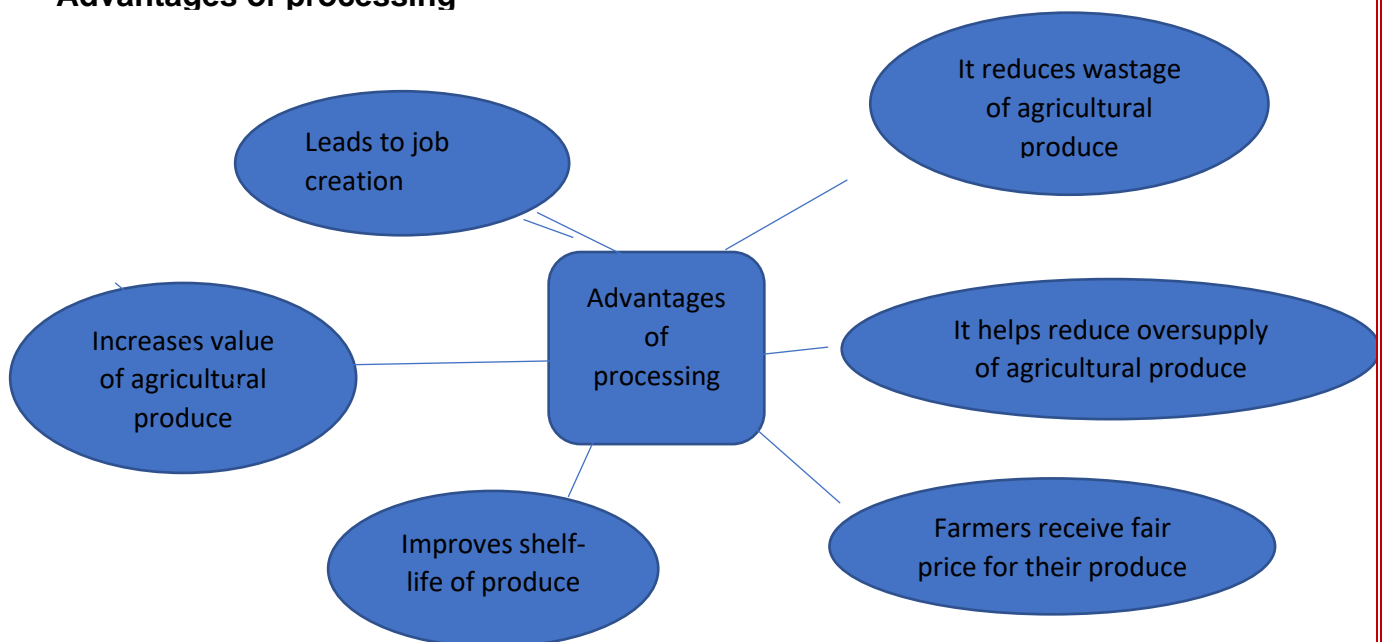
- Containers must be **clean, dry**
- **Relevant** for the type of product
- There should be **no odour**, or importation of foreign objects.
- It must be **rigid** and be able to support the product.

Processing includes changing a product from its raw form into a new type that is easier for the consumer to use. Examples of processing include milling maize, preparing sausage, canning tomatoes and making orange juice and drying fruits.

Examples of processed foods



Advantages of processing



Advantages of processing

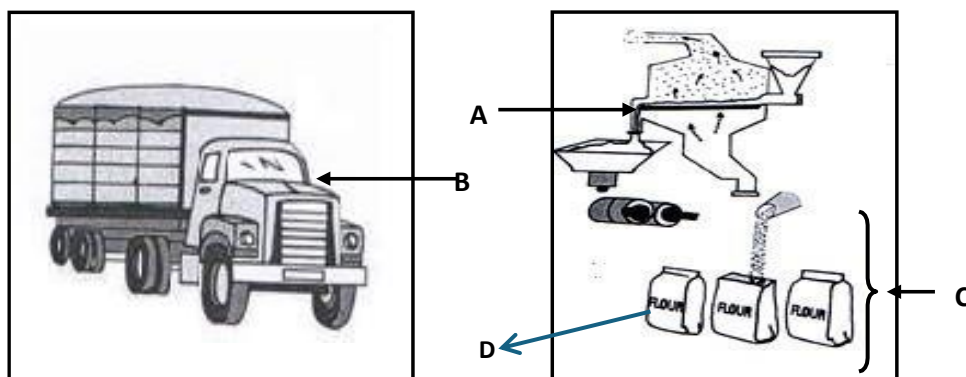
- Overcome over-supply of the product ☐
- Allows easier packaging and handling of product ☐

- Provide job opportunities ☐
- Ensures the availability of product throughout the year ☐
- Reduces spoilage/perishability/longer shelf life ☐
- Ensures food security ☐
- Improved food safety ☐
- Makes the products more appealing to the consumers

ACTIVITIES.

Activity 1

1.1 The pictures below illustrate the functions of marketing



- 1.1.1 Identify the marketing functions illustrated in B and C. (2)
- 1.1.2 State TWO guidelines for the marketing function in C. (2)
- 1.1.3 Name TWO advantages of the marketing function in A. (2)
- 1.1.4 Suggest TWO aspects to consider when choosing D. (2)

1.2 Give a marketing function that matches EACH of the following statements:

- 1.2.1 Products are placed in boxes. (1)
- 1.2.2 Products are kept in cool place giving them a longer shelf-life (1)
- 1.2.3 Changing a product from its raw form

1.2.4 Produce is moved from the farm to consumers.

(1)

(12)

Activity 2

2.1 A farmer needs to understand how the market works and how best to place the product.

2.1.1 Define the concept *marketing*. (2)

2.1.2 Indicate for EACH of the descriptions below, (a) to (c), whether it refers to marketing or selling.

(a) Market survey conducted on 300 customers to determine their needs(

(b) Focus on acquiring money to buy a container to sell the produce in the that season. (1)

(c) Focus on the number of bags of potatoes sold at a time (1)

(d) Requires long term plan (1)

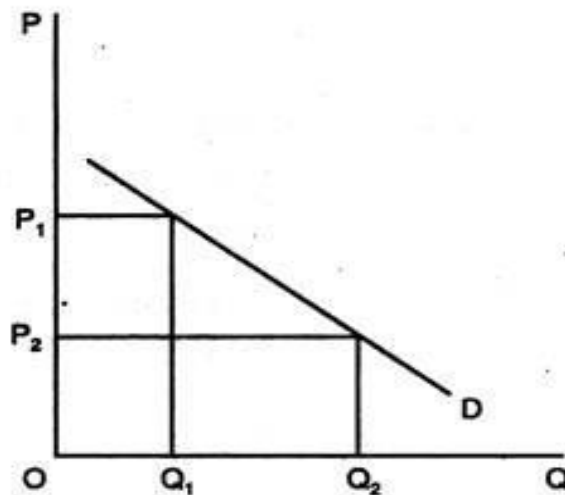
(e) Sales volume orientated (1)(7)

DETERMINATION OF PRICE USING DEMAND AND SUPPLY

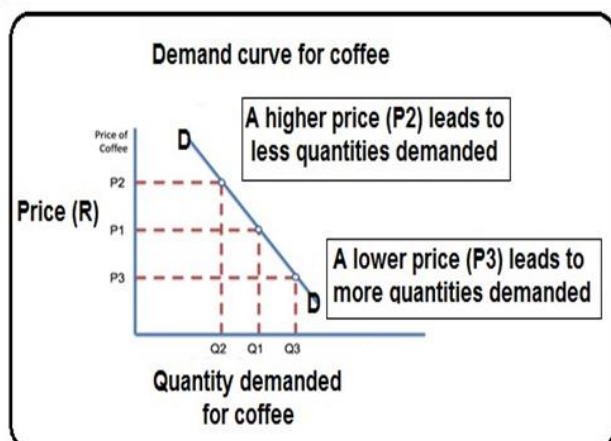
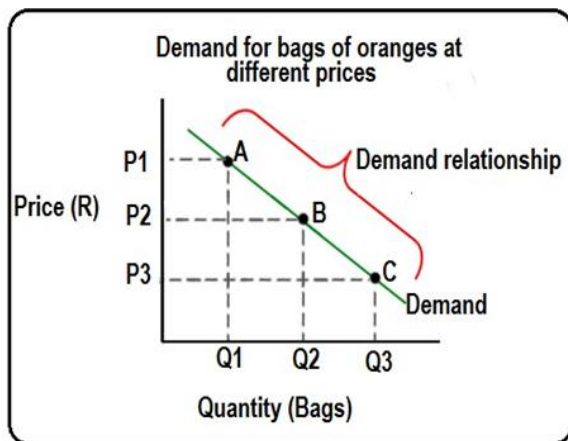
Definition of demand: Quantity of a product bought at a particular price and time.

Demand refers to willingness to pay a specific price in a given time for a product.

- **Demand curve:** is a graph of the relationship between the price of a good and the quantity demanded.



A graph showing demand curve.



Demand curves

Interpretation of the demand curve

At point A, the quantity of oranges demanded will be Q_1 and the corresponding price will be P_1 . At point C, the quantity of oranges demanded will be Q_3 and the corresponding price will be P_3 .

Law of demand: The higher the price, the lower the quantity demanded and vice versa

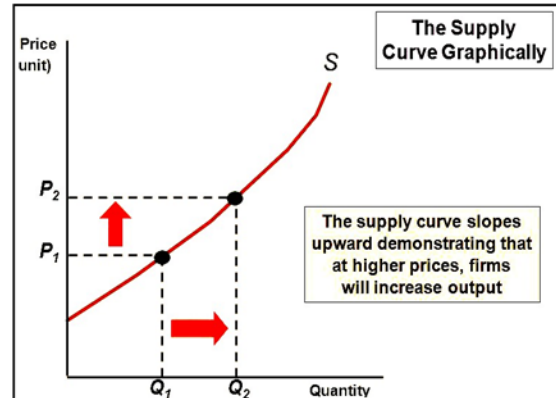
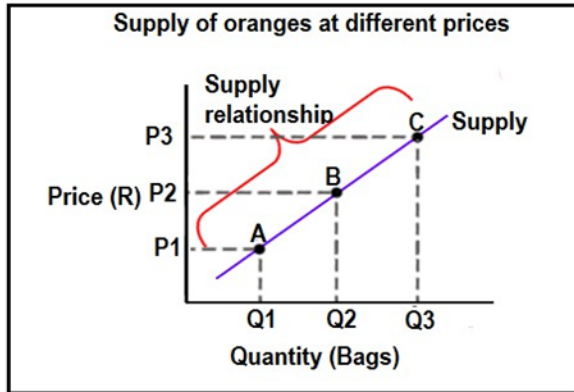
The demand relationship illustrates the negative relationship between price & demand.

Factors influencing demand of a product.

- 1 **Price** An increase in the price of a product will lead to low demand for that product.
- 2 **Quality** of the product. The higher the quality, the higher the demand and vice versa.
- 3 **Consumer taste and preferences.** When consumers prefer a product such as chicken to a competing product such as beef, the demand for chicken will increase.
- 4 **Fashion.** Changes in fashion can lead to a change in demand for certain products. For example, if the demand for Nguni cattle skins is in fashion, the demand for skins will increase.
- 5 **Compliments.** If the price of a produce that competes with other products is noticeably high, the demand for the product will be lower as consumers prefer to buy cheaper products.
- 6 **Festive seasons.** At certain times of the year such Christmas, the demand for meat and vegetables increase.
- 7 **The number and income of consumers.** Higher number of consumers is expected to lead to increase in demand for a

product. Conversely, lower number of consumers will lead to a decrease in demand for a product.

Supply curves



Supply curves

Interpretation of the supply curve

A, B and C are points on the supply curve. Each point on the curve reflects a direct correlation between the quantity supplied (Q) and price (P). At point B, the quantity of goods supplied will be Q2 and the price at P2 and so on.

Law of supply : The higher the price, the higher the supply and vice versa

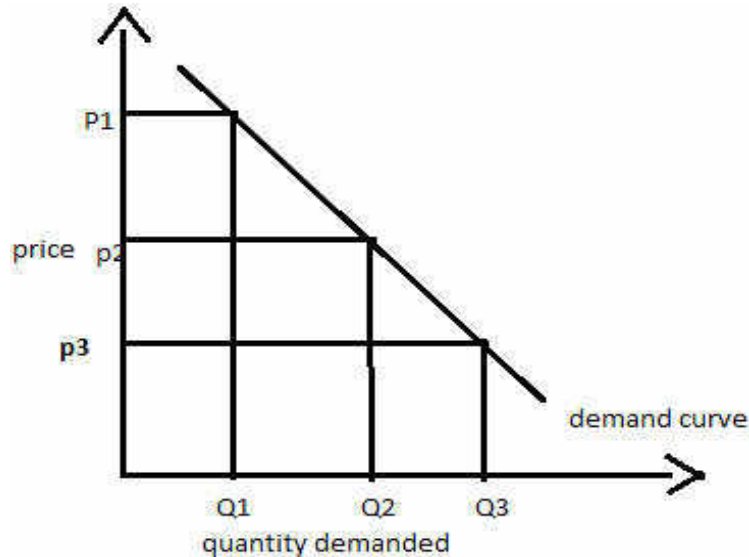
FACTORS AFFECTING SUPPLY OF A PRODUCT

- 1 **Price.** The higher the price of a produce, the higher the quantity sold by farmers because they get extra income from selling the produce.
- 2 **Production cost.** High cost of producing a product lead to farmers producing less. Low input cost will lead to high production of produce.
- 3 **Technological changes.** Improvements in technology in the production processes lead to increased production.
- 4 **Government subsidy and taxation.** Government subsidies such as paying part of the cost of fertilizer for farmers will reduce farmers production costs which in turn will lead to increased production.
- 5 **Political instability.** Conflicts can disrupt and decrease the supply
- 6 **Number of suppliers and /producers.** Production of the same product, for example, maize by many farmers at the same time and to the same market will lead to high supplies of the product.
- 7 **Environmental conditions/climate.** Agriculture is highly dependent on the weather. Increase in temperature and carbon

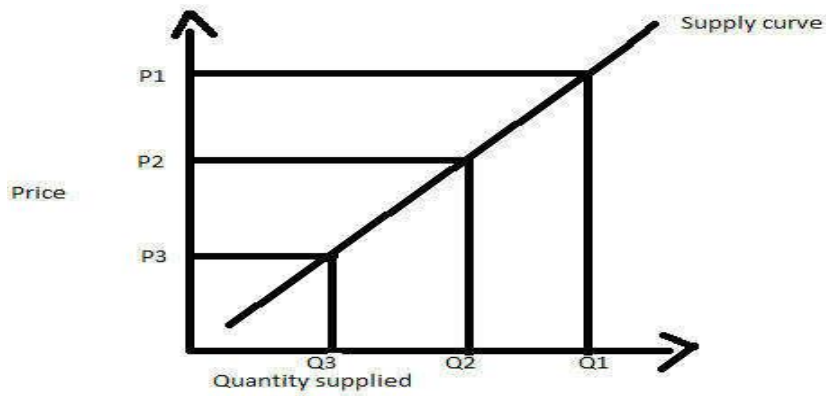
dioxide levels can increase some crop yields in some places. Very cold conditions may lead to lower supply of summer crops in South Africa.

THE LAWS OF DEMAND AND SUPPLY

The Law of Demand: The *Law of demand states that the price and quantity of a good are inversely related to each other.* In other words, when the price of a product such as apples increases, the demand for the same decreases.

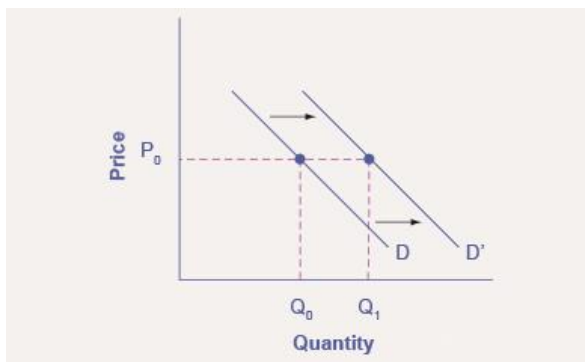


The Law of Supply: The *Law of supply states that all things being equal, the an increase in the price of goods or services results in an increase in their price.* For example, if the price of potatoes increase, farmers will sell more of potatoes to increase their revenue/income.

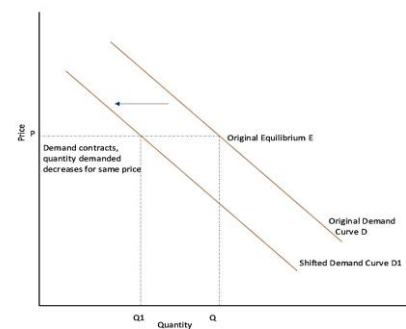


A graph illustrating the Law of Demand

Shift in Demand Curve:



A graph showing a shift in demand curve to the right.



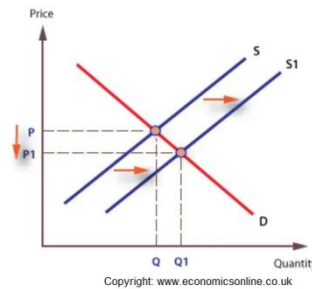
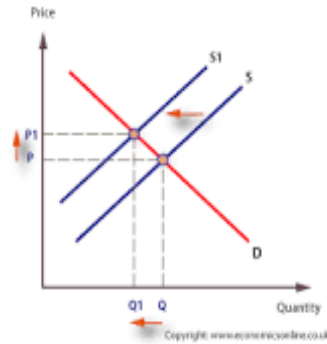
Graph showing a shift in demand curve to the left.

If the quantity demanded at each price increase, the demand curve shifts to the right. If the quantity demand at each price level decreases, the demand curve will shift to the left.

Causes of shift in demand curve

- Consumer income
- Consumer preferences
- Population size & composition
- Changes in prices of related goods

Shifts in Supply Curve



Factors that influence shift in supply include

- Changes in production costs
- Improved technology, which makes production more efficient.
- Industry growth and shrinkage

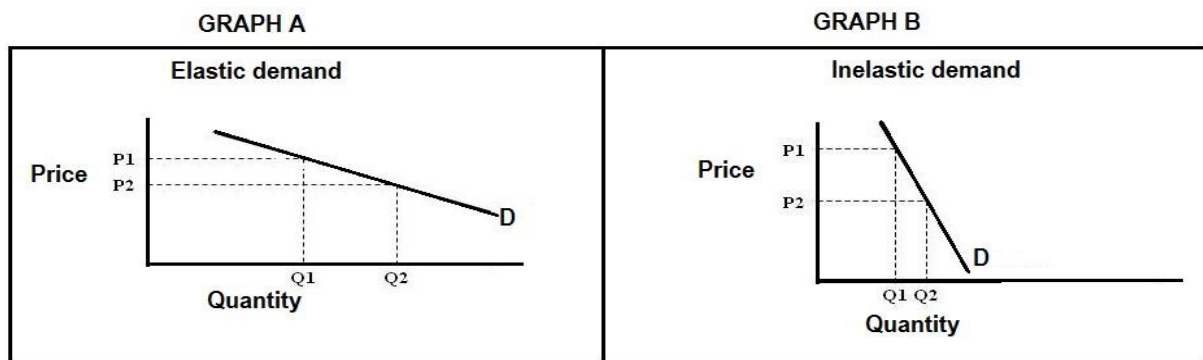
PRICE ELASTICITY AND INELASTICITY OF DEMAND AND SUPPLY

Elasticity – This refers to the response of a demand or supply curve to price change

Price elasticity of Demand- This a measurement of the change in demand for a good or service in relation to a change in its price.

Elastic demand - a slight change in price will cause a big decrease in the quantity demanded. An example could be a *chocolate bar* or *cavella shoes*.

Inelastic demand - a change in price will cause a small/no change in the quantity demanded. The price of *maize meal* or *fuel* and most agricultural products is inelastic as people will still buy the product regardless of price change.



Price elasticity of demand

Price inelasticity of demand

Factors that affect the elasticity of demand

Nature of the product . Luxury items such as cheese show more elastic demand than necessities such as maize meal and cabbage.

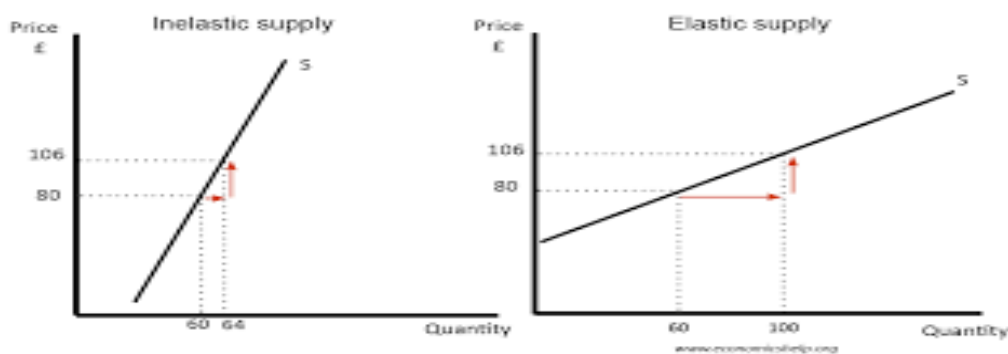
Availability of substitute products. Products having varieties of substitutes tend to have much more elastic demand than those that do not have substitutes. For example, if the price of orange juice increases, many people will look for other types of drinks such as apple, mango, and pear drinks so the demand for orange juice is elastic.

Time period . Demands for products become more elastic with passage of time. For example, if the price for fertilizer is increased by say 40%, a farmer's demand might not change immediately but as time passed, the farmer might change for compost or farmyard manure.

Proportion of consumers budget spent on the item- Changes in prices will be more elastic if the product involved takes a chunk of the consumers income.

Price Elasticity of supply

This refers to the measure of how sensitive the quantity supplied of a good is to changes in price.



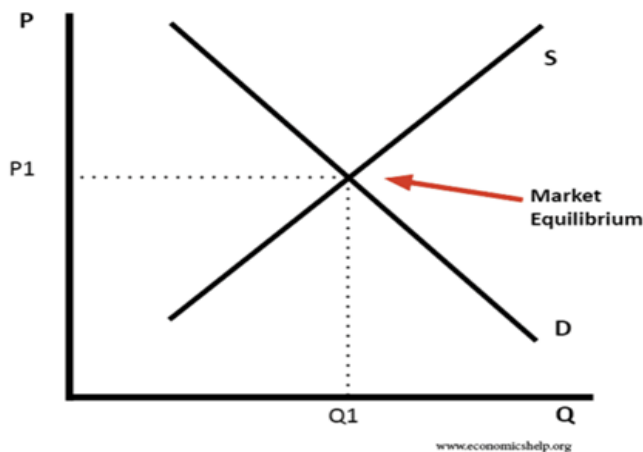
- **Inelastic supply** - When the change in supply is relatively less when compared to the change in price.
 - **Elastic supply** - When the change in supply is relatively more when

compared to the change in price.

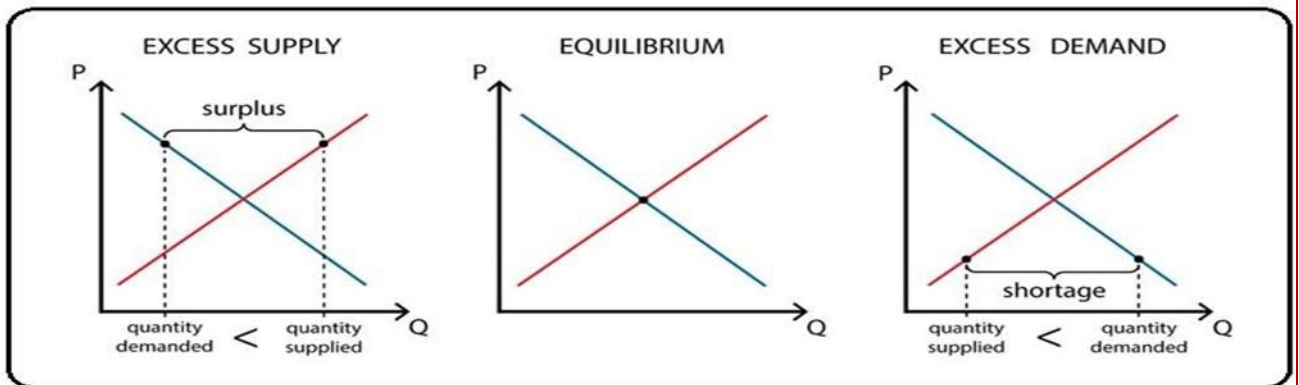
MARKETING EQUILIBRIUM

The market equilibrium is the point where the amount of product supplied by the producer is equal to the amount sought by buyers; supply is equal to demand.

Equilibrium price: the price at which the demand is equal to supply, and the market is cleared of all goods. If a market is in equilibrium, the price will not change unless an external factor changes the supply and demand, which results in a disruption of the equilibrium.



A graph showing market equilibrium.



Market equilibrium graphs showing surpluses and shortages.

Surplus occurs when production is above the equilibrium point. This often occurs if the floor price is set above equilibrium price.

Shortage occurs when production is below the equilibrium price. This normally occurs if the ceiling price is set below the equilibrium price.

ACTIVITIES.

Activity 3

3.1 Define the terms below:

- 3.1.1 Demand (2)
- 3.1.2 Supply (2)
- 3.1.3 The Law of supply (2)
- 3.1.4 Market equilibrium (2)
- 3.1.5 The Law of Demand. (2)

Activity 4

4.2 Various options are provided as possible answers to the following questions. Select the appropriate answer and write only the corresponding letter (A–D) beside each question number (1.1 to 1.5) in your answer book.

4.2.1 One of the following is not a characteristic of the term selling?

- A A long- term plan
- B Personal communication of information
- C Exchange of goods for cash
- D Convincing people to buy a product.

4.2.2 An advantage of processing raw agricultural produce is:

- A Reduces oversupply and wastage
- B A decrease in job opportunities
- C A decrease in the value of the product
- D. A shorter shelf life

4.2.3 The Law of demand states that:

- A The higher the price, the higher the quantity of goods bought.
- B The higher the number of consumers, the lower the quality of good bought.
- C The lower the price, the higher the quantity of goods bought.
- D The lower the price, the lower the quantity of goods bought.

4.2.4 ... occurs at the point where the market demand and supply curves meet.

- A Shortage
- B Market development
- C Surplus
- D Market equilibrium

4.2.5 One of the following factors influences the supply of a product.

- A Increases in the number of consumers
- B Taste and preference of the consumers in the short term
- C Government subsidies and taxation policies
- D The range of the product.

(10)

Activity 5

5.1 The diagram below shows the demand for maize meal at different prices within a period of two months



5.1.1 Identify the marketing concept illustrated by demand **A** and **B** above.

5.1.2 Give a reason for the answer to QUESTION 2. (2)

5.1.3 Explain the reason why consumers responded in such a way to price change. (2)

5.1.4 Suggest TWO other products that could have caused consumers to respond in the same way as in Q 5.1.1. (2)

5.1.5 Suggest ONE product that would have caused a different response to Q 2.1.1. (1)

Activity 6

6.2 The table below represents the quantities of fruit sold at different prices.

PRICE (R)	QUANTITIES OF FRUIT (POCKETS)
20	3 500

25	3 000
30	2 500
35	2 000
40	1 500
45	1 000

6.2.1 Use the data in the table above to draw a line graph comparing the quantities and the prices of the pockets of fruit. (6)

6.2.2 Deduce the relationship between the price and the quantity of fruit demanded. (2)

(8)

AGRICULTURAL MARKETING SYSTEM

Free marketing

- **Free Market:** goods are exchanged freely no restrictions or controls.



A vendor selling farm produce

- **Advantages of a free market system**
 - Producers sell where they want.
 - Intermediaries are eliminated.
 - Producers can sell at own price and customers can bargain.
 - Entrepreneurship is rewarded.
 - Consumers are likely to benefit from better quality products.

Disadvantages of Free Marketing system

- There is risk to the producer.
- Price fixing may occur.
- There is greater fluctuation of prices.

CHANNELS /OPTIONS OF A FREE MARKET SYSTEM/

1.Farm gate marketing/Bakkie sale /Truck sale

It is a form of marketing done by the farmer at the site of production. Examples include the sale of vegetables ,broilers and animals.



Advantages and disadvantages of farm gate marketing.

Advantages	Disadvantages
Low marketing costs	The farmer will have to accept the local price
Produce is sold at low prices	Farm may not be well located to reach customers
There is no transport cost involved	Buyers must be present at farm to purchase produce
Consumers get fresh produce with minimal loss of quality	There may be limited supply of produce

2.Fresh Produce market

The farmer sends his produce to the **agent** at the market who negotiates for a good price on behalf of the farmer.



Advantages	Disadvantages
The market is able to sell produce in high volumes	Large volumes can be sold
Farmer can take advantage of above average prices in times of supply shortages.	Famer must have access to reliable market information

Produce is sent to agents at the municipal fresh produce markets	There can be price fluctuations in the market.
	Markets are often far from production centres
	Farmers pay agreed commission to market agents

3. Stock Sales/Livestock Auction Sale

Livestock are sold on auction near to a farm to the **highest bidder**. The auction is mostly run by livestock auction specialist.



Advantages	Disadvantages
The auctioneer advertises the event.	The seller may not be offered the expected price
Payment by the buyer is guaranteed	Lower prices than that of the market is a reality
Small scale farmers have access to these auctions	Small scale farmers may not be financially sound to transport their animals to the auction site

4. Direct /contract marketing

Farmer sells directly to the retailer/supermarket who in turn sells to others under a contract arrangement.

Advantages	Disadvantages
It saves time, money and labour	There should be always quality products
Many customers can be attracted very quickly	Customers do not know what they are buying
Middlemen are cut out	The farmer must have enough produce to meet client's requirements

5. Internet marketing



This is also known as web marketing or e-marketing. In this case, goods are sold on the internet through a computer or smart

cell phone. It is a type of direct sales which includes marketing done via emails and wireless media.



Advantages	Disadvantages
Produce can reach global audience in a short space of time	It only helps consumes with internet/ smart phone network access
It has relatively low cost	Attracting customers may not be easy
Products can be delivered directly to the clients	Not all consumers shop online
Low capital-intensive business	The possibility of fraud/scamming is a big risk
Money can be transferred before goods are delivered	

AGRICULTURAL COOPERATIVES

A cooperative is a voluntary organisation formed by a group of people who have a common need that they want to address.



Types of Agricultural Cooperatives

- 1 Agricultural cooperatives sell products in with higher profits and provide for their members production requirements as cheaply as possible.
- 2 Commercial or consumer cooperatives. Their aim is supply the consumer requirements as cheaply as possible

Principles of Agricultural Cooperatives

- Democratic member control
- The highest authority of a co-operative is in the hands of members during a general meeting.
- Members of cooperatives have the democratic right to vote for their directors.
- In business operations of a co-operative, how much a member gets for bonuses depends on how much capital he or she has contributed
- Open and voluntary membership
- Discrimination is not allowed in cooperatives .
- Autonomy and independence of a co-operative

Advantages of cooperative marketing

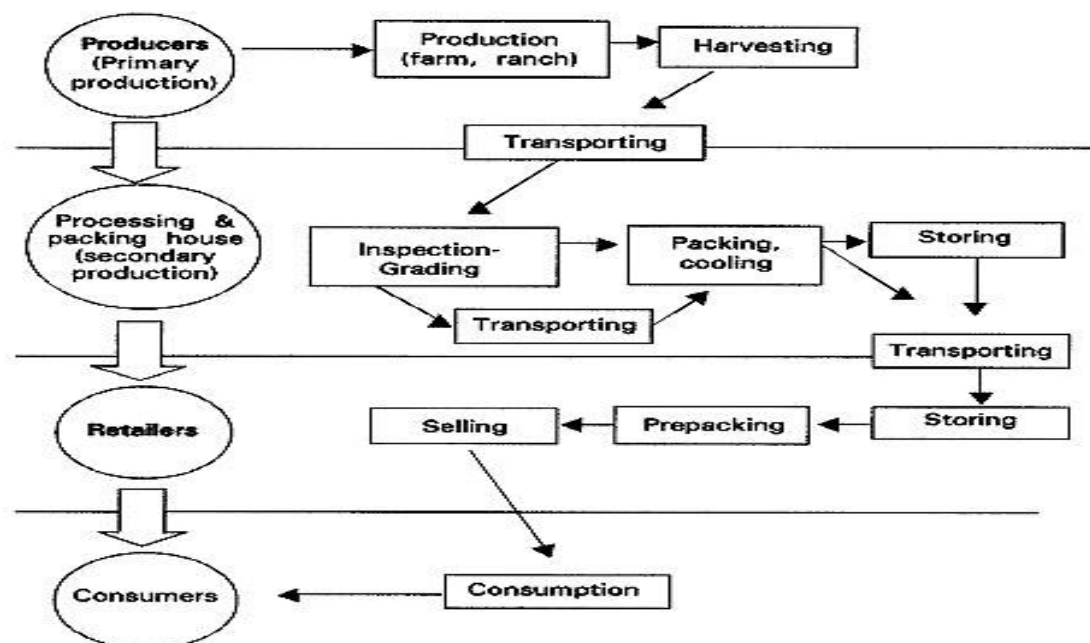
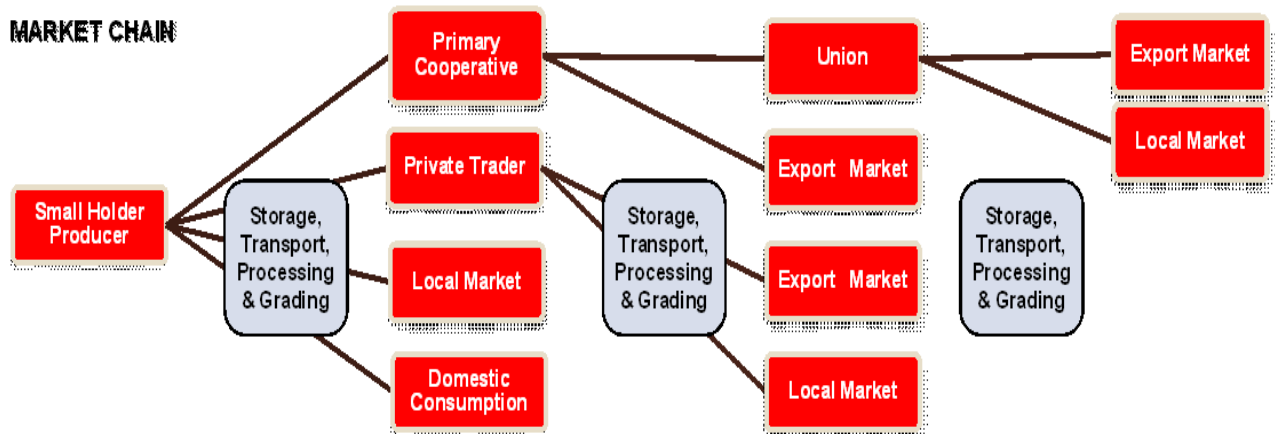
- . Lower marketing costs/cost distribution
- . Services are supplied cheaper/bulk purchasing
- . More bargaining power
- . Access to funding/credit to producers
- . Higher prices are obtained
- . Elimination of the intermediaries
- . Potential for growth
- . Access to better infrastructure
- . Branding

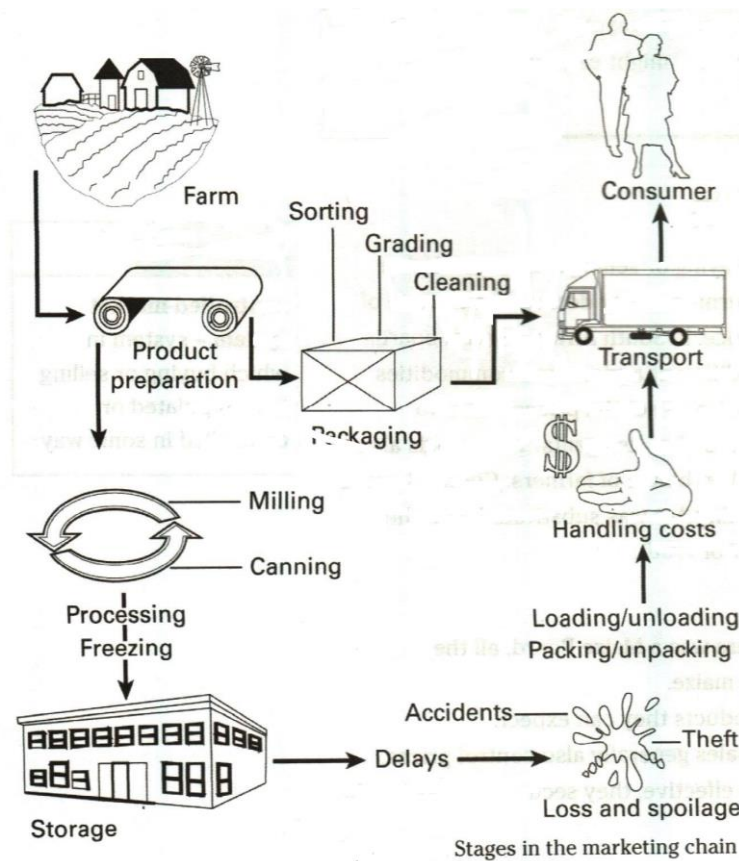
The concept of a marketing chain

An agricultural marketing chain is the path an agricultural product follows from the farmer to the consumer. The first link in the chain is the production on the farm. **Marketing chains** are sometimes called **agri-business chains** or **supply chains**. All these terms are used **interchangeably** to describe the various activities and actors involved in producing and marketing the product to the consumer.

MARKETING CHAIN

MARKET CHAIN





Factors that hamper the value chain of agricultural products

- Labour markets: Strict labour laws and the high cost of labour in South Africa can increase the cost of production.
- Infrastructure: Insufficient storage facilities for agricultural products, especially during peak harvesting periods, can lead to a drop in quality or product losses.
- Transport: The high cost of transport, limited availability of transport by road and the lack of proper rail transport slow down the movement of goods along the value chain.
- Bulkiness in relation to the value
- Lack of capital.
- Accidents, theft and spoilage along the marketing chain.
- Seasonal character of production .
- Standardisation .
- Marketing through intermediaries

Ways to streamline and improve the agribusiness chain.

- Harvest fruit and vegetables at the correct stage of ripeness and grain at correct moisture content to increase their shelf life.
- Improve infrastructure of farm and public roads.
- Have cooling facilities on the farm to store fruit and vegetables
- Use qualified packers with knowledge
- Use sophisticated grading machines of a high standard prevent damage to fruit.
- High quality packing material prevents further damage and improves marketing price.
- Transport produce in cooler containers to prevent spoilage.
- Make use of internet and cell phone connections as a marketing strategy.
- Reduce transport cost by combining loads to meet market demand.

Role of legislation in agricultural marketing

- Marketing of Agricultural Products Act (No. 47 of 1996). This Act aims to increase market access for all participants, and enhance the viability of the agricultural sector.
- Agricultural Product Standards Act (No. 119 of 1990). This Act controls the sale and export of certain agricultural products, and some imported products.
- Perishable Products Export Control Act (No. 9 of 1983). This Act controls the export of perishable products from South Africa.
- Meat Safety Act (No. 40 of 2000). This Act sets and maintains national standards at abattoirs, promotes meat safety, and regulates the import and export of meat.
- Agricultural Produce Agents Act (No. 12 of 1992). This Act, which was amended in 2003, led to the establishment of a council representing agricultural produce agents.
- Consumer Protection Act (No. 68 of 2008). This Act aims to promote a fair, accessible and sustainable marketplace for consumer products and services.

Agricultural entrepreneurship

An entrepreneur is a person who identifies an opportunity, gathers resources and sets up a business, taking on the risks involved in the hope of making a profit.

Important aspects of being an entrepreneur and entrepreneurship

- Identifying an opportunity:
- Innovation and creativity:
- Identifying the need for and obtaining resources:
- Creating and growing a business:
- Taking risks:
- Being rewarded
- Managing the business:
- Getting resources:

Personal characteristics of entrepreneurs

- Passion and a positive attitude:
- Strong leadership:
- Control:
- Need for independence:
- Need for achievement
- Risk taking:
- Creative and innovative thinking:
- Adaptability, determination and perseverance:
- Confidence:
- Responsible:

Phases of the entrepreneurial process

- Phase 1: Identifying a opportunity
- Phase 2 : Evaluating the opportunity
- Phase 3: Determining the resources required
- Phase 4: Developing the business plan .
- Phase 5: Starting and managing the enterprise
- Phase 6 : Growing of the business

The agri-business plan

What is a business plan? A business plan is a document that sets out the objectives, target market, needs and financial requirements of a business.

Reasons for drawing up a business plan in the agricultural sector

- Mapping out the direction your business;
- Setting out you objectives
- Attracting investors
- Obtaining financing

Reasons for drawing up a business plan in the agricultural sector

- Helps the manager to think through the financial details
- Helps define goals
- Outlines the roles and responsibilities of individuals involved
- Provides time frames for completion of projects or activities
- Provides guidelines for decision making and to compare progress
- Provides information that financial institutions and government assistance programmes require
- Provides clear strategies and objectives to follow
- Provides managers and staff with direction and focus
- Helps management save money by identifying mistakes before the plans are implemented
- Helps the manager to foresee problems and take appropriate action in time
- Provides information about the external and internal business environment.
- Helps the manager to identify opportunities
- Helps the manager to analyse the life cycle of the business and each activity in the business
- Helps the manager to plan for capital requirements

The format and lay-out of an agri-business plan

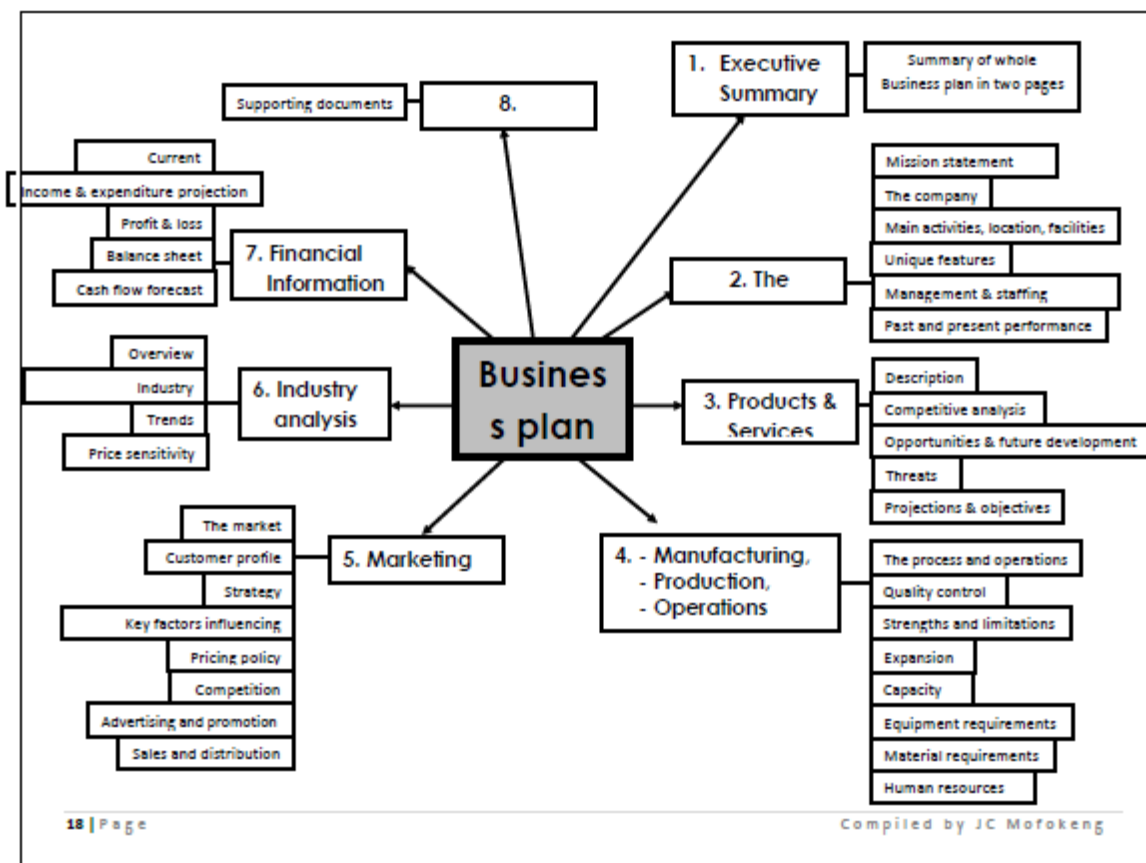
- The title page
- Content page
- Executive summary
- Business profile or Management team:
- Business objectives:
- Business concept
- The marketing plan
- Production plan
- The human resources plan
- Financial plan

Problems encountered when drawing up a business plan

- Poor writing
- Incomplete plan
- Budget and cash flow errors
- Unclear or unrealistic goals
- Not identifying potential risks
- Poor research
- Not competitive
- Unenthusiastic
- Too generic
- No or weak planning
- Risks
- Competition
- Supplies Insufficient research ..
- Leaving gaps, being vague or providing too much information.
- Insufficient technical detail.
- Overambitious or unrealistic assumptions c and projections.
- Incomplete financials
- Not highlighting potential competition
- Hiding weaknesses and risks.
- Using the incorrect format.

SWOT analysis

SWOT stands for Strengths, Weaknesses, Opportunity and Threats. The evaluation of the strengths and weaknesses of the internal environment and the opportunities and threats of the external environment of a business is called the ! SWOT analysis.



ACTIVITIES

(30 Marks; 45 Minutes)

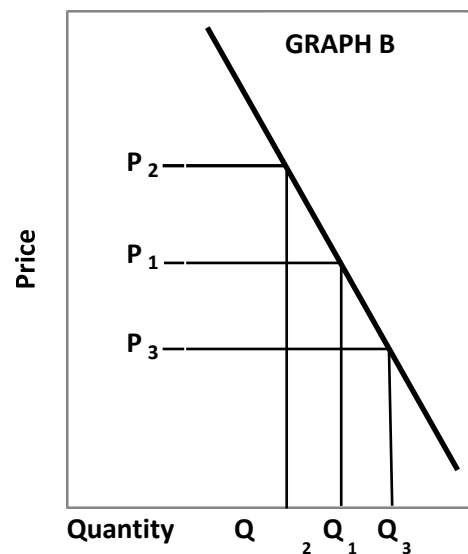
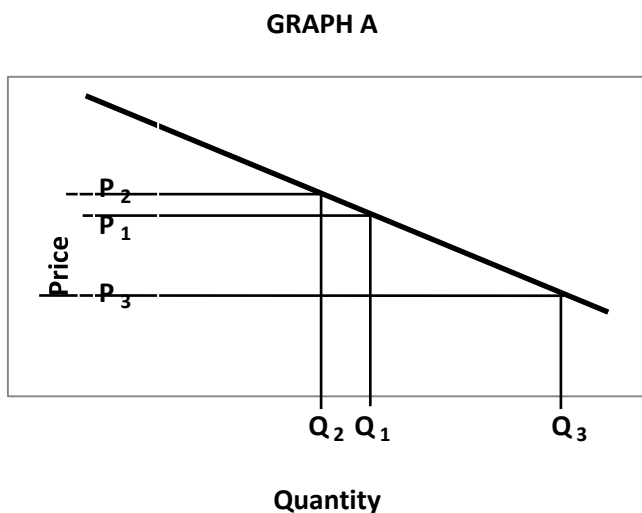


1.3 Change the underlined words in each of the following statements to make them TRUE . Write only the answer next to the to the question 1.3.1-1.3.6 in the ANSWER BOOK.

- 1.3.1 Controlled marketing is system where two or more independent organisations work together to meet their common economic ,social and cultural needs.
- 1.3.2 Hedging is a form of marketing where goods are exchanged for other goods or services.
- 1.3.3 Selling is a customer orientated.
- 1.3.4 Value-adding is the alteration of the raw product into a form that is easier for the consumer.
- 1.3.5 Packaging involves covering and labelling the product so that it appeals to the marketer.

ACTIVITY 2

2.2 The graphs below show the change in the demand for products in relation to the change in price.



2.2.1 Identify the graph (A or B) that represents EACH of the following:

- (a) Price inelasticity of demand
- (b) Price elasticity of demand

(1)

(1)

2.2.2 Give a reason for your answers to QUESTION 2.2.1(a) and (b). (2)

2.2.3 State THREE other factors that may cause elasticity of demand. (3)

2.4 Define the following concepts

2.4.1 Price elasticity of demand (2)

2.4.2 Controlled marketing (2)

2.4.3 Pool system (2)

2.4.4 Entrepreneurship (2)

2.4.5 Hedging (2)

Activity 3

1.3 The marketing channels below are related to free marketing system.

1.3.1 Give one marketing channel for EACH of the statements from the list below: Write only the channel next to the question numbers (.1.3.1 (a) – (d).

Internet marketing; stock sales; fresh produce market; farm gate marketing; contract marketing.

(a) A farmer sells spinach direct from the farm. (1)

(b) Goat, sheep and cattle are sold to the highest bidder. (1)

(c) Products are electronically advertised and sold (1)

(d) Mangoes and apples are delivered to markets immediately (1)

1.3.2 Name TWO disadvantages of a free marketing system (2)

2.1 Two groups of learners used different strategies to promote and market their produce from the school garden.

GROUP 1	GROUP 2
Sold vegetables to the local supermarket	Sold vegetables from door to door at their own price
Vegetables from each individual in the group were combined into one stockpile for marketing	Each individual in the group was responsible for selling their own produce

2.1.1 Identify the marketing system used by GROUP 2 (1)

2.1.2 Refer to the table above and justify with TWO reasons why the marketing system identified in QUESTION 2.1.1 was chosen. (2)

2.2 Avocado pear farmers grouped themselves to produce and sell their produce together.

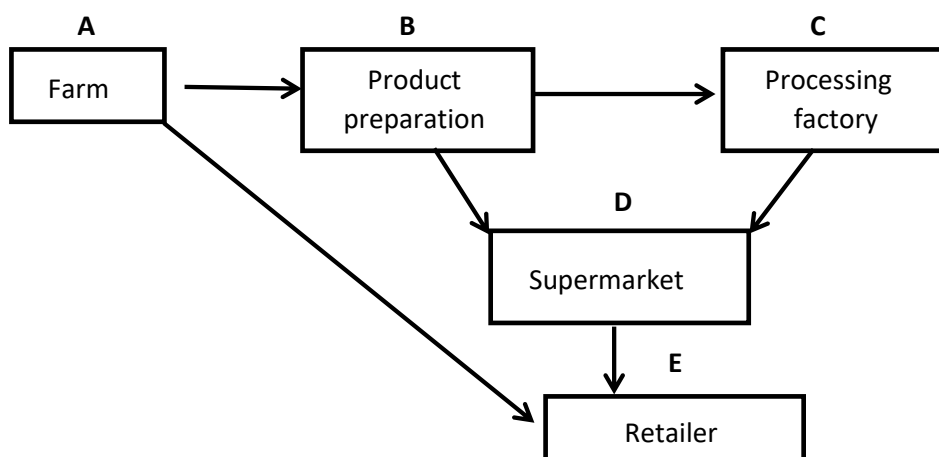
2.2.1 Identify the agricultural marketing system used by the farmers (1)

2.2.2 Indicate the role of the marketing system in QUESTION 2.2.1 (1)

2.2.3 Name TWO benefits of the marketing system in QUESTION 2.2.1 (2)

2.2.4 State TWO factors that may hamper the marketing of avocado pears (2)

3.2 The flow chart represents a marketing chain



3.2.1 Identify the marketing chain illustrated above (1)

3.2.2 Name the factor that may hamper the marketing at stage E if fewer products are sold (1)

3.2.3 Indicate TWO ways to improve the agribusiness chain between stage A and stage E.

Activity 4

(Business plan)

4.2 A business plan is a plan of action that an entrepreneur should have for a business.

4.2.1 Give TWO reasons for drawing up a business plan.
(2)

4.2.2 List THREE items that should be included in the format of a good business plan.
(3)

4.2.3 State TWO problems that may be encountered when drawing up a business plan.
(2)

4.3 Read through the following terms, and decide whether they are **Threats, Opportunities, Weaknesses or Strengths** for a grain producing enterprise.

4.3.1 Untrained labour force

4.3.2 Low grain prices

4.3.3 Drought

4.3.4 Imports from other countries

4.3.5 Changes in legislation

4.3.6 Consumers moving away from eating bread

4.3.7 Good soil

4.3.8 Favourable climate

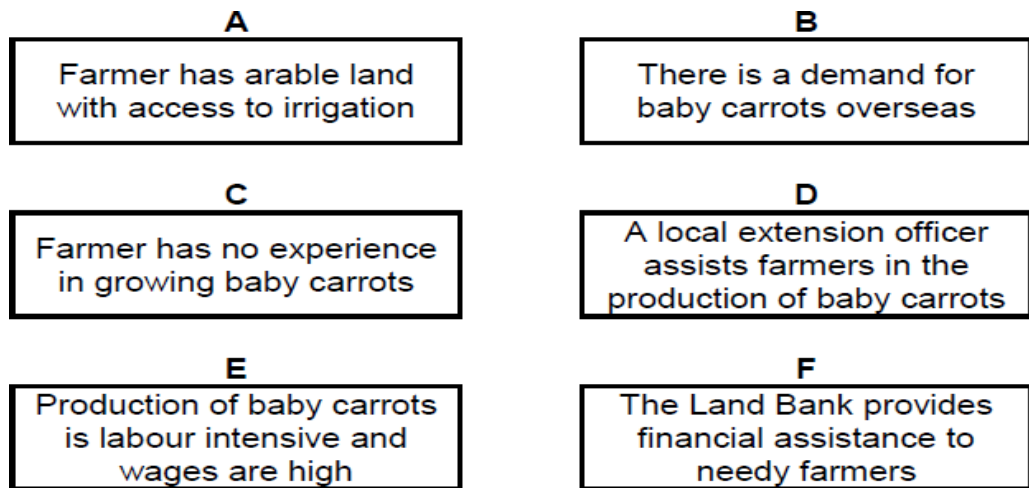
4.3.9 Insecticide-resistant pests

4.3.10 Increase in diesel price

4.3.11 Decrease in water costs

4.3.12 Lack of management knowledge(1X12) = 12

4.4 The schematic representation below shows the aspects of a SWOT analysis done by an emerging farmer.



4.4.1 Link statement A, B, C and E in the schematic representation with the elements of a SWOT analysis. (4)

4.4.2 Explain how the farmer may use the strengths and opportunities in the schematic representation above to improve the farming enterprise.(2)

An entrepreneur is a person who identifies an opportunity for a business, does research on what will be needed and combines good ideas with the forces of production to produce and make profit.

8.1.1 In the scenario above, identify THREE phases of the entrepreneurial process. 3)

8.1.2 Name THREE personal characteristics of a successful entrepreneur. (3)

8.2 The table below shows the characteristics of two individuals.

INDIVIDUAL A	INDIVIDUAL B
<ul style="list-style-type: none"> • Works for someone • Trades his/her time for salary • Controlled by fear • Uses a curriculum vitae (CV) to seek employment 	<ul style="list-style-type: none"> • Works for himself/herself • Always looking for new business ventures • Sells a concept • Has a business plan • Has an appetite for risk

8.2.1 Identify the individual (A or B), in the table above, who represents an entrepreneur. (1)

8.2.2 Identify TWO personal characteristics, in the table above, of an entrepreneur. (2)

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