AGRICULTURAL SCIENCE

GRADE 12 NOTES

COMPILED BY

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RESOURCES

1. **FOCUS AGRICULTURE GRADE 12**
2. **STUDY AND MASTER AGRICULTURAL SCIENCE**
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5. **MIND THE GAP GRADE 12 STUDY GUIDE**

TOPIC 1: Animal Nutrition and digestion

TERM 1

Week	Date (days)	Knowledge Area	Topic	Date completed
1		Animal nutrition	A comparison on the external structure of the alimentary canal of: A ruminant (cattle and sheep) and non-ruminant (fowl and pig) ➢ Functions and adaptations of various structures of the alimentary canal ➢ Description of the internal structure of the following: ✓ Rumen ✓ Reticulum ✓ Omasum ✓ Abomasum; and ✓ Small intestines	

Animal nutrition: is the food that an animal eats, the way it is digested and how it is used in the animal body.

[Each type of animal has a specific nutrient requirement, and it is very important for farmers to understand animal nutrition so they can feed their animal effectively.]

Unit 1: the alimentary canal of farm animals

Alimentary Canal : The alimentary canal is the passage along which food passes through the body.

❖ The canal contains a series of organs of the body involved in digestion.

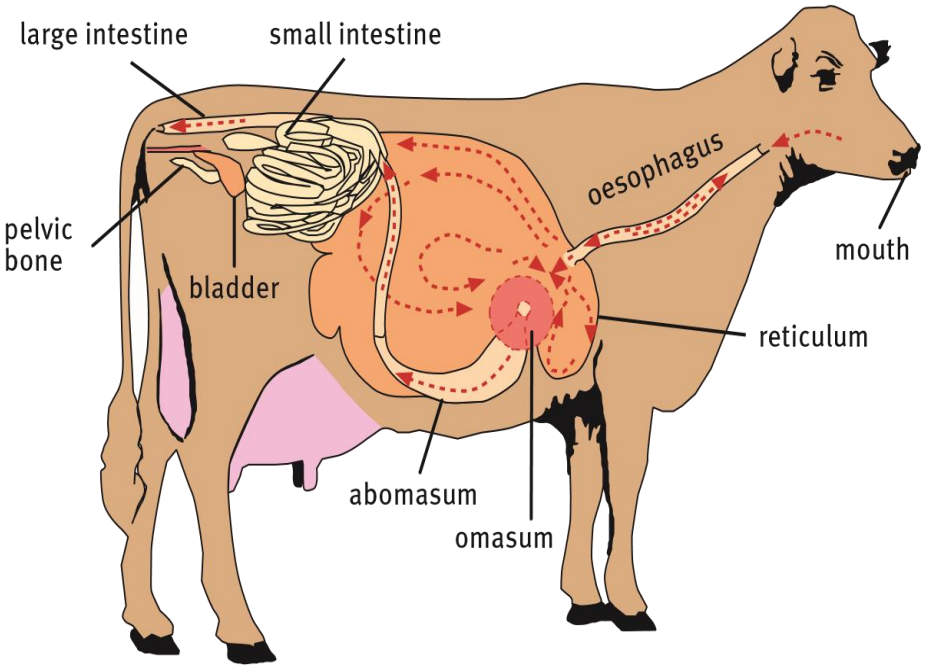
❖ The alimentary canal also absorbs water and excretes parts of food that cannot be digested.

• **Ruminants' animal:** animals that have a more complex stomach divided into four compartments. That later regurgitate previously swallowed food to chaw and swallow again.

• **Regurgitate:** bringing food from the stomach back to the mouth for chewing and swallowing again].

• **Non-ruminants** animal: animals that have a simple (single) stomach and that do not regurgitate their food. Ruminant's animals are monogastric animals.

The external structure of alimentary canal of ruminants (for example, cattle and sheep)



The capacity of the stomach of a cattle is between 150 and 200 ℓ. **Its stomach is divided into four compartments. They are:**

1. the rumen (or large stomach)
2. the reticulum (or net stomach, also called honeycomb)
3. the omasum (or leaf stomach)
4. the abomasum (or true stomach, also known as the milk stomach).

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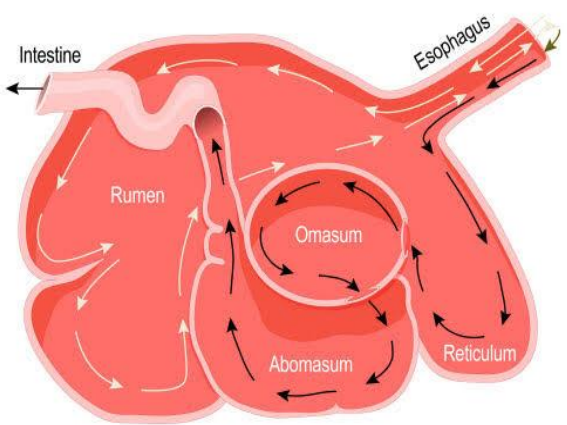
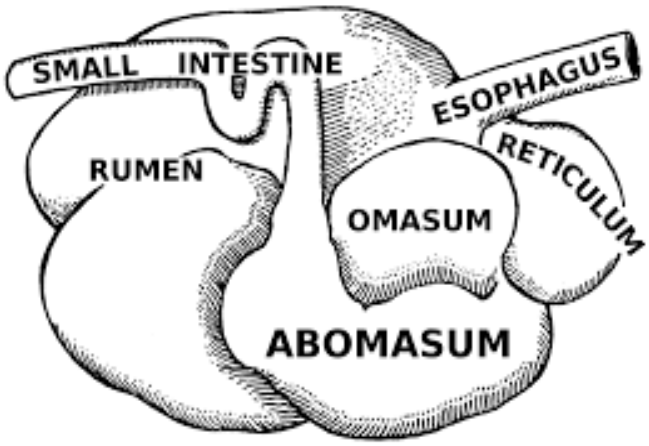
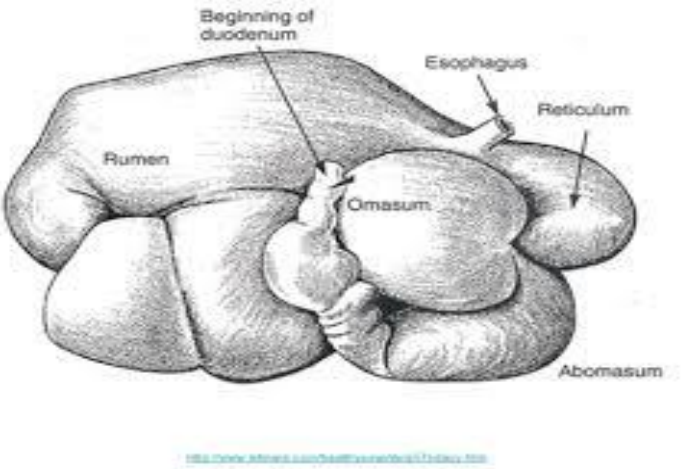






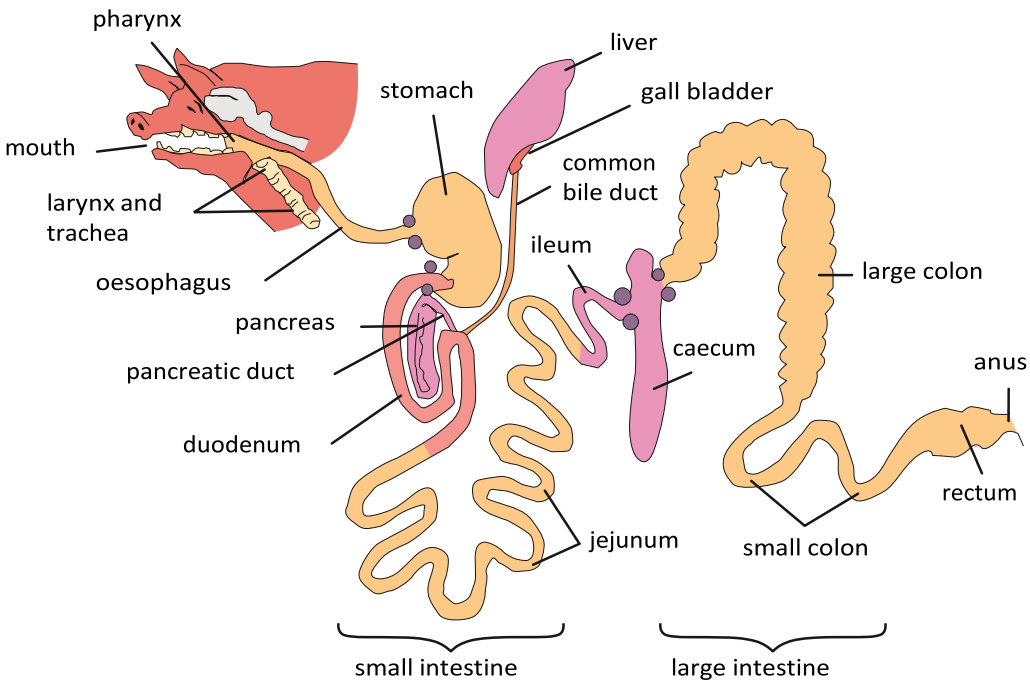
- The small intestine in cattle is about 45 m long and is attached to the end of the **abomasum**, which is the last compartment of the stomach. The small intestine in turn is connected to the **large intestine.** The large intestine is an elongated 'bag' about 11 m in length. It consists of the **cardia**, the **colon** and the **rectum**, and it ends in the anus.

Alimentary canal of non-ruminants: External structure

- The main difference between the structure of the alimentary canal of ruminants and non-ruminants is that non-ruminants do not have **forestomaches.**

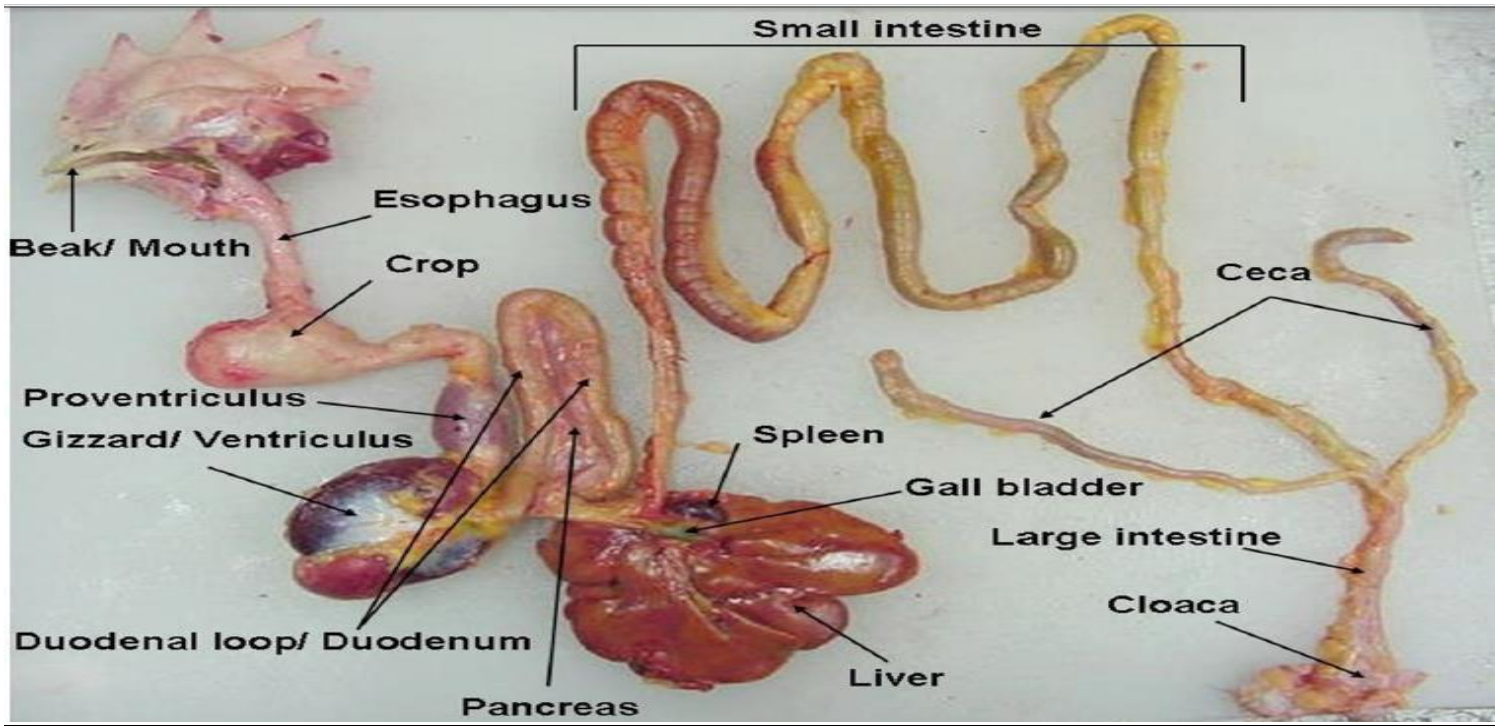
- However, like ruminants, horses are herbivores and they have a long colon or hindgut in which micro-organisms help with breakdown of plant material.

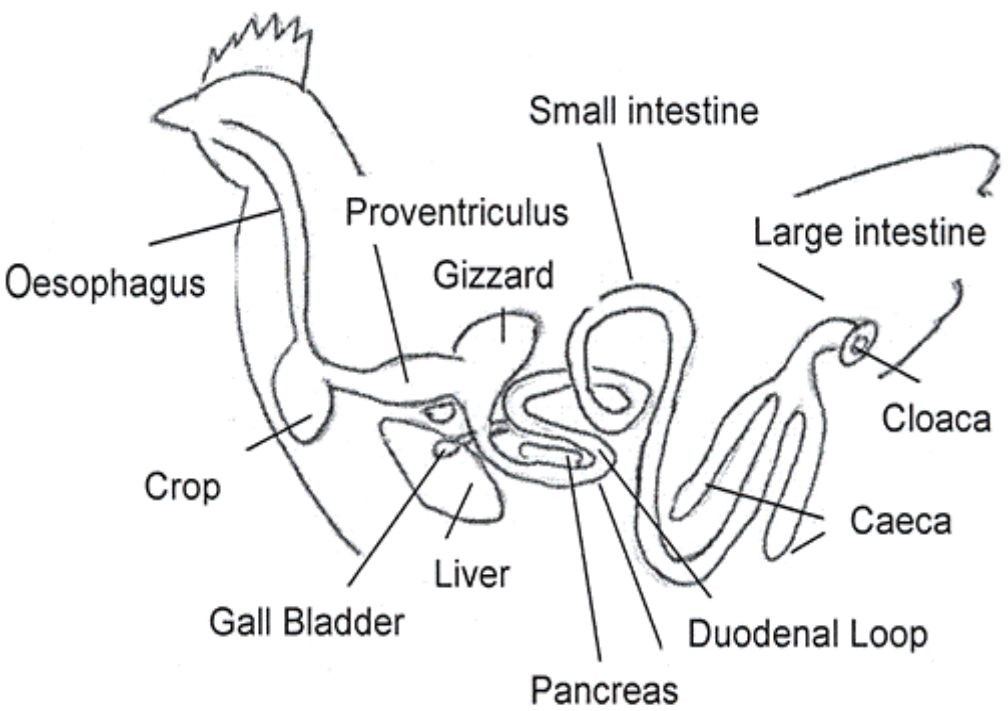
The alimentary canal of a pig



- The pig is a typical non-ruminant. It has a true stomach and no forestomach (i.e. it has no rumen, reticulum or omasum). The alimentary tract contains these organs: mouth, oesophagus, stomach, small intestine and the large intestine (it can be sub-divided into the duodenum, jejunum and ileum).

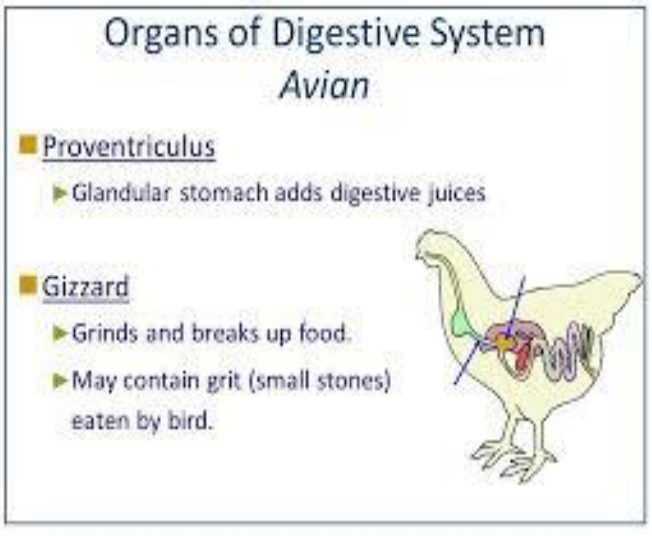
The alimentary canal of a fowl





- Fowls have a different **oesophagus** to pigs and cattle. Fowls have a soft, bag-like structure known as the crop. Food is stored in the crop. A fowl's stomach consists of:

- the gland stomach
- the muscle stomach.



The **digestive juices** are secreted in the **gland stomach**. The food is ground in the muscle stomach. After the muscle stomach is the small intestine. There are two blind guts (caeca) where the small intestine joins the large intestine . After the rectum is a large cloaca. The cloaca is the external opening of both the digestive system and the reproductive system.

FUNCTIONS AND ADAPTATIONS OF VARIOUS STRUCTURE OF THE ALIMENTARY CANAL

1.Functions and adaptations of the mouth.

- Digestion starts in the Mouth. Teeth grind food into smaller pieces by chewing,
- while Salivary gland in the mouth secrete saliva, or spit that soften food which makes it easier for tongue to move it around the mouth.
- The tongue moves the **bolus** of food to the pharynx (or throat) and then into oesophagus or **(gullet).**
- In cow and pigs the lower jaw are movable and used to aid with chewing and grinding of the food

2.Functions of the Tongue

- It is a taste organ that helps the animal to distinguish between the tastes of different feeds.
- The cow has prehensile tongue that is used to wrap around and grasp around grass for intake into mouth.
- It moves the food towards the teeth for chewing process.
- It rolls the food into a ball and help to mix it with saliva to form a bolus.
- Tongue is also used to drink water
- It used by young animal such milk during lactation.
- Animal use tongue to detect or feel foreign object in the mouth, which help to prevent animal from swallowing them.

3.Function and adaptations of the oesophagus.

The muscular layer of the oesophagus contract and relax forcing the bolus of the food to move down to stomach by process of peristalsis.

peristalsis -contracting and relaxing of muscles in the digestive tract that is responsible for the movement of food

- the oesophagus connects the mouth to the forestomach of ruminant.
- The oesophagus also connects mouth to the the single-chambered stomach of non-ruminant.
- Responsible for the transportation of food to the stomach by process of peristalsis.
- In ruminant animal reverse peristalsis or retro-peristalsis also take place via oesophagus.
- Mucous membrane in gullet lubricate food which makes easier for digestion.

4.Functions and adaptations of crop.

- The crop stores food materials temporarily
- The crop moistened and softened the food
- Very little digestion take place in the crop of the fowl

5.1Functions and adaptations of stomach.

- Ruminant animals have complex stomach, divided into four chambers: **Rumen, Reticulum, Omasum, Abomasum.** Ruminants swallow their food and regurgitate it later to chew it. This process known as **chewing the cud.**

5.1.1Functions of Rumen (or large stomach)

- Rumen digest retained large particles to allow ruminants to extract the maximum nutrition possible for their diet.
- Rumen provides a suitable pH for the functioning of microbes that are necessary to digest cellulose(cellulose is the carbohydrates in plats)
- Microbial fermentation of ingested feed takes places in the rumen.
- Walls of rumen (and reticulum) move continuously, thereby mixing ingested feed with rumen fluid.
- Contraction of the rumen(and reticulum) help with the flow of the finer food particles into the omasum

5.1.2 Functions of Reticulum (or net stomach, also called honeycomb)

- Rumination takes place in Reticulum.
- Large feed particles are returned to rumen for further digestion.
- Reticulum traps hard indigestible substances such as rocks and wire that are ingested accidentally during grazing.
- The ridges in the lining of reticulum increase the surface area for absorption.
- The reticulum helps with the absorption of volatile fatty acids. The boluses for regurgitation and rumination are formed in the reticulum.

5.1.3 Functions of omasum (or leaf stomach)

The lining of the omasum has many leaf-like folds which are arranged against each other like pages of book that absorb water from the remaining food.

- Traps hard and indigestible substances
- separate coarse and fine food materials
- Grinding of food particles
- Sends large substances back to the rumen
- Absorption of water
- Absorption of some volatile fatty acids

5.1.4.Functions of Abomasum (or true stomach, also known as the milk stomach).

Abomasum is the true or glandular stomach and function like the single-chambered stomach of monogastric animal.

- Abomasum send **chyme** to the small intestine.
- The muscular wall of abomasum **churns** the food.
- Abomasum facilitates the initial breakdown of proteins.
- Two enzymes are secreted in the abomasum: **1.pepsin:** which digest and break down proteins **2. Renin curdles milk**

❖ **5.2 Non- ruminants(pigs and chickens)** have a simple stomach of only one part. This animal chew their food and swallow t once. The stomach has thick muscular walls contain many glands that secrete **gastric juice**.

5.2.1.Stomach of fowl or chickens

➢ Stomach of chickens is divided into two parts

The proventriculus or gland stomach and The ventriculus or gizzard or muscle stomach(sometimes referred to as the fowl's molar teeth)

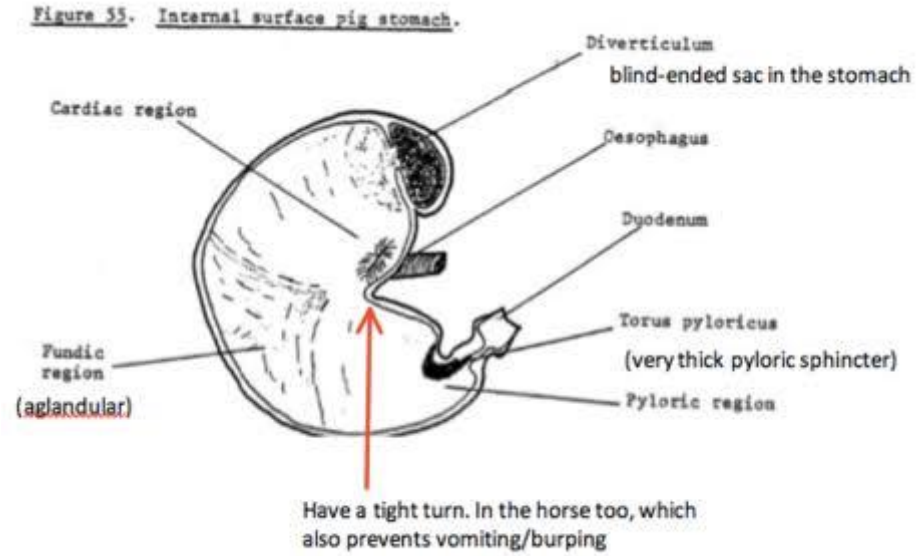
➢ **a) The proventriculus or gland stomach**-secretes the digestive juices pepsin and hydrochloric acid to start digestion of the food.

➢ It is responsible for chemical digestion of food.

➢ **B) The ventriculus or gizzard or muscle stomach(sometimes referred to ad the fowl's molar teeth)** – normally contain small stones that are used gride the food to prepare it for digestion.

The food is then mixed with me enzyme mixture from the proventriculus.

5.2.2. stomach of pig



➢ The stomach of pig is subdivided into three parts or reegion namely, **1.)Cardiac, 2.)fundic and 3.)pyloric**

1.**The cardiac region** secretes mucus and mixes it with the digested food.

2.The fundic region (small blind sac) is where the digestive process in the stomach stats.

➢ Gastric glands in fundic region secrete hydrochloric acid that makes the content of the stomach acid.

- Digestive enzymes such as pepsinogen are also secreted here.
- The pepsinogen is then broken down by the hydrochloric acid into pepsin that is involved in the breakdown of protein.

3 The pyloric region-

- secretes mucus that lines the digestive membranes to protect them from damage by the low PH of the digested matter as it passes into small intestine.
- The pyloric sphincter regulates the amount of chyme that enter small intestine so that digestion and absorption can take place efficiently.
- Digested feed particles are absorbed from the stomach into bloodstream.

6.Functions and adaptation of small intestine.

- Small intestine is sub divided into three parts, **Duodenum, jejunum, and ileum.**

Duodenum

- Duodenum is the first and the shortest part of the small intestine.
- Partly digested food from the stomach enter duodenum through the pyloric sphincter.

The liver and the pancreas secrete material through ducts into duodenum.

- **Bile ducts:** the bile ducts carry **bile salts, a greenish fluid** manufactured in the and store in the **gall bladder.** It released into the **duodenum to digest fats**.
- **Pancreatic Duct:** The main pancreatic duct carries two secretory products that are very importance for Digestion**. (1.) Digestive enzymes and**

(2.) Bicarbonate

TWO functions of the digestive juice in Gall bladder Bile

- ✓ Increases the solubility of fats
- ✓ Acts as an antiseptic
- ✓ Acts as a detoxifying agent
- ✓ Lubrication of the alimentary canal
- ✓ Enhances peristalsis
- ✓ Activates lipase
- ✓ Changes the pH from acid to alkaline/helps to neutralise the acid from the gastric juices
- ✓ Emulsification of fats
- ✓ Promotes the absorption of fatty acids and glycerol
- ✓ Assists with the absorption of fat- soluble vitamins

- The **duodenal Glands** secrete duodenal juice.
- The **Glands of Lieberkuhn** are tubular indentations of the epithelium between the villi. They secrete duodenal juice **(succus entericus)**

Jejunum

- This is the second section of the small intestine. It is thicker and more vascularised than ileum.

➢ The inner surface is covered with finger-like projections called villi that increase the surface area for the absorption of nutrients.

- The villi in the jejunum are much longer than those in the duodenum of ileum. The epithelial cells that line the villi have larger numbers of microvilli that are called the **Brush border.**

➢ The food is digested by enzyme and absorbed across the epithelium and into bloodstream.

- The nutrients can pass through the intestinal wall by passive or active transport.

Active and passive Transport

➢ **In passive Transport**- molecules diffuse into the intestinal cells down a concentration gradient. This means that molecules move from region of high concentration to a region of low concentration of molecules.

➢ Energy is required for **active transport.** Amino acids, small peptides, vitamins and most glucose move across the intestinal lining by active transport.

❖ **Functions of small intestine**

- Small intestine is adapted for the absorption of soluble digested food molecules **(nutrients)**
- Small intestine plays an important role in water and acid-base balance.
- the duodenal area of the small intestine has glands that produce **intestinal juice-(combination of enzymes that break down the various substances.)** Pancreatic enzymes and bile are also secreted here.
- Small intestine has finger like Villi covered with tiny projections called microvilli which increases the surface area villi for better absorptions.

The enzymes in small intestine break nutrient molecules down into their building blocks:

✓ **Carbohydrates** are broken down into **simple sugars (monosaccharides)**
✓ **Fats** are broken down into **fatty acids and glycerol.**
✓ **Protein** are broken down into **amino acids**

7.Functions and adaptions of large intestine.

➢ The large intestine is a large tube divided into three parts: **Caecum, Colon and Rectum.**

- The main function of large intestine is to absorb water from waste and return this water to the body.
- The wall of large intestine has glands that produce mucous to lubricate the mainly non-digestible food material that remain after digestion is complete.
- The caeca increase the surface area for the absorption of nutrients.
- Colon help helps with absorption of mineral salts by blood.
- The colon provides a suitable environment for bacteria to grow and reproduce
- The large intestine stores undigested waste material.

Description of the internal structure of Rumen, Reticulum, Omasum, Abomasum and Small intestine.

1. Internal of Rumen

- Rumen is the largest stomach and contains billions of bacteria and protozoa that do most of the cow's digestion.
- There are many finger-like protrusions called **papillae** responsible to keep the temperature constant.
- **Papillae-** is a finger like protrusions found on the wall of the rumen that assist in keeping the temperature constant

2. Internal of Reticulum.

- The reticulum has a honeycomb-patterned lining.
- Rumination occurs in the reticulum when the animal regurgitates a bolus of incompletely chewed food and chews it again.

3. Internal of Omasum.

The lining of the omasum has many leaf-like folds **which are arranged against each other like pages of book** that absorb water from the remaining food.

4. Internal of Abomasum. (True stomach)

- The abomasum of ruminants is like the simple stomach found in non-ruminants like the pig.
- It has a smooth, slippery internal surface. The oesophagus enters the abomasum at the upper part.
- The upper part of the abomasum contains glands which produce hydrochloric acid, and the lower part contains glands which produce gastric enzymes.

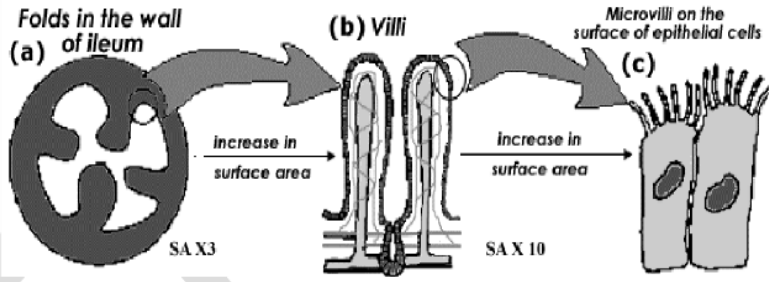
5. Internal structure of small intestine.

- The small intestine of ruminants is moist. It appears to be smooth, but the small intestine contains microscopic, finger-like projections called villi.

➢ The villi increase the absorptive ability of the intestines.

Internal structure of the intestinal villi.

- Villi are small, finger-like growths or extensions of mucous membrane of the small intestine.
- Each villus consists of connective tissue which is surrounded by a layer of epithelial cells.
- A small lymphatic vessel is responsible for the absorption
- Each villus has a few involuntary muscles which keep it in constant movement.



Distinction between intestinal folds and Villi

Intestinal folds	Villi
• Bigger extensions of the intestinal mucous membrane. • Comparable smaller surface area for absorption. • Supplied with veins and arteries.	• Smaller extensions of the mucus membrane on the folds. • Comparable bigger surface area for absorption. • Supplied with venous and arterial capillaries.

Take this table out

Adaptation of small intestine to the absorption of the most digested food.

- Long enough to provide sufficient absorption area.
- Many folds increase surface area for absorption.
- Villi also increase surface area for absorption.
- Involuntary muscles provide constant movement or peristalsis.

CHAPTER TWO: Digestion in the non-ruminants (pig/fowl) and ruminants (cow)

❖ Digestion in non-ruminants

Digestion in non-Ruminants- digestion in non-ruminants is a combination of mechanical **(involves a physical movement)** and chemical actions **(involves interactions between substance)**. The mechanical actions break food down into smaller pieces **and** chemical action breaks the components of feed into their basic chemical constituents.

1.A brief explanation of the intake of feed

Pigs take in their feed with their lips, and they grip the food with their canine teeth. The tongue moves the food into the mouth, and it is then chewed by the large molars.

Digestion in non-ruminants is very similar to our own digestion. We are also non-ruminants. We are also omnivores, meaning that we eat both plant and animal matter. If you have learnt about human digestion in Life Sciences, you will find this section easy to understand.

2.The process of digestion in the mouth, stomach, small intestine and large

intestine (colon): either mechanical digestion and or chemical digestion (enzymes)

2.1 Mouth

Mechanical process: Mechanical breakdown of food into finer particles is called chewing. The tongue moves the food around in the mouth and then to the back of the mouth or throat where it can be swallowed.

Chemical process: Saliva is secreted into the mouth in response to the presence of food. The saliva softens the food. The enzyme known as salivary amylase then begins the chemical breakdown of starch into the sugar called maltose.

2.2 Stomach

Mechanical process: Food passes from the oesophagus into the stomach. The stomach contracts and moves the ingesta around by muscular force.

Chemical process:

- The mechanical action of the stomach mixes the hydrochloric acid (HCl) and digestive enzymes in the stomach with the food so that its chemical breakdown can begin.
- The hydrochloric acid produced reacts with the enzyme pepsinogen and forms pepsin, which breaks down proteins into smaller components called peptides.
- The digestive enzyme rennin reacts with the protein in milk, called caseinogen, and causes it to curdle or clot.
- The enzyme reaction forms the protein casein, which can be digested.

2.3 Small intestine

Mechanical process: The main function of the small intestine is to absorb nutrients that have been broken down into their basic components. The nutrients are absorbed through the villi by the processes of osmosis and diffusion, which you will learn about in detail later on in this unit. The absorption of nutrients is assisted by the mechanical contraction of intestinal walls.

Chemical process: Various enzymes are released into the duodenum from the liver (bile) and the pancreas. They break down fats, protein and starches in the small intestine and some chemical digestion takes place.

Examples of digestive juices in the small intestine

(a) Bile- changes **pH** from acid to alkaline.

(b) Pancreatic juice- changes PH from acid to alkaline.

(c) Succus entericus (intestinal juices)

3. The functions of the accessory glands such as the liver, pancreas, and intestinal glands

(a) **Functions of Liver**

- To store glycogen
- To store the fat soluble vitamins A, D, E and K
- The liver secrete bile.
- The liver converts glucose to glycogen
- Secrete heparin, which prevents blood clotting.
- Liver produce red blood cells in embryos and and destroy oldnred blood cells in mature animal.
- Liver help with excretion of waste products

❖ **Digestion in ruminants**
Important terminology: rumination, regurgitation, peristalsis.

(a) **Rumination (also called chewing the cud)-** Grinding of reversed food into a small particle.

(b) **Regurgitation-** process by which food in the forestomach is returned to the mouth for rumination

(c) **Peristalsis-** the rhythmic contraction and lease of muscles in the digestive tract that is responsible for the movement of food.

Explanation of the intake of food, chewing of the cud.

Cattle use their long, mobile, muscular tongues to grasp their food. This is made possible by the rough surface of the tongue.

- The sharp, lower incisors help to cut the grass as it is pulled into the mouth.
- The food forms a loose mass, or bolus, in the mouth, but it is hardly chewed at all before it is moved by the tongue to the back of the throat and swallowed.
- It moves down the oesophagus by the process of peristalsis, and this process is assisted by the large amount of saliva secreted into the mouth.
- The food then enters the forestomach where the grass is mixed with water and coated in microorganisms by the contractions of the rumen.
- The honeycomb surface of the reticulum trap the coarse, long fibres of the grass and squeeze them into a bolus, or lump.
- The bolus is moved up the oesophagus and into the mouth by reverse peristalsis.
- The food is then chewed again. Cows chew the cud, or ruminate, for up to eight hours each day. They make up to 40 000 chewing movements a day.

The differences between a mature ruminant and a young ruminant based on the four stomach compartments (size, functionality, etc.)

Differences in the digestive tract of mature and young ruminants

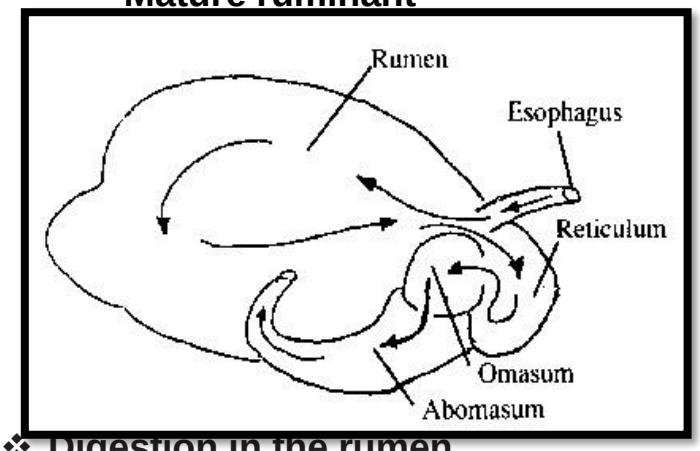
- The rumen, reticulum and omasum of young ruminants are all underdeveloped.
- The forestomach of the new-born ruminant is designed to digest milk initially.
- As the young ruminant grows older, it begins to graze, and the forestomach also begins to develop. There is therefore a difference in size and functionality between young and mature (weaned) ruminants.

Size of the stomach compartments of mature and young ruminants

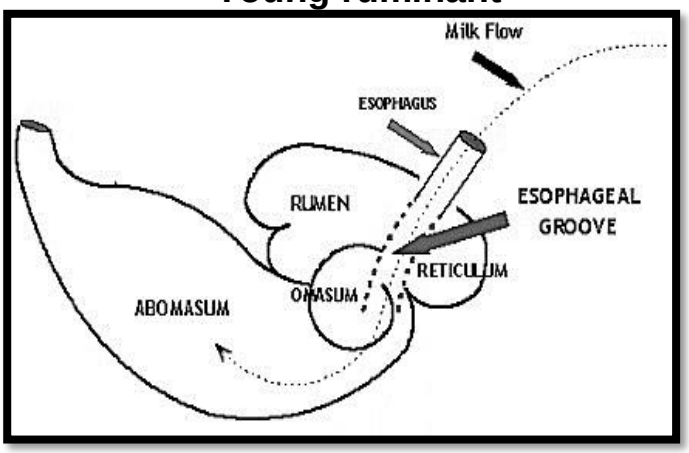
A major difference between mature and young ruminants = the size of their stomach compartments.

- At birth the rumen, reticulum and omasum of the calf are small and underdeveloped, and the abomasum is the largest stomach.
- The rumen starts to enlarge in size when the calf begins to ruminate and it is functional when the calf is three months old.
- The rumen is the largest stomach compartment in a mature ruminant.
- It is important to provide the young ruminant with concentrate and hay so that the rumen develops as soon as possible.

Mature ruminant



Young ruminant



❖ **Digestion in the rumen**

1. The concept: rumen microbes
2. The different types of rumen microbes
3. Important requirements for normal functioning of rumen microbes/microorganisms
4. The functions of the rumen microbes
5. The absorption of food in the rumen directly by osmosis and diffusion into the blood stream

BRIEF INTRODUCTION ABOUT RUMEN MICROBES

- Digestion in the rumen is a process of **fermentation**.
- **Fermentation** is carried out by microbes or microscopic organisms in the rumen.

Rumen bacteria are living organisms.

- They play a very important role in the digestive process of a ruminant.
- They live in **symbiosis** with the ruminant and enable it to digest cellulose. Symbiosis means that two living organisms live together and benefit each other.

1.Rumen microbes- are microorganism that live in the rumen → able to digest the cellulose of plants into basic nutrient components.

2. The different types of rumen microbes

1. Rumen bacteria.
2. Protozoa.
3. Fungi and yeasts.

3.Important requirements for normal functioning of rumen microbes/microorganisms?

What are their requirement of rumen microbes in order to survive?

- Easily digestible carbohydrates
- Regular intake of food for fermentation
- Sufficient mineral nutrients(Na/Cu/Co/P)
- Anaerobic/oxygen free environment
- Presence of CO2
- Sufficient nitrogen
- Suitable pH/slightly acidic pH/pH of 5,5 to 6,5
- Warm environment/temperature of 38-420c
- Continual elimination of end products
- Osmotic condition/moist environment

4.The functions of the rumen microbes (1. bacteria. 2.Protozoa. 3.Fungi and yeasts.

- Synthesis of vitamins
- Synthesis of amino acids
- Digestion of cellulose
- Hydrolysis of proteins

1. DIGESTION OF CELLULOSE / ROUGHAGE

- Micro-organism digest cellulose to form Fatty acids, carbon dioxide and methane

Over accumulation of methane can cause animal to bloat

2. SYNTHESIS OF VITAMIN

- Micro-organism can make vitamin B and K
- It is not important to include vitamin B Complex and vitamin K in the feed of
- ruminant

3. SYNTHESIS OF PROTEIN

- Micro-organism break large protein molecule into amino acids (smaller
- compound)

4. DIGEST STARCH

- Micro-organism digest starch into maltose (simpler substance)

5.The absorption of food in the rumen directly by osmosis and diffusion into the bloodstream.

Active and passive Transport

- **In passive Transport**- molecules diffuse into the intestinal cells down a concentration gradient. This means that molecules move from region of high concentration to a region of low concentration of molecules.
- Energy is required for **active transport.** Amino acids, small peptides, vitamins and most glucose move across the intestinal lining by active transport.
  Active transport is a Process that requires energy whereby molecules such as amino acids small peptides, vitamins and most glucose move across the intestinal lining into intestinal cells

Table 1: Nutrients and their corresponding end products after digestion

Nutrient	End products
Protein	amino acids
Carbohydrate	Glucose
Cellulose	fatty acids and salts of organic acids
Fats	fatty acids and glycerol
Minerals	in various soluble forms
Vitamins	in various soluble forms

Components of feed	▪ The functions (importance) of each of the following: ▪ Water ▪ Proteins ▪ Carbohydrates (sugar, starch, and crude fibre) ▪ Fats and Oils (ether extract) in animal production and growth ▪ The bio-chemical functions (importance and deficiencies) of the following mineral constituents: ▪ Macro-elements: calcium, phosphorus, magnesium, sodium, chlorine, potassium, sulphur and ▪ Trace-elements: iron, iodine, zinc, selenium, copper, cobalt

CHAPTER 3: Components of feed

TERM	DEFINITION
Amino Acids	-building blocks(monomers) of protein
Concentrates	-feeds that have high percentage of TDN (> 60%) in small volume
Crude fiber	-consists of cellulose and lignin, which are extremely difficult to digest.
Digestibility	-portion food that is absorbed by the body and not excreted
Digestible Nutrient	-The portion of the nutrient which may be broken down (digested) and absorbed and used by the body
Dry matter	-all the constituents of feed except water.
Feed	- a substance, which is eaten by a farm animal and which, after physical and chemical digestion, provides the basic nutrients which the animal needs, for maintenance growth, reproduction and production.
Maintenance ration	-amount of feed needed simply to maintain the body mass and composition of an animal (i.e. support life).
Minerals	-inorganic elements needed in small quantities in an animal's body
Nitrogen free extract	-consists of easily digestible carbohydrates like sugars and starch
Osteomalacia	-the disease found in fully grown animals when too much calcium has been removed from their skeletons.
Nutrition	Nutrition is the science of dealing with the utilization of food by the body processes which transforms food into body tissues, and energy.
Nutrient	A Nutriënt is a single class of food or group of foods that aids in the support of life and makes it possible for animals to grow or provide energy for physiological processes.
Production Ration	amount of feed that is over and above the maintenance ration which provides energy for production such as milk, eggs and meat.
Urea	-is a cheap NPN source that can be used by ruminants to synthesize proteins.

Vitamins	-organic compounds needed in small quantities in animal body

2. Components of feeds

Animals require all the essential nutrients to balance their daily ration. These nutrients become indispensable for life. All the major nutrients includes; WATER, CARBOHYDRATES, PROTEIN, LIPIDS, MINERALS AND VITAMIN**.**

These nutrients are needed for many purpose which includes:

- Regular function of the animal's system
- Protection of body system
- For growth
- For production
- For reproduction
- To perform work

1. WATER

- Made up of 2 hydrogen atom and 1 oxygen atom (H_2O)
- Water is the cheapest nutrients.
- It is a basic unit for all fluid in the animal's body
- Animals can survive for long without food, but only few days without water

SOURCE OF WATER (WAYS IN WHICH ANIMAL OBTAINS WATER)

- Drinking water
- Water from the feed it eats
- Metabolic water (water produced by chemical reactions in the animal's body)

IMPORTANCE OF WATER IN ANIMALS

- Regulates body temperature (act as a cooling agent)
- Medium for chemical reaction
- Act as a transport medium

 Act as a lubricant

WATER USAGE AND FEED INTAKE IN RELATION TO TEMPERATURE AND OTHER FACTORS

- **ON A COLD DAY** (low temperatures)

Animal drink LESS and eat MORE feed

REASON: energy released from feed is used to keep the animal warm

- **ON HOT DAY** (high temperatures)

Animal drink MORE water and eat less feed

REASON: large amount of water help the animal to cool down

2. CARBOHYDRATES

It is created by PLANTS through **photosynthesis**

It is an ORGANIC COMPOUND

It includes:

1. SIMPLE CARBOHYDRATES: **GLUCOSE**
2. COMPLEX CABOHYDRATE: **STARCH**
3. INSOLUBLE CARBOHYDRATES: **CELLULOSE and LIGNIN**

Made of element carbon, hydrogen and oxygen

Has **HIGH CRUDE FIBRE** CONTENT

FUNCTIONS OF CARBOHYDRATES

 Needed for fattening of farm animals

 Provide bulkiness of ration

 Important source of energy

BUILDING BLOCK OF CARBOHYDRATES

 Glucose

EXAMPLES OF CARBOHYDRATE RICH FEEDS

 Maize

 Wheat

 Sorghum

 Oat

3. PROTEIN

- It is the most expensive feed
- It is an **ORGANIC COMPOUND**
- It is divided into :
- **CRUDE PROTEIN**- all proteins found in feed
- **DIGESTIBLE PROTEIN**- amount of protein that was not excreted in faeces but to be used by the animal
- Made up of element carbon, hydrogen, oxygen, nitrogen and sulphur
- Has **low crude fibre content**

FUNCTION OF PROTEIN

- Needed for growth
- Needed for reproduction
- Needed for production (wool, meat, eggs and milk
- Repair worn out tissues

BUILDING BLOCK OF PROTEIN

Amino acid

EXAMPLES OF PROTEIN RICH FEED

- Soya bean
- Fish
- Bone meal
- Sunflower oil cake
- Peanut oil cake
- Lucerne

PROTEIN SUPPLIMENT

Proteins can be supplemented by **SOURCE OF NPN**;

- **UREA**- cheap source

- **BUIRET**- expensive feed

4. FATS AND OIL (LIPIDS) is an

- It ORGANIC COMPOUND

Differences between FATS and OIL

- **FATS** – Originates from animals
  - Solid at room temperature
- **OIL** – originate from plants
  -liquid at room temperature

FUNCTIONS OF LIPIDS

- Protects important organs (such as heart, liver, and lungs)
- Act as a shock absorber
- Act as an insulation material

BUILDING BLOCK OF LIPIDS

- Fatty acids and glycerol

5. VITAMINS

EXAMPLES OF VITAMINS AND THE RESPECTIVE DEFICIENCY DISEASE

DEFICIENCY

Example of fat soluble vitamin

- **Vitamin A**

Night blindness

Keratomalaise

Poor vision

- **Vitamin D** (needed for absorption of calcium and phosphorus)

Oestomalacia

Rickets

- **Vitamin E** (act as antioxidant)

Stiff lamb disease

- **Vitamin K**

Poor blood clotting

Example of water soluble vitamin

- **Vitamin B1**

Polyneuritis

- **Vitamin B2**

Curled-toe paralysis

- **Vitamin B12** (it contain element cobalt)

Poor hatching of chicken

Wasting disease

6. MINERALS

- This are inorganic substances that are required for normal body functioning
- They ar e divided into:
- **MARCRO MINERAL** – are minerals that are needed in large quantities **MICRO MINERAL** -
- are minerals that are needed in small quantities
  - They can cause metabolic disease when they insufficient

Mineral	Deficiency
Calcium	Rickets and Oestomalacia
Phosphorus	Pica (animal feed on non-feeding object)
Iodine	Goitre (enlargement of thyroid gland)
Iron	Anaemia (low **haemoglobin** in blood)
Zinc	Parakeratosis (rough skin in pigs) Keratinization (hairlessness)

❑ Copper	Swayback
❑ Cobalt	Wasting disease

❖ **The bio-chemical functions (importance and deficiencies) of the following mineral constituents.**

There is a difference between **organic and inorganic substances** in animal feeds.

Inorganic substances that have a **nutritional value** are **called minerals.** We can subdivide minerals into **macro- and micro-elements.** We make this distinction based on the quantity required by the animal's metabolism. Micro-elements are also called trace elements.

Macro elements include -calcium, phosphorus, magnesium, sodium, chlorine, potassium, sulphur

Macro-element	Bio-chemical function	Deficiencies
Magnesium (Mg)	– Healthy bones. – Activation of enzyme systems. – Necessary for carbohydrates metabolism.	– Muscle contraction. – Nervousness. – Slow growth. – Drop in milk production.
Sodium (Na)	– Used to regulate osmotic pressure. – maintain the pH of the circulatory system.It also helps the nervous system. – Help the kidney to function properly.	– Craving for salt. – Loss of appetite. – Slow growth. – Reduced milk production Sodium and chlorine deficiencies can be corrected by adding salt to the diet or providing salt licks for ruminants. However it is important to note that salt poisoning can occurif the salt intake is too high.
Chlorine (Cl)	– Essential for water metabolism. – Hydrochloric acid and chloride are important gastric secretion.	– Poor protein metabolism. – Decreased growth. – Metabolic alkalosis.
Potassium (K)	– To maintain osmoticpressure. – To regulate pH inthe body. – Required for normal digestion and to transmit nerve impulses to muscles.	– Slow growth in chicken – Muscle weakness – Lower feed efficiency – Reduced feed and water intake
Sulphur (S)	– Metabolic functions. – Amino acid and vitamin formation in rumen. – Formation of wool fibers.	– Protein deficiency. – Poor performance.

calcium	– Healthy bones and teeth. – Blood clotting. – Healthy nervous system and muscle tissue. – Maintenance of PH of the body.	– Rickets in young animals. – Osteomalacia in older animals. – Milk fever in high-producing dairy cows.
phosphorus	– Healthy bones and teeth. – Metabolism of carbohydrates. – Formation of protein, nucleic acid and cell membrane. – Muscle contraction.	– Rickets in young animals . – Osteomalacia in older animals. – Stiff sickness.

- **Trace-elements:** iron, iodine, zinc, selenium, copper, cobalt

Trace elements are inorganic minerals or micro-elements animals require in very small amounts to perform essential bodily functions. A lack of trace elements in the diet may affect animal health and production, while an excess of some may have toxic effects.

Micro-element	Bio-chemical function	Deficiencies
Iron (Fe)	Essential for the effective functioning of haemoglobin which transports oxygen around the body. Copper is also needed for the effective functioning of haemoglobin.	– Causes anaemia in new-bornpiglets raised in intensive systems on concrete floors. – Symptoms of anaemia are pale skin and membranes – weakness, laziness and sometimes swelling of the head and shoulders. – Diarrhoea – Poor appetite – Rapid breathing and accelerated heartbeat
Iodine (I)	– The thyroid glandrequires iodine to produce thyroxin hormone.	– Causes the thyroid gland to swell and form a goitre. – Low reproduction capacity. – Give birth to hairless, weak or dead young.
Zinc (Zn)	– Required for the health of the skin. – It also helps to maintaingeneral body condition and ensure effective growth of hair and feather development	– Causes parakeratosis, in pigs (skin becomes thick and rough) – In chicks, causes stunted growth, foot abnormalities and frizzy feathers. – Keratinisation (causes manginess and hairlessness of neck and shoulder)

Selenium (Se)	Is needed for the effective formation and function of muscle.	– In calves, causes white muscle disease (skeletal muscles and the heart appear pale and abnormal). – This causes stiffness of themuscles, but may also affectthe smooth muscle of the body, sometimes causing death due to heart failure.
Copper (Cu)	– Needed for the effective functioning of haemoglobin, the protein which transports oxygen in the blood. – Also necessary for the normal growth of hair and wool – Essential for the nervous system to function effectively.	– In young lambs causes swayback (weak muscles dueto poor nerve functioning and a tendency to sway and fall over). – In older lambs the copper deficiency causes steel wool (wool is discolored and lacks crimp).
Cobalt (Co)	An essential component ofvitamin B12. This vitamin is required for effective digestion of roughage, and normal growth and functionof animals.	– Causes a wasting disease in sheep and cattle, with symptoms similar to malnutrition. – Animals showpoor appetite, stunting, weakness, anaemia, decreased fertility, slow growth and poor productionof milk and wool.

4	**30/01 - 03/02/23**	**Components of feed (Continued)** **Digestibility of feeds, Quality of feed, energy value of feeds and nutritive ratio**	**The functions and two deficiencies of the following vitamins:** • **Water-soluble: Vitamin B1; B2; B6 and B12 (Vitamin B complex); and** • **Fat-soluble: Vitamin A, D, E and K** **Digestibility of feed** • **The concepts: digestibility and digestibility coefficient of feeds** • **The factors that affect/influence/determine the digestibility of feeds** • **The methods of improving/increasing digestibility of feeds** • **Calculation and interpretation of the digestibility coefficient of a Feed**

		Digestibility of feeds, Quality of feed, energy value of feeds and nutritive ratio (Continued)	**Quality of feed: biological value of proteins** • **The concepts: biological value (BV), essential amino acid index and ideal proteins.** • **The importance of animal proteins in rations** • **The evaluation of feed protein in terms of biological value, for example egg and milk** **Energy value of feed** • **The units in which energy value is expressed** • **The terminology: gross energy, metabolic energy, digestible and net- energy** • **The purpose/aims of calculating energy value of the feed** • **Schematic representation of feed energy flow** • **Calculation of feed energy flow and interpretation of the results** **Nutritive ratio** • **The concept: Nutritive Ratio (NR)** • **The purpose/aims of nutritive ratio in animal feeding** • **Calculation of the nutritive value of a feed and interpretation of the Results**

Function of the vitamin	**Deficiency symptoms of the vitamin**
Water-soluble vitamins	
Vitamin B1 • serves as a co-enzyme in carbohydratemetabolism	• loss of appetite, which results in loss of mass • weakening of the nerve cells • female animals will not come into heat • birth rate is lower and mortality rate higher • lactation decreases in cows • hens hatch fewer eggs

Function of the vitamin	**Deficiency symptoms of the vitamin**

Vitamin B2 • is a prerequisite for normal growth	• loss of appetite, which results in slow growth • skin rashes and eye abnormalities • a disease known as curled-toe paralysis occurs inchickens • pigs experience symptoms such as chronic diarrhoea,skin sores, stiff limbs and sore eyes
Vitamin B6 • is a constituent of co-enzyme A • plays a role in biochemical reactions such as fatand cholesterol synthesis • is involved in cell respiration	• leads to growth and reproduction failures • skin and hair lesions • a retardation of growth and feather developmentin chickens • scurvy skin and thin hair in pigs • pigs exhibit a characteristic goose-stepping
Vitamin B12 • plays a role in various metabolic reactions • is essential for cell division	• growth is retarded • hens experience poor egg hatching • pigs experience pain in the hindquarters, which resultsin an unsteady walk
Fat-soluble: Vitamin A, D, E and K	
Vitamin A • plays a role in the sharpness of normal vision • controls bone growth • required for a healthy mucous membrane inthe body • required for fertility in both male and femaleanimals	• poor night vision; eventually it can lead to blindness • gives rise to deformed, weak or dead young • fertility is reduced and can lead to total infertility
Vitamin D • helps with the absorption of calcium andphosphorus • plays a role in depositing calcium and phosphorusin growing bone • plays a role in the synthesis and functioning ofhormones	• a decrease in food consumption, which results inslow growth • rickets in young animals; rickets is a disease wherethe bones of the animal are weak and break easily • adult animals experience brittle bones, known asosteomalacia
Vitamin E • counteracts the oxidation of unsaturated fatty acids • plays a role in normal cell respiration	• the degeneration of embryos in fowls • muscle degeneration in sheep • liver degeneration in pigs
Vitamin K • plays a role in blood clotting	• bleeding, which cannot be stopped, and which willlead to the death; common in chickens

CHAPTER 4: Digestibility of feeds – biological value,energy value and nutritive ratio

❖ Digestibility of feeds.

- ➢ the concepts: **digestibility** and **digestibility coefficient of feeds**

TERM	DEFINITION
Biological Value (BV)	-is an index of the quality of the protein in a feed
Co-efficient of digestibility	-is a measure of the digestibility of a feed expressed as a percentage in terms of dry matter(DM).
Digestibility	-the portion of the feed that is absorbed and not excreted by the body.
Digestibility - coefficient	the proportion of a nutrient taken into the digestive tract that is actually digested
Digestible energy	-gross energy value of a feed minus energy lost in faeces.
Gross energy	-the energy that is released as heat when a feed is completely oxidized to carbon dioxide, water and gases.
Maintenance ration	-amount of feed needed simply to maintain the body mass and composition of an animal (i.e. support life).
Metabolic energy	-gross energy value of a feed minus energy lost in faeces, urine and gaseous end-products of digestion.
Nett energy	-gross energy minus energy lost through faeces, urine, digestive gases and lost as heat.
Nutritive ratio (NR)	-ratio between digestible protein (DP) and digestible non-nitrogen compounds
Production ration	-the additional amount of feed an animal needs on top of the maintenance ration in order to do work and for production

Digestibility= Digestibility of feed refers to the amount of the feed which is not excreted in thefaeces and is therefore assumed to be absorbed by the animal.

Digestibiity= is the amount of feed that is absorbed by an animal and not excreted.

Digestibility coefficient of feeds= Coefficient of digestibility is expressed as the amount of dry matter contained in the feed minus the amount excreted inthe faeces, as a fraction of the dry matter. The answer can be expressed as a coefficient or it canbe converted to a percentage.

factors that affect /**influence /determine** digestibility of feeds

- **Animal species/ type of animal:** Ruminants digest high- fibre feeds better than monogastric
- **Feed composition:** The higher the crude fibre content, the lower the digestibility

- **Processing:** Processing can improve the digestibility of feed. For example, processeswhich break up the feed into smaller pieces can increase digestibility.
- **Size of the meal/ Quality of feed taken in:** Large meals pass rapidly through the digestive tract. This willreduce the amount of digestion and therefore lower the digestibility.
- **Age of plants fed to the animal:** young plants are usually more digestible. This isbecause older plants contain more indigestible lignin.
- **Preparation of feed**: grinding, milling, boiling or soaking can improve the digestibility of cereals.
- **Individuality**: individual animal has different ability to digest food.
  - ➢ <u>The methods of improving/increasing digestibility of feeds.</u>

- **Grinding, crushing and rolling** are ways of increasing digestibility of grain feed. This makes it easier for older cattle and calves to chew the feed and it improves the taste.

- **Pellets or cubes** =Pelleting reduces the bulk and is used for outdoor feeding – because there is less wastage from wind and weather. Pelleting increases the digestibility of roughages (hay) significantly.

  - **Pelleting =**The intake of pigs and poultry improves when they are fed pelleted meal. This is because pelleted meal is easier to eat.

  - **Heating =** Grain can be boiled or roasted to soften it and expand the germ. This makes the grain more digestible.

  - **Additives/ Flavours=** Additives can be added to feed to improve or increase their digestibility.

- Grinding
- Pelleting
- Crushing
- soaking
- popping and micronizing
- dry rolling and cracking
- roasting
- mixing with molasses
- cutting hay at early stage

➢ **<u>calculation and interpretation of the digestibility coefficient of a feed</u>**

92% of 7 kg = 92/100 ×7 = **6.44** kg

96% of 4 = 96/100 × 4 = **1.92** kg

Note: In this case it is always important to **subtract the moisture content** (get rid of **the influence of moisture onthe mass**)

Digestibility % = <u>DM intake (kg) - DM excreted (kg) × 100</u>

DM intake (kg)

= <u>6.44 – 1.92</u> × 100 □

6.44

$= \frac{4,52 \times 100}{6,44} = \mathbf{70,18\%}$

This means that 70,18% of the feed is digested or absorbed by the animal which indicates that this is a feed with a high digestibility content and most of itI s taken into the blood stream of the animal to be utilised for energy, fattening or lactating purposes(production) or other life processes.

Quality of feed: biological value of proteins

TERM	DEFINITION
Biological Value (BV)	-is an index of the quality of the protein in a feed
Co-efficient of digestibility	-is a measure of the digestibility of a feed expressed as a percentage in terms of dry matter(DM).
Digestible energy	-gross energy value of a feed minus energy lost in faeces.
Gross energy	-the energy that is released as heat when a feed is completely oxidized to carbon dioxide, water and gases.
Metabolic energy	-gross energy value of a feed minus energy lost in faeces, urine and gaseous end-products of digestion.
Net energy	-gross energy minus energy lost through faeces, urine, digestive gases and lost as heat.
Nitrogen free extract	-consists of easily digestible carbohydrates like sugars and starch
Nutritive ratio (NR)	-ratio between digestible protein (DP) and digestible non nitrogen compounds
Production ration	-the additional amount of feed an animal needs on top of the maintenance ration in order to do work and for production

The concepts: **Biological value (BV)**,**Essential amino acid index** and **ideal proteins**.

a) **Biological value (BV):** is the index of the quality of the protein in a feed.
: **BV**= refers to the ability of a specific feed protein to fulfil the nutritional needs of an animal.
It is a measure of how much nitrogen is available for metabolism and growth. A feed with a high BV provides all of the amino acids needed by theanimal, whereas a feed with a lower BV does not.

b) **Essential amino acid index:** amino acid that cannot be synthesised by animals and need to form part of animal's ration or protein intake.

c) **Ideal proteins:** An ideal protein supplies all essential amino acids in the right amounts. This means that the protein has the optimal nutritionalquality. An example of an ideal proteinis the protein found in eggs. It is used as a standard for comparison with other proteins**.**

- **The importance of animal proteins in rations=** Animal proteins in rations are needed for three processes in the body.

1. **Growth:** Young animals need protein for tissue growth.
2. **Production:** The production of milk, eggs and meat requires an extra intake of protein in the diet.
3. **Reproduction:** Animals require additional proteins to produce and feed their young

- **Evaluation of feed in terms of biological value, for example egg and milk.**

- The BV of egg protein is considered to be **100**. This is because it contains all 10 essential amino acids, in the right proportions.
- The BV of milk as a feed protein is also relatively high, namely **80**. It is richer in the amino acid lysine than egg protein, but its nutritional quality is limited by a deficiency of the sulphur-containing amino acids methionine and cysteine.

- **Energy value of feed**

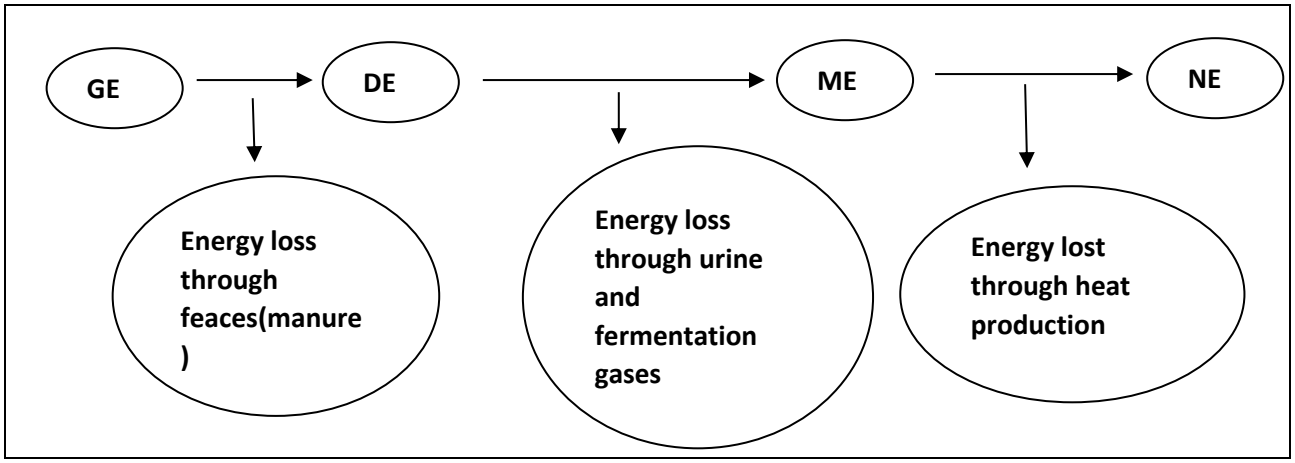
The units in which energy value (EV) is expressed

- The energy value of a feed is measured by burning a sample in a laboratory **(a process called controlled combustion).**

- **The energy value of feed is measured in terms** of
  - kilojoules (kJ). Fats have 39 kJ of energy per gram and carbohydrates have 17 kJ of energy per gram.
  - Megajoules(mj)
  - Joules(j)

Types of energy

1. **gross energy:** The total amount energy released by a feed
2. **metabolic energy:** Digestible energy in the gross minus the energy loss with urine and fermentation gases (methane)
3. **digestible energy:** is the gross energy minus energy loss via faeces.
4. **nett energy:** is the gross energy that is lost in manure, urine, gases, and body heat



	Gross energy (MJ)	Energy in urine (MJ)	Energy in faeces (MJ)	Energy for heat loss (MJ)	Energy in methane (MJ)
Energy (MJ/kg DM)	18,53 × 12 = 186,36	1,13 × 12 = 13,56	7,32 × 12 = 87,84	1,75 × 12 = 21,0	2,5 × 12 = 30,0

Digestible energy = GE – faeces
= 186,36 – 87,84
= 98,52 MJ
Metabolic energy = DE – (urine + methane)
= 98,52 – (13,56 + 30,0)
= 98,52 – 43,56
= 54,96 MJ
Net energy = ME – heat increment
= 54,96 – 21,0
= 33,96 MJ

The cow will have 33,96 MJ energy available from the 12 kg of food she consumed to use for maintenance and production purposes.

Calculation of feed energy flow and interpretation of the results

Determine the net energy that a cow will have after 100 KJ of energy. 30% of the energy consumed is lost in feaces, 8% is lost as methane gas, 5% is lost in the urine and 30% lost to the atmosphere as Heat loss.

The purpose/aim of calculating the energy value of feed:

- To determine the animal diet.
- To determine feeding standard.
- To determine ration formulation.

❖ **Nutritive ratio**

- the concept: nutritive ratio (NR) = The nutritive ratio is the ratio between the digestible protein compounds and the digestible protein compounds and the digestible non-protein in a ration of feed compounds.
- Is an indicator of the a feed.
- The NR is the ratio between the type of production and loss of heat.

The purpose/aim of the nutritive ratio in animal feeding.

- Nutritive ratios are used to differentiate the nutritive requirements that are used by the animal for maintenance, growth, reproduction and production.
- It is used to determine whether or not a feed is suitable for specific animal species during a specific phase of its production cycle
- It is used to determine whether or not a feed is suitable for The fattening phase during the production cycle of a specific animal.

For maintenance	**For growth**	**Milk production**	**For reproduction**	**For fattening**
NR between1:6 and 1:8 not wider than 1:8	NR 1:5 or less	NR 1:5 or less	NR less than 1:5	NR 1:9- 1:10
Protein needed for thereplacement of tissue	Lots of protein needed of high biological value	Lots of protein needed of high biological value	Lots of protein needed of high biological value	Protein only for maintenance
Carbohydrates,fats and vitamins only for maintenance	Carbohydrates,fats and vitamins only for maintenance	Sufficient carbohydrates and fats for maintenance and production	Carbohydrates,fats and vitamins for maintenance. An increase needed to support last third of pregnancy	Carbohydrates and fats needed in largequantities
Minerals only for the replacement of losses	Sufficient minerals and vitamins for growth	Sufficient minerals and vitamins	Sufficient minerals and vitamins	Minerals and vitamins for maintenance

Calculation of the nutritive value of a feed and interpretation of the results

A feed contains total digestible nutrients of 80% and a digestibleprotein of 8%

1. Calculate the nutritive ratio of this feed. (3)

2. How would you describe the nutritive ratio of the above feed?(1)
   Indicate the use of this feed. Explain your answer (3)

1.This is non nitrogen substances, therefore the protein componentmust be subtracted.

Nutritive ratio (NR)= 1: % Digestible non nitrogen substances

% Digestible proteinThus

$$\frac{80 - 8}{8} = \frac{72}{8} = 9$$

The nutritive ratio is the 1: 9

2. The nutritive ratio of this feed is wide
3. This feed would be used for fattening, because the it contains relatively few digestible proteins and a relatively higher proportion of other digestible nutrients such as carbohydrates and fats

ANALYSIS OF NUTRITIVE RATIO

- **RATIO ABOVE 1:6**

 It's a WIDE RATIO

 Has LESS PROTEIN and MORE CRBOHYDRATES

 NOT SUITABLE for growth and production but SUITABLE for fattening and maintenance

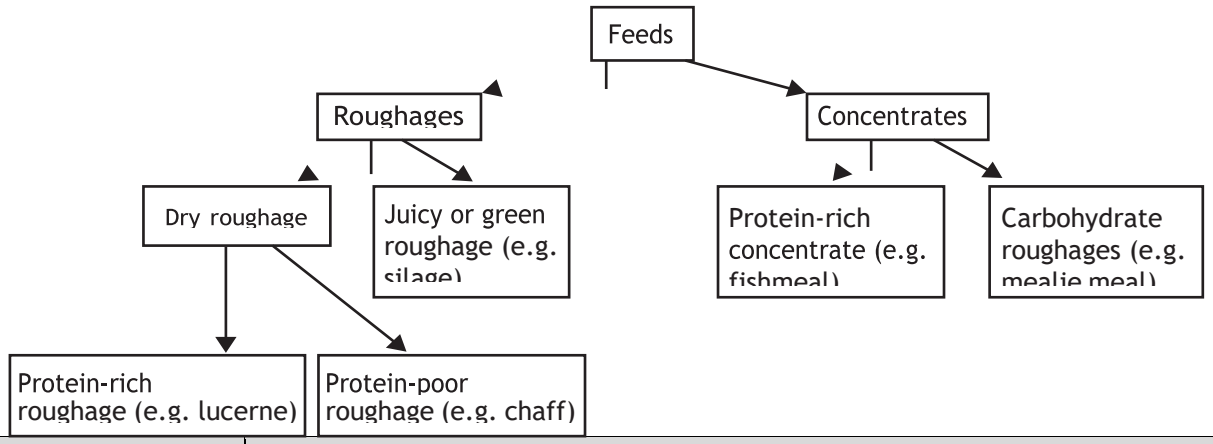
- **RATIO BELOW 1:6**

 It's a NARROW RATIO

 Has MORE PROTEIN and LESS CARBOHYDRATES

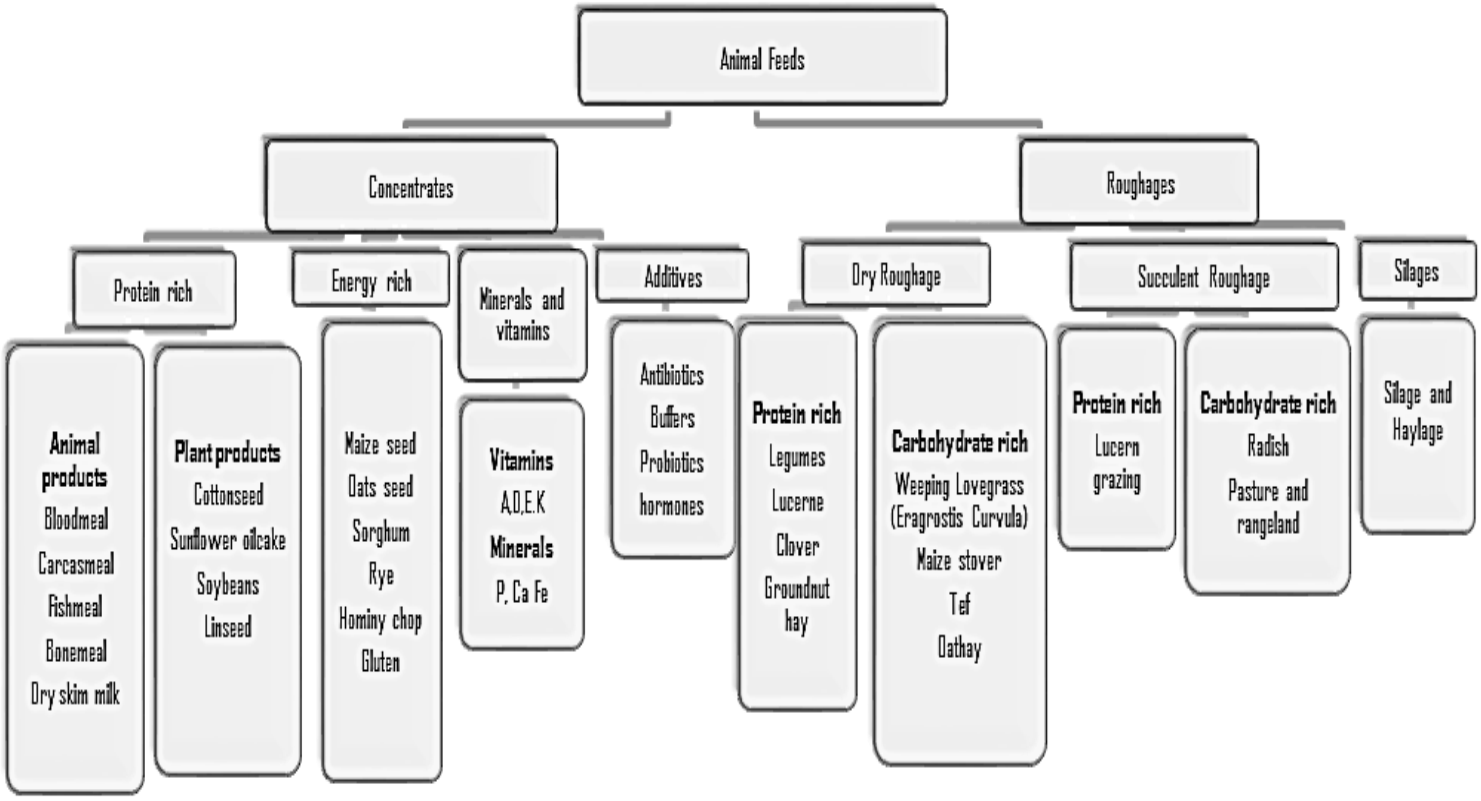
 MOST SUITABLE for growth and production but NOT SUITABLE for fattening and maintenance

- Types of feed



TERM	DEFINITION
Balanced Rations	-feed that supply the needed nutritional requirements to farm animals
Bloating	- accumulation of gases in the rumen, causes excessive constipation which may be fatal to the animal.
Cafeteria style	– the type of mineral provision that depends on the animal to take in as much as it requires.
Concentrates	- feeds that have high percentage of TDN (> 60%) in small volume
Dry matter	- all the constituents of feed except water.
Forage	- is plant material eaten by grazing livestock
Fodder	- a type of animal feed, is any agricultural foodstuff used specifically to feed domesticated livestock,
Maintenance ration	-amount of feed needed simply to maintain the body mass and composition of an animal (i.e. support life).
Molasses	-a sugarcane by-product energy supplement added to a winter lick for ruminants.
Nitrogen free extract	-consists of easily digestible carbohydrates like sugars and starch
Production ration	-the additional amount of feed an animal needs on top of the maintenance ration in order to do work and for production
Roughages	- feeds that have small percentage of TDN (< 60%) in small volume
Silage	-is a fermented feed resulting from the storage of green forages under anaerobic conditions
Feed Supplements	Feed supplements are the compounds used to improve the nutritional value of the basal feeds so as to take care of any deficiency
Feed Additives	Feed additives are the non-nutritive substances usually added to basal feed in small quantity for the fortification in order to improve feed efficiency and productive performance of the animals. Some commonly used feed additives are as below

Schematic representation of feed types



classification of animal feeds:

- Animal feeds can be classified according to the concentration of nutrients in them.
- Animal feeds can be subdivided into **roughages** and **concentrates** based on their origin and fibre content.
- Feeds high in crude-fibrecontent are called **roughages.**
- Feeds with a high concentration of nutrients with little crude fibre are called **concentrates**. There are also several subcategories.

1. Roughages- have high crude fibre content and are consequently bulky. Per unit of mass and volume theycontain very few digestible nutrients (not more than 60%).

Roughages (often called forage or fodder). Roughages are mainly used to feed ruminants as they contain cellulose, which only rumen microbes can digest.

Forage refers to plants that are eaten where they grow, whereas **fodder** refers to plants which are harvested and taken to animals.

The characteristics of roughages :

- high nutritive value with more than 60% TDN
- High fibre content.
- Low percentage of digestible nutrients.
- Low in readily available carbohydrates.
- Low weight to volume ration.

Different types of Roughage:

a) Roughage with a good nutritional source, this includes, **young grass, hay, legumes, high quality** juicy silage.
b) Roughage with a poor nutritional source, this includes **straws, chaff and hulls**.

Function of dry roughages

- Ruminants are depended on roughage.
- Cheapest source of feed.
- Provides bulkiness to the ration.
- Roughage enhances rumen development in young ruminants.
- Dry roughage prevents bloating in ruminants

Protein-rich roughage	**Characteristics of Lucerne Hay**	**Suitability of Lucerne hay**	**Suitability for supplying protein**
Examples: Lucerne hay, Cowpea / Peanut Hay	• Most nutritious of all hays. • Extremely rich in calcium. • Relatively rich in proteins. • Lucerne is palatable. • Green Lucerne tends to cause frothy bloat in ruminants	• Growth – suitable for growth purposes.. • Production – extremely suitable especially with ruminants. Energy – excellent for horses, but must be supplemented with mealie meal Fattening – unsuitable, needs a supplement of maize	**Good**
Carbohydrate-rich roughage (Protein poor	**Characteristics of oat hay / straw**	**Suitability of oat hay**	**Suitability for supplying protein**
Examples: Mealie plants, oat hay, straw from cereals, grasses	• Poor in protein. • Very tasty. • Low digestibility. • Cheap roughage. • Poor in vitamins and minerals. • Supplies the bulk to the ration.	• Growth – unsuitable for growing animals. • Fattening – suitable, if supplemented with carbohydrate-rich concentrate. • Production – must be supplemented with protein-rich concentrate. Energy – poor if not supplemented	**Low**

Examples of Roughage.

- Silage
- Lucerne
- Legume hays
- Oats
- straw

2.Concentrates

Concentrates- are expensive animal feeds that have a small volume per unit mass. The fibre content is low. In other words, Concentrates are not bulky and are generally very pricey.

- Concentrates are feeds with either a high protein content, such as fishmeal, or high energy content, such as maize meal.
- They have a high TDN, greater that 60%, and so have a high nutritive value.
- Concentrates can be of plant or animal origin.
- Both ruminants and non-ruminants can be fed with concentrate diets. They have high levels of **protein or carbohydrates, depending on their type.**

Characteristics of concentrates:

- High nutritive value with more than 60% total digestible nutrition
- Not bulky feeds
- Protein rich only suitable for non-ruminants
- Concentrates are used to balance roughages by providing more protein and energy for the animal.
- Pigs and fowls are fed concentrates because they cannot digest roughages.
- Intensive meat and dairy production animals need to feed on concentrates.
- Concentrates are used for fattening animals for slaughter.

Different types of concentrates

- Protein rich concentrates
- Carbohydrates-rich concentrates

Functions of concentrates

- Provide animal with 60% total digestible nutrients.
- Used to increase milk and meat production.
- Necessary for fattening, growth, and reproduction.
- Protein-rich concentrates are a very important food source for non-ruminants such as pigs and poultry.
- Protein-rich concentrates supply essential amino acids which the animals need from their diets.
- The protein in these concentrates can also be utilized by ruminants. The ruminants break down protein concentrates and use them as an energy source.

Examples of concentrates.

a) Carbohydrate-rich concentrates from:
   - Maize
   - Oats
   - Barley
   - Rye
   - sorghum

b) Protein-rich concentrates from plants like:
   - Lupins
   - Groundnut
   - sunflower

c) Protein-rich concentrates from animal include:
   - Fish meal
   - Carcass meal
   - Crayfish meal

➢ Subdivision of feeds

the comparison between protein-rich and carbohydrate-rich types of feeds (examplesof protein-rich and carbohydrate-rich feeds).

Feeds can be subdivided into two groups based on their main source of energy, namely carbohydrate-rich and protein-rich type feeds.

Comparison between protein-rich and carbohydrate-rich type feeds		
Type of feed	**Main energy source**	**Food sources**
protein-rich	high protein levels	**animals:** milk powder, fishmeal, carcass-meal, blood meal; **plants:** legumes (lucerne and clover), beans (soya)
carbohydrate-rich	high carbohydrat elevels	cereal grains (maize, wheat, oats) and oil-rich seeds (sunflower)

Balancing a ration.

To achieve the best production from your farm animals you must provide them with optimum nutrition throughout the production cycle. A ***ration*** is the amount of feed an animal receives in a

24-hour. ***Rations*** must be properly ***balanced*** for farm animals to use feeds most efficiently. ***Ration balancing*** is another management tool the efficient producer can use to maximize profits.

An easy way to balance a ration is the use of the **Pearson Square. The Pearson square** can be used for balancing proteïen feeds and energy feeds **Step 1.**

Draw a square and write the percentage of the required nutriënt number in the middle of the square. That number represents the nutritional requirement of

Step by Step the animal. Eg CP – Crude Proteïen

Step 2. Write the CP of the available feeds to use in the ration on the left of the square at each corner. NB select the feeds so that the number in the middle of the square fall between the numbers on the left.

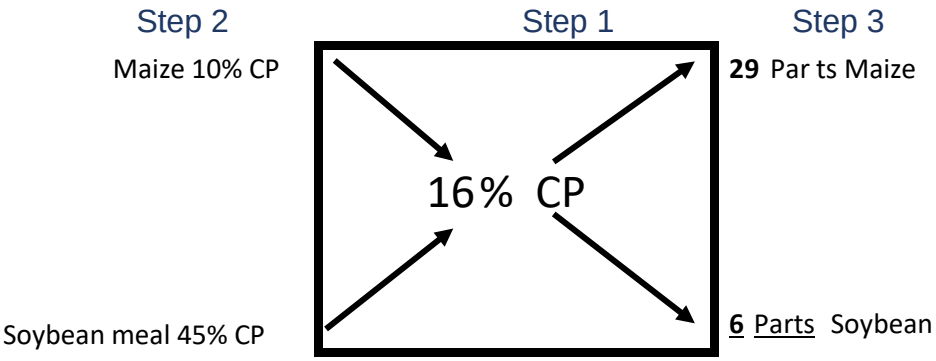
Step 3. Subtract the nutrient values on the left from the nutritional requirement in the middle disregarding any negative as follows. The subtracted value from the top left corner is written at the bottom right corner and visu versa.

Step 4. Add the subtracted values of the feedstuff parts together to determine the total.

Step 5. Divide the ingredient for which you want to know the ration by the total parts. Multiply by 100 to determine the percentage. Round if necessary.

Step 6. To determine the amount of each feed ingredient, multiply the percentage of each ingredient by the total amount of feed desired.

Eg. Mix a ration with 16% CP nutriënt requirement for cattle using Soybean meal and Corn as feedstuffs. Calculate the percentage of feed used in the ration. Also the kg of each feed needed in a 500 kg mixture.



35 Total Parts **(Step 4)**

Ratio of maize to Soya (29:6) Step 5

To determine the percentage of Maize to use in the ration 29/35 * 100 = 83% Determine the % of Soybean meal to use in the ration 6/35*100= 17%

To determine the kg of maize meal to use in a 500kg ration 500 x .83 = 415kg

Determine kg of soybean meal to use in 500kg ration 500 X .17 = 85 Kg

500 kg

Thus in a 500kg feed mixture you will the mix 415 g maize meal and 85 kg soybean meal to get a 500kg ration with 16% CP to feed to cattle.

- **supplements to rations**

supplements: this are substances that are added to normal ration when they are absent or lacking from the ration.

Supplement will provide the required nutrients for growth, reproduction and heathy body.

The different ways of supplementing: minerals, vitamins, non-protein nitrogen andgrowth stimulants

Supplement may be:

- Vitamins.
- Minerals.
- NPN (non- protein nitrogen).
- Growth stimulants.
- Synthetic amino acids.

1. **vitamins**

ways of supplementing vitamins

a) injection
b) drinking water
c) adding to the ration.

2. **minerals**
   ways of supplementing minerals

   a) **mineral lick**= blocks that contain salts and minerals are placed close to drinking water and animal lick
   b) **drinking troughs**= minerals are added to drinking troughs of soluble phosphate salts.
   c) **Dosing**= placing of minerals into the mouth of the animal (needs more labour)
   d) **Supplementing rations**= minerals are added to the concentrate feed.
   e) **Injection**= minerals are injected to animals that shows mineral deficiencies
   f) **Cafeteria**= style mineral provision-minerals are provided to animals, and they take the them when they need them.

3. **NPN non-protein supplements**
   a) Urea = cheap nitrogen source for ruminants.
      =They are supplied as part of mineral licks; it is poisonous if supplied in
         a. Large quantities.
   b) Biuret= it is an expensive nitrogenous source less soluble and safer to use.

4. **Growth stimulants/ growth regulators**
   a) **Growth hormones=** growth promoting hormones it is stimulated growth it is available in pullets that are implemented under the animal skin.
   b) **Thyroid regulator=** regulates secretion of thyroxines (thyroid gland, helps in metabolic processes)
   c) **Anti-biotics=** prevent animals from getting diseases
      =animals stay healthy/ this are added to animal feeds
   d) **Tranquilizers=** given to animals that shows a sign of stress/ they become calm and eat more.

- **planning a feed flow programme**
  - the terminology: feed flow program, maintenance and production ration
  - a brief overview of the Pearson square method (feed formulation)
  - calculation and the drawing of feed requirements using a single Pearson square method
  - the interpretation of the Pearson square results for feed mixtures
  - fodder/feed flow/fodder production planning
  - the importance of fodder flow/fodder production planning
  - basic calculation of a feed/fodder flow program for a group of livestock (number of animalsand feed needed over a period)

<table>
<tr><th>TERM</th><th>DEFINITION</th></tr>
<tr><td>Animal unit equivalents (AUE)</td><td>Standardising grazing demand among different herbivore species. An AUE expresses the quantitative forage demand of a particular kind and class of animal relative to that of an animal unit, based primarily on metabolic bodyweight
<table>
<tr><th>Type of Herbivore</th><th>Animal Unit Equivalents</th></tr>
<tr><td>Mature Cow, Non-Lactating</td><td>1.0</td></tr>
<tr><td>Mature Cow, Lactating</td><td>1.2</td></tr>
<tr><td>Mature Bull</td><td>1.2</td></tr>
<tr><td>Sheep, Mature, Non-Lactating</td><td>0.2</td></tr>
</table>
</td></tr>
</table>

Carrying Capacity	Number of grazing animals a management unit is able to support without depleting rangeland vegetation or soil resources.
Fodder flow programme	Enough feed for all the animals through(all year round) the year
Fodder	Includes all grazing, hay, silage, and roots available on the farm
Feed/fodder Intake	Amount of feed voluntarily consumed by an animal
Stocking rate	Actual number of animals on a management unit throughout the time period of grazing.

Topic 2: Animal production systems

Term	Definition
Breeding	the mating and production of offspring by animals.
Carrying capacity	is the maximum stocking rate possible while maintaining or improving vegetation
Environment	the surroundings including all external factors where the animal lives and operates.
Intensive animal farming	is a system where large numbers of animals are concentrated in a small area.
Large-scale or commercial farming	is a farming system which usually involves large numbers of animals
Nutrition	the process of taking food into the body and absorbing it for maintenance, growth, reproduction, repair of worn tissues.
Stock density	is the number of animals on a specific area of the pasture for a specific period of time **or** Is the number of animals on a given piece of land over a particular period of time
Stocking rate	Is the number of animals on a given piece of land over a particular period of time **or** is the number of animals on a specific area of the pasture for a specific period of time

There are various ways to raise farm animal. The different ways to raise farm animals are called production systems. The two main production systems are intensive and extensive production systems. They are used in the two main types of farming systems: **large-scale (commercial) farming** and **small- scale (or subsistence) farming.**

Description and comparison of intensive and extensive animalproduction systems

The term extensive and intensive in animas production refer to the how many numbers of animals are kept per unit of surface area. **An intensive animal production system** is one the in which the are large number of animals kept in a small area. **Intensive production** Is an agricultural production system that is characterised by high inputs of capital, labour, or intensive usage of technologies, such as pesticides and chemical fertilisers

Intensive Farming	Extensive Farming
High labour and capital use	Less input of labour and capital
High animal population density compare to land	Low animal population density to area/land available
Large output per land size	Small output per land size
Generally closer to the market area	Largely distant from market areas

Three common types of intensive farming production are:

1) **commercial dairies:** large numbers of lactating cows are fed and milked
2) **broiler production:** large numbers of birds are raised in well-designed poultry houses.

3) **feedlots:** young sheep and cattle are kept in small camps and fed rations which will fatten or grow the animals to market readiness

An extensive animal production system is one in which animals are kept on a large surface area, it can involve small numbers of animal or large number of animals. **Intensive production** is an agricultural production system characterised by few labourers and less capital intensive operation, were farmer uses few inputs on large areas of land, example extensive farming **is the keeping of ruminants**, such as sheep on natural pastures.

Differences between intensive and extensive production systems		
	Intensive systems	**Extensive systems**
Surface area used	small area	large area
Number of animals	large number of animals	small/large but spread over large area
Nutrition	food provided	animals forage for themselves but food canbe provided
Housing	specialised, usually closed housing needed	simple shelters or open housing
Marketing	supplies markets	can be for markets or own use

Differences between small-scale and large-scale farming systems		
Factors	**Small-scale or subsistence farms**	**Large-scale or commercial farms**
Size of farm	Small	large
Number of animals	Small	large
Purpose of farming	own use	commercial markets

The differences between <u>small-scale/subsistence</u> and <u>large-scale/commercial</u> farming systems.

1) **Subsistence farming system.**
   - Subsistence farming is a form farming in which farmer grows a variety of crops and livestock to meet the needs of their family rather than selling to markets.
   - Small-scale farming is usually on a small property such as in a backyard and they involve small numbers of animals.
   - Subsistence farming is widely practiced by rural communities in Africa.
2) **Commercial farming systems.**
   - **Large scale of commercial farming system** involves large numbers of animals, animals are either housed or raised extensively on veld, and the main aim of commercial farming is to sell products to market.
   - They are usually large-scale operations and frequently consist of monoculture.

Impact of commercial farming systems on the environment

- Commercial farms require the use of insecticides, fertilizers, irrigation system and machinery which can harm the soil organisms and destroy soil texture.
- Now let's work together to find out how **Monoculture, Fertilizers, Excessive irrigation, Machinery** use in commercial farming systems can have impact on the environment.

<u>Factors to increase animal production under intensive farming</u>

1) Nutrition/feeding
2) Environment
3) Reproduction/breeding and
4) General enterprise management

Raising animals in intensive systems allows an increase in production. Various factorsmust be addressed to achieve this. We look at broiler production as an example.

1. Nutrition and feeding

Commercial broilers are hybrid birds that are selected for their ability to grow rapidly when fed a nutrient-rich diet. This ensures that the broiler is ready for themarket at roughly 30 days of age.

2. Environment

Broilers are generally raised in well-designed houses:
where they are fed good quality food, so they do not have to use energy looking for food that protects the animal from the excesses of the weather which can cause disease and death, and which can reduce their food intake that have artificial lighting in winter which increases their food intake and therefore their growth.

3. Breeding

To increase production under intensive farming Farmers can use genetically-modified animals that are adaptable, that produce high quality animal products, and also resistance to diseases and pest.

4. General enterprise management

Intensive broiler production systems are very economical, but they must be managed properly to avoid deaths and loss of production.

- **Hygiene:** Avoid Overcrowding amongst birds, overcrowding can cause hygiene problems. This includes the build-up of ammonia from the faeces.
- **Housing design:** contraction of strong shelter to protect broiler during hash conditions.
- **Good ventilation:** Houses must be well ventilated because poor ventilation can cause respiratory problems in the birds.
- **Feeders and watering points:** There must be enough feeders and watering points evenly spaced throughout the house so that the birds to have easy access and prevent weight loss.
- **Disease management:** Broiler farms have an intensive vaccination and medication programme to limit the effects of disease. The broiler house is managed as an all-in-all-out system. This means that all the birds are removed and slaughtered at the same time. The house is then cleaned and disinfected before new birds are brought in.

Animal shelter/ protection/ housing

Term	Definition
Backyard system	the system of using part of the homestead as mini farm for growing crops and raising animals
Feedlots	a plot of ground/building where livestock are fattened for the market.
Feed shed	it is a building that is used to keep animal feed
Free range	a system of animal management where animals are not confined and can roam and forage over an area of open land.
Holding shed	it is a building that is used to shelter animals for a limited period of time
Hoppers	containers for grain which narrow near the bottom and release grain from this end.
Hyperthermia	condition in which the body temperature is much higher than normal.
Hypothermia	condition in which the body temperature is much lower than normal.
Shelter	is a place giving temporary protection from bad weather or predators, includes, simple shelters, open and closed housing, sheds, holding pens and crushes.

Thermoregulate	control the body temperature to its optimum level.
Ventilation	the entry and circulation of air freely.
Watering points	is the place where livestock receive their water.

Important or reasons for shelter/housing

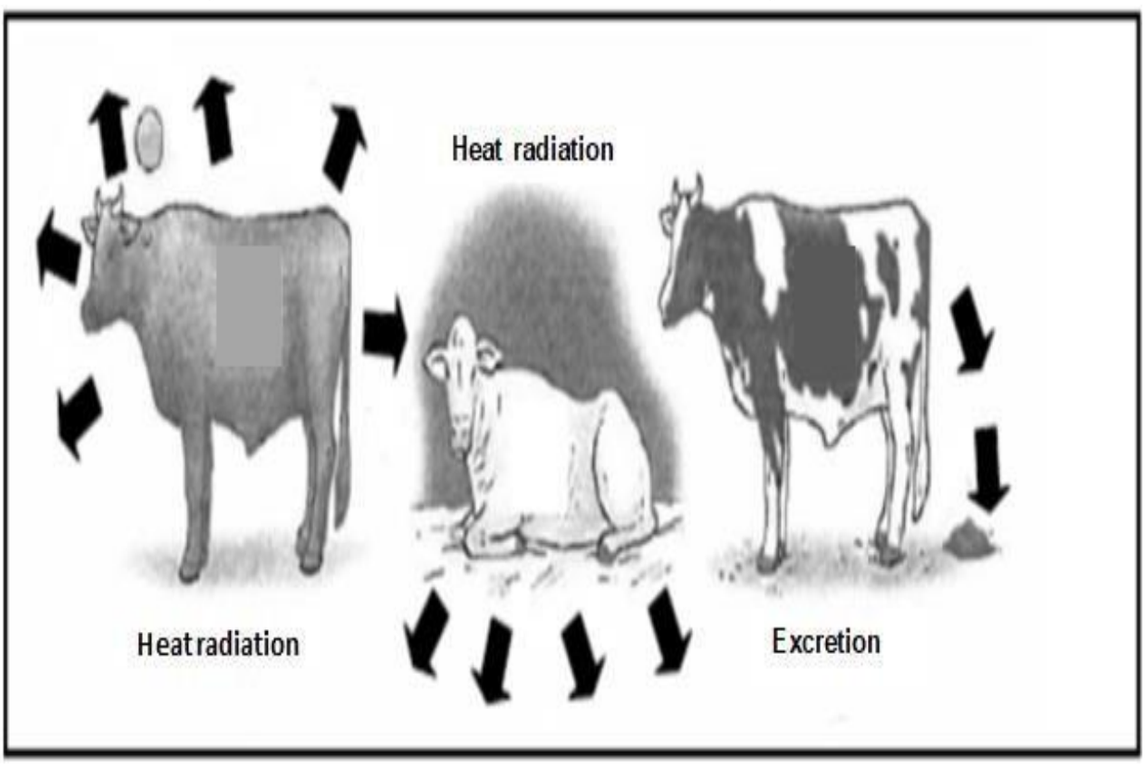
- To protect animals from severe cold, (causes results in hypothermia.)
- To protect animals from extreme heat, Death due to hyperthermia can be caused by extreme heat.
-
- To protect animals from Wetting: Wetting by rain causes chilling of the animal because it lowers the body temperature and uses up valuable energy. It can cause damage to the wool of sheep. For example: sheep can suffer from fleece rot, or a skin infection called lumpy wool.
- To protect animals from Strong sun: Pigs with light skins can suffer from sunburn and so they need protection from sunlight.
- To reduce chances of predation which results in high production.
- To protect animals from strong Wind: Strong prevailing winds can cause chilling.

Shelter and housing protect animals against:

- Severe cold
- Wetting by rain
- Strong sun
- Extreme heat

Different ways in which animals lose body heat

- **Evaporation** is the loss of heat when sweat dries out of the skin.
- **Heat radiation** is the loss of heat that radiates from a warm body into the colder surrounding atmosphere.
- **Conduction** is the loss of heat when an animal's body is in contact with a colder surface area. E.g wet soil
- **Convection** is the upward movement of warm air and downward movement of cold air.
- **Excretion** loss of body heat when urine and faeces leave the body.



Management strategies to reduce heat loss through heat radiation

- Provide shelter**.**
- Access to drinking water
- Breeding heat adapting animals.

Signs of heat stress in animals

- Excessive salivation
- Loss of appetite
- Restlessness
- Decrease in production.

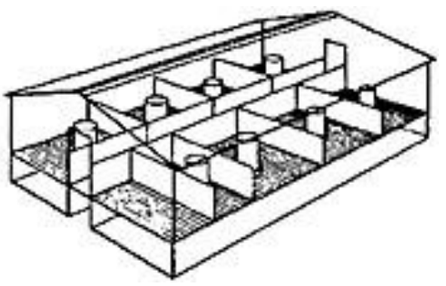
The different structures used for sheltering/housing livestock

The type of farming enterprise or system (e.g. extensive animal production or intensive animal production) determines the type of shelter used.

- Simple shelters and screen
- Open housing
- Closed housing
- Sheds
- Holding pens and crushes

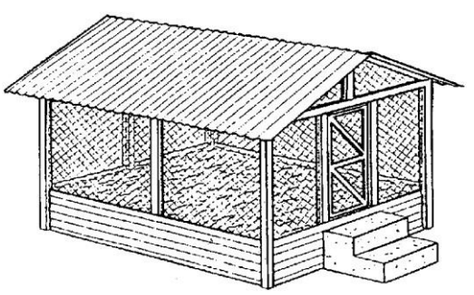
Different structures used for sheltering

Pigs: Pigsties are made from bricks, cemented floors and poles. In intensive pig production system, the pigsties have furrowing pens, rearing pens and fattening pens.



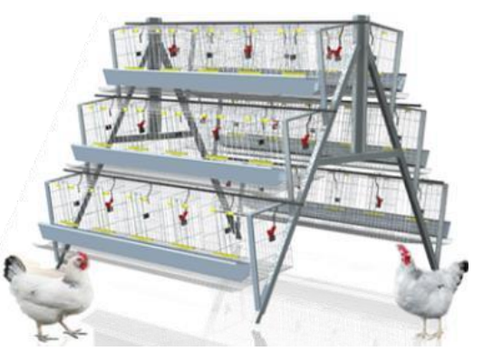
Pigsty

Chickens: Intensive chicken production system uses deep-litter and battery cages to house the birds. The deep-litter system is made from permanent materials that are easy to clean.



Deep-litter house

The battery cages are made from wire. These cages are placed in the fowl run.



Battery cage

Dairy cows: Structure used for milking cows must be easy to clean. A large number of dairy cows needs a milking shed with buildings such as milking parlour, milk room, feed shed and holding pen.

Milking parlour

Feed shed

Different housing is provided for backyard systems, intensive systems, free range systems and semi-intensive systems of animal production. All these animal production systems relate to pigs, poultry, sheep, goats and cattle. These are general and common livestock in South Africa.

Holding sheds: used to keep a lot of animals and protect them from elements. Water and food are provided especially when the animals are kept for extended periods.

Holding pens: these are used to keep animals before handling them. These are generally in the open without overheard covers. Water and food are provided.

Feed sheds: some animal feeds including supplements are not available on the farm. The feed is brought to the farm and stored in the shed. The feed sheds protect animal feed from spoilage due to rain, rodents and insects.

Handling facilities: these are used to handle animals for a number of reasons.

The different intensive production systems

1. Backyard systems
2. Intensive/semi-intensive system
3. Free range systems (e.g. poultry, pig, dairy production system)

1. Backyard farming

Farm animals are sometimes raised in backyards in buildings such as garages. These systems are not usually suitable because they have poor ventilation, rough unhygienic floors and they do not receive sunlight. Intensive farms in backyard buildings often experience health problems and are in violation of some municipal and health by-laws.

2. Intensive/semi-intensive systems

Intensive and semi-intensive systems include closed animal houses, open houses with pens, holding pens for handling animals, shearing sheds or milking parlours, and feed stores. The system will be chosen based on the type of animal being raised.

Free range systems are in between intensive and backyard enterprises. Animals are provided with housing but they also have access to enclosed camps in which they forage for food.

2.1 Free range poultry production system

In this system, layers are given a house where they can lay eggs and roost, and a run in which they can exercise, sunbathe and investigate their surroundings. They are able to scratch around for food

but they are also given enough food to meet with their production needs. This kind of housing allows for a more stimulating environment than intensive systems. Animals are therefore less likely to be bored, stressed or develop behavioural abnormalities.

2.2 Free range pig production system

This system provides a shelter and open pens, and sometimes a mud wallow or a sprinkler system to keep pigs cool.

The shelter is in the form of permanent open-sided houses or mobile houses like corrugated barrels. The pigs use the pens to move around in, rootle in soil and to defecate.

The pens can be rotated around the house or the house can be moved to keep the pen area hygienic.

Crops can be planted where the pigs have fertilised the soil. Pigs can forage for some of their food but they can also be provided with feed. The amount of feed given will depend on the level of production.

2.3 Free range dairy production system

Most small dairies in South Africa are free range systems as the cows are grazed in a series of open camps. They usually graze on forage or they are fed fodder such as silage.

These camps must provide shade and some solid shelter from rain.

The cows are brought into a holding pen and from here they move into the milking parlour. (Calf houses are sometimes used to separate individuals and limit the spread of infection.)

Separate milking stalls, divided by rails, usually contain feed troughs to encourage and train the cows to enter the stalls.

Milking is done by hand or with milking units, and the milk is stored and chilled in a milk room next to the milking parlour.

The basic housing or shelter requirements/guidelines for an intensive production system.

Holding sheds, Feed sheds and Holding pens

1. Basic requirements for feeding sheds.

- constructed of suitable materials that will not injure the animals
- have overhead shelter that prevents feed from being wetted by rain
- provide shelter from sun, if they are open
- have enough feeders to prevent dominant animals from keeping other animals away
- have a good water supply that is in the shade to prevent evaporation and concentration of mineral salts
- be regularly cleaned to prevent rodent problems

2.Basic requirements of holding pens and holding sheds

- must be constructed with suitable materials that will not injure the animals:
- well-built with strong metal, cement or wooden poles to support cross poles or wire netting
- no barbed wire, corrugated iron, sharp edges or protruding poles or nails which could injure animals
- gates that allow flow of animals to their destination.

The basic Equipment and tools for intensive housing systems.

1. Feeders
2. Water supply
3. Bedding r litter
4. Lighting

1. Feeders: Feed is the most expensive item in any farming setup. It is therefore important to prevent unnecessary wastage and spoilage. Feeders must be spaced to ensure that all animals receive sufficient food for their needs.

2. Water supply: Clean, fresh drinking water is an essential requirement for animals kept in intensive systems. Water containers and piping must be made of material that can be easily cleaned and disinfected.

●Automatic drinkers are used in intensive poultry farms. They are connected to a pipe system which delivers water into the container or tube. This also allows the farmer to deliver vaccine and medication in the water. Examples of commonly used drinkers are the Bell type, troughs and nipple drinkers.

→ Most farms favour the nipple system because they are less wasteful and labour intensive, and more hygienic because they prevent litter wetting.

→ Nipple drinkers deliver a drop of water from the end of a tube when the bird pecks at it. Intensive piggeries also use this system because of the advantages discussed for poultry. Semi-intensive systems either use nipple drinkers or troughs which are filled automatically or manually.

3.Bedding or litter: Used in intensive and semi-intensive systems to keep animals warm and dry. For poultry, wood shavings are preferred in deep litter systems such as in broiler houses. Other options include sunflower seed shells, chopped wheat straw and crushed peanut shells. Hay and maize stalks must be avoided because they carry a large amount of fungal spores. Sawdust is not generally used because it is too fine and creates dust.

●Straw can be used as bedding for dairy stalls, calf housing, sows units, free range houses for pigs and to line the nest of hens.

4.Lighting: Artificial lighting is used mainly in intensive poultry production to increase the number of daylight hours. This increases the feed intake and growth rate of broilers and ensures continuous egg production throughout the year by layers. The layers moult and decrease their egg production during autumn under natural conditions due to a shortening of daylight hours. But artificial lighting increases the farm's power usage.

Common behaviour of the following farm animals under various conditions:

1. Large Ruminants.
2. Small Ruminants.
3. Intensive non-ruminants (pigs) and poultry.

1.Common behaviours of large ruminants

General behaviour of large ruminants: Domestic cattle are social animals that gather in herds. The herd has a hierarchical structure, which means that some animals dominate others by showing an aggressive display. The hierarchy of dominance becomes important when food is limited as the animals will then compete and the most dominant animal will get the most feed. This behaviour is used to communicate dominance without injuring the subordinate animals.

Aggression is shown when by lowering of the head, bellowing, and pawing the ground.

Breeding behaviour of large ruminants

The breeding behaviour of cattle follows a pattern.

A cow on heat becomes excitable, mounts or butts head with other cows and seeks out the bull. The bull responds to the smell of the cow's urine. When the cow is ready, she will stand still for the bull and allow him to mount her and mate.

Maternal behaviour of large ruminants

Cows about to calve show specific maternal behaviour.

- They will look for an isolated shelter with a soft, dry surface to lie on.
- The cow licks the calf and eats the afterbirth immediately after calving.
- A strong, specific maternal bond forms if the calf is allowed to stay with her.

Abnormal behaviour of large ruminants

- Various types of abnormal behaviour are seen in cattle. This behaviour is most commonly seen when they are ill.

2. Common behaviours of small ruminants

General behaviour of small ruminants

Sheep form strong social groups and bonds within a flock and they stay close together while grazing or being herded. This is called **mobbing behaviour.**

- If you handle sheep routinely they become tame and will readily learn to enter camps or chutes.
- Unlike cattle, sheep have a poorly defined hierarchy, and they seldom show aggression, except among rams during the breeding season.

Breeding behaviour of small ruminants

Ewes on heat will seek out the rams and stay close beside them. The smell of the ewe in oestrus will stimulate the ram. The ram will smell the ewe's urine and he will extend his neck and curl his lip (flehmen) in response. A ewe on heat will stand for mating.

Maternal behaviour of small ruminants

- Many ewes look for an isolated spot in which to lamb.
- They will lick the lamb and eat the foetal membranes after the lamb is born.
- The lamb finds the ewe's teats and begins to suckle within an hour or two of birth.

Abnormal behaviour of small ruminants

- Sheep show abnormal behaviour under certain conditions, especially when they are ill.

3. Common behaviours of intensive non-ruminants (pigs)

General behaviour of intensive non-ruminants(pigs)

- Domestic boars are usually kept apart from the sows except when they mate.
- Pigs have a well-developed sense of smell and hearing. But they have poor eyesight, so they use their snouts to examine and explore their surroundings.
- Pigs are heat sensitive because they can only sweat from their snouts. They wallow in mud bathes or lie in puddles of water to cool down.
- Young piglets are sensitive to cold and will huddle with their littermates during cold weather.

Breeding behaviour of intensive non-ruminants (pigs)

Sows on heat become interested in boars and respond to their smell. Sows may nibble the boar's ears and will allow the boar to sniff and nose them. The boar mates with the sow when she stands.

Maternal behaviour of intensive non-ruminants. (pigs)

- The sow builds a nest six hours before giving birth. She hollows out a depression and lines it with straw, grass and sticks. Sows in intensive units will show the same behaviour, although they may be unable to build nest. Piglets compete for the sow's teats after birth.

Abnormal behaviour of intensive non-ruminants

Abnormal behaviour is seen in pigs under certain circumstances, especially when they are ill.

3.2 Common behaviour of poultry

General behaviour of poultry

Newly hatched chicks are precocial (able to look for their own food and water).

- They are born with a strong pecking instinct which drives them to investigate all objects on the ground as possible food.
- Birds show dominant-submissive behaviour a few weeks after hatching
- Dominant birds will peck less aggressive birds, especially at food troughs. This means that birds at the bottom of the pecking order get less feed.

Breeding behaviour of poultry

Breeding is initiated by the male who does a courtship display. He spreads his wings and uses calls and postures.

- Unwilling hens run away or ignore this courtship display.
- Hens ready to breed crouch down and allow the male to mount and mate with her.
- Maternal behaviour of poultry
- Broodiness has been bred out of commercial laying strains of poultry since their eggs are infertile and are collected for use soon after they are laid. In breeding systems a broody hen incubates her eggs for 21 days after which the chicks hatch.

Abnormal behaviour of poultry

Poultry usually behave abnormally when they are ill.

HANDLING OF FARM ANIMALS

Term	Definition
Broodiness	the tendency of a hen to sit on eggs.
Feedlots	a plot of ground/building where livestock are fattened for the market.
Flight zone	is a distance that agricultural and wild animals like to keep between themselves and a threat of danger.
Handling	to touch or hold or move animals from one place to another.
Hoppers	containers for grain which narrow near the bottom and release grain from this end.
Panoramic vision	some animals can see all around e.g. cattle
Roost	is when chickens settle for rest especially when they have laid eggs.
Rotational grazing	involves moving animals between different grazing camps so as to achieve veld management objectives.
Rounding off	fattening or growing animals for market readiness
Watering points	is the place where livestock receive their water.

Animal behaviour: is the way in which an animal reacts and interacts with other animals, human beings and the environment.

Cattle, Sheep, Pigs and Poultry: These animals will behave differently under various conditions such as mating, grazing, treatment for health reasons, giving birth, transportation, milking, artificial insemination.

Generally animals are more difficult to handle under these conditions. Flight zone and blind spot are very important areas that influence animal behaviour.

Flight zone is the distance that animals like to keep between themselves and a threat of danger.
Blind spot is the spot out of animal's front line of vision.

Reasons for handling livestock (cattle, pigs, sheep and poultry) include:

- Artificial insemination
- Health reasons (vaccination, dosing, cleaning of sheds etc)
- Feeding
- Parturition (giving birth) and egg laying
- Marketing

- Slaughtering

The reasons/ importance of handling farm animals

Farmers and farm workers are required to handle animals at some time during the production cycle. They must know how to handle animals so that the animals are not harmed or killed, and the handler is not hurt by large or aggressive animals.

Animals might need to be handled for the following reasons

- During animal health programme when medication need to administered, or when animals are inspected for diseases or injury.
- During a normal management programme, such as dehorning, marketing, castration and docking of animals.
- During programme of prevention and treatment of external parasites, such as ticks, by dipping the animas.
- Prevention and treatment of internal parasites, such as tapeworm.
- Determination of animal age or classification of animals in a heard.
- Generation of data such as the growth rate, mass, and market-readiness
- Determination of special data from an animal such as a pregnancy test.
- Transportation of animals (to the market or around the farm

The effects of incorrect handling of farm animals (harm and effects)

- Damages the skin/wool/meat
- Leads to injured and stressed animals
- Rams can harm a handler
- Ewes may reject their lambs
- Sheep will get frightened
- Animals become fearful, aggressive and even more difficult to handle.

Harm caused by incorrect handling:

Bruising: This is the most common injury. It can be caused by rough handling and poor facilities such as gates that are too narrow or protrusions on structures like crushes or holding pens. At slaughter the bruised meat has to be trimmed off the carcass with the result that the farmer gets less for the animal.

Broken legs: Rough handling can scare animals. They may try to jump out of pens and break their legs, fall in crushes or be trampled by other animals.

Drowning: Young calves often drown in dip tanks when adult animals jump on top of them.

Broken necks: Animals may run into fences or barriers and break their necks if handlers chase them wildly.

<u>The following are some of the incorrect ways of handling farm animals:</u>

- Aggressive handling
- Plucking feathers from poultry that is not calm
- Moving cattle and pigs in large groups
- Moving animals across the road without proper warning to traffic is dangerous
- Kicking and beating animals when moving is harmful

<u>Major causes of animas handling accidents</u>

- Fearful, agitated animals
- Faulty equipment
- Male dominance aggression
- Maternal aggression

BASIC GUIDELINES FOR HANDLING THE FOLLOWING FARM ANIMALS

1. Large ruminants (cattle)
2. Small ruminants
3. Intensive non-ruminants (pigs) and
4. Poultry

Basic guidelines

- Ensure the are no rushed movements or loud noises
- Ensure that object is not thrown
- Ensure that animals are not injured
- Ensure that appropriate facilities and equipment are used correctly
- Aways keep the safety measures for a particular animal

Guidelines for handling livestock (cattle, sheep and poultry) The following must be considered when handling farm animals:

- Handler should not yell at livestock
- Be cautious to animals that are blind to one eye
- Never approach animal from the back
- Talk softly to animal when approaching it
- Do not work with big and small animals in the same crush
- Crush should be wide without sharp objects

1. Basic guidelines for handling large ruminants (cattle)

●Herding cattle: Learn to judge the flight zone of cattle. It varies depending on how often the cattle are handled, so handle them regularly so that they develop a predictable flight zone.

●When herding cattle, you need to find the point at which the animal keeps moving forward. Move slowly but confidently while you talk or whistle

to cattle.

●You reduce and increase your distance from the animal to move it forward.

→ If you move inside the flight zone, the animal will run away.

→ If you move out of the flight zone, the animal will stand still. .

●Handling bulls and cows with calves: Never enter a pasture or camp in which bulls are kept unless you know the animal well.

●Aggressive bulls are usually fed and watered from outside their camps.

●Cows with calves may become aggressive and charge their handlers.

Guidelines when moving cows with calves

- Give cows time to pick up their calves before moving
- Avoid chasing cows and calves with dogs
- Beware of aggressive behaviour/avoid being too close
- Move them slowly
- Keep an obstruction between handler and the cows

2.Basic guidelines for handling small ruminants (sheep)

Like cattle, sheep have a flight zone which varies in size according to how frequently they are handled. The distance of their flight zone will decrease if they are handled often. Sheep have a tendency to follow leaders so tame animals or goats can be used to lead them.

a. Herding sheep: Apply the same flight zone principles described for cattle.

i. You may need more than one handler to drive sheep in from the veld in the right direction.

ii. Trained sheepdogs can be used to round up sheep.

b. Handling individuals: You can drive individual sheep into a small camp to handle them.

i. Use your arms or a barrier gate to drive them into a corner where they cannot escape.

ii. Grasp the flank fold and raise the head upwards to catch the animal.

iii. Never grab sheep or goats by the wool or hair because this is painful and can bruise them.

3.Basic guidelines for handling intensive non-ruminants (pigs)

Pigs should be moved in small groups rather than as individuals. Coax the animals along slowly and allow them to investigate their environment because they have poor eyesight. Use a passage made with moveable gates or boards to guide pigs. Do not use electric prodders on pigs.

a.Handling small pigs (under 10 kg): Grasp the hind legs, lift the piglet and support it under the chest.

i. Then place the piglet gently back on the ground.

ii. Never lift piglets by their ears.

b.Handling larger pigs (over 10 kg): Make a passageway with two boards and move the pig slowly to where you want it to go.

i. Clear the way ahead and urge the pig forward by applying gentle pressure with the boards to its side

ii. If you need to restrain the pig for some treatment or examination, then lead it into a small crate or passage where it cannot move.

iii. If the animal struggles, keep the head still with a snare or rope which is looped around the top half of the snout.

4.Basic guidelines for handling poultry

A The method used to handle poultry will depend on the tameness and age of the bird. Regular handling will make them tame and prevent injuries.

i. **Handling baby chicks:** Chicks are very fragile so they must be handled gently. Place your hand over them and scoop them off the ground with the other. Do not squeeze or drop them because this will cause injury or death.
ii. **Handling adult birds:** Move slowly towards the bird and drive it into a narrow space such as the corner of the run. Place your hand on the back of the fowl you want to catch, grasp its legs and place your fingers between the feet. Never grab the feathers, wings or tail as this will injure the bird.

Animal	Tools for handling
Cattle	Halters, Head rails, Cradles, Crushes, Portable pens, Loading ramp, Prodders, Spotlight, Ropes, Chains, Electric fencing
Pigs	Plywood boards, Nose ropes, Crushes, Prodders, Plastic shakers, Slappers, Boxes
Sheep	Crushes, Gates, Plastic shakers, Slappers, Guiding animals, Nylon flags

DIFFERENT TECHNIQUES/ TOOLS USED TO HANDLE FAARM ANIMAS

Correct use of techniques, tools and aids will help produce healthy, productive animals.

1. Ropes

Ropes can be used to handle and restrain large farm animals in various ways.

- You can restrain cattle by looping a rope around the neck or horns.
- It can also be used to lift the feet of cattle to examine their hooves.
- Dairy cows can be hobbled with ropes while they are being milked so that they cannot kick their handler.

- You can restrain large pigs with a snare or loop of rope.

2. Halters

Halters are made of leather, nylon or rope and they fit around the head of the animal.

- A length of rope is attached to the halter and it is used to lead the animal.
- They are useful to lead tame cattle, and even large bulls can become halter tame.
- Halters can also be used to keep the head of a cow still when a neck clamp is not available.

3. Nose tongs

Nose tongs can also be used to restrain cattle when no neck clamp is available, or it can be used in addition to the neck clamp.

- It is useful to attach a rope to the end of the nose tongs and this prevents injury to handlers if the nose tongs come loose.
- Place the pincers of the tongs around the nostrils and close the tongs.
- Cattle will not struggle as their noses are sensitive.

3.Boards

Boards are used to move larger pigs from one place to another.

4. Neck clamps

The neck clamp is a piece of metal equipment which can be opened so that the animal can place its head through and then the clamp is closed around the neck.

- Animals are usually driven through a crush and towards the clamp which is mounted at the end of the crush.
- The neck clamp allows very firm restraint of the head for procedures such as dehorning or examining the mouth. Neck clamps must be used very carefully to prevent injury.

Basic requirements for transporting farm animals

Transport	Treatment
Before transport	• Transport permit must be completed before transporting animals • Keep farm animals together for two to three days before transporting them • Dehorn animals before transporting them • Group animals of the same size for transportation
Loading and unloading	• Loading ramp must be properly designed • Crush for unloading should be wide and straight • Crush for loading should have high solid sides • Steps must be part of the design for loading and unloading crushes for cattle and pigs

General guidelines for transporting

- Animals must not be transported when roads are busy
- Familiarise animals with loading area
- Truck floor must not be slippery
- Do not transport cattle, sheep, goats and pigs together
- Truck must be ventilated
- Clean the back of the truck before loading animals
- Do not load animals too long before departure

Basic guidelines for vehicles transporting animals

- Suitable for the animals
- Sufficient floor space
- Sides must be strong

- The back must be closed to avoid inhalation of exhaust fumes
- Sides need to be high enough
- Floors should not be slippery/bedding
- No sharp edges to harm/injure animals
- Protection against cold/hot conditions
- Well ventilated
- Provide shade
- Must be kept clean

BASIC GUIDELINES/REQUIREMENT FOR TRANSPORTING/MOVING FARM ANIMALS FROM ONE FARM TO ANOTHER

- Use trained drivers as sudden braking, excessive speed and sharp turning can cause injuries.
- Do not transport pregnant, diseased or injured animals if possible.
- Do not transport different species together unless they can be separated.
- Do not mix animals of different ages unless they can be separated from each other as young animals may be crushed.
- Keep animals in a quiet shady area for a few hours before they are transported.
- Do not load animals more than an hour before transporting.
- Ensure there is sufficient ventilation and light in the crates on the truck.
- Ensure that there are no sharp projections in the crates which can injure animals.
- Ensure that the floor of the crates is not slippery.
- Use a vehicle with solid sides to load animals so that they cannot fall off.
- Clean the vehicle before and after loading.
- Hose down cattle and pigs in hot weather to cool them down.
- Do not overcrowd the animals.
- Do not shout, kick, prod or whip animals when offloading.

Term	Definition
Antibiotics	are chemical compounds used to kill bacterial and fungal infections.
Antibodies	protein substances produced by white blood cells in response to specific foreign antigens.
Bacteria	are microscopically small, single celled organisms.
Biopsy	is an examination, under a microscope of a tissue from a living body to determine the cause or extent of disease.
Clinical examination	is when you examine animals for signs of disease.
Contagious	means an ability to infect other animals.
Diagnosis	is the identification of a disease from the examination of symptoms.
Endemic	is when a disease occurs in a population regularly and can be predicted.
Epidemic	is a widespread occurrence of a disease that spread rapidly through an area.
Fungi	are single –celled or multicellular organisms.
Pathogens	are disease –causing organisms.
Post mortem	takes place when one cuts open the carcass of dead animal to determine the cause of death.
Protozoa	are single celled organisms that live within the animal or on the animal.

Quarantine	means keeping animals in isolation for a fixed period of time to enable officials from the Department of Veterinary Services to test for and detect diseases.
Vaccination	is the injection of a single substance into an animal to prevent a specific disease.
Vectors	are insects or ticks, that carry the disease organism from infected to healthy animals.
Viruses	are very small acellular structures, only visible with a powerful electron microscope, they multiply only within a living cell and can be transmitted from one organism to another.

Signs of poor health/ sick animals [cattle, pigs, and chickens]

General symptoms of animal diseases

- Lack or loss of appetites
- Loss of weight and body condition
- Rough dull coat and hair loss
- Eyes are dull and glassy
- Fever
- Rapid pulse rate
- Sneezing and coughing
- Diarrhoea or faeces too hard
- Shivering
- Rough and dry skin
- Body temperature is high which may indicate fever
- Animal show solitary behaviour (animal isolate itself from the herd and looks weak and depressed)

Signs of poor health cattle

- Drops production of dairy cows drops
- Swollen udder
- Urine may be discoloured
- Teeth grinding
- Discoloured urine
- Isolation from the herd or flock
- Dirty hocks and tail area
- Discharge from the nose, eyes, and reproductive tract
- Ruminant graze less and do not regurgitate
- The membrane of eyes is dull and plane
- Rough and dry skin
- Animal walks with a lame gait
- Discharge on the eyes, nose, mouth, or reproductive tract
- Diarrhoea or hard faeces
- High body temperature, which may indicate fever
- Animal loses weight
- Rise of pulse rate
- Animal show solitary behaviour (animal isolate itself from the herd and looks weak and depressed)

Signs of poor health in pigs

- Isolation from the group
- Swollen navel, udder, and joints
- Rapid irregular breathing

- Blistered skin
- Diarrhoea or constipation
- Vomiting
- Lameness
- Loss or lack of condition and weight
- Listlessness

Signs of poor health in poultry(chickens)

- Decrease in egg production as well as egg quantity
- Loss of feathers
- The area between the eyes and nose is swollen fluid running from the nostrils
- Abnormal shape of the beak
- Twisted and weak neck
- Nervousness and depression
- Eyes and comb are dull
- Running fluid from the nostrils
- Respiratory distress
- Yellow and green diarrhoea

Testing of animal health

Handle animal that are sick calmy and quietly. Separate sick animal s from other animals so that they can be tested and find out why they are sick and the correct treatment can administered.

Methods of restraining (controlling) animals

Head gates, which trap the heads of large animals (for example, bulls)
Squeeze chutes, which prevent the animal from moving (for example, cattle and sheep)
Halters, which are used to lead the animal and tie the animal to post (for example, cattle and horses)
Nose leads, which hold large animals (for example, bulls) by the nose
Casting harnesses, which are used to get an animal to lie down (for example, cattle, sheep and goats)
Mouth openers, which are used to open the mouths of animals (for example, cattle, horses, sheep and goats)
A crush or race, which is used for large ruminants when they are vaccinated, examined, or undergo other treatment.

Methods of testing animal health

It is very important to recognise a disease early so that it can be treated and cured. There are various methods can be used to investigate and test or diagnose suspected ill health in animal, herd or group of animal.

1. Clinical examination (preliminary examination of the animal's health
2. Further examination
3. Laboratory test or testing of samples
4. Post-mortem

These includes.

1. take the animal temperature by using rectal thermometer.
2. Determine the animal's pulse rate, pulse rate is equal to the number of heartbeats per minutes.
3. Determine the respiratory rate of the animal by watching the movement of rib cage and counting the number of breaths in one minute.
4. In ruminants, the rate of rumen contraction can be determined. In healthy animals the rumen contractions occur two to four times per minute. You can feel on the left flank to determine the rumen contraction

1.2 Laboratory test or Testing of samples

Various laboratory tests can be done on live animals to help make a diagnosis.

i. **Blood smears:** These can be made to diagnose diseases like anthrax or various blood-borne diseases in which parasites can be seen in blood cells.

ii. **Serology:** Blood samples can be tested for antibodies to infectious agents.

iii. **Cultures:** You can do a culture for an infectious agent. This involves the growth of the culturing material in a laboratory from an abscess or a milk sample in order to identify the bacteria that caused it.

iv. **Faecal examination:** Faecal samples can be tested for signs of roundworm and 65fluke eggs will indicate the severity of the infestation.

1.3 post-mortem – post-mortem examinations help reveal the cause of an animal's death.

- A post-mortem (or PM) is the procedure when you cut open the carcass of a dead animal to determine the cause of death.
- The cause may be obvious such as when a large number of internal parasites are found.
- But if no macroscopic signs are found, then samples must be taken for microscopic examination of tissue samples to determine a specific diagnosis → This is called histology.

Methods of administering medicine to animals

1. Dosing
2. Vaccination
3. Mixing medicine with food
4. **Topical application-** powders, lotion and spray can be applied ton the skin
5. **Balling gun-** medication such as pills, tablets can be administered orally by using a baling gun
6. **Drenching gun-** use to administer liquid medication into mouth to control internal parasite.
7. **. Stomach tube-** use to pass medicine directly into stomach
8. Cannula and trocar-
9. **Rectal injection-** use to treat constipation
10. **Vaginal injection-** used calving or abortions and to treat infection of vigal diseases
11. **Intramammary-** used to treat canal of udder
12. **Through the nose-** medicine in gas or vapour form are injected through a nose
13. **Injection through the skin**

    13.1 **intramuscular injection-** hormones and antibiotics are normally injected intramuscularly

    13.2 **subcutaneous or hypodermic injection-** injected directly beneath skin using needle.

    13.3 **intravenous injection-**injected directly to blood through blood vein
14. dipping
15. spray races
16. hand dressing and hand spraying
17. foot dips and bely dips

sustainable use of medication

- Medicine must be safe for the specific animal
- Check expiry date
- Correct dosage according to weight and age
- Correct method of administering the medicine
- Correct period of application/
- correct intervals between administering medication
- Proper storage according to instructions
- Use registered medicine
- Use sterilized equipment

TWO economic implications of diseases

- Export bans affect economy
- Job loss

- Financial implications/millions of rands lost
- Cost/time/labour of medication
- Suspension of production

Duties of stock owners to prevent the spread of deadlydiseases

- Burn the carcasses
- Dispose of all the manure/bedding/ other contaminatedmaterial
- Clean/disinfect housing
- Report to the authorities

- Quarantine/isolate affected animals

Purpose of a quarantine station

- To isolate/detain animals and ü
- prevent diseases/pests entering/spreading in the country ü
- Treat animals with antibiotics
- Vaccination/inoculation

INFECTIOUS, NON-INFECTIOUS, AND METABOLIC ANIMAL DESEASES

INFECTIOUS ANIMAL DESEASES

- Infectious animal diseases are diseases that are transmissible or disease that can pass from one animal to another animal through **contaminated food**, body secretions, contaminated objects, by air inhalation or by **vector organism.**
- The insects that transmit infectious diseases are called **vectors.**
- Infectious disease that are very infective are called **Contagious diseases, infective** mean that the pathogens can enter, survive and multiply in the host.
- Infectious diseases are caused by pathogens such as **viruses, bacteria, parasites and fungi.** Infectious diseases are characterised by their ability to spread from one sick animal to other healthy animals.

NON-INFECTIOUS DESEASES

Non-infectious diseases include the direct and indirect effect of all environmental factors on the health of an animal.

METABOLIC ANIMAL DESEASES

Metabolic disorders are a result of a poor metabolism, or enzyme or hormonal abnormalities in an animal. If there are any disturbances in these metabolic processes, the body will not function properly and disease symptoms may occur.

❖ **Level of seriousness of animal disease (chronic, per-acute and acute)**

Pre acute	Acute	Chronic
Very sudden, develops within Hour.	Develops within a day or Two	Develops over time (e.g weeks,months) and Persist for longer
Server, often fatal	Mild, severe or fatal, causes More fatality than chronic	Mild, severe or fatal
Sometimes no time to Administer treatment.	Can disappear without Being treated e.g influenza	Can re-occur after Treatment
Example: anthrax	Can cause severe Outbreaks e.g foot-and-Mouth disease	Can go undetected and result in lowered production

Acute animal diseases:

- acute diseases cause sudden death onset of usually severe symptoms. Animal can recover from an acute disease.
- Acute disease are characterized by fever, loss of appetite, restlessness and depression.
- The animala may become immobile and be reluctant to move

Pre-acute animal diseases

- Animals maybe found dead found without previous signs of disease. The onset of a pre-acute reaction is sudden and unexpected.
- It manifests (Acute diseases are characterized by) lack of appetite, high fever, depression, severe panting and racing pulse.
- Animal maybe found dead.

Chronic animal diseases

- Chronic diseases are long lasting and recur repeatedly in the same animal in acute or sub-acute episodes.
- The chronic disease may progress and get worse and eventually lead to death.
- Non-specific clinical signs may include loss of appetite, poor performance and loss of weight.

The main micro-organisms causing diseases in animals

(i)virus

(ii) bacteria

(iii) fungi

(iv) protozoa and

(v) parasites

❖ The most important diseases found in South Africa based on the mode of transmission, animal host, symptoms, and treatment:

Viral diseases

- Foot-and-mouth disease (FMD),
- rabies, Rift valley fever (RVF),
- avian/bird flu,
- swine fever/flu and
- vcNewcastle disease (NCD)

Bacterial diseases

- Anthrax,
- mastitis, and
- tuberculosis (TB)

Protozoan diseases

- Anaplasmosis,
- red water,
- heart water and coccidiosis

Fungal diseases

Lumpy wool and ringworm

The economic implications of animal diseases

The preventative/control measures for animal disease

Viral diseases

Disease	Transmission	Host	Symptoms	Treatment
Foot-andmouth diseases	• Transmitted by means of secretions and excretions from infected animals • Ingestion of contaminated feed • Entry through skin abrasion or mucous membrane	• Farm livestock except horses • Hooved animals	• High fever • Nasal discharge • Lesions on the tongue, mouth, nose, around hooves and in between toes • Sticky foamy salivation	• Quarantine infected animals • Vaccinate animals • Slaughter and burn infected animals • Cleanse and disinfected equipment and vehicles

Rabies	• Saliva through bite of infected animal	• Livestock like cattle, goats and sheep • Domestic cats and dogs	• Aggression • Excessive salivation • Paralysis of lower jaw and tongue • Changes in normal behaviour	• Immunisation and vaccination • Destroy infected animals and burn carcases
Rift valley fever	• Bites of mosquitoes and other biting insects • Handling of infected meat or blood of infected animals	• Cattle, sheep and goats • Humans	• High fever • Abortion • Death of young animals • Anorexia	• Annual vaccination • Spray with insecticides to control vectors • Slaughter and dispose of infected animals
Avian influenza (bird flu)	• Spread directly by movement of infected birds • Contaminated clothes, vehicles	• Ducks, turkey, geese, chickens, ostriches and other birds	• Death • Nasal discharge • Diarrhoea • Swelling of combs and wattles • Loss of weight and appetite	• Mass slaughter of infected birds • Vaccinate poultry
Swine flu/fever	• Contact with infected pigs • Infected tick vectors • Blood or respiratory excretion of infected pigs	• Domestic and wild pigs	• High fever • Loss of appetite • Bleeding and vomiting • Diarrhoea • Muscular weakness	• Infected pigs should be kept away from swinefree • areas Slaughter and dispose of all infected animals
Newcastle diseases	• Secretions from nose, mouth and eyes of infected animals • Chicken eating contaminated feed and drinking water	• Poultry of all ages and types	• Loss of appetite • Nasal discharge • Yellow/green watery diarrhoea • Paralysis of wings and legs	• Vaccination • Cull infected birds and burn the carcasses • Disinfect poultry house

Bacterial diseases

Disease	Transmission	Host	Symptoms	Treatment
Anthrax	• Transmitted through spores • Contaminated feed	Cattle, Sheep and Goats	• High fever • Swelling of neck and throat • Decrease in milk production • Rumination stops	• Quarantine infected animals • Vaccinate animals • Treat with antibiotics • Disinfect animal sheds, parlour and equipment
Mastitis	• Bacteria invade teat canal • Milker,	Dairy cattle, Sows, Dairy goats, pigs ,	• Swollen, hot and painful udder	• Clean and disinfect milking parlour and
	milking machines and flies transfer the bacteria	sheep, humans	• Lack of appetite • Decline in milk production • Milk may contain clots	• equipment Treat teats with • germicide Treat with antibiotics
Tuberculosis	• Through inhalation, saliva, ingestion, droppings	Cattle, pigs, sheep, humans	• Chronic coughs • Increased rate of respiration and breathing	• Vaccinate animals • Disinfect premises regularly • Quarantine affected animals

Protozoan diseases

Disease	Transmission	Host	Symptoms	Treatment
Anaplasmosis	• Ticks and biting flies	Cattle, Sheep, Goats	• Yellow and pale mucous membrane • High fever • Weight loss • Lack of appetite • Anaemia	• Treat with antibiotics • Dip and vaccinate young animals • Control ticks and flies
Redwater	• One-host blue tick	• Cattle, sheep and goats	• Rapid respiration rate • Lack of appetite • Anaemia • Jaundice	• Vaccination • Treat with antibiotics
Heartwater	• Bont tick (three-host ticks)	• Cattle, sheep and goats	• Uncoordinated movements • Diarrhoea • Nervousness • Listlessness • Difficulty breathing	• Immunisation and intravenous injection

Coccidiosis	• Eggs in the faeces of infected animals • Contaminated feed and grazing	• Cattle, sheep, goats and poultry	• Loss of appetite • Diarrhoea • Muscle tremor and convulsion	• Isolation and sanitation • Prevent overcrowding • Use feeders and drinkers
	pastures			

Fungal diseases

Disease	Transmission	Host	Symptoms	Treatment
Lumpy wool	• Direct transmission of fungal spores to non-infected animals • Spores transmitted by contaminated equipment • Spores transmitted by biting insects	Cattle, Goats and Sheep	• Lumps and scabs on the fleece • Scabs on ears, lips, scrotum, face and shanks	• Use zinc sulphate to dip animals • Isolate infected sheep • Use antibiotics to treat badly affected animals
Ringworm	• Direct contact with infected animal • Hands of handlers • Flies	Cattle, Goats, Sheep, Pigs, Rabbits and Birds	• Hair loss • Crusty grey-white scabs • Scaly and itchy ringlike lesions	• Isolate infected animal • Wash skin with iodine • Disinfect shearing equipment with fungicide

9	06 - 10/03/23	Internal parasites / endoparasites External parasites / ectoparasites	Internal parasites / endoparasites • The concept: internal parasites • The main groups of internal parasites • The most important internal pa rasites (based on their life cycles, animal hosts, symptoms, and treatment): Tapeworms Liver fluke; and Round worms • The financial implications and detrimental effect of internal parasites • The preventative control of measures of internal parasites External parasites / ectoparasites • The concept: external parasites • The types of external parasites • The most important external parasites Ticks (the life cycle of single/two/three host ticks) Nasal worm (sheep); and Blow flies, lice, and mites (sheep) • The financial implications and detrimental effect of external parasites • The preventative/control measures of external parasites Task 1: Practical Task, Marks: 50, Reporting: 25 Date: Friday, 10 March 2023	

Term	Definition
Animal pests	are organisms that live in or on the body of an animal or share the same environment as the farm animal.
External parasites (ectoparasites)	are parasites that attack the body tissues such as blood, skin and hair of animal.
Internal Parasites	are parasites that live inside the host and rob it of its food and blood

Internal parasites / endoparasites

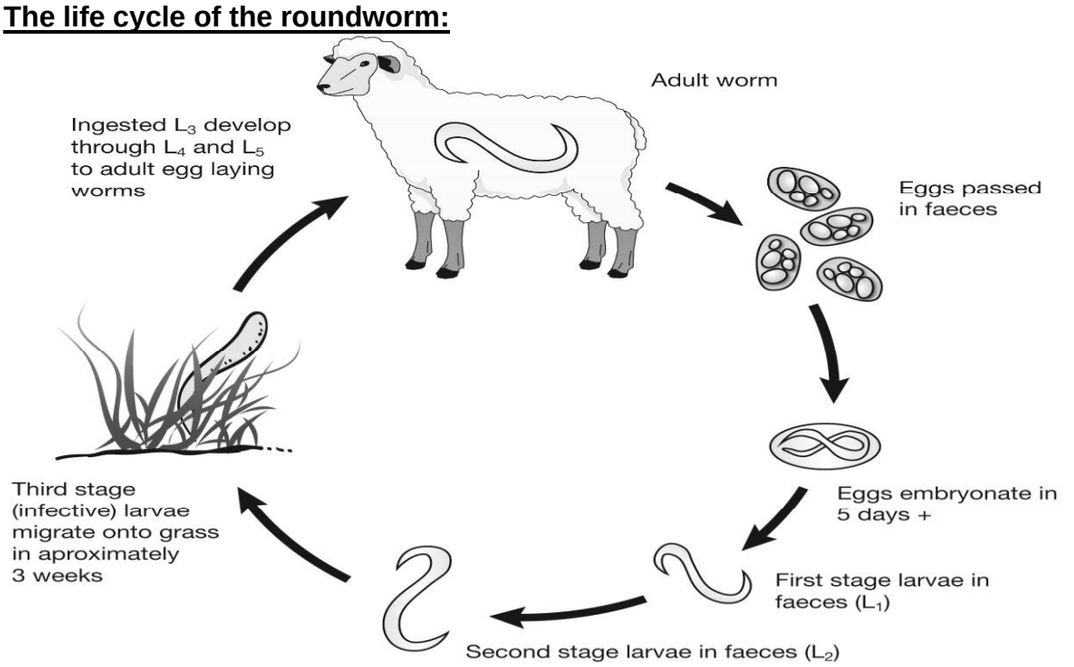
	Tapeworm Long narrow and flat organism that lives in intestines of hosts	**Liver fluke** Flat leaf-like flukes in the bile ducts in the liver	**Roundworm** Small, white thread-like and lives in the gut and lungs of hosts
Animal hosts	Cattle, Sheep and Goats	Cattle, Sheep and Goats	Cattle, Sheep and Goats
Symptoms	Diarrhoea, loss of condition	Diarrhoea, Anaemia	Anaemia, Diarrhoea

Treatment	Dosing with dewormer	Dosing with dewormer specific for liver fluke	Dosing with broad spectrum dewormer

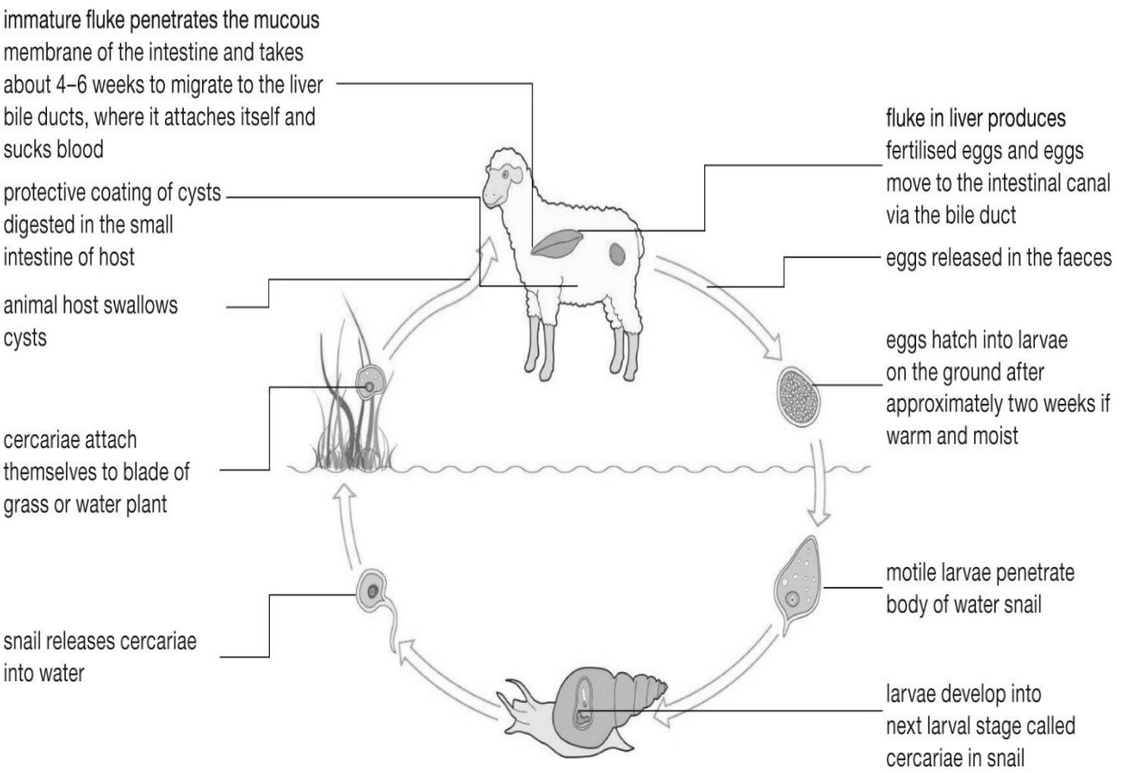
The most important internal parasites **Tapeworms , Liver fluke; and Round worms** (based on their life cycles, animal hosts, symptoms, and treatment):

Tapeworm	**Liver fluke**	**Roundworm**
Eggs in faeces ↓ Embryo in intestine ↓ Scolex in intestines ↓ Adult tapeworm	Eggs hatch in water ↓ Larvae in snail ↓ Young flukes attach to grass ↓ Cattle eat grass with fluke ↓ Adult fluke in liver of cattle	Eggs in faeces ↓ Embryo in faeces ↓ Larvae on grass ↓ Adult roundworm in sheep

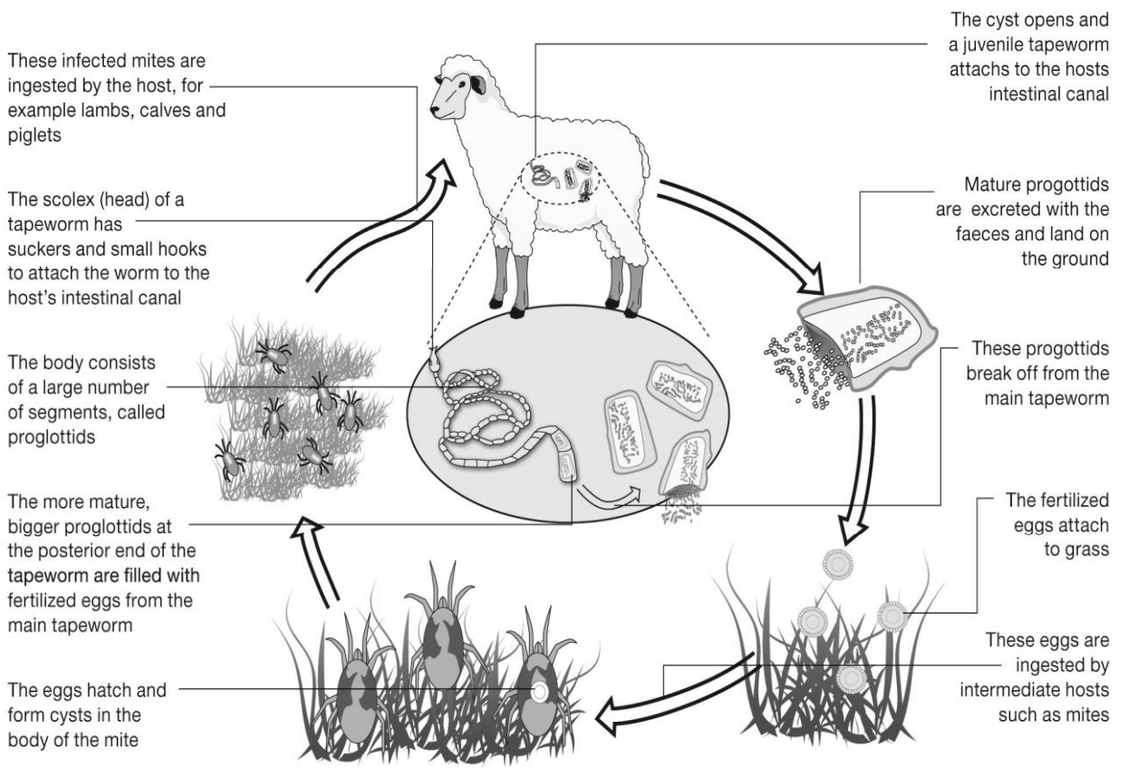
The life cycle of the roundworm:



1.1 **The life cycle of the liver fluke:**



1.2 **The life cycle of the tapeworm**:



- Farmers often do not realise an animal is affected as clinical symptoms do not always indicate internal parasite infestations.
- Usually, it is poor food conversion, reduced growth rate and poor resistance against diseases that indicate a parasite infection.
- Farmers can look at typical symptoms listed for some of the parasites in the text, like diarrhoea for bankrupt worm or dark-coloured faeces for animals infected with hookworms.

2 **Environmental control:**

- Provide sufficient food to help animals withstand parasites.
- Time lambing or calving carefully. A lamb or calf born in the dry season starts its life when most internal parasite populations are at their lowest numbers. Young animals are more susceptible to internal parasite infestation than mature animals.
- Eliminate overgrazing and practise some form of rotational grazing where possible.
- Eliminate moist conditions around drinking troughs.
- If possible, keep animals out of wetlands during the rainy season.

Financial implications and detrimental effects of internal parasites

- Skin/hides/teats/udders/ears are damaged
- Financial/cost/time/labour implications of treatment
- Loss of profit
- Loss of production and income
- High mortality rate
- Treatment cost is high
- Infested meat is dangerous to humans
- Production losses
- Death of animals

Environmental condition for survival of an intermediate host

- Wet/moist condition

Basic preventative and control measures

- Provide clean drinking water

precautionary measures to prevent parasite infestation

- Avoid/fence off wet areas during grazing
- Rotational grazing/resting veld
- Zero grazing
- Veld burning
- Breed animals resistant to parasite infestation
- Clean drinking water
- Provide clean drinking water
- Provision of good nutrition

Roles of the state in controlling the spread of internalparasites

- Meat testing/inspection/hygiene
- Research/outreach to farmers
- Legislation on the duties/roles/responsibilities of owners
- Impose product bans

External parasites / ectoparasites

- The concept: external parasites
- The types of external parasites
- The most important external parasites
  - Ticks (the life cycle of single/two/three host ticks)
  - Nasal worm (sheep); and
  - Blow flies, lice, and mites (sheep)

2.5.2 External Parasites

	Animal host	Symptoms	Treatment
Ticks	Sheep, pigs, cattle	Anaemia, weight loss, reduced quality and quantity of meat	Remove ticks by shearing, dip animals with chemicals, vaccination

Nasal worm	Sheep	Irritation an infection in nasal cavity Los of condition	Chemical dewormer Dosing with medicine
Blowflies	Sheep	Skin breaks Soiled fleece Distress	Tail docking Chemical control
Lice	Sheep, cattle, pigs, chickens and goats	Restlessness Loss of appetite	Dipping with chemicals Quarantine
Mites	Sheep and cattle	Skin irritation Inflammation	Dipping with chemicals
		Loss of appetite	

Life cycles (simplified)

One-host Ticks (Blue tick)	Two-host Ticks (Red-legged tick)	Three-host Ticks (Bont tick)
Eggs ↓ Larvae ↓ Nymphs ↓ Adults	Eggs ↓ Eggs hatch to six-legged larvae ↓ Larvae moults to nymph on first host ↓ Nymph moults into adult and attach to second host for feeding and mating	Eggs in winter ↓ Larvae in first host ↓ Larvae moults to nymph on second host ↓ Nymph moults in adult and leave second host ↓ Adult attach to third host for feeding and mating

Blowflies	Nasal worm
Eggs on sheep wool ↓ Eggs hatch to larvae ↓ Larvae drop off sheep ↓ Larvae turn into pupae ↓ Adult blowflies grow from pupae	Eggs on nostrils ↓ Larvae in sinuses ↓ Larvae turns pupae on ground ↓ Adult fly

Financial implications and detrimental effects of external parasites

- Decreased production results in money loss
- Dip and chemical treatments are expensive
- Labour costs are expensive
- Veterinary costs are expensive

Basic preventative and control measures

- Biological control
- Shearing around the tail of sheep
- Application of relevant chemicals

Economic Implication of animal diseases and parasites

- Banning of export of animals and animal products
- Negative financial impacts on farmers due to diseases and parasites
- International trade decreases and this affects economy of the country
- Disease and parasites outbreak impact on food security
- Disease and parasites outbreak impact on job security
- Costs of control, prevention and treatment are high

The basic principles of good health to control animal diseases and parasites or pests

The following are some of the measures used to promote good animal health and control diseases, pests and parasites:

- Regular inspection of animals for early detection of diseases or infections
- Vaccination of animals to prevent diseases and parasites
- Correct application of medicine and treatment techniques
- Animal feed must be free from contamination
- Animals must have access to fresh clean drinking water
- Isolate affected and infested animals from the herd (quarantine)
- Practice controlled veld fires to encourage new vegetation and kill pests and parasites

10	13 - 17/03/23	Plant and metallic salt Poisoning The role of government in Animal Health	Plant poisoning: • The most important plant poisoning: maize fungus, poison bulb, thorn apple, etc. • The treatment of animals suffering from plant poisoning • The preventative/control measures of plant poisoning Poisoning by metallic salts: • Common salt poisoning (the symptoms and treatment): salt poisoning and urea poisoning • The preventative/control measures of salt poisoning • The basic principles of good health to control animal diseases and parasites/pests The role of the State in animal protection	

Plant and metallic salt Poisoning

Term	Definition
Aflatoxin	is a mould that is produced by maize fungus and is carcinogenic.
Alkalosis	excessive blood alkalinity that is caused by high levels of bicarbonate in the blood
Carcinogen	is any substance that promotes the formation of cancer.
Toxicity	level of being poisonous or toxic

Plant poisoning:

- The most important plant poisoning: **maize fungus, poison bulb, thorn apple,** etc.
- The treatment of animals suffering from plant poisoning
- The preventative/control measures of plant poisoning

Poisoning from Plants

This form of animal poisoning is not very common but does occur.

It normally occur when the pastures are overgrazed and only poisonous plants remain.

Indigenous and non-indigenous plants in South Africa can be poisonous to animals. The most common and important plant poisoning are:

1. Maize fungus

Maize fungus grows on maize cobs. This fungus produces threads of filaments called **hyphae.**

Maize fungus leads to aflatoxin in animals. It is prevalent in North West, Free State, Mpumalanga and KwaZulu-Natal.

Treatment includes:

- Keeping affected animals calm to reduce further infections
- Increasing the supply of proteins and vitamins A, D, E, K and B

Poisoning from maize fungus can be prevented or controlled through:

- Removing infected feed from animals
- Removing source of poisoning

2.Poison bulb

This type of poisoning is mainly caused by bulbs. The most common is one-leaf Cape tulip. The whole plant is poisonous. It grows mainly in Free State, North West, Northern Cape, Eastern Cape.

Treatment includes:

- Administer charcoal into the rumen of the affected animal.

Prevention and control can be achieved through:

- Keeping new animals from the infested grazing land

3.Thorn apple

This is a weed that produces thorny seed capsules. It often grows between cultivated crops. The whole plant contains high levels of toxins.

Treatment includes:

- Treating the affected animal with **charcoal**
- Prevention and control can be achieved through:
- Removing the source of poisoning

2.6.2 Salt poisoning

The intake of less water and more salts by farm animals results in salt poisoning. Salt poisoning is related to the quantity and quality of water intake by animals. Animals that are mainly affected are poultry, cattle and pigs.

Symptoms of salt poisoning

- **Cattle**: loss of appetite, dehydration, partial paralysis
- **Pigs:** stop eating and drinking, become deaf and blind
- **Poultry:** leg paralysis, diarrhoea, increased thirst

Symptoms of salt poisoning in animals

- Excessive salivation
- Increased thirst
- Vomiting
- Constipation
- Wobbling/circling/seizures/blindness/partial paralysis
- Dragging of the hind legs/knuckling of the fetlock
- Mucous membranes of the mouth are red and dry
- Hypersensitivity to touch
- Frequent urination
- Inflammation of the stomach and intestines
- Aggressiveness
- Diarrhoea

Treatment of salt poisoning

- Fresh quality water must be provided to animals
- Remove source of poisoning
- Provision of fresh water in small amounts at short intervals
- Small animals can be given a hypertonic dextrose/isotonic salinesolution
- Removal of the source

Prevention of salt poisoning

- Supply sufficient clean fresh water to animals.
- Ensure that there is water supply closer to the salt licks in the camps

Poisoning by metallic salts: When metallic salts and inorganic substance mix with animal feed, animals are poisoned.

- Common salt poisoning (the symptoms and treatment): salt poisoning and urea poisoning
- The preventative/control measures of salt poisoning

Urea poisoning --Urea is a non-protein source of nitrogen for ruminants. Urea poisoning in animals occurs when it is not properly mixed in the ration.

Symptoms of Urea poisoning

- Bloating
- Painful muscular cramps (tetany)
- Breathing with difficulty
- Frequent defaecation and urination

Treatment of Urea poisoning

- Administer vinegar to reduce the effect of alkalosis.

Prevention of Urea poisoning

- Gradual increase in urea supplement to animal ration.
- Limit access to licks containing urea to animals that show salt deficiency.

Type of research done by the state at the Veterinary Institute

- Veterinary research to improve vaccines/diagnostic/newproducts
- Surveillance/control/preventing diseases
- Surveillance/control/preventing diseases
- Producing disease/blood vaccines

Other roles the state play to protect the animal industry

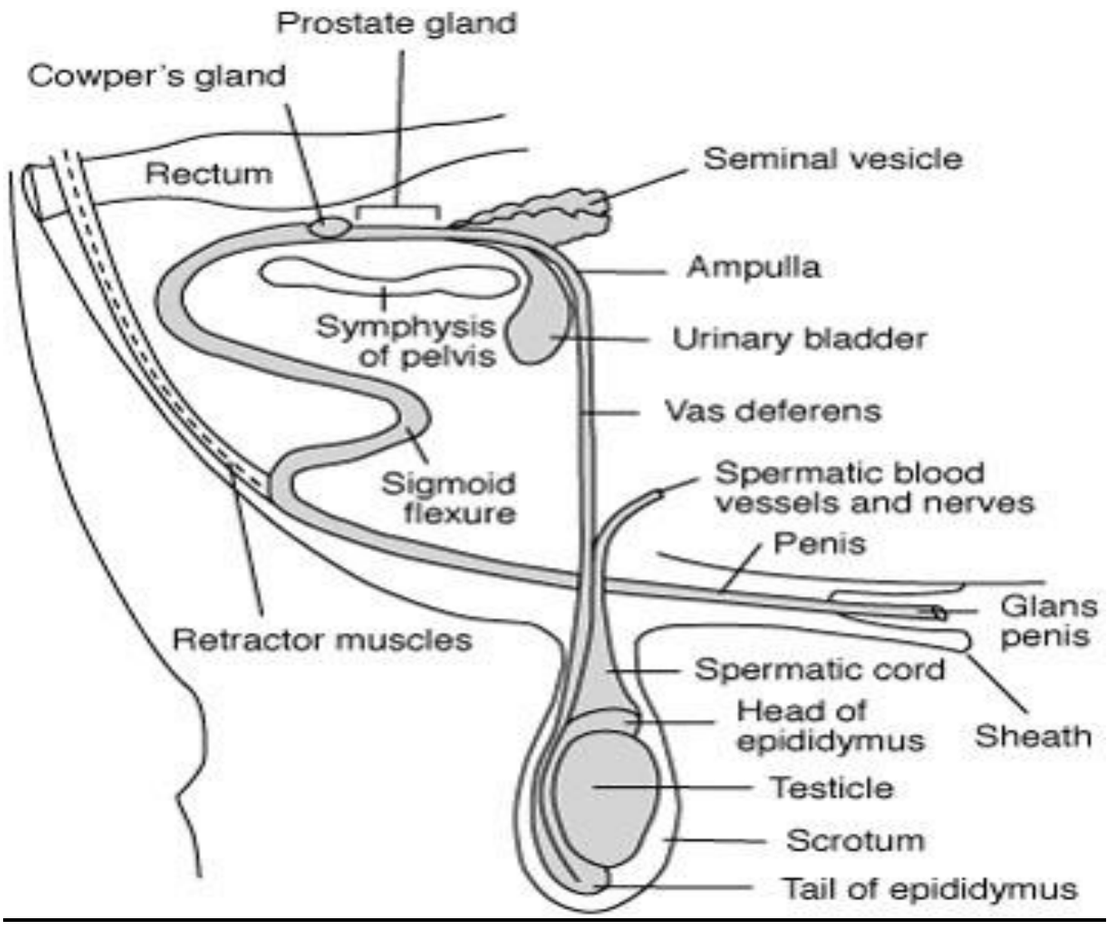
- Animal health schemes
- Duties of owners of animals
- Import bans
- Importation of vaccines
- Movement permits

Animal reproduction

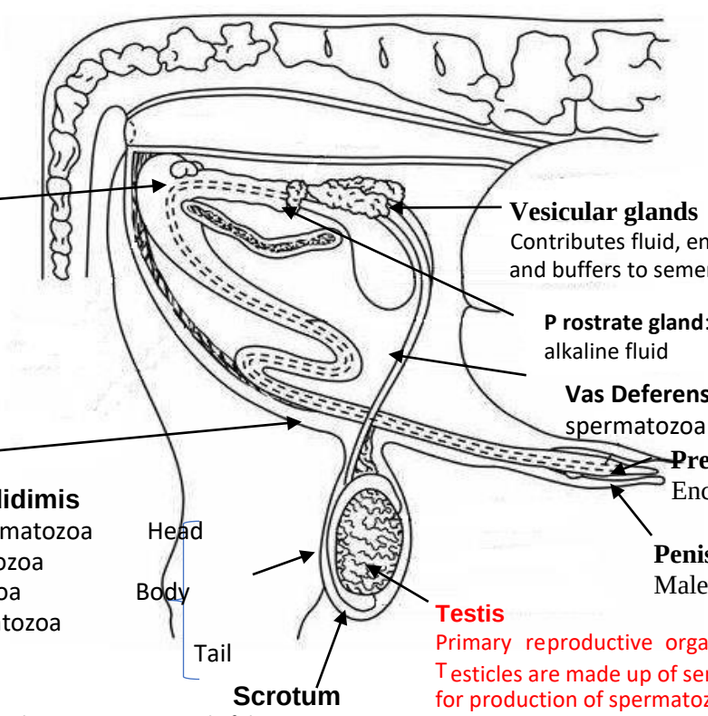
Male reproductive system

TERM	DEFINITION
Ampulla	Site for fertilisation
Cervix	A firm tube-like structure found between the uterus and the vagina
Clitoris	Small elongated erectile organ at the anterior part of the vulva
Ejaculation	Release of semen into the vagina during copulation/mating

Epididymis	A single, narrow, coiled tube that transports sperm from testes to the vas deferens
Fallopian tubes/ oviducts	A pair of coiled tubes that extend from the ovaries to the uterus
Gametogenesis **Oogenesis/ovigenesis** **Spermatogenesis**	Formation of gametes Formation of a mature ovum from a primary oocyte Formation of spermatozoa in the testes
Oocyte	An immature ovum that into a follicle
Ovary	Primary sex organ of a female
Ovulation	A release of a ripe ovum from an ovary
Ovum	Female gamete
Penis	A male organ of copulation
Primary reproductive organs	produce gametes or sperm/ova,
Prostate gland	A gland that lies in the form of a ring around the urethra in males
Reproduction	Production of offspring
Scrotum	A sac that houses and protects the testes
Secondary reproductive organs	The duct system transporting the gamets and associated organs
Semen	A mixture of sperm & fluids from the seminal vescicle, prostate gland & Cowper's gland
Sperm	Male gamete
Testis	Primary sex organ of a male animal
Testosterone	A male hormone responsible for male characteristics
Uterus	An organ where a developing embryo is implanted
Vagina	A female mating organ/ a birth canal
Vulva	External opening of the vagina



Structure of testicle



Cowper's glands
Flushes urine residue from

Retractor Muscle

Urethra

Epididimis
Concentration of spermatozoa
Transport of spermatozoa
Storage of spermatozoa
Maturation of spermatozoa

Head
Body
Tail

Scrotum
Support and temperature control of the testes
Protection of the urethra

Vesicular glands
Contributes fluid, energy substrates, and buffers to semen

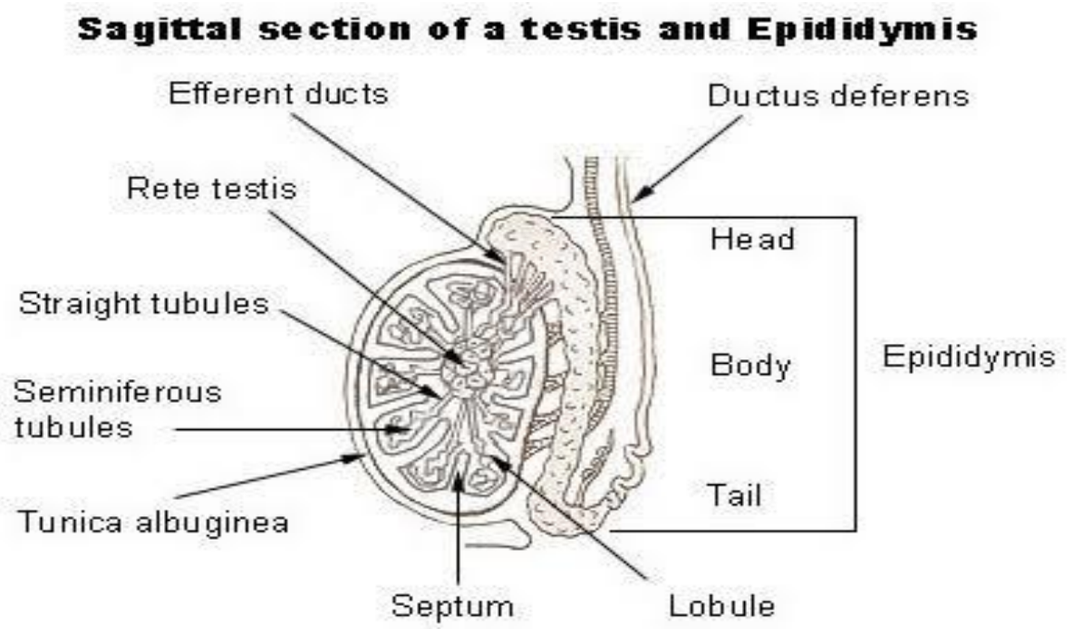
P rostrate gland: Secretes milky, alkaline fluid

Vas Deferens : Transport of spermatozoa

Prepuce
Encloses free end of penis

Penis
Male organ for copulation

Testis
Primary reproductive organ
Testicles are made up of seminiferous tubules for production of spermatozoa
Production of androgens



Reproduction – the process by which animals give rise to offspring.

Male reproductive organs

1. **primary reproductive organs**
   a) Testes
   b) Epididymis
   c) Scrotum
2. **secondary reproductive organs or bulbo-urethral glands**
   a) vas deference or sperm duct
   b) urethra

3. accessory sex glands

a) Seminal vesicles
b) Prostate glands
c) Cowpers glands
d) penis

1. primary sex organs

Testes- are paired oval glandular that are located near the kidney and descend outside the body cavity into a pouch of skin called the scrotum.

Each testis is suspended at the end of a tissue called the **spermatic cord** that run from abdomen. Spermatic cord carries the **ductus deferens-** blood vessels, nerves and muscles necessary for the functioning of the testes.

The testes consist of

Seminiferous tubules- responsible for the formation of spermatozoa. Seminiferous tubules are lined with **stratified epithelium**, they also contain **Sertoli cells**- that are responsible for the feeding and development of the sperms.

Between the seminiferous tubules the are **interstitial cells** called **Leydig cells**. There are endocrine glands that are stimulated by **luteinising hormone** to secrete a male sex hormone called **Testosterone.**

This male sex hormone testosterone is needed for:

1. Development of secondary sex characteristics
2. Normal mating behaviour
3. The functioning of the accessory glands
4. Production and transport of spermatozoa
5. Maintenance of the male duct system

6. Maintenance of optimum conditions of spermatogenesis.
7. Depositing of spermatozoa into the female tract.

Function of testes

1. Function is to produce sperm or spermatozoa in the seminiferous tubules.
2. The testes also produce the male sex hormone, testosterone.
3. Seme is stored in the testes
4. The testes are also endocrine organs secreting the male sex hormone testosterone

B. EPIDIDYMIS

Epididymis- is a single long tightly coiled tube that is attached to one side of the testes.

Epididymis is made up of

i. Head (caput epididymis) which is connected to the vasa afferentia.
ii. Body (corpus epididymis)
iii. Tail(cauda epididymis) which goes over vas deferens

Functions of epididymis

1. Storage organ of sperm
2. It acts as a transport organ for the development of sperm to the vasderens
3. Sperm mature and becomes fully motile in the epididymis
4. Stimulate sperms production
5. Concentrate the sperm

C. SCROTUM

Scrotum- is a two-lobed sac (layer of skin) encloses the testes.

Scrotum walls consist of

a) outer skin layer
b) the smooth central muscular layer
c) the inner layer

functions of scrotum

1. hold and protect the testes
2. regulate the temperature of the testes

The scrotum helps to regulate the temperature in two ways:

1. The cremaster muscle of the scrotum holds the testes against the body when the ambient temperature is cold and lowers the scrotum during warm weather.

2. The scrotum also has a thin skin to allow heat radiation which keeps the testes cooler than the rest of the body.

2. secondary sex organs

A. Vas deferens

Vas deferens also called Ductus deferens,- is a long, muscular tube that travels from the epididymis into pelvic cavity, to just behind the bladder

The tail of the epididymis passes into a tube called the **vas deferens.** The last 10 cm of the vas deferens is thicker than the start of the tube and it is known as the **ampulla.** The vas deferens connects the **epididymis to the urethra.**

Functions of vas deferens

1. Transport and store sperm
2. Responsible for ejaculation of sperm
3. The vas deferens transports mature sperm to the urethra,

B. URETHRA

Urethra- is the tube that carries urine from the bladder to outside of your body. In males, it has the additional function of **expelling (ejaculating) semen** when you reach orgasm. When the penis is erect during sex, the flow of urine is blocked from the urethra, allowing only semen to be ejaculated at orgasm.

Functions

1. To transport urine from the bladder to outside of your body.
2. Responsible of ejaculating.

3. Accessory Glands

The secondary or accessory sex glands of the bull are a group of glands behind the bladder in the pelvic cavity. These glands are located along the pelvic portion of the urethra. They have ducts that empty their secretion into the urethra.

SEMINAL VESICLE

- Is the largest sex gland
- Secretes sticky fluid that that provide energy for sperm

PROSTATE GLAND

- Forms a ring around the urethra
- Secrete a milky, alkaline fluid that regulates ph.

COWPER'S GLAND

- Secrete fluid that lubricate and clean the urethra

Accessory glands include

1.Seminal vesicles (vesicular glands): the versicular glands are pair of the globular that look like a cluster of grapes and there are the largest secondary sex glands.

Location: The seminal vesicles are sac-like pouches that attach to the vas deferens near the base of the bladder.

Functions

1. The seminal vesicles make a sugar-rich fluid (fructose) that provides sperm with a source of energy and helps with the sperms' ability to move (motility).
2. The fluid of the seminal vesicles makes up most of the volume of your ejaculatory fluid, or ejaculate.
3. The phosphate and carbonate buffers in the secretions protect the semen against changes in PH

2.Prostate gland- Is a single two-lobed gland that surrounds the urethra in a ring shape form

Location: The prostate gland is a located below the urinary bladder in front of the rectum.

1. The prostate gland contributes additional fluid to the ejaculation.
2. Prostate fluids also help to nourish the sperm.
3. The urethra, which carries the ejaculate to be expelled during orgasm, runs through the centre of the prostate gland.
4. It lubricates and cleanses the urethra
5. It improves the mobility of sperm
6. It provides seminal fluid to the sperm to form semen
7. Secretion help to maintain the correct PH of the seminal fluid
8. It secrete a milky,slightly alkaine mucus that gives semen its characteristic smell.

3.Bulbourethral glands or Cowper's glands:

Location: The bulbourethral glands, or Cowper's glands, are pair of glands located on the sides of the urethra, just below the prostate gland.

These glands produce a clear, slippery fluid that empties directly into the urethra. This fluid serves to lubricate the urethra and to neutralize any acidity that may be present due to residual drops of urine in the urethra.

Functions

1. The mucous fluid maintains the correct PH of the seminal fluid.
2. The secretion lubricates and cleanses the urethra before ejaculation.
3. Secretion also improves the mobility of sperm during ejaculation.

4. **Penis**

The penis is the male organ for mating. It has three parts:

- **The root**: This is the part of the penis that attaches to the wall of your abdomen.
- **The body or shaft**: S-Shaped like a tube or cylinder, the body of the penis is made up of three internal chambers. Inside these chambers there's a special, sponge-like erectile tissue that contains thousands of large spaces that fill with blood when you're sexually aroused. As the penis fills with blood, it becomes rigid and erect which increase S-shape, which allows for penetration during mating.
- **The glans penis**: is the free end of the penis. Is well supplied with sensory nerves and resembles the clitoris in the female.

Functions

1. To transport semen during mating.
2. It is an excretory organ for urine.
3. The male(bull) organ used for mating or copulation.
4. Penetrates the female sex organ during mating, depositing semen.

Prepuce (foreskin)- is a sheath of skin that encloses the free end of the penis just above the tip.it can be compared to the labia minor in the female. The fore skin ca be divided into the:

1. Prepenile portion (the outer fold)
2. Penile or inner fold

Spermatogenesis can be divided into three parts:

1. Spermatocytogenesis (mitosis)
2. meiosis and
3. spermiogenesis.

Spermatogenesis- is the process by which sperm cells are produced in the testes.

1During spermatocytogenesis, germ cells engage in a cycle of several mitotic divisions that increases the yield of spermatogenesis and to renew stem cells and produce spermatogonia and primary spermatocytes.

Meiosis involves duplication and exchange of genetic material and two cell divisions that reduce the chromosome number and yield four haploid round spermatids.

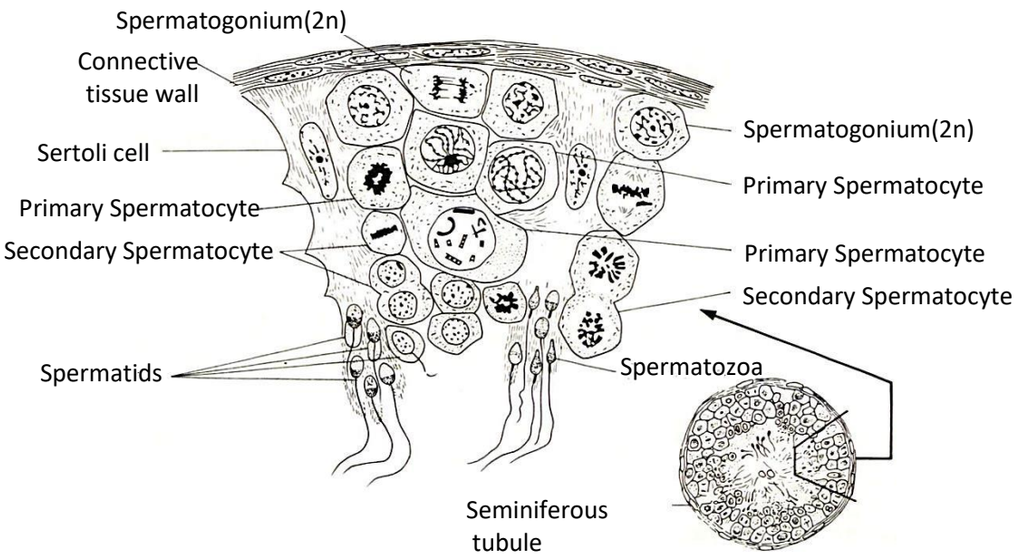
Spermiogenesis involves the differentiation of round spermatids into fully mature spermatozoa released into the lumin of seminiferous tubules. The seminiferous epithelium is composed of several generations of germ cells due to the fact that new generations of sperm cells engage in the spermatogenic process without waiting for the preceding generations to have completed their evolution and to have disappeared as spermatozoa into the lumen of the tubules.

Sperm formation(spermatogenesis)

Spermatogenesis is the process during which the primary male sex cells undergo metamorphosis in the tubules of the testes and develop into spermatozoa. The process starts when the animal reaches puberty.

Spermatogenesis in the testis

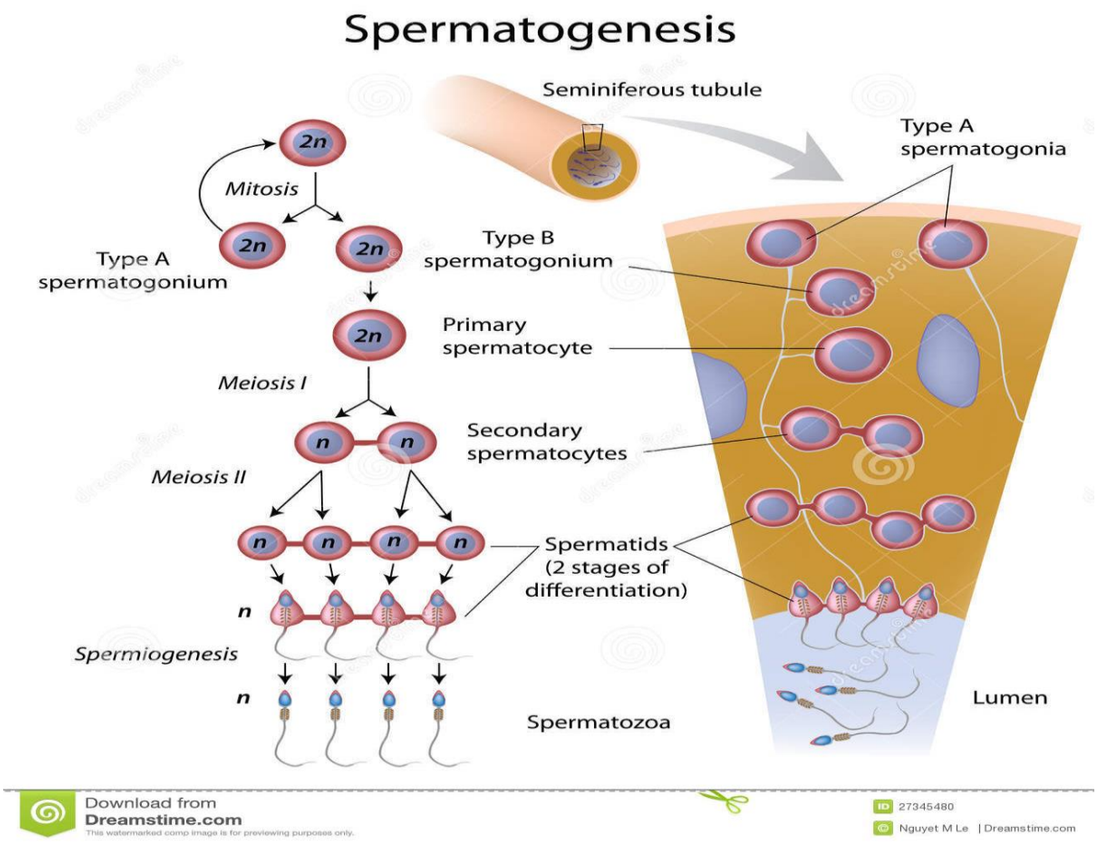
Sections through testicular tissue to illustrate the process of spermatogenesis and the role of the Sertoli cells in supporting the germ cells. The interstitial tissue lies between individual seminiferous tubules.



PROCESS OF SPERMATOGENESIS

1. **SPERMATOGONIUM** (the undifferentiated male germinal epithelial cell) found in the wall of the seminiferous tubule divides by **MITOSIS** to form a primary spermatocytes that are diploid (2n)
2. **PRIMARY SPERMATOCYTE** divides by **MEIOSIS 1** to form secondary spermatocytes
3. **SECONDARY SPERMATOCYTE** divides by **MEIOSIS 2** to form haploid spermatid
4. **SPERMATID** undergo differentiation (change) and develop into a **MATURE**

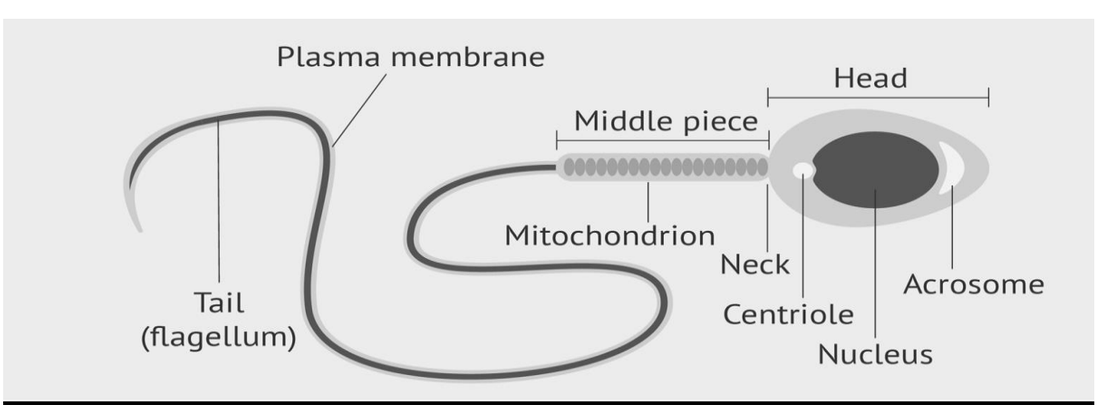
SPERM



Spermatogenesis

- It occurs in the Cows of the somniferous tubules
- Seminiferous tubules are the original cells which contain spermatogonia
- Spermatogonia (2n) divide mitotically to form primary spermatocytes
- Primary spermatocytes (2n) divides mitotically (1st meiosis division) divide to from secondary spermatocytes (n)
- Each secondary spermatocytes divide meiotically (2nd meiotic) to form spermatids (n)
- Spermatids undergo metamorphosis to form spermatozoa
- The Sertoli cells feed the developing sperms.

Spermatozoa



Distinction between sperm cell and semen

Sperm cell - Male gamete/reproductive cell for fertilisation

Semen - Mixture of sperm cells and the fluidsfrom the accessory glands

Acrosome: for penetrating the ovum (capacitation)

: It releases the enzyme **hyaluronidase** which help the sperm to penetrate female gamete (ovum) for fertilisation)

Head: carries genetic material (the nucleus with haploid (n)chromosome containing DNA the egg cell to form a zygote)

Neck: connect the head to the middle piece. It contains **centriole** that help with cell division.

Middle piece: contain mitochondria that supply energy for the spermatozoon to move Tail: for the movement of sperm cell into the fallopian tube.

Mobile tail/ flagellum: it enables the movement of sperm cells into the fallopian tube by process of **oscillation**

STERILITY AND INFERTILITY:

Sterility- The male shows interest in a female and is able to serve the female but fertilization does not occur. It is permanent in nature.

Infertility – The failure of animals to produce gametes, to mate or for fertilization to occur. Infertility is temporary in nature and can be caused by various factors>

FACTORS CAUSING INFERTILITY IN BULLS

Infertility in bulls can be classified into three main groups e.g.

1. ABSENCE OF SEX URGE/LACK OF LIBIDO
2. INABILITY TO COPULATE /IMPOTENCE
3. INABILITY TO FERTILISE

1.ABSENCE OF SEX URGE/LACK OF LIBIDO

Although the bull may be healthy and normal it does not show an interest in cows. This may be due to the following factors.

Immaturity.	Spermatozoa are produced as early as 8-9 months of age the various sex organs are fully developed only at an age of 2 years.
Lack of experience	Young bulls growing up on their own sometimes display no interest in cows due to a lack of experience and ignorance.
Exhaustion	Physical and sexual overstrain bulls display a lack of sex urge. Moderate exercise is essential for health and fertility. Correct ratio1bull:20-25 cows is important.
Malnutrition	Underfeeding and feeding an unbalanced ration a deficiency of constituents such as vitamins, minerals and proteins occurs and consequently the bull will not display sex urge. Overfeeding causes obesity and the animal is not inclined to copulate.
Diseases	Diseases coupled with fever and anaemia and which cause weakening and exhaustion, lower the sex urge.
Temperament & Environment	Each bull has its own temperament and a change in care, treatment and environment often cause a lack of sex urge.

2.INABILITY TO COPULATE /IMPOTENCE

Bulls may display sex urge but cannot serve a cow owing to various abnormalities.

Abnormalities in conformation	Weaknesses of the back or hind legs make serving of the cow difficult or impossible. Corpulence aggravates the problem.
Diseases.	Pain and infections of joints and feet prevent bulls from serving cows.
Injuries	The penis may break during copulation. The anterior part of the penis becomes paralysed and a bloody swelling forms. Tick bites cause festering which leads to outgrowths between the penis and the sheath

Congenital deformities	The penis may be too small or too short. The two muscles on the ventral side of the S-shaped curve may be too short so that the penis cannot be extruded properly. A constriction of the prepuce will also prevent the penis from being extruded.

3.INABILITY TO FERTILISE

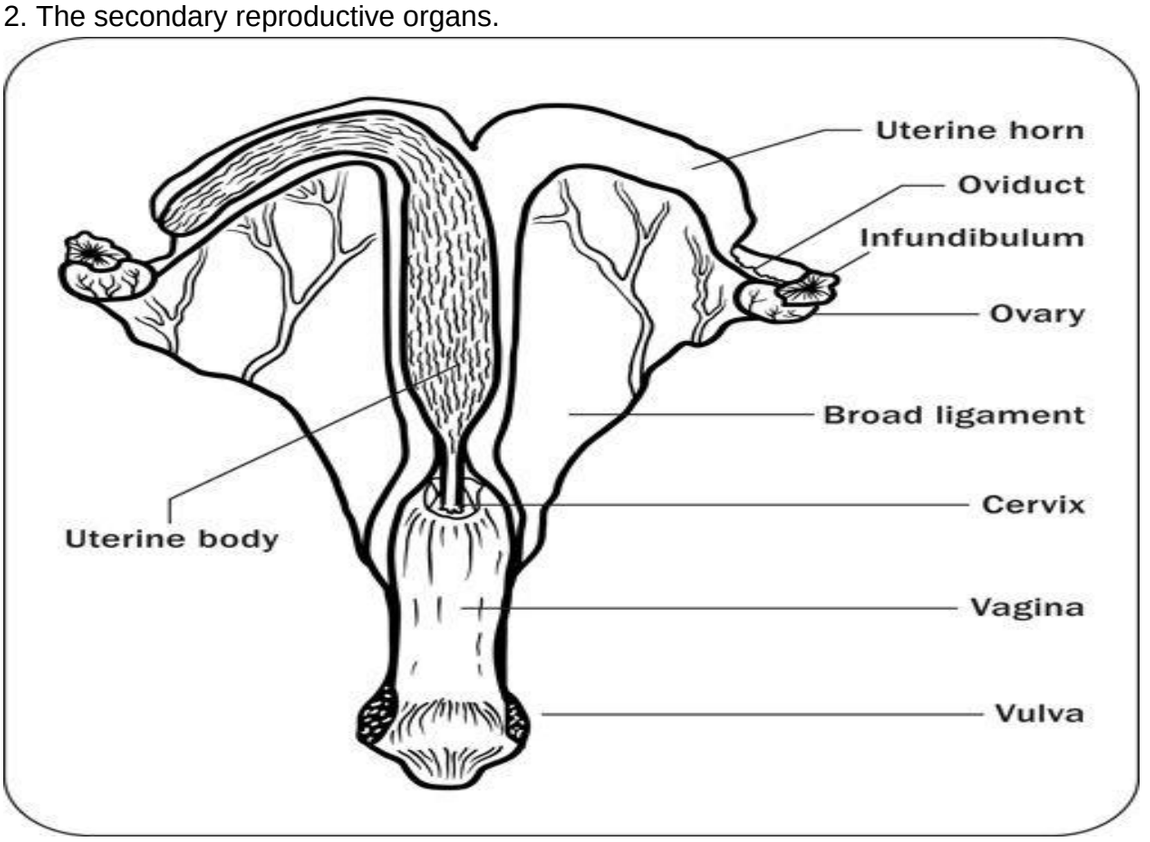
Usually the sex urge is very good but the bull cannot fertilise cows because the spermatozoa have been damaged after they were produced or no spermatozoa were produced.

Exhaustion and malnutrition	No spermatozoa are produced or they are ejaculated before they are mature. Immature spermatozoa are usually deformed and infertile
Diseases	Spermatozoa formed after animals have recovered from diseases such as gallsickness or redwater are abnormal. Lumpyskin disease suppresses sperm formation for up to one year
Infection of the sex **organs**	The testes may be infected by germs either through the blood or the lymph stream or the vasa deferentia or they can penetrate from the outside through wounds.
Congenital deformities. e.g Hypoplacia & Criptorchidism	Underdeveloped testes are or when both testes remain in the abdominal cavity, bulls are infertile. Navel hernias may prevent the bull to serve. Scrotum hernias cause the intestines to slip down into the scrotum and the animal becomes infertile. Abnormalities of the structure of the acrosome impede the secretion of the enzyme hialuronidasis which is responsible for the dissolving of the membrane of the ovum and fertilisation cannot take place. The head and tail of a spermatozoan may be torn apart and the animal is infertile

feMale reproductive system

The reproductive organs of the cow are involved in the processes of **ovulation, mating, fertilisation, pregnancy and calving**. They are mostly located inside the abdominal cavity. They can be divided into two categories:

1. The primary reproductive organs and
2. The secondary reproductive organs.



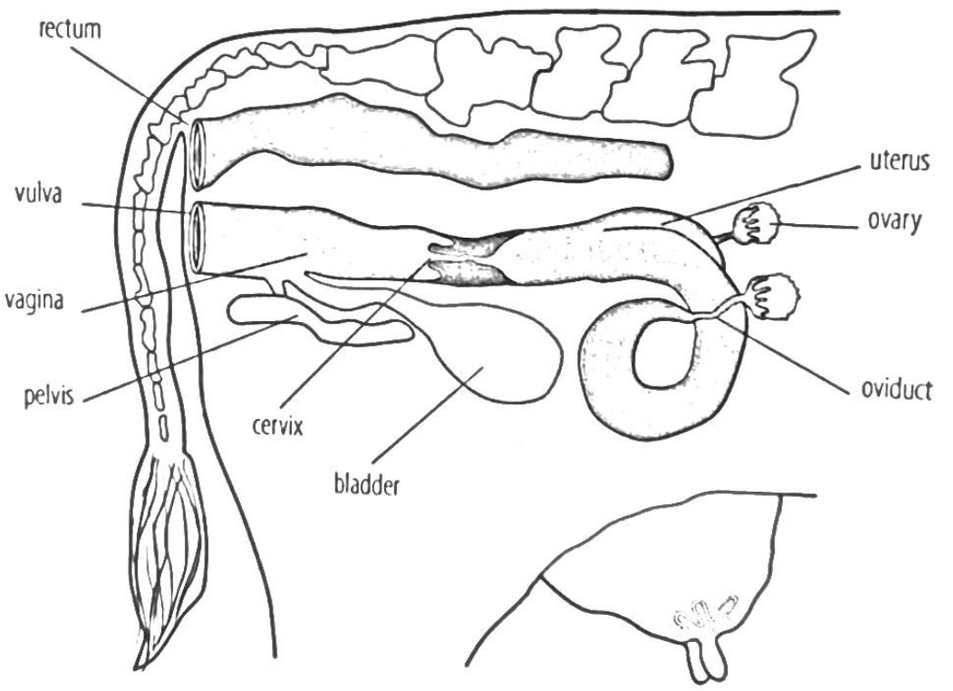
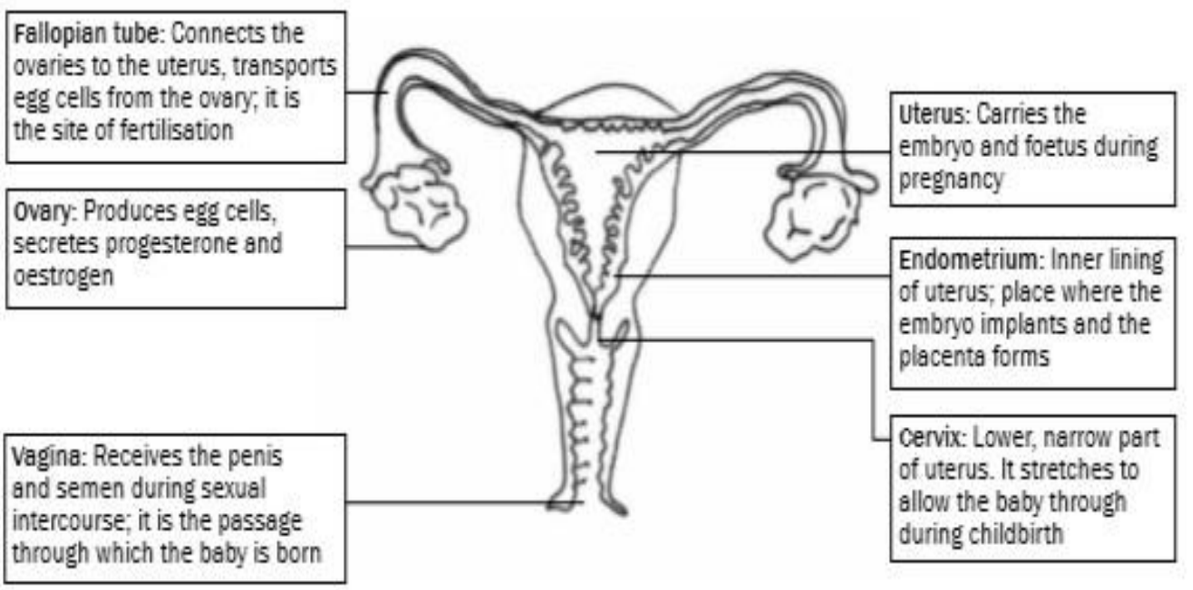


Figure 5.1.8 The reproductive tract of a cow



A. Primary sex organs

i. ovaries

B. Secondary sex organs

i. Vulva
ii. Vagina
iii. Uterus
iv. Fallopian tube

Primary sex organs

Ovaries- The ovary is the primary reproductive organ of the cow. There are two ovaries, one on either side of the abdomen. They are attached by the fallopian tubes to the point of the horn of the uterus. They contain the ova or eggs of the cow. When the cow reaches puberty a few ova will ripen every 21 days.

Functions of ovaries

i. Production of female gametes.
ii. Produce the main female sex hormones (oestrogen/progesterone), oxytocin, relaxin, inhibin.

B. Secondary sex organs

Vulva- is the entrance to the vagina. It has two lips = the bigger lips on the outside **labia majora** and smaller lips inside **labia minora**. The clitoris is located ventrally inside the labia, it erect during oestrus and stimulation during mating.

When the cow approaches oestrus, the vulva swells, is red and moist.

Functions of vulva

i. Vulva forms part of the reproductive tract for mating.
ii. Passageway for urine
iii. The birth can for the calf and expulsion canal of foetal membrane during parturition

Vagina- A muscular tube. It is adjacent to the cervix of the uterus on one end and it opens to the outside through the vulva or lips of the vagina on the other end. The **hymen** is the membrane at the entrance of the vagina.

Functions of vagina

1. Female organ for copulation,
2. Receive sperm during mating.
3. It is the passageway for foetus and foetal membrane during parturition.
4. The muscular wall of vagina helps with the **transport of sperm.**
5. The cell in the mucous lining lubricates the vagina during mating.
6. During artificial insemination instrument is threaded through the vagina and cervix to deposit the sperm

Uterus- A muscular tube which can be divided into various parts: the thick neck or cervix, the body and the horns. The uterus is lined on the inside with a layer called the endometrium.

The wall of the uterus consists of:

1.Perimetrium – is the outer layer

2**.Myometrium** – is the middle layer

3.**Endometrium** – is the mucous layer

Functions of uterus

- The main function of uterus is to provide a suitable environment for the development of foetus.
- Contraction of uterus wall help with the expulsion of calf at birth.
- Responsible for the implantation of the blastocyst (zygote)
- To and nourishment of the zygote
- Glands in the uterine walls secrete uterine milk that provides nutrients for the development of embryo.

Fallopian tube- These tubes are also called the oviducts and they are two winding tubes which pass from the horns of the uterus to the ovaries. Each tube forms a funnel shaped body at the ovary called the **infundibulum.**

Fallopian tubes consist of three parts:

1) I**nfundibulum** – catches and channels the ova during ovulation.

2) **Ampulla** – is the main site of fertilization.
3) **Isthmus** – serves as a reservoir for healthy sperm.

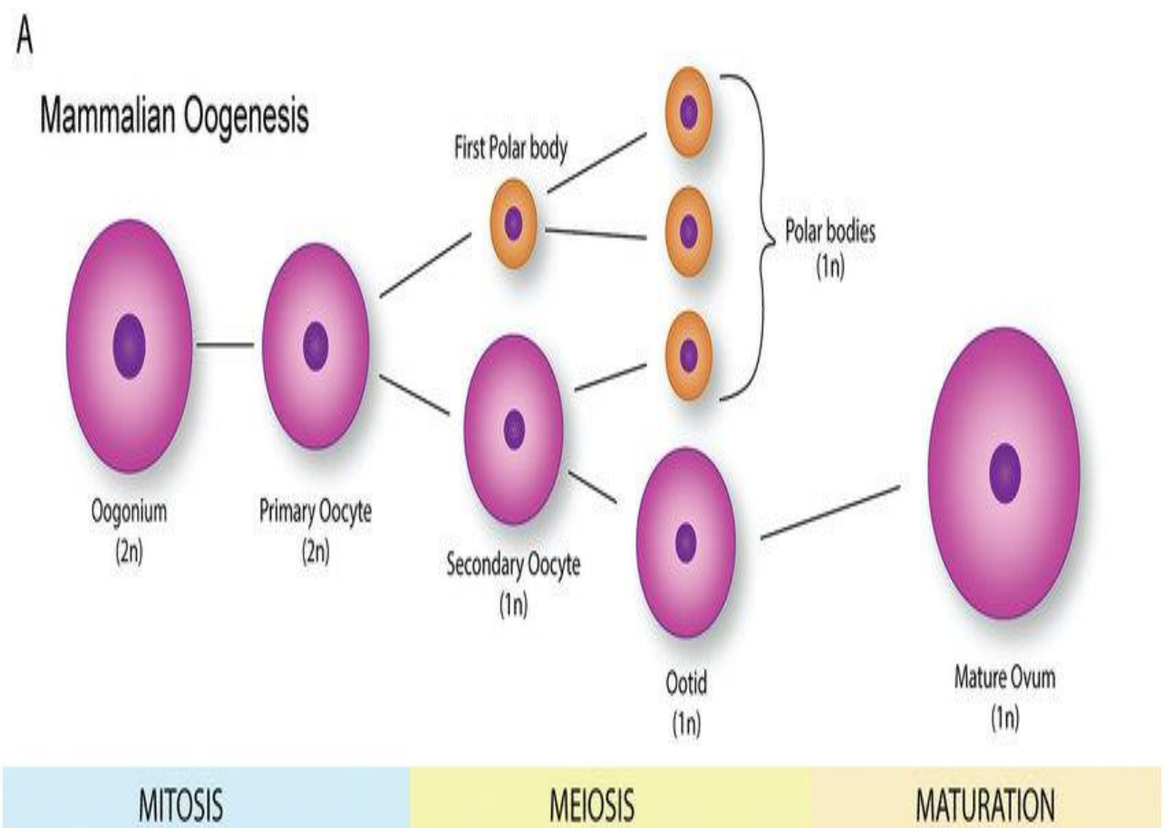
Functions of oviduct

1. They Transport ova to the point of fertilisation by the spermatozoa.
2. Fertilisation of the egg by the spermatozoa occurs in the oviduct.

PROCESS OF OEGENESIS/ OVIGENESIS

The process whereby eggs(ova) are formed or produced by ovary. The process is as follow.

- The **primordial germ** cells differentiate into **oogonia (2n diploid)**
- The **oogonium** divides by the process of mitosis and develops into **primary oocytes (2n diploid)**
- Primary oocytes divide and from secondary (n haploid) under the influence of follicle-stimulating hormone (FSH)
- Secondary oocytes divide to for **ootids** and three polar bodies
- The ootids differentiates and matures and an **OVUM IS FORMED**



OESTRUS AND OESTRUS CYCLE

TERM	DEFINITION
Anoestrus	• A sexually mature, non-pregnant cow shows no signs of oestrus
Oestrogen	• A female hormone responsible for onset of behavioural oestrus
Oestrus	• A period when a female is receptive of a male & allows mating
Oestrus cycle	• A 21 day period which a follicle develops into a mature ovum
Oocyte	• An immature ovum that develops into a follicle
Ovulation	• A release of a ripe ovum from an ovary
Ovum	• Female gamete
Prolactin	• A female hormone responsible for production of milk
Prostate gland	• A gland that lies in the form of a ring around the urethra in males
Reproduction	• Production of offspring
Superovulation	• Treating a female with hormones in order to produce many ova at the same time
Synchronisation of oestrus	• A treatment of a large number of animals with hormones so that they all reach oestrus at the same period
Ovary	• Primary sex organ of a female

Oestrus or "HEAT"- is the term used to describe the readiness of the cow for mating. It occurs at the stage in the 21-day oestrus cycle at which the cow ovulates (in heat) and is therefore ready to be fertilised by the bull.

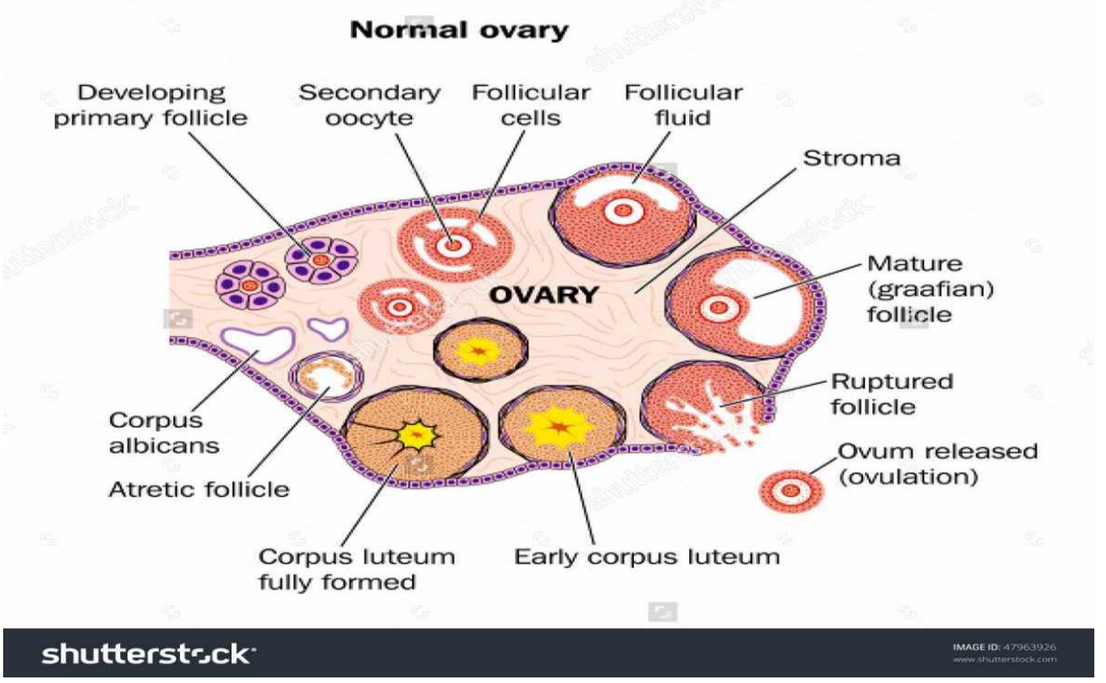
Oestrus starts at puberty and repeats every 21 days, it can be interrupted by **pregnancy**, **diseases, adverse climate conditions**, **malnutrition.**

FOUR PHASES/STAGE OF OESTRUS

a) Pro-oestrus
b) Oestrus
c) Met-oestrus
d) Di-oestrus

Pro-Oestrus	Oestrus (in heat).	Met Oestrus Post estrus	Dioestrus FINAL phase

• 2 to 3 days • primary follicles are stimulated by FSH (follicle stimulating hormone) the • oocyte develops into an ovum • follicles are now called Graafian follicles • Graafian follicles function as endocrine glands and secrete the oestrogen • Oestrogen is responsible for symptoms of oestrus • Muscles of the cervix relax to allow spermatozoa to move from the vagina to the body of the uterus	• about 16 hours-18 • phase of sexual desire • characterised by changes in behaviour of the cow, the vulva becomes more swollen, the genital organs are redder and large quantities of mucus are secreted. • follicles grow to the size of a pigeon's egg. • Ovulation only occurs 6 to 14 hours after the period of oestrus. • The cow will allow mating only during this period	• 3 days. • sudden cessation of heat • hypophysis secretes lutilizing hormone (LH). • FSH and LH stimulates the Graafian follicle to ripen • LH and oestrogen are responsible for rupture of the ripe Graafian follicle. • Ripe ovum is released(ovulated) • After ovulation LH stimulates the ruptured Graafian follicle to form the *corpus luteum* •	• about 15 days • sexual inactivity. • cow is calm and restful and displays no sexual desire. • corpus luteum secretes progesterone which, together with oestrogen, is responsible for final preparation of the uterine wall. • The corpus luteum decreases in size during the last few days of the phase • If fertilisation has taken place the corpus luteum will persist for the whole pregnancy period.



Pro-oestrus

- This last for 2 to 3 days.
- FSH is secreted by the pituitary gland to stimulate the development of graafian follicles
- The corpus luteum regresses
- Progesterone level decrease
- Oestrogen which responsible for oestrus characteristic is released.
- Oestrogen will stimulates blood supply to the genetical tract and cause the vulva swell and redden.
- The visible veins of female reproductive tract increases. Cow become exited but dot not actually mate.

Oestrus- period of sexual activity

-is when the female is receptive to the male, and will stand for mating.

the average length of oestrus is 12-18 hours, the oestrus is controlled by FSH and LH.

Ovulation occurs 10-12 hours after the end of oestrus and after the behavioural sigs of oestrus have stopped.

Concept of ovulation- Process whereby the membrane containing the ripefollicle bursts with the help of LH and the ripe ovum is released into the infundibulum

SIGNS OF OESTRUS

- Restless, excitement
- Decrease in milk production
- Swollen vulva, moist and red interior
- She mounts other cows
- She goes to bull and allows mating
- Mucous discharge from through vagina (bullstrings)
- Cows urinate frequently (dribbling)
- Cow sniffs the genitalia and licks the vulva of other cows
- The dung contains a jelly like mucous.
- Tail in raised position
- Cow raises her head and curls her lips.
- About one to three days after oestrus cows have a bloody mucus discharge (met-oestrus bleeding)

MET-OESTRUS

- This phase last for 2-3 days
- It occurs 4-16 hours after the end of oestrus
- The corpus luteum is formed. The oestrogen level is low and progesterone level begin to rise.
- The ovulated eggs are picked up by the oviducts and transported to the uterine horns

DI-OESTRUS

It last for 15 days

The cow is sexually inactive

If the ovoloursum is fertilised the corpus luteum will persist

If the animal does not become pregnant corpus luteum will degenerate (break down by prostaglandin secreted by the endometrium) after about 15 days

THE PRACTICL METHODS DAIRY FARMERS CAN ADOPT TO ASSIST IN IDENTIFYING COWS ON HEAT

- Observation of the cow's behaviour for a period of 20-30 minutes two to three times a day.
- Place a bull in a pen near the cows, cows in oestrus will normally move towards the bull
- Heat mount detectors- when cow mount another cow in oestrus the dye will change colour
- Tail paint
- Tail pain markers;
- Rectal palpation of the ovaries and uterus
- Taking vinal smears or testing of urine samples
- Measuring vaginal and body temperature.

Devices to detect oestrus in the cow

- Pedometer
- Chin-ball marker
- Tail-chalking
- Kamar heatmount detector

Hormones	Organ	Functions

Gonadotrophic releasing hormone	Hypothalamus	• Releasing FSH and LH release
Follicle stimulating hormone (FSH)	Pituitary gland	• Follicle growth • Estrogen release
Luteinizing hormone (LH)	Pituitary gland	• Ovulation • Corpus luteum formation and function •
Oestrogen (Estradol)	Ovary	• Delays FSH • Mating behavior • Secondary sex characteristics • Maintenance of female duct system Mammary growth
Progesesterone (Progestins)	Corpus Luteum	• Maintenance of pregnancy • Mammary growth • Delays secretion of FSH • Preparing the uterus to receive the fertilised egg v

Oxytocin is released by the hypophysis. It is responsible for:

- stimulating contraction and relaxation (peristalsis) of the smooth muscles in the oviduct and uterus to aid the movement of the sperm to the ovum after mating
- stimulating uterine contractions for expulsion of the foetus and foetal membranes during parturition
- stimulating the myoepithelial cells of the mammary gland causing milk ejection
- possibly also playing a role in the regression of the corpus luteum.

Relaxin: is secreted by the corpus luteum.

- At the end of pregnancy, relaxin stimulates the ripening and opening of the cervix and relaxation of the pelvic ligaments.

Inhibin: is secreted by the ovarian follicles.

- It suppresses the release of FSH from the pituitary gland.
- It may be involved in the selection of the follicle for ovulation.

Prostaglandin is released by the uterine lining.

- It causes the corpus luteum to regress, which is an indication that the cow is not pregnant. When the female does not become pregnant, the uterus releases prostaglandin to induce luteolysis (luteolysis is the degradation of the corpus luteum).
- It is used to synchronise oestrus.

Prolactin (PRL) is synthesised in the anterior pituitary gland in the brain. The secretion of prolactin is enhanced by stimulating the udder and teats. It is responsible for:

- inducing milk synthesis. During pregnancy the secretion of prolactin increases and thereby promotes the development of the mammary glands to prepare them for milk production
- stimulating lactation after parturition
- maintaining milk secretion during suckling of young offspring
- inhibition of the ovarian functions to prevent ovulation while the cow is still lactating
- helping to refill the mammary gland after suckling or milking
- inducing maternal behaviour in females to care for and nurse their offspring
- suppressing the secretion of GnRH.

Luteotrophic hormone (LTH): is secreted by the anterior pituitary gland in the brain. It is responsible for:

- inducing the growth of the mammary glands
- initiating the secretion of milk after parturition
- Stimulating the udder to continue the secretion of milk
- maintaining the functioning of the corpus luteum and thereby Preventing high lactating cows from coming into oestrus
- Stimulating maternal behaviour in mature female animals.

Synchronisation of oestrus (heat)

Synchronisation of oestrus (heat)- Refers to changing the oestrus cycle of group of female in herd so that they can came into oestrus at approximately the same time using hormones

1. Prostaglandin injection
2. Progestin or progestogen administration
3. Cosynch oestrus synchronisation
4. MGA (melengestrol acetate)
5. Gonadotropin releasing hormone (GnRH) injections

Injecting gonadotrophic hormones	Follicle development is stimulated by these hormones to induce oestrus
Injecting oestrogen hormones	Synthetically manufactured oestrogen, generally known as stilboestrol, is used to induce oestrus.
Injecting progesterone	This hormone prevents oestrus and the animals will show signs of oestrus a few days after injections are discontinued
Squeezing out of the corpus luteum	As a rule the cow shows signs of oestrus four days after the corpus luteum has been squeezed out because the source of progesterone, which suppresses the development of follicles, has been removed

Advantages and disadvantages of synchronisation of oestrus

Advantages

- Less time is needed for oestrus detection
- Uniformity of calves at weaning
- Introducing new genetics to the herd
- Castration and branding can be done can be done at the same time as young are of the same age
- Reproductive performance is improved as more cows become pregnant at the same time

Disadvantages

- The need for high for a high-level management
- the need for good handling facilities
- Being too expensive for small scale farmers
- heat detection involves high labour cost and good and good facilities and is time-intensive
- synchronisation involves high labour management and high technology
- Some of the drugs required to synchronise oestrus are very expensive.
- The results of some methods are variable, which means the outcome of the synchronisation of oestrus process is not always consistent.
- Prostaglandins cause abortions in pregnant animals.

- Progesterone administration is a lengthy process.

Factors causing infertility and sterility in cows

1. **Congenital** or inborn factors include:
2. **Injuries to the reproductive tract during mating**, birth or the passing of the placenta can cause adhesions or blockages in the reproductive tract.
3. **Ovarian problems** may cause several reproductive difficulties. These problems include failure to come on heat (anoestrus) and failure to ovulate.
4. **Diseases** can cause infertility in cows.
5. **Malnutrition** can affect the fertility of the cow. For example: underfeeding will cause a delay in puberty, while overweight cows will also show fertility problems.
6. **Management** must be handled correctly. For example: cows that are mated at the wrong time, subjected to unhygienic conditions and poorly adapted to their environment may develop fertility problems.

Factors causing infertility in cows

Cows are infertile when they are neither normally fertile nor completely sterile. So, **infertility is thus not necessarily permanent**, and can be caused by factors such as injuries to the reproductive tract, ovarian problems, diseases, malnutrition and poorlivestock management, Retained placenta, metritis, Anoestrus, Repeat breeders, abortions,hereditary conditions

Factors causing sterility in cows

Sterility is a total loss of fertility. Sterility is thus caused when the factors that result in infertility persist. These can be:

- diseases of the genital organs (e.g. retained placenta)
- infections (e.g. trichomoniasis)
- physiological (e.g. repeat breeding)
- anatomical (e.g. freemartinism).

MATING AND EJACULATION

Mating is the primary (breeding) of a sexually mature male and female ani animal to produce offspring. Copulation mast take place whereby a male reproductive organ (penis) is introduced into female copulatory organ (vagina).

During mating the male animal deposits spermatozoa (sperm) inti vagina of the female. Successful mating will eventually result in fertilisation and new offspring.

Why in animal herd most animal have same characteristic?

In many animal species there's struggle between between the male animals before they can mate with the females. The survivor normally gets the opportunity to pass his genes

COPULATION

- In natural mating copulation takes place for a cow to be pregnant.
- The male organ of copulation is penis, and the female organ of copulation is penis.
- The aim of copulation is that the bull must deposit semen containing sperm into female reproductive tract to fertilize the ovum and eventually lead to the birth of a new offspring.
- Female only allow copulation during oestrus or standing heat.
- The bull will sniff the vulva and the smell will increase LIBIDO. The bull will then mount the cow.
- The time between insertion of penis and ejaculation last about seven seconds(this means copulation last for seconds.(in horse and pigs is last for minutes
- Copulation stops when a bull has ejaculated.

Causes for lack of libido(LIBIDO-sexual drive)

- Immaturity
- Inexperience
- Diseases
- Underfeeding/overfeeding/malnutrition
- Old age/senility
- Overwork/exhaustion/over exertion
- Improper handling/stress
- Lack of testosterone
- Temperament
- Environment

EJACULATUON

Ejaculation is the injection of semen containing sperm by the bull during copulation.

Ejaculation occurs due to the powerful contraction of urethra.

It occurs with a violent thrust during which the hind feet of the bull may lift from the ground.

Ejaculate = materials that bull ejaculates

In the ejaculates thousands of sperm are deposited into the vagina as well as some secretion that are important to maintain the viability and mobility of the sperm.

Important characteristics of ejaculate

- High quality
- Mobility and normal morphology and able to penetrate ovum to ensure successful fertilisation and pregnancy rates
- Sperm must also be able to transport genetic material

Mating and other methods of mating

Male sexual display and courtship behaviour patterns

- the bull detects the cow is in pro-oestrus about two days before oestrus and become very excited as the cow reaches oestrus.

- During the oestrus period the cow increases urination so that the bull can sample both the odour and test the urine.
- The bull also paw the ground and snorts, resting his chin on the cow's rump just before mounting ten copulation.
- The bull guards receptive female to prevent it from mating with other bulls.
- The bulls display a flehmen response, curling the upper lip and stretching out the head.
- Testosterone enhances the LIBIDO of the male.

Factors that regulate mating behaviour in bulls

- Hormonal influence
- Social and sexual interaction
- Senses: smell, sight and touch
- Genetics
- Environmental factors
- Health and previous experience
- Social ranking of a bull influences its rate of sexual activity and the most dominant animal mate
- New bulls that are introduced to the herd attract greater sexual attention, thereby stimulating bulls that are too inactive

Main stages of mating

- Courtship (sexual attraction)
- Mounting
- Penetration
- Copulation
- Ejaculation
- Dismounting

TERM	DEFINITION
AI	• The process whereby sperm is placed into a female's uterus/ cervix by artificial means rather than natural mating
Embryonic transfer/transplant	• Removal of a fertilised ovum from the uterus of a superior cow & transferring it to the uterus of the inferior cow
Embryo	• A developing animal formed from a fertilised ovum
Nuclear transfer/ cloning	• A process that produces an identical copy of biological material
Superovulation	• Treating a female with hormones in order to produce many ova at the same time
Synchronisation of oestrus	• A treatment of a large number of animals with hormones so that they all reach oestrus at the same period

The Main requirements for successful artificial insemination:

• The cow must be in oestrus

• The semen must be healthy and viable

• The inseminator must be familiar with the technique

ADVANTAGES OF AI

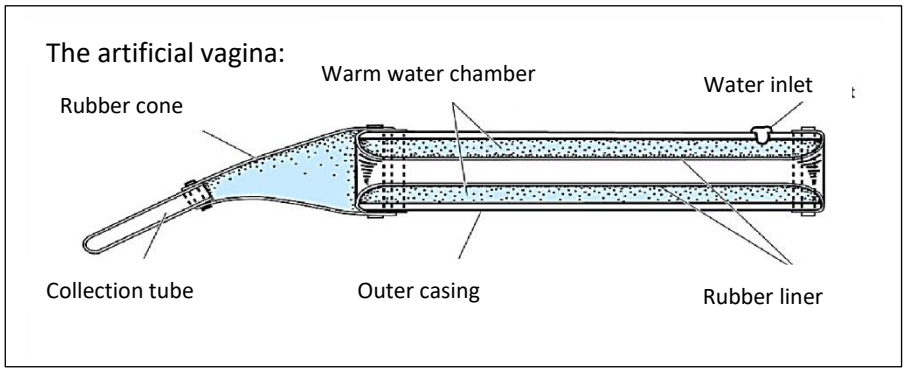
- It is a rapid economic method if improving the quality of the herd.
- Semen from outstanding bulls is obtainable.
- The usable duration of a cow's life is pro-longed.
- It enables the breeder to implement a planned breeding policy.
- bull can still be used after its death.
- Calving percentage is higher
- Prevent the spread of STD'S

DISADVANTAGES OF AI

- Labour intensive
- Time consuming
- Expensive procedure
- The success is varied
- Cows can be damaged or hurt by inexperienced technique
- Heat detection must be done regularly.
- It is expensive and specialized techniques is needed
- Diseases spread rapidly.
- Spread of diseases if semen is not tested
- Inexperience/unskilled operator may cause damage to the animal
- Decreased genetic variation
- Some heifers are difficult to inseminate successfully
- May not give the desirable results
- Higher management demands
- Undesirable traits/congenital defects may be transferred to moreoffspring

Methods of Semen collection

The Artificial Vagina: It uses thermal and mechanical stimulation to stimulate ejaculation. To collect semen, the male mounts the female but the penis is diverted into the artificial vagina and the semen is collected after ejaculation



- **Electro – ejaculation:** This techniques involves the application of a series of short, low voltage pulses of current into the rectum, where the pelvic nerves are involved in the ejaculatory response

THE BASIC REQUIMENT FOR SEMEN COLLECTION

- All he equipment for the collection of semen must be sterilised before use to prevent the spread of bacteria.
- The flour area must not be slippery and enough handlers must be available
- The area where the semen is collected must be as close as possible to the laboratory where the semen is analysed.
- The male animal must be clean during AI
- To prevent damaged to sperm caused by cold shoch after semen collection, the collecting vial must be warmed.
- When using artificial vagina, a teaser bull must be available

Basic requirements for the collection of semen from bulls

- Should be close to a laboratory .
- Equipment must be clean/sterilised
- Availability of appropriate equipment/artificial vagina
- Male animal must be clean/healthy.
- Warm collecting vial/placed in a water bath/prevent temperatureshock.
- Personnel must be trained/experienced.
- Floor not slippery
- Semen must be protected from direct sunlight.
- Teaser cows availability

CHARACTERISTICS OF GOOD QUALITY SEMEN (SEMEN EVALUATION)

- It is opaque
- Milky/normal colur
- Sticky
- At least 80% sperm should show forward mobility
- 85% alive
- Less than 20% abnormal sperm
- No blood in sperm
- Mo deformed sperm

CHARACTERISTICS OF POOR-QUALITY SPERM

- Grey semen, which indicates infection
- Reddish semen indicates the presence of fresh blood
- Dark brown semen contains old blood
- Abnormal sperm count

TYPES OF SEMEN DILUTANTS AND FUNCTION OF SUCH DILUTANTS

Semen dilutant is a liquid diluent which is added to semen to preserve its fertilizing ability.

Collected semen must be treated with a dilutant which **contains egg yolk, milk, glycerol, buffers, and antibiotics.**

BUFFER: control the PH of diluted semen at between 6,7 and 7,0

Milk: protect the sperm membranes from changes in temperature such as cold shock.

Fructose and glucose: provide energy for the sperm.

Antibiotic: protect the sperm from bacterial growth

Glycerol: use to protect sperm cells ice and solute during the free-thaw process

The function of the dilutant:

- Increases the volume of the semen
- provides nutrients for the sperm cells
- provides protection against changes in pH
- prevents bacterial growth
- increases the viability of the sperm cells
- provide energy to spermatozoa
- increase volume of semen

Basic requirements for the storage of semen:

- For shorter periods it can be stored at 5o C
- For longer times the sperm should be placed in 0,2ml or 0,5ml straws, and frozen in liquid nitrogen at -196 o C.
- To thaw, the straws are placed in water between 32- 35 o C for 15 seconds.

CORRECT TIME FOR AI

- If the signs of heat are observed in the morning the cow should be inseminated in the morning
- If the signs of heat are observed in the afternoon the cow is inseminated the next morning
- Heifers of all breeds are inseminated between the age of 15 to 27 months so that their first calves are born before they are 3 years old.
- Cows must be inseminated within 2-4 months after calving because they reach maximum fertility during this period.
- Best results are obtained if insemination is carried out during the second half of oestrus, or within 5 hours after visible signs of oestrus.
- Normally ovulation occurs within 14 hours after oestrus.
- Insemination takes place after the visible signs of oestrus have disappeared.

THE CORRECT TECHNIQUE FOR CARRING OUT (AI)

- **A** pistolette is used to inseminate the cows
- Insemination is carried out in a shed to eliminate unfavorable conditions such as wind, dust and rain.
- before insemination - bring cow to a stall so she is calm during insemination.
- A tube with semen is taken from the thermos flask, thawed, and inserted in pistolette and covered with sheath.
- The rectum is cleaned and the left hand is inserted into the rectum to remove faeces and the cervix is palpated.
- The hand is pushed in further to inspect the uterus and the horns of the uterus to ascertain to stimulate the secretion of oxytocin.
- The vulva is wiped clean, the inseminating tube(pistolet) inserted into the vulva and moved gently along the upper side of the vagina until it touches the little finger.
- Because the cervix is open during oestrus the inseminating tube enters the opening with ease.

- The semen is deposited either in the cervix or in the body of the uterus or in equal quantities in both these organs.

2.EMBRYO TRANSPLANTATION

Embryo transfer: transfer of embryo from donor cow to the recipient cow.

:transfer of *in vivo or in vitro* fertilised embryo.

Donor cow: cow of superior genetic merit.

Recipient cow: usually of inferior genetic merit: also known as the surrogate mother.

Embryo flushing: removal of valuable embryos from the uterus of a donor cow.

Super ovulation: treating of donor cow with hormones to allow for the production of many mature ova at once.

AIMS AND PURPOSE OF ET

- To prevent the extinction of valuable animals and to increase the number of endangered scare animals.
- To improve diseases resistance by using embryo of superior animals that are resistant to certain diseases
- To improve the growth rate and production yield

ADVANTAGES OF EMBRYO TRANSPLANTATION

- More pregnancy can be produced
- High profit due to increase in sales.
- Productive lives of cows are increased
- Superior genes are introduced into herd
- More offspring per year can be produced form a superior animal than what is normally achieveble.
- Profit is made from the increased sale of quality genetics.
- Genetic material can be transported internationally
- Valuable older cows that are unable to carry pregnancy can extend their reproductive lives by producing further pregnancy
- Allows top quality female livestock to have a great influence on the genetic advancement of a herd or flock
- Provides the opportunity to introduce desired genetic material into populations of livestock
- Greatly reduces the risk of transmission of infectious diseases
- Can be used very effectively on commercial farms with good management

DISADVANTAGES OF EMBRYO TRANSPLANTATION

- Involves sterile procedures to harvest and transfer the embryos; therefore requires a highly skilled operator
- It is an expensive process
- Pregnancy rates in ET are highly variable, averaging only about a 50% success rate

FOUR sequential stages used in ET

- Synchronisation of oestrus in donor and recipient cows
- Superovulation of donor cows
- Insemination of donor cows

- Washing of the embryo from the uterus
- Transfer embryo into the uterus of recipient cows

3.Cloning by nuclear transfer

Cloning- process at which identical copy of the donor animal is produced from its unclear.

Cloning in biotechnology refers to processes used to create copies of DNA fragments.

Cloning by nuclear transfer involves producing an exact copy of an existing animal. It is done by injecting the nucleus of a somatic cell from the animal to be cloned into an unfertilised ovum or egg cell. The ovum's own DNA is removed. This results in a new cell that will dividenormally, forming an embryo that is identical to the donor animal. The embryo is placed in the uterus of a surrogate mother where it grows to term.

Types and aims of cloning:

1.Reproductive cloning

Farm animals are cloned to reproduce individuals with valuable genetic material.

- farmers may want to reproduce animals that have a particular advantage such as disease resistance or exceptional production characteristics)

2.Therapeutic cloning

The main aim is to use embryonic stem cells, which have the unique ability to generate virtually all types of cells in an organism, to grow tissues in

Types of cloning:

Reproductive cloning: Is used to generate a cloned embryo, which is then implanted into the uterus of a recipient female to give rise to a cloned offspring that is genetically identical to the adult donor female. – Not always successfull and cloned animals commonly have abnormalities, regardless of the type of donor cell or species involved

Therapeutic cloning; Is performed with the aim of finding cures for diseases. The intention is not to create a cloned offspring but to derive embryonic stem cells that can be used for cell therapy

AIMS OF CLONNING

- To produce large number of genetically identical animals
- To Produce superior cows with desirable genetic characteristics.
- To produce high quality meat and dairy products.
- To increase the number of endangered species.
- Endangered or extinct species can possibly be revied
- Therapeutic cloning is performed for medical reasons.

Aims of cloning

- Produce large numbers of genetically identical animals
- Production of offspring from a higher quality animal
- Preservation of superior genetics/characteristics
- Increase the population size of endangered species
- Achieve high quality meat and dairy products
- For medical purposes

ADVANTGES OF CLONNING

- More animals with the desirable characteristics can be produced.
- Many animals can be produced
- Cloning allows further research to be undertaken.
- Cloning can serve specie promo to extinction.

DISADVANTAGES OF CLONNING

- Cloned animal have shorter life span.
- Discarded embryo in therapeutic cloning are useless and is involves killing of a potential life.
- Cloning is regarded as inhuman.
- Many believe that scientists are play God.
- Cloning is an expensive process
- Large offspring syndrome.

Fertilization and pregnancy

TERMS	DEFINITION
Pregnancy	Begins with a fertlised ovum and ends with birth
Gestation	The time from fertlilizationto birth,during which the foetus develops inside the mother
Fertlization	The joining of the nucleus of a male and female gamete, to form a zygote
Monozygotic twins	one of a pair of twins who develop from a single fertilized ovum and therefore have the same genotype, are of the same sex, and usually resemble each other closely.
Dizygotic twins	two offspring born of the same pregnancy and developed from two ova that were released from the ovary simultaneouslyand fertilized at the same time
Freemartin	The result of dizygotic twins where in the placenta male hormones affect the female calf, having an influence on the expression of female characteristics
Abortion	The termination of pregnancy before the foetus is viable:
Foetus	An unborn animal in the later stages of development
Acrosome	An organelle covering the head of animal sperm and containin g enzymes that digest the egg cell coating,thus permitting the sperm to enter the egg.
Placenta	An organ that attaches an embryo to the uterine wall

Fertilisation and pregnancy

You can define fusion in different ways

Key words for fertilization definition

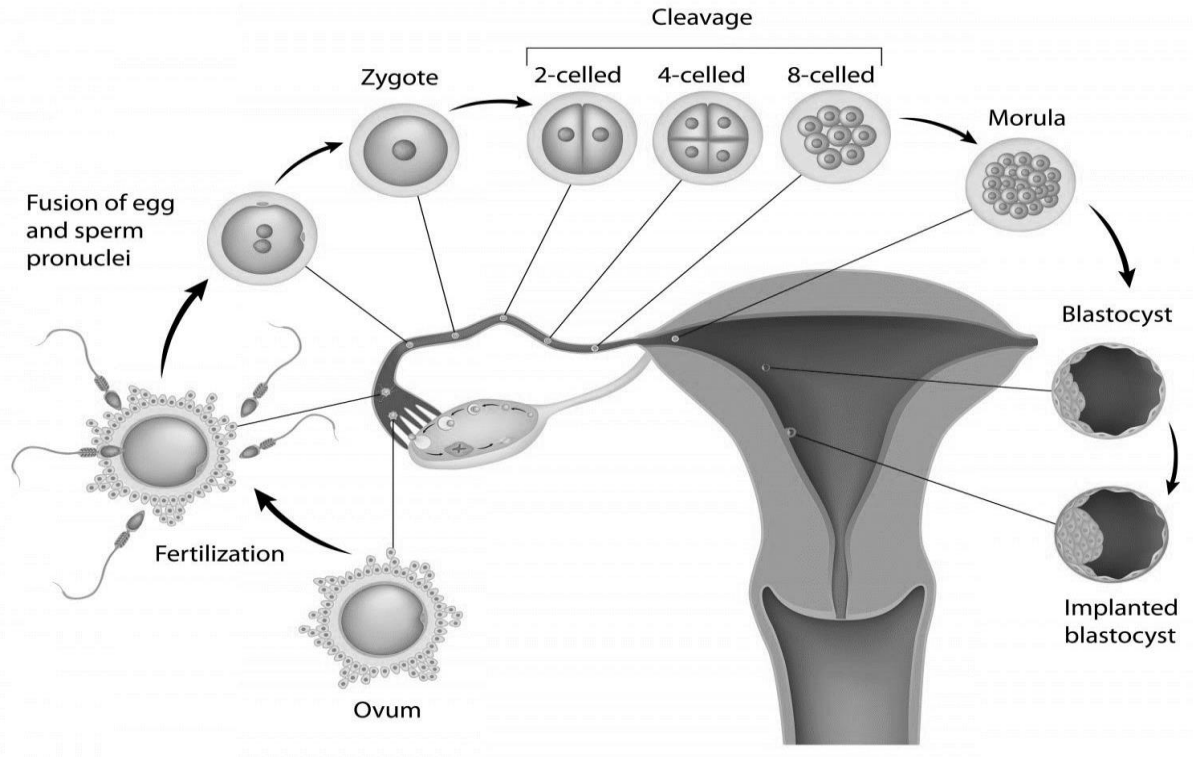
Male gamate(n) ---female gamate (n)

Sperm cell ----ova

Haploid gamate----haploid gamate

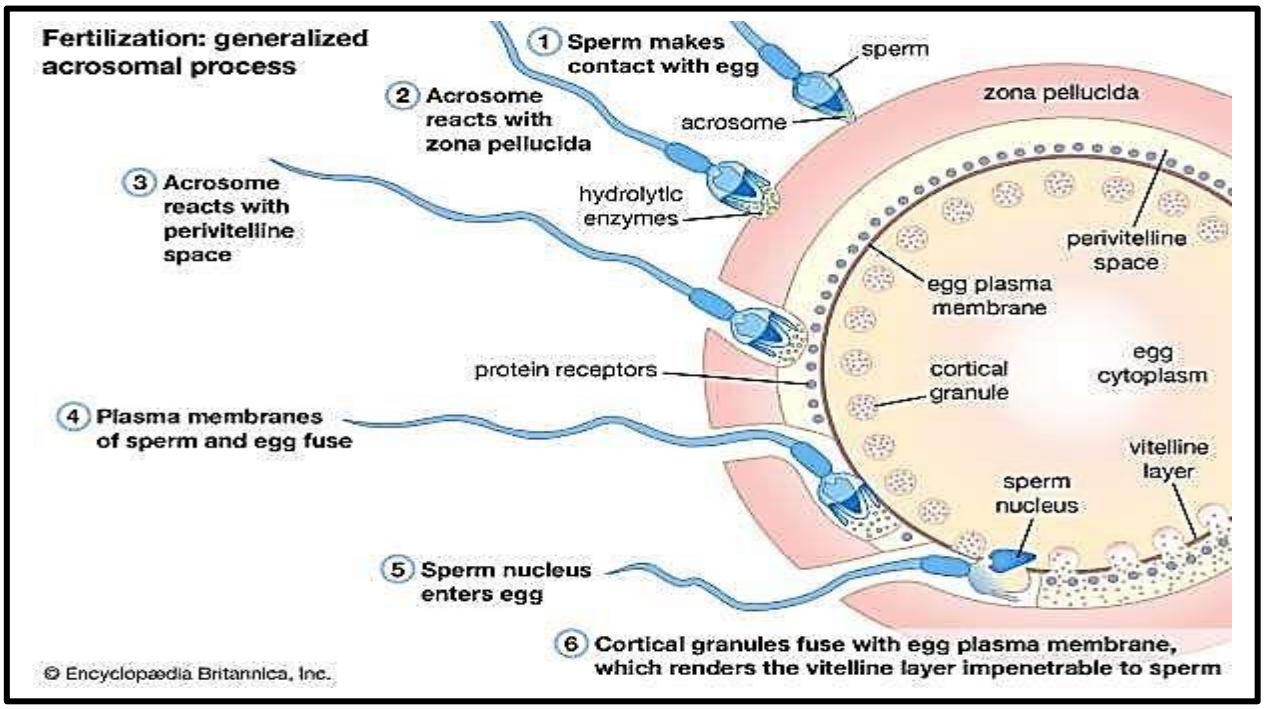
The Fertilisation Process

- Fertilisation process is achieved through natural mating. It starts with the bull ejaculating semen through the vagina into reproductive tract of female during copulation.
- The sperm cells swim through the cervix enter uterus and move towards the fallopian tube. And fertilisation must take place within 24 hours while sperm are still viable and motile.
- Mating usually takes place before ovulation and release of ripen ovum. Sperm cell reaches oviduct before ovum.
- **Released ovum move by process of peristaltic movement to the ampulla, which is the site where fertilisation take place**.
- Unfertilised ovum can remain alive for 6-12 hours.



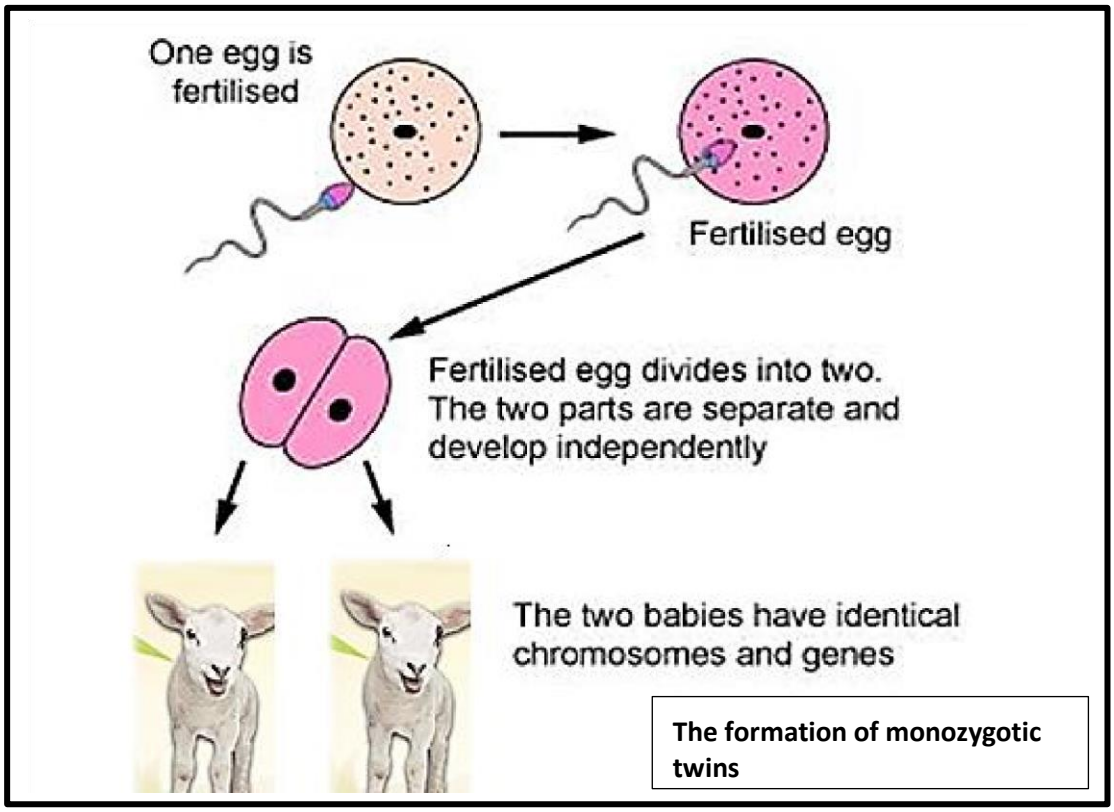
- The acrosome of the sperm must be prepared to be released from the head of the sperm. The sperm releases the enzyme hyaluronidase that enables the sperm cell to penetrate the **zona pellucida** surrounding the oocyte.
- Sperm cell loses its tail and the nucleus of male gametes fuses with the nucleus of female gametes to form diploid zygote. When a single sperm fused with the ovum membrane of ovum become impenetrable to other sperm.

- The zygote starts dividing, in process called **cleavage,** into two-cell embryo, four-cell embryo, eight-cell embryo and finally 16 cell embryo.
- Within three to four days, the 16-cell embryo enters the uterus where the foetus and its placental membranes will develop until parturition of the c



Multiple Births: - Monozygotic Twins, Dizygotic twins & Freemartins

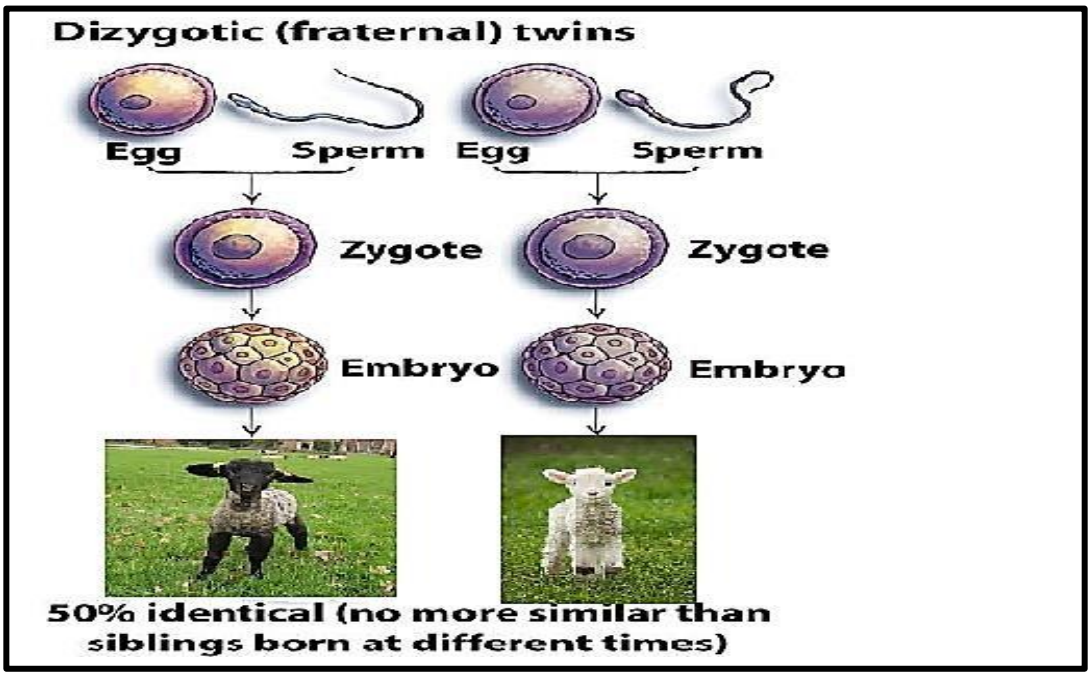
Monozygotic twins result from a single fertilized egg (zygote) The zygote divides to from two separate daughter cells, each developing into an individual. Each individual is genetically and phenotypically identical.



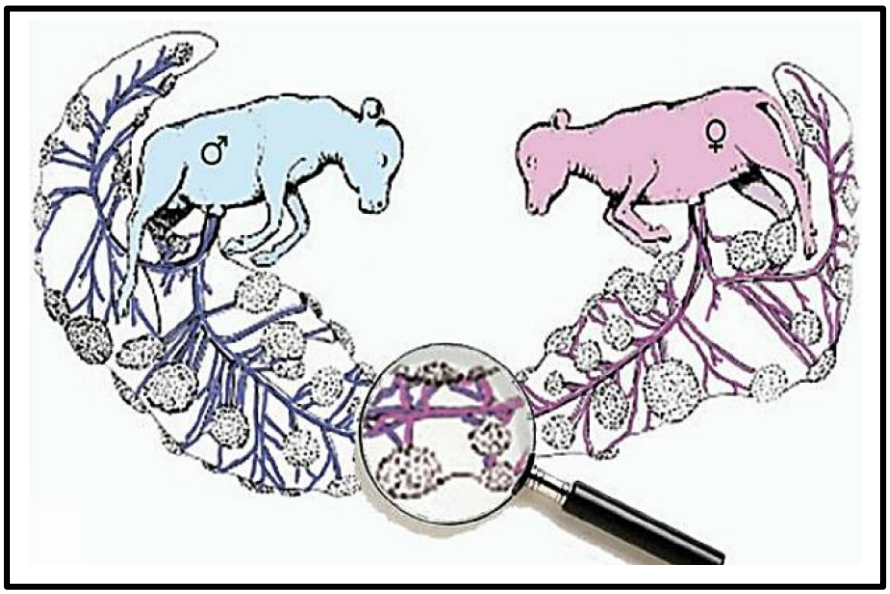
The formation of monozygotic twins

Dizygotic twins:

Dizygous twins from when two ova are released at the same time during ovulation. Each ovum is fertilized by different sperm. The sex of the twins can be the same or different.



Freemartin: The result of dizygotic twins where in the placenta male hormones affect the female calf, having an influence on the expression of female characteristics. This female calf is normally sterile and called a **freemartin**



Formation of multiple births (twins)

The natural incidence of multiple births in cattle is due to multiple ovulations.

Several factors such as: breed, genetics, parity and even environmental effects may influence the incidence of the twinning in cattle.

Multiple birth may increase problem during pregnancy and parturition.

Formation of multiple births (twins)

If more than one ovum is shed during ovulation, then more than one zygote can be formed. For example, pigs normally have 6–14 piglets and sheep can give birth to twins or triplets. Multiple births are less common in cows but does occur. The formation of the twins is dizygotic if two ova are fertilised and monozygotic when the embryo splits into two during development.

Formation of freemartins

- A freemartin is an infertile female calf that develop in the same uterus as a normal twin male calf.
- freemartin is one of the most serious forms of sexual abnormality found in cattle.

Dizygotic twins of different sexes occasionally develop an interconnected blood supply. If this happens, the heifer receives testosterone which causes the underdevelopment of the female sex organs and the formation of tiny ovaries. This results in a sterile freemartin. These heifers can be identified by external signs such as excess hair on the vulva and an underdeveloped udder and teats.

PHASES/STAGES OF PREGNANCY

1. Ovum period
2. Embryonic period
3. Foetal period

1.The ovum period last from fertilisation to implantation (7 to 12 days) fertilised diploid zygote moves oviduct to uterus while diving by mitosis into two-cell embryo, four-cell embryo, eight-cell embryo and finally 16 cell embryo. This mitotic division is called **cleavage**.

This solid ball consisting of sixteen cells called the **morula** reaches the uterus about four days after fertilisation. The blastocyst attaches to the endometrium in the uterus and this is called **implantation**

2.embryonic phase last from 12 to the 45 day after fertilisation

- Tissues and organs develop / placenta develop
- Blastocyte becomes an embryo with 3 membranes

Functions of embryo

- They protect embryo from injuries
- Responsible for gaseous exchange.
- Removal of waste product.
- Nutrition
- Lubricant during birth

3.foetal stage- lasts from about day 46 up to parturition. During this period the foetus grow and develop the characteristic features of the specific mammal.

THREE causes of abortion in dairy cows

- Infections/diseases
- Malnutrition
- Injuries
- Maltreatment/stress
- Environmental factors
- Genetic/congenital factors
- Strong laxatives
- Toxic elements in feed
- Vaccination/immunisation
- Twinning
- death of zygote,
- mummification
- maceration
- drops of the foetal membrane

BIRTH (PARTURITION) AND DYSTOCIA

1.Parturition: Natural END of pregnancy (process of giving birth)

- Birth of the new-born calf.
- This process occurs at the end of the gestation period that last about 283 days in cows.
- During parturition the fully developed foetus is expelled through the birth canal of the cow.

2.Dystocia: Condition of prolonged and difficult parturition, due to various

reasons

3.Retention: Keeping back (the placenta) after birth

4.Placenta: a flattened circular organ in the uterus of pregnant mammals, nourishing and maintaining the foetus through the umbilical cord.

SIGNS/ CHARACTERISTICS OF COW APPROACHING PARTURATION

- on the day of calving the cow stops eating,
- isolates herself,
- searches for a place to give birth,
- shows restlessness and discomfort,
- attempts to urinate often.
- Swollen teats
- Milk leaks from the teats
- Vulva enlarges and becomes softer.

FUNCTIONS OF THE LAYERS COVERING THE FOETUS

Foetal membranes/layers and their functions	
Foetal membrane/layer	**Function**
amnion (inner membrane)	➢ Encloses amniotic fluid which serves as shock absorber around foetusand provides lubrication for birth of calf ➢ The inner membrane that contains the amnion fluid, that protects the embryo. The embryo is connected to the amnion by the umbilical cord
chorion	➢ Fuses with allantois ➢ (Embryonic bag) The outer membrane that attaches to the uterus
allantois (outer membrane)	➢ Encloses the allantoic fluid which collects the excretory products fromthe foetus
chorio-allantois	➢ Attaches to uterus wall and forms the cotyledons of the placenta whichallows exchange of nutrients between the foetus and mother

THE STAGES AND PHASES OF parturation

1. Preparatory stage

2. Ejection stage (delivery stage)
3. Expulsion of placenta (after birth)

Stage 1: Preparatory

The uterus begins to contract involuntarily at intervals during the preparatory stage. The cervix opens as a result of hormone secretion and is pushed open further by the fluid-filled foetal membranes that press against the uterine end of the cervix. The allantois or outer membrane ruptures and releases allantoic fluid which lubricates the birth canal.

Stage 2: Expulsion of the foetus

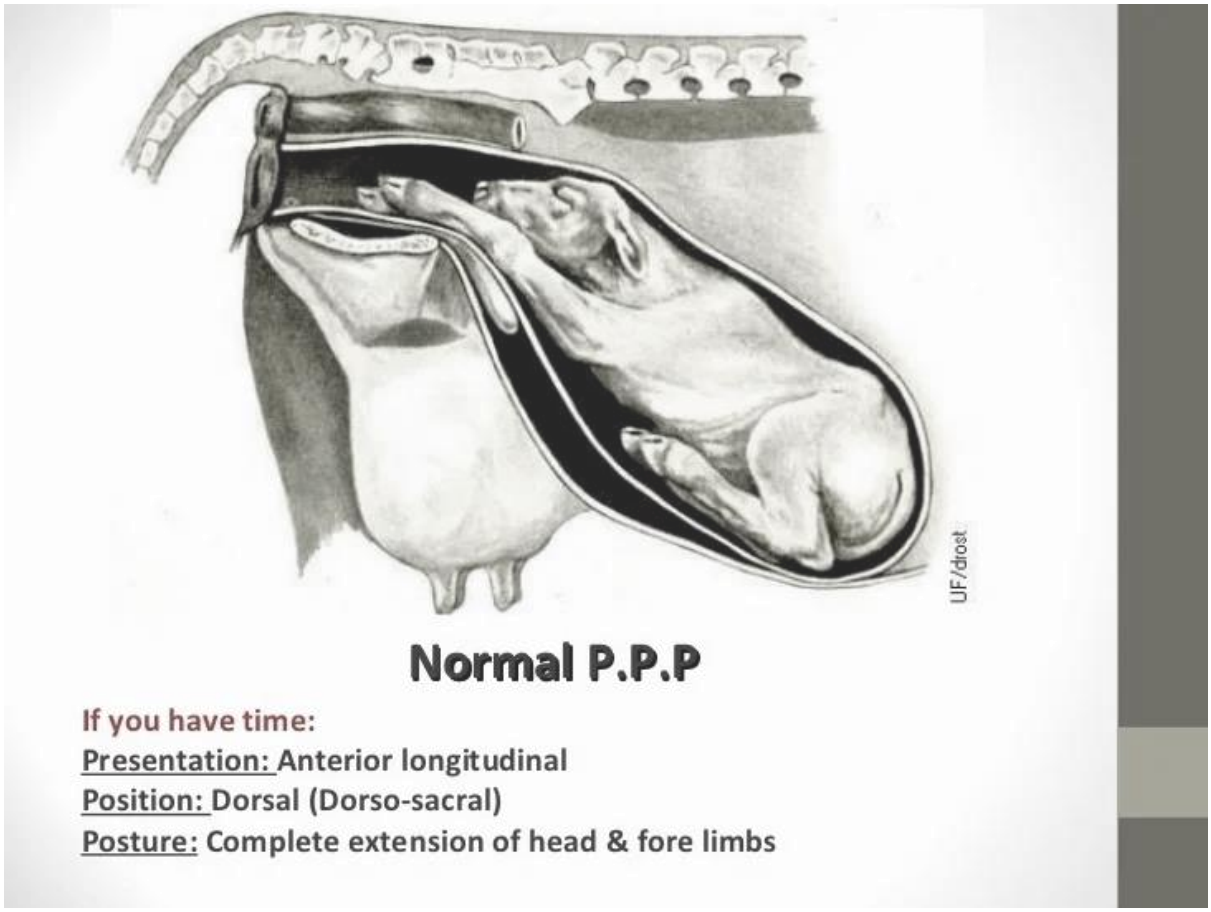
The cow usually lies down in this stage. In addition to involuntary uterine contractions, the cow begins to strain using her abdominal muscles to expel the foetus from the birth canal. These combined contractions propel the foetus through the dilated cervix. The amnion (inner membrane) ruptures which releases fluid to help lubricate the passage of the foetus. The foetus is expelled

and the umbilicus pulls loose from the uterine wall. The calf's breathing reflex is stimulated because it no longer receives oxygen through the umbilicus or navel.

Stage 3: Expulsion of the afterbirth

A period of rest follows the expulsion of the foetus from the uterus. The uterine muscles then contract again and expel the so-called afterbirth, which is composed of the placenta, umbilical cord and foetal membranes.

CORRECT POSITION OF THE CALF IN THE UTERUS BEFORE BIRTH



CONDITION WHICH INTEFERE WITH NORMAL PARTURATION

- Deviation of the head
- Flexion of the elbow
- Retention of the forelegs
- Hydrocephalus
- Congenital defects
- Twins
- Posterior presentation
- Age of the cow
- Size of the pelvic area
- If cervix does not dilate.

FACTORS CAUSESING RENTETION OF THE PLACENT/ AFTER BIRTH IN COWS

- Infection in the reproductive tract
- Abnormal delivery
- Metabolic disorder
- Advanced age of the cow
- High environmental temperature
- Heredity defects or weakness
- Sexual transmitted diseases
- General infection or abortion.

Lactation, dry period, milk ejection

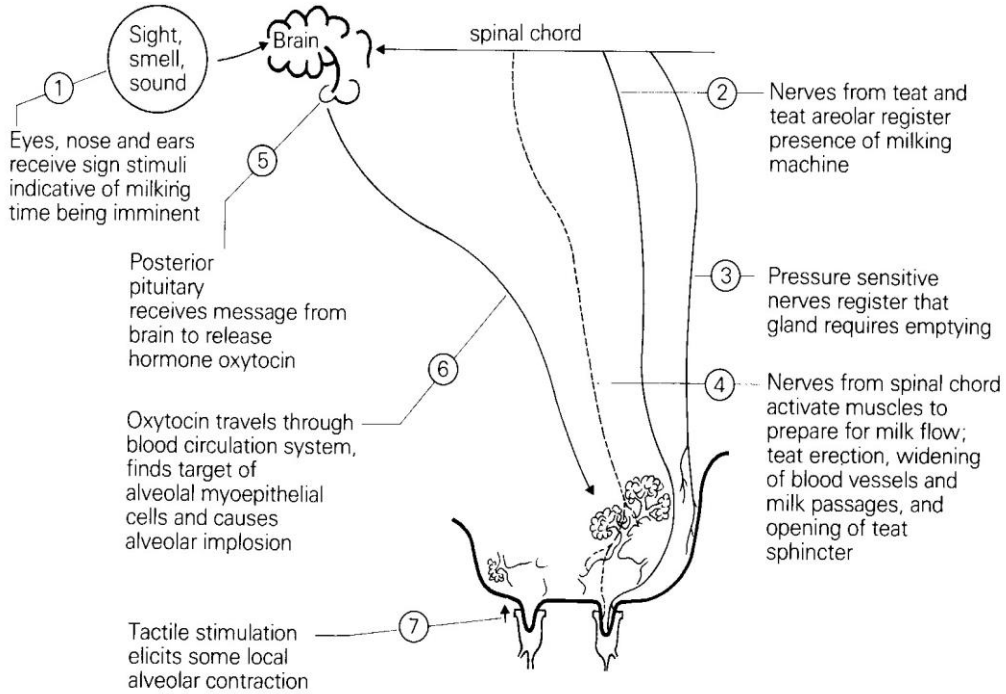
TERMS	DEFINITION
Colostrum	Yellow milk secreted during the first 3 days after calving
Lactation	The secretion of milk by the mammary glands. The action of suckling an infant.
Lactation period	The secretion of milk from the mammary glands and the period of time that a mother lactates to feed her young. The process can occur with all post-pregnancy female mammals
Dry period	Period from the end of lactation until the mother has another offspring

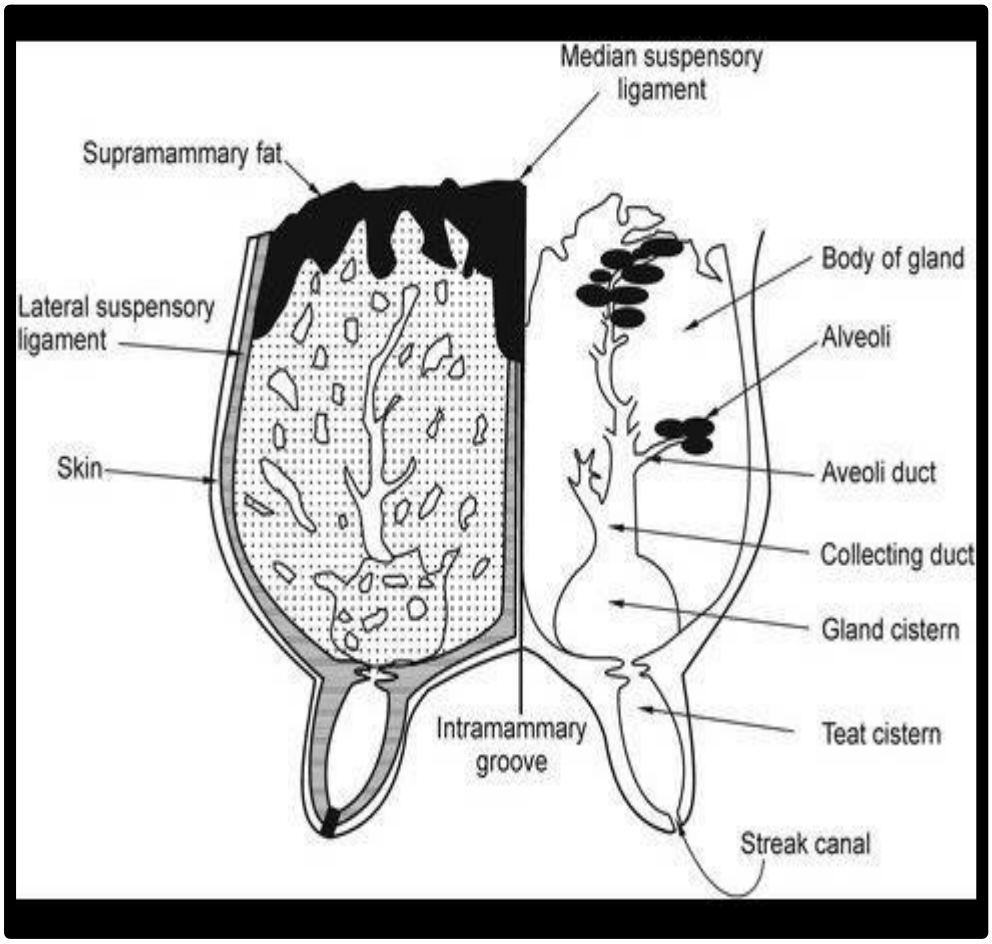
Lactation: is the production of milk in order to nourish the newborn animal. **Weaning**: occurs when the young animal is used to food other than its mother's milk.

In dairies, the calf is removed but the mother cow is **milked daily**. This keeps up her milk production until she is dried off by the farmer. **The dry period in dairy cows is the period after this drying off has occurred.** The dry period usually occurs when the calf is weaned. In dairies the calf is removed so the farmer needs to imitate this by gradually reducing milking until lactation stops.

The milk ejection (milk let down) is the release of milk from the udder into the teats, which allows the calf to drink or the cow to be milked.

STRUCTURE OF UDDER AND FUNCTIONS





The udder is covered with skin and is attached to the body by several ligaments. Each quarter of the udder is made up of a mass of secretory tissues or **alveoli** which are arranged in groups or **lobules.The alveoli produce the components of milk.**

The teat itself has a cavity and an opening which is called the **teat orifice.** The teat opening is held closed by a sphincter muscle which helps to prevent the entry of bacteria up the teat canal. Bacterial invasion of the udder causes an infection called

mastitis which decreases milk production.

MILK EJECTION AND HORMONES INVOLVED

For the remaining 50 to 60% milk to be removed, **successful milk ejection has to take place**. This happens due to the **milk ejection reflex**, which is a neuro-hormonal reflex.

Milking or suckling stimulates nerve endings in the teats, bringing about the release of the **hormone oxytocin from the pituitary gland 20 to 40 seconds later.**

Oxytocin causes the expulsion of milk from the alveoli by stimulating the epithelial cells of the ducts to push the milk down into the gland cavities and then into the teats.

Oxytocin is present in the bloodstream for 6 to 7 minutes after stimulation, which therefore is the time available for milking a cow if the maximum yield is to be obtained from her.

An excited or scared cow will secrete the hormone adrenalin. This hormone will inhibit milk ejection, which will prevent the cow from being milked properly.

COLOSTRUM OR BEESTINGS- is a yellowing, salty, creamy liquid released from the mammary gland for 3 days after calving. It is more yellow than normal milk and contains extra nutrients, **proteins, fats and lactose**. It also contains **antibodies** that enhances the calf's **resistance to diseases.**

Stimuli by the milker.

- Washing od udder
- Massage of the udder
- Appearance and sound of the milker
- Milking action

FUNCTIONS OF COLOSTRUM

- High in nutrients therefore supply nutrition in calf
- Contain growth factors that are necessary for the normal growth of calf.
- It contains fats and lactose
- Contain antibiotics, antibiotics increase resistance to diseases
- Rich in minerals i.e calcium and phosphorus

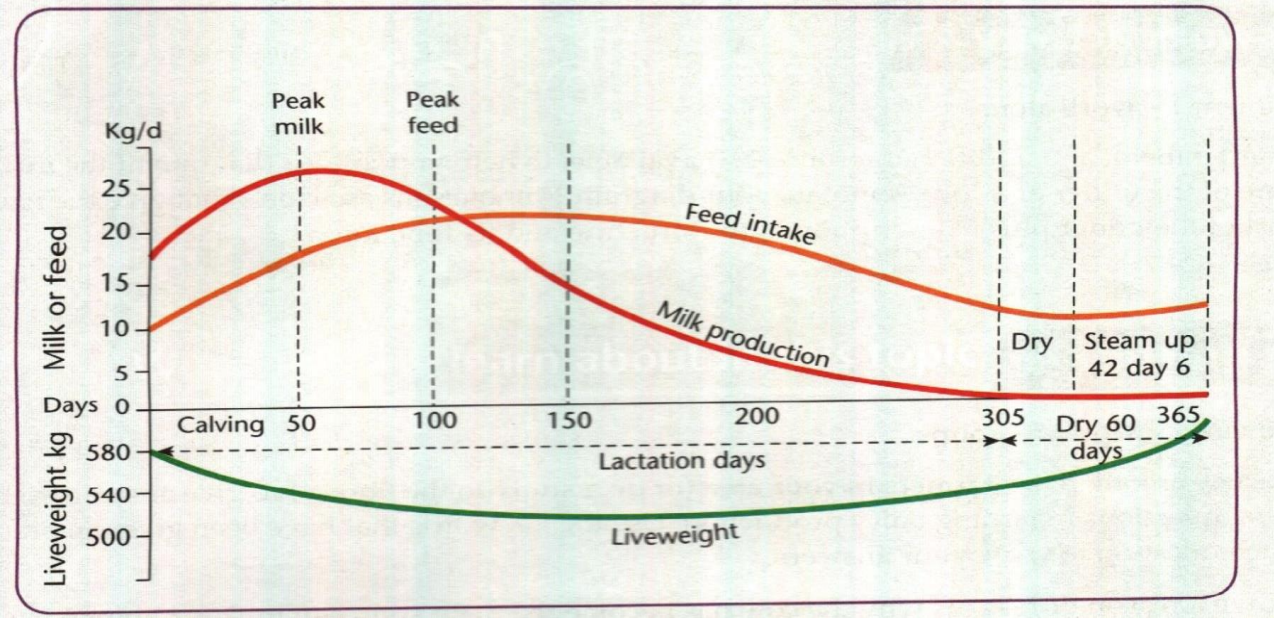
Constituents of first milk COLOSTRUM(

- Antibiotics
- Minerals(calcium ca /phosphorus
- vitamins

THREE reasons for the drop in milk production

- Illness/sickness/diseases
- Malnutrition/improper feeding
- Extreme environmental conditions

The lactation curve



Lactation curve:

- The cow starts to secrete normal milk 3 days after parturition. The lactation curve reaches maximum production eight weeks after calving. When milk production reaches its peak, the butterfat content is at it lowest. As milk production decreases the butterfat content increases.
- The nutrition of the cow influences the butterfat content and cows that is fed more roughage will have a higher butterfat content in their milk.
- The lactation period stretches form parturition until the cow dries up. During this period there is an inverse relationship between amount of milk produced and the butterfat content . When the milk production is low the butterfat is high (normally early in the lactation period) and when the milk production is high the butterfat is low (later in the production period).
- The cow secretes colostrum for a few days just after calving and then she begins to produce normal milk.
- The cow starts to secrete normal milk 3 days after parturition. The lactation curve reaches maximum production eight weeks after calving. When milk production reaches its peak, the butterfat content is at it lowest. As milk production decreases the butterfat content increases.
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Milk production in cows is influenced by the following:

- The age of the cow
- The nutrition of the cow
- Pregnancy inhibits milk yield, especially after the fifth month
- Temperature changes
- The number of times a cow is milked per day influences milk yield

- A good dairy cow produces roughly 40 litres per day at this early stage of lactation
- Milk production reaches a peak roughly 1–2 months after lactation begins.
- Thereafter the daily production gradually decreases until she is dried off two months before her next calf is due to be born.
- This fluctuation in the amount of milk produced is shown by a lactation curve.
- Dairy farmers record the lactation curve of the herd to monitor their production.
- This allows farmers to assess whether the cow's milk production has reached its genetic potential.
- The amount of milk produced during the lactation cycle depends on genetics and the feeding of the animal.