ANIMAL ANATOMY, MORPHOLOGY AND PHYSIOLOGY

LEARNING OUTCOME 1: Examine the shape, form and appearance of an animal to determine the quality of the animal. (k, u, s, v/a, gs)

Activity

In groups or as an individual define the following terms in line with animal production.

(a) Anatomy
(b) Morphology
(c) Physiology

ANATOMY OF FARM ANIMALS

Anatomy refers to the structure of the animal's body including bones, muscles and systems.

- The skeletal system provides the structure and support. Farm animals have similar basic skeletons with adaptations e.g Cattle have strong limbs for weight bearing.
- Muscular system for movement, meat production relies on muscle development e.g in pigs or cattle.
- Digestive system i.e. that of ruminants, non-ruminants and poultry birds.
- Respiratory system which supplies oxygen and removes carbon dioxide.
- Reproductive system, this varies between one species and another, it's important for breeding.
- Nervous and circulatory system, controls body functions and transport nutrients and oxygen.

MORPHOLOGY OF FARM ANIMALS

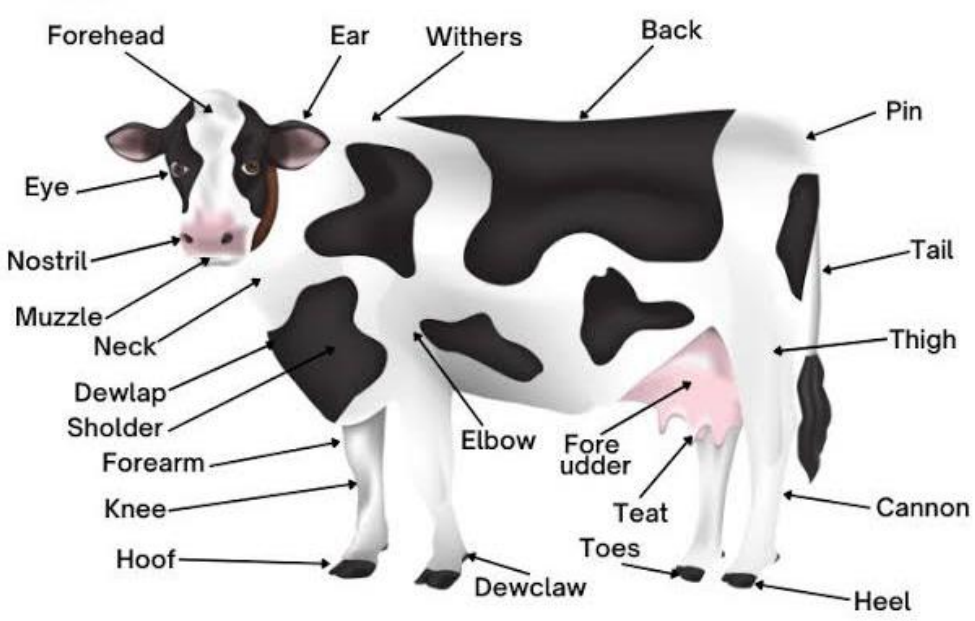
Morphology is the study of the form and external features of animals (how they look outside)

Examples

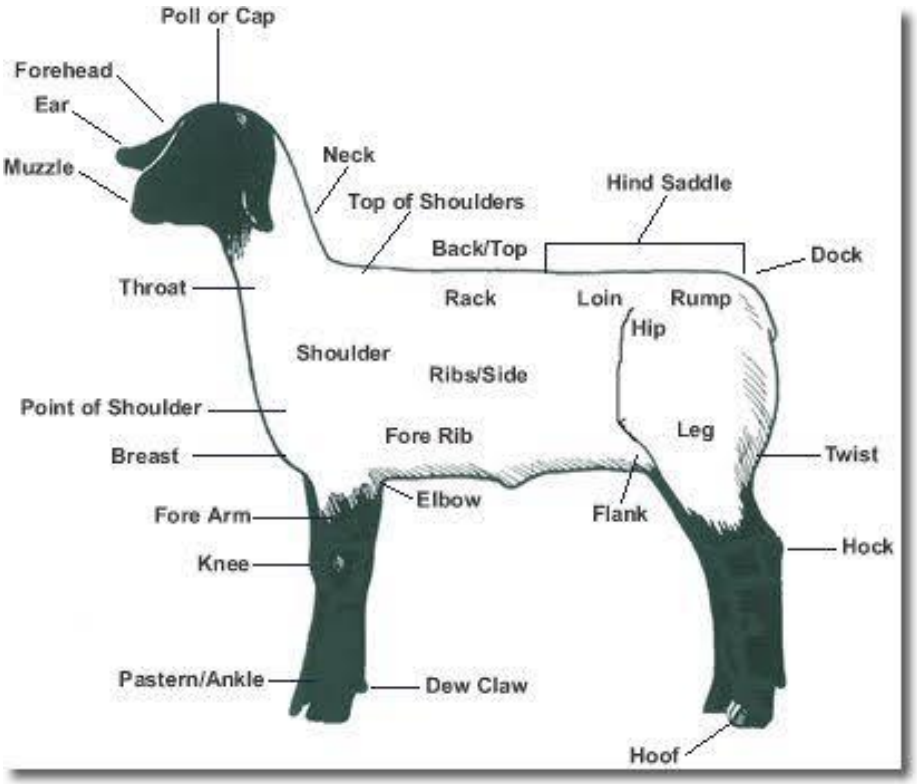
- Cattle have large bodies, broad hooves, horns (in some breeds) and strong necks.
- Sheep and goats, these are smaller than cattle, cloven hooves, and wool or hair coats.
- Pigs these have barrel-shaped bodies, flat snouts, short legs etc.
- Poultry have feathered bodies, beaks instead of teeth, wings etc.

Anatomy of different farm animals

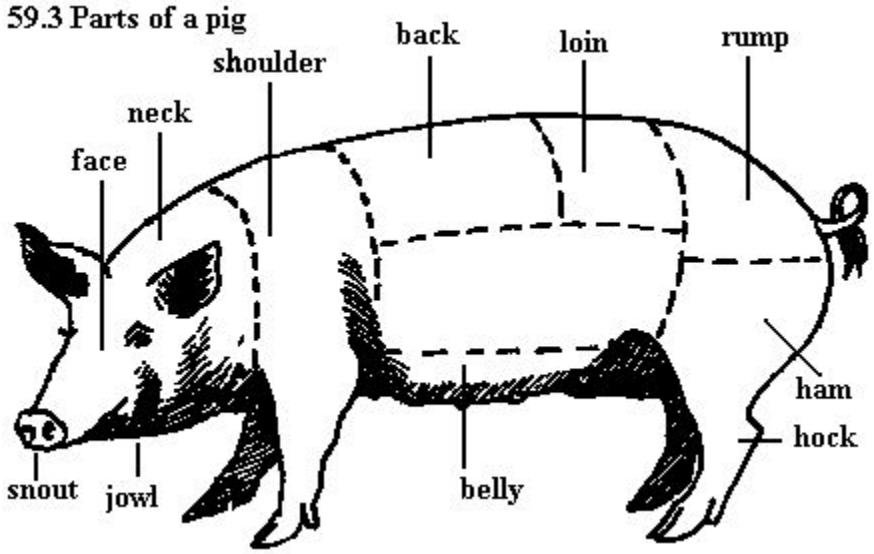
Cattle



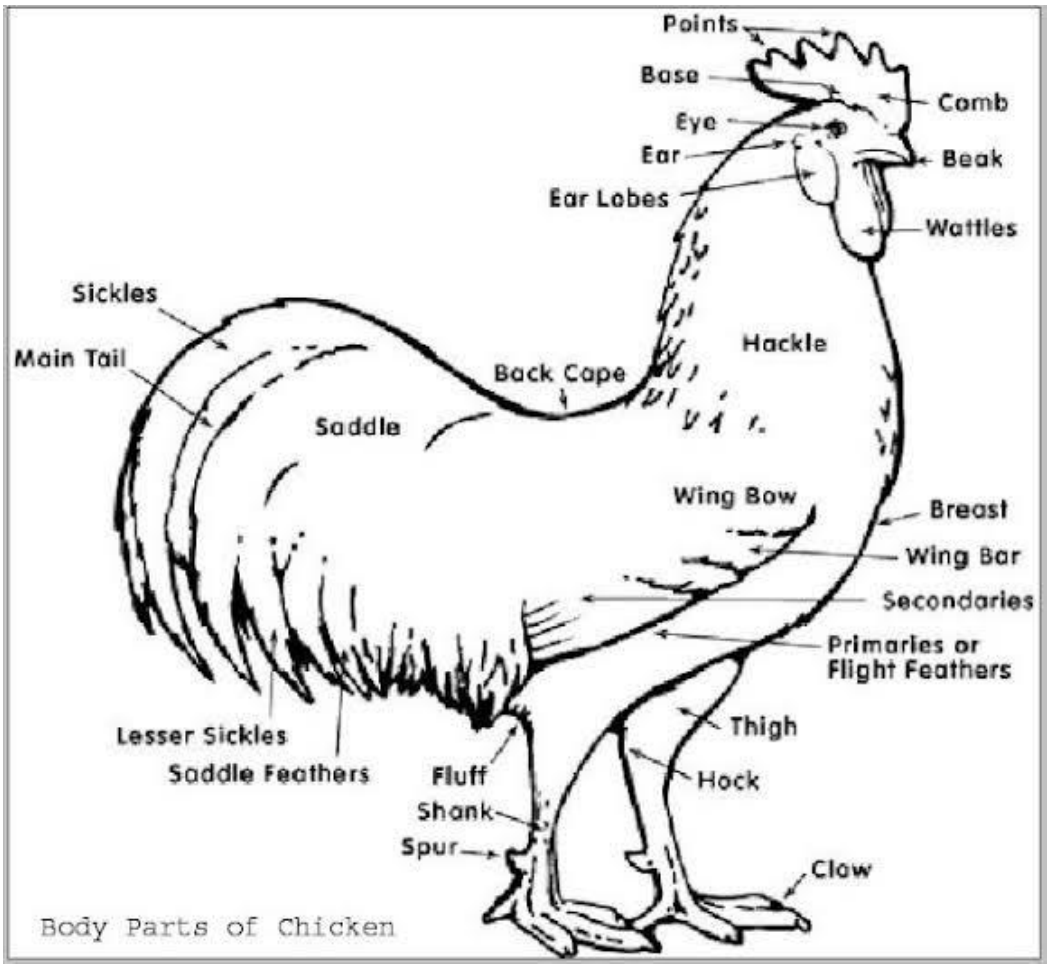
Sheep



Pig



Poultry bird



N.B

Morphological traits are important for:

1. Breed identification

The morphology of local cattle is different from exotic cattle.

Activity

Describe the morphological differences between local and exotic breeds of cattle

Local breeds

- They are usually small in size
- They have prominent humps
- They have short and smooth hair
- They have thicker skins
- They have more sweat glands
- They have long and narrow heads
- They have long legs and can walk long distances
- They have tough muscles

Exotic breeds

- High live weight
- High birth weight
- They are hump less
- Most are polled (without horns)
- Big in size
- Long and thick hairs
- Less sweat glands
- Short legs

2. Adaptation to the environments

- Local animals have more sweat glands to enable them lose excess heat in the tropics wile exotic have less sweat glands since they are of a temperate origin with low temperatures.
- Local animals have short and smooth hair to easily lose excess heat in the tropics while exotic have long and thick hairs to guard against heat loss.

3. **Selection for production traits** i.e. body size, udder shape, fat distribution etc.

- Local animals have a small body which I not of economic importance in line with beef, on the other side, exotic animals have a big body size for a good beef merit.
- Exotic diary animals have a bigger udder to produce milk in large quantities as compared to local animals.

BEEF ANIMALS

These are animals that produce large quantities of good quality meat, breeds include Boran, Aberdeen Angus, Hereford, Galloway, American Brahman. They have a blocky shape.

The significance of a blocky shape is that the animal has built strong muscles for meat production.

Characteristics of good beef cattle

- Should have a blocky/ square appearance
- Should have thick muscles
- Should have short legs and long broad backs
- Should have square lumps
- Should have short legs and a small head
- Adaptability of the animals to the local environment
- Resistance of the animals to parasites and disease
- Physical condition of the animals i.e should not be lame or sick
- Age of the animals i.e should not be too old

Diary type

These are animals that are suitable for producing milk in quantities of economic importance eg Friesian, Sahiwal, Jamaican hope, Ayrshire, Guernsey. They have a triangular shape.

The significance of a triangular shape is to hold a large udder for milk production.

Characteristics of good quality dairy cattle

- High milk production i.e should be able to produce a lot of milk

- They should be docile for easy handling
- Fecundity, they should have the ability to reproduce fast
- Longevity, should have the ability to live for long
- A good diary temperament i.e should give milk willingly
- Are relatively constant milk producers
- Have a wedge shape with wide hind quarters
- Prominent/ big pin bones
- A well-formed and well suspended udder
- Should be resistant to high temperatures
- Should be tolerant to water shortage or drought

Dual purpose type

These produce good quantities of milk as well as good quality carcass at the end of the milking period e.g Dexter, Red poll, Short horn and south Devon

Work/drought animals

These are animals that are tough and muscular and suitable for doing farm jobs

Characteristics of work animals

- Have free moving limbs
- They are strong
- They have sound feet
- They easily submit to discipline and training
- They have a quiet temperament
- They should have sharp ears to easily pick instructions

PHYSIOLOGY OF FARM ANIMALS.

LEARNING OUTCOME 2 Analyze the relationship between different animal body systems for increased production. (k,u, s, v/a, gs)

Physiology deals with how the body functions including digestion, reproduction, lactation, metabolism and immunity.

Examples

1. **Digestive physiology**
    - Ruminants rely on microbial fermentation in the rumen.
    - Pigs and poultry digest food enzymatically in the stomach and intestines.
2. Reproductive physiology
    - Hormonal control of estrus cycles, ovulation and pregnancy.
    - Artificial insemination and embryo transfer rely on understanding of reproductive physiology.
3. Lactation physiology
    - Hormones like prolactin and oxytocin regulate milk production essential for dairy animals.

Activity

In groups or as an individual, discuss how digestion takes place in ruminants, non-ruminants and poultry birds

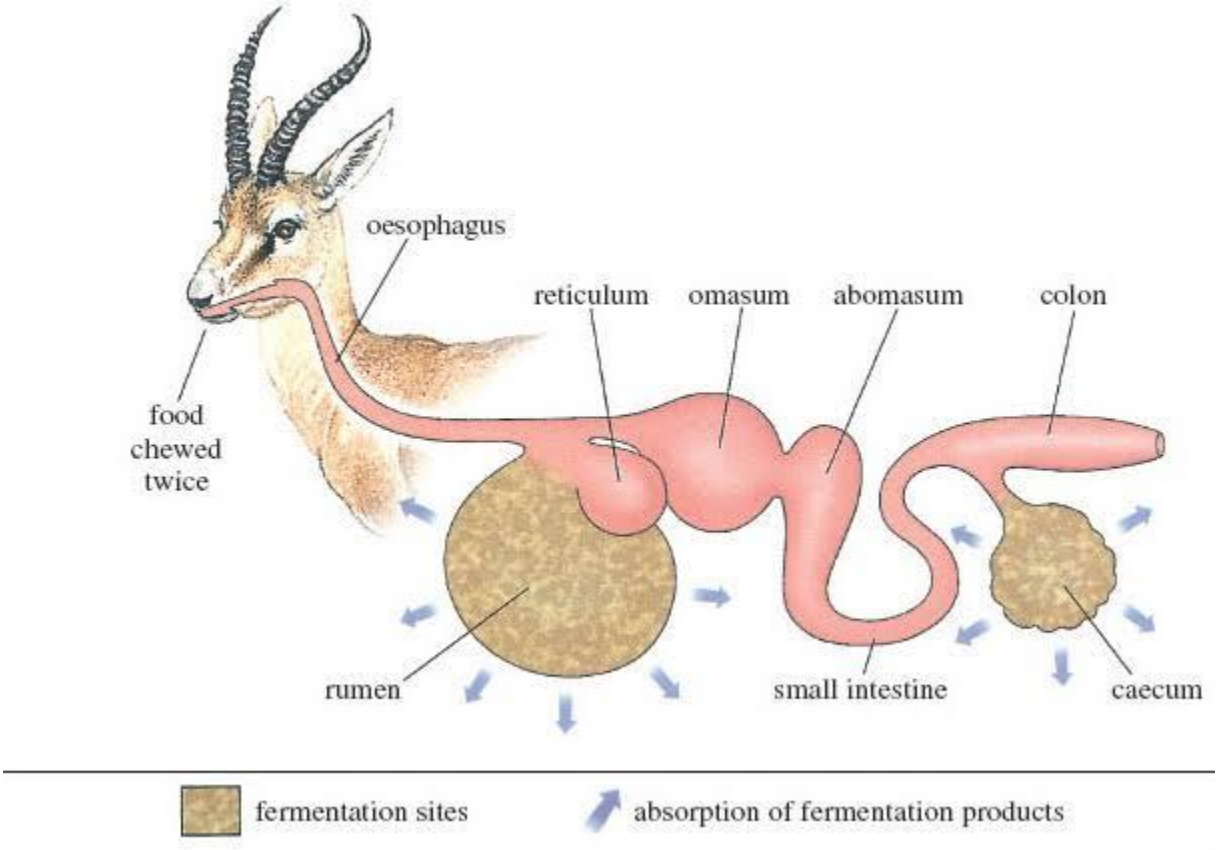
Digestion in farm animals

Digestion is the process by which animals break down complex food substances into simple ones that can be utilized by the body Digestion in animals can be classified into two i.e ruminants and non-ruminants

Ruminants are animals that chew cud e.g sheep, cattle, goats and buffalo. Non – ruminants are animals that don't chew a cud and have one stomach compartment. E.g pig rabbit and horses

DIGESTION IN RUMINANTS

Digestive system of ruminants.



Ruminants have a highly complex stomach comprising of four stomach compartments, small intestine and large intestine

MOUTH

This has four functions I:e

- Food gathering (Prehension)
- Mastication (chewing food before swallowing)
- Insalivation (Mixing food with saliva)
- Rumination (Chewing cud)

Functions of Saliva

- ✓ Aids mastication and swallowing

- ✓ Maintains the pH of the rumen at optimum since it contains a lot of potassium, sodium and bicarbonates
- ✓ It contains nutrients such as mucin that provides the rumen microbes with carbohydrates
- ✓ It helps in digestion of lipids as it contains lipase enzyme
- ✓ Controls bloat i.e. has anti-fronting properties

OESOPHAGUS

The food the goes through the esophagus by peristalsis to the first stomach compartment i.e. the rumen

RUMEN (Pouch)

This is the largest of all stomach compartments

Functions of the Rumen

- Break down of carbohydrates and cellulose to volatile fatty acids such as acetic acids, butyric acids and formic acids
- Break down of proteins to peptides, ammonia and amino acids
- Fermentation of food (anaerobic) releasing carbon dioxide and methane
- There is synthesis of amino acids from ammonia
- Vitamin B and K acre synthesized by micro-organisms
- It stores food

Roles of the rumen microbes

- They produce enzymes such as cellulose that help in the digestion of coarse fibre to volatile fatty acids
- They build up proteins from non – protein nitrogen containing compounds consumed by **the animal**
- They synthesize vitamins for the animal especially K,C and B complex
- They manufacture essential amino acids for the animal
- They conserve the protein consumed by the animals by converting it into ammonia that would have been excreted

Roles of the ruminant animal to the rumen microbes

- Provides anaerobic conditions i.e lack of oxygen since the microbes are anaerobes
- Provides suitable temperatures of approximately 39^0c

- Provides a suitable pH for the microbes
- Provides moisture to the microbes from saliva, through drinking, and from food
- Provides energy in form of carbohydrates an adequate supply of nitrogen to be able to build up their bodies and their numbers

RETICULUM (Honey comb)

It has a honey comb texture hence the name, Here bacterial action continues, coarse particles are separated from the fine, fine particles are passed to the omasum and the rough particles are sent back to the mouth for chewing

OMASUM

This has a series of muscular leaves, it grinds food further to fine particles, the movement of the leaves aids the food to be passed to the abomasum

ABOMASUM

This is the true stomach its walls secrete gastric juice containing hydrochloric acid and two enzymes pepsin and rennin, Pepsin breaks down the proteins to peptides while rennin coagulates milk in young animals , Gastric juice also contains mucus which lubricates the passage of food

SMALL INTESTINES

Here digestion is completed, absorption of the digested food takes place here

The small intestine has three parts i.e

- Duodenum in which bile is secreted
- Jejunum in which pancreatic juice which contains amylase, lipase and trypsin are released to complete digestion of starch to maltose, lipids to fatty acids and glycerol and proteins to peptides
- Ileum where absorption takes place

LARGE INTESTINES

This is where the absorption of water takes place

CAECUM

Bacterial digestion takes place here

RECTUM

The dung is stored here

ANUS

An opening through which dung passes out of the animal's body

N.B Digestion in the calf is similar to that of the non-ruminants with only the abomasum functioning, passage of the food to other stomach compartments is prevented by the Esophageal groove that seal them off

DIGESTIVE DISORDERS in cattle

Bloat

This is the swelling of the belly / rumen in ruminant animals due to accumulation of gasses in the rumen

Conditions predisposing the animals to bloat

- Feeding animals on young succulent grass that breaks down too rapidly and releases more gases that can't be removed by belching action
- Feeding the animals on too much proteins/ legumes
- Feeding the animal on concentrates
- The animal feeding too rapidly
- Chocking, the animal may swallow large solid particles that block the gut

Treatment of bloat

- Piercing the upper side of the rumen using the trocar and canula
- Drenching the animals using mineral oils
- Giving the animals anti-bloat drugs
- Using the bloom stick method to force out the gases out of the rumen

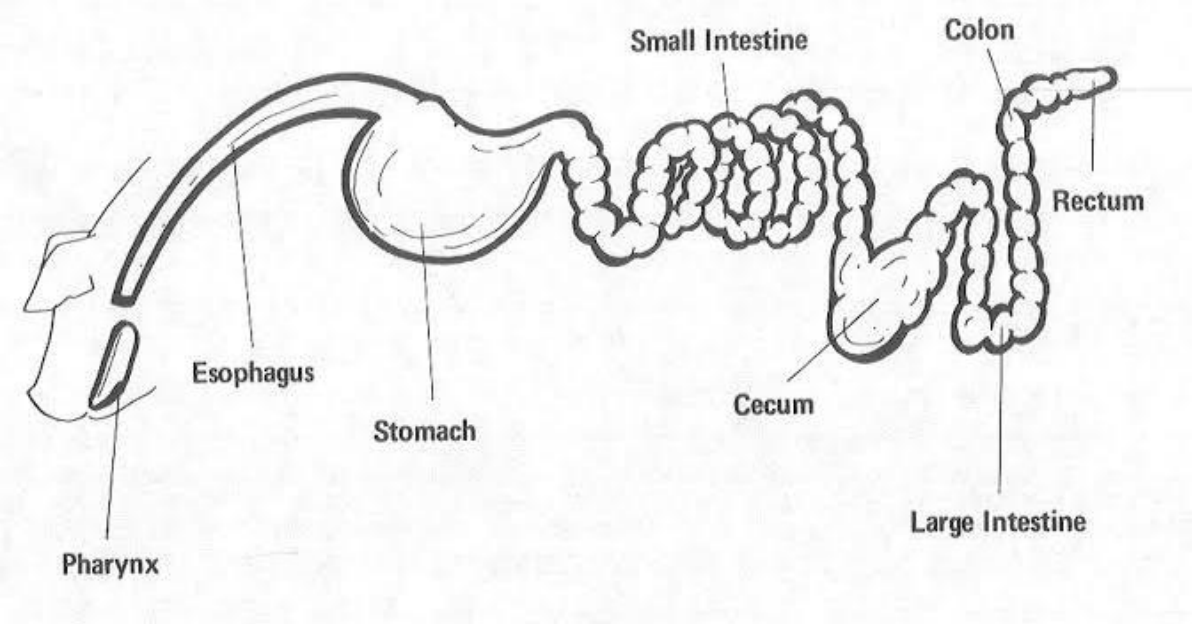
Control of bloat

- Avoid feeding the animal on too young lushy grass
- Avoid feeding the animals on too much proteins/ legumes

- Feeding the animals regularly to avoid rapid feeding by the animal

DIGESTION IN NON –RUMINANTS

Digestive system of a non – ruminant



Mouth

The food is mixed with saliva the saliva contains enzyme ptyalin which breaks down starch to maltose the food is the pushed through the esophagus into the stomach, Ptyalin works in an alkaline environment

Stomach

The food is stored a little to allow for proper digestion and released at a time by the pyloric sphincter, the food is churned and broken down by the muscular action of the stomach walls, Gastric juice is also added to the food, this contains hydrochloric acid and two enzymes rennin and pepsin

Roles of HCL

- Provides an acidic medium for action of enzymes i.e. it activates pepsinogen to pepsin and prorenin to rennin
- Kills harmful bacteria which come along with the food
- It renders calcium and iron salts suitable for absorption in the small intestines

- It begins the hydrolysis of sucrose to glucose and fructose
- It splits nucleoproteins to nucleic acids and proteins

Small intestines

- Digestion is completed here
- The digested food is absorbed into the blood streams

Pancreatic juice is secreted here which contains Trypsin, Amylase, and lipase which digest proteins, starch and lipids respectively

The liver produces bile which contains salts which emulsify/break down fats

Large intestines

- Water absorption takes place here
- Mucus is secreted gear to lubricate the passage of the digested food

Caecum

This is well developed in non-ruminant herbivores it contains bacteria that digest roughages/cellulose

Rectum

Feaces are collected here before expulsion to the anus

Anus it's an opening for expulsion of the dung from the animal's body

Similarities between ruminants and non-ruminants

- Both use one stomach compartment when still young
- In both digestion of starch, lipids and proteins ends in the small intestine
- Absorption of water occurs in the colon
- In both food is broken down mechanically(chewed) in the mouth

Differences between ruminants and non-ruminants

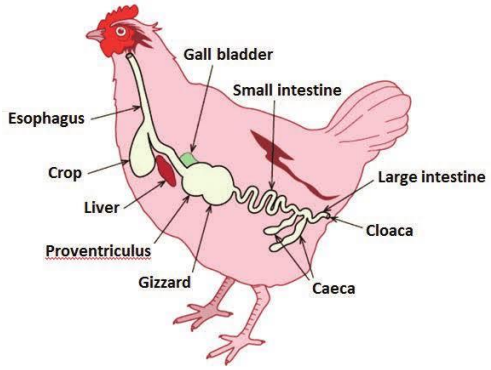
RUMINANTS	NON-RUMINANTS
Have four stomach compartments	Have one stomach compartment
They chew a cud	They don't chew cud

The saliva contains no amylase	The saliva contains amylase
The saliva contains lipase	The saliva contains no lipase
Can digest coarse fibre	They cannot digest coarse fibre
Fermentation is possible due to presence of rumen microbes	Fermentation is impossible
Depends on volatile fatty acids for energy i.e lactic, butyric, proprionic, and acetic acid	Depends on glucose for source of energy
Most digestion and absorption takes place in the rumen	Most digestion takes place in the small intestines
Can build proteins from non-protein nitrogen compounds	Cannot make proteins from non-protein nitrogen
They have a small caeca because they already have microbes in the rumen	They have a large caeca that holds bacteria to assist in digestion

Digestion in poultry

Birds are monogastric animals and therefore single stomached, the digestive system of birds is similar to that of other non- ruminants with more specialization, additional parts include the crop and venticulus

Diagram of the digestive system of a fowl



The digestive system is comparatively long and from the beak to the vent it may be 5-6 times the external length of the bird

Mouth

The lips and the teeth are replaced by the beak, the beak picks food into the mouth, the salivary gland secretes mucus saliva which lubricates food as it is passed down the esophagus

Crop

It is a pouch formed as a specialised area of the gullet, it stores food because the stomach has a little storage capacity, and food is released a little at a time in the stomach

Grandular stomach (Proventiculus)

It is also known as the true stomach, the gastric glands produces gastric juice which contains Hcl and enzyme pepsin, Hcl makes the medium acidic while pepsin converts proteins to polypeptides, the food spends a little time here and therefore digestion in stomach is of little importance

Gizzard

It is oval in shape with two opening at its upward side one from the Proventiculus and the opening into the duodenum

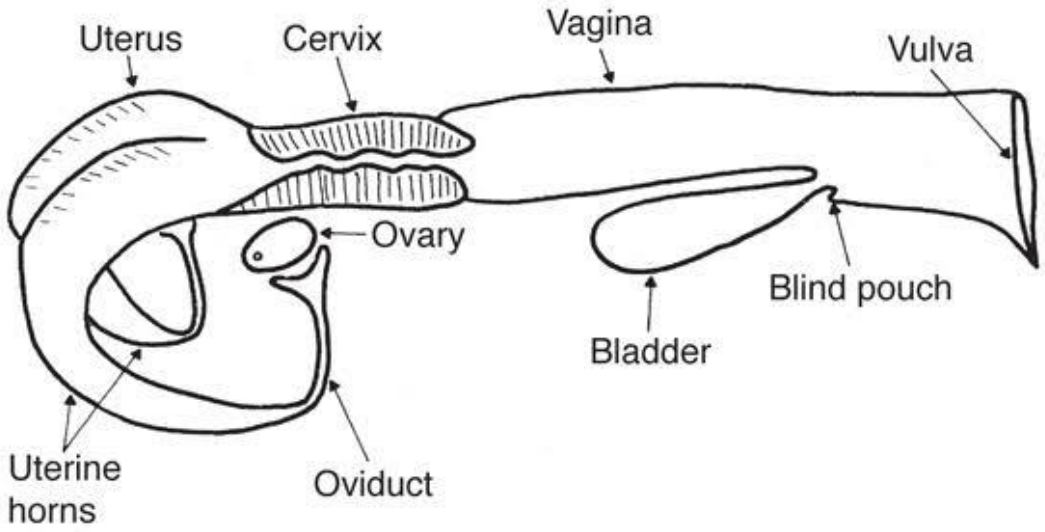
It is adapted to its function by possession of red thick powerful muscles, furthermore the muscles are internally covered by a thick honey epithelium internally, the gizzard also has grits to enable it grind hard food particles that enter it

The chief function of the gizzard is to grind / crush food particles by the aid of grit which is taken in by the bird through the mouth during feeding, from the gizzard digestion follows the same pathways just as in man

Reproduction in farm animals.

Reproduction is a way how living things multiply in numbers through breeding within them selves

Reproductive system of a cow



Ovary, this produces the ova, it also secrets hormones such as estrogen and progesterone

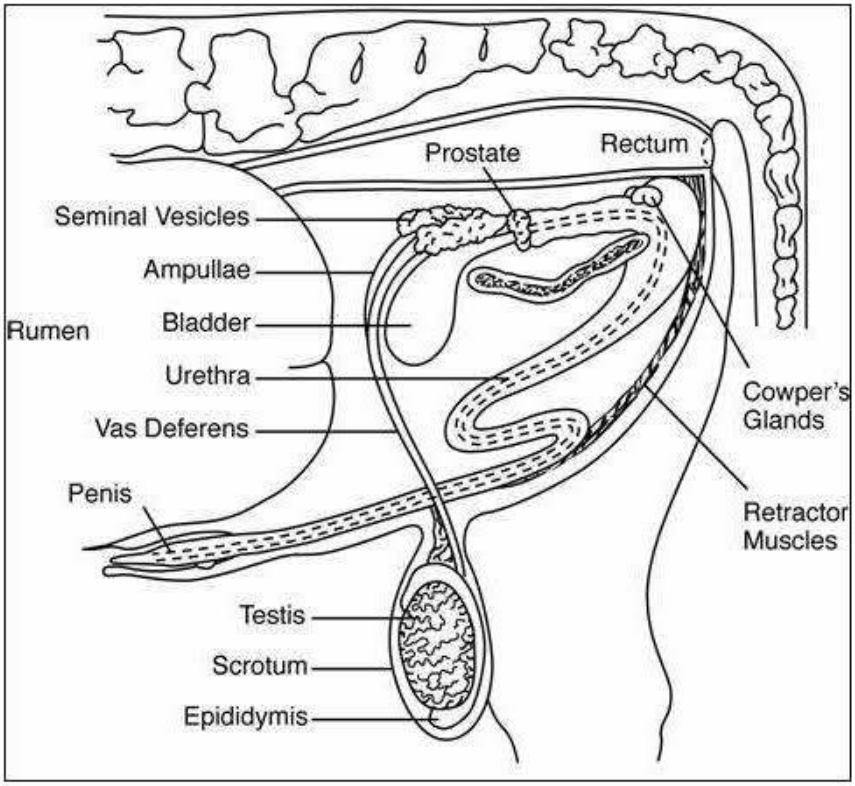
Oviduct, this connects the ovary to the uterus, its where fertilization takes place

Uterus, this is where the fertilized egg (zygote) develops into the embryo

Cervix, Is the neck of the womb, it's a muscular bund that seals the womb, it closes during pregnancy to prevent entry of any substances that would harm the embryo

Vulva, Is the external opening of the female reproductive tract it serves as a passage for urine and acceptance of the penis during mating

Reproductive system of a bull



Testes, These have several coiled tubes called seminiferous tubules inside which the sperm is made, it has spermiogenic cells that differentiate into sperms, Has interstitial cell layers which produces the male androgens i.e testosterone, it has sertoli cells that provide nutrition for the sperms

Scrotum, is a sac that protects the testes from mechanical damage, also has a mechanism for regulating the temperature of the testes

Epididymis, this is a long coiled tube that stores the sperms, also serves as appoint for concentration and maturation of sperms, It transports the sperms from the testes to the sperm ducts

Sperm ducts, these carry the sperms from the epididymis to the urethra

Urethra, Is an arrow tube that serves as a passage for urine and semen

Cowper's gland, these produce materials that clean the urethra to remove urine

Prostate gland, these produce electrolytes that balance the pH of the reproductive tract

Seminal vesicles, these provide nutrients to the seminal fluids

Penis, A spongy erectile tissue that becomes filled with blood during erection, it serves a purpose of passing out urine and erection

Retractor muscle, enables the penis to be drawn and extended during erection

Hormones associated with reproduction

These include,

Estrogen Its secreted by follicles in the ovary

Roles of estrogen

- Stimulates the formation of secondary sex characteristics
- Governs the production of heat
- Stimulates the growth and repair of the uterine walls
- It increases ciliary activity and mucus secretion in the oviduct
- It induces thickening of cells in the vaginal lining
- Stimulates growth of the duct system in the udder

Progesterone, Also called pregnancy hormone secreted by the remains of the Graafian follicles in the ovary i.e. the yellow body (Corpus luteum)

Roles of Progesterone

- It completes development of the uterus
- It prevents further heat in case of pregnancy
- It causes development of the alveoli in the udder
- It facilitates the secretion of the uterine milk on which the fetus feeds

Testosterone, Produced in the testes responsible for secondary sex characteristics in male

Relaxin Its produced by the ovary, it causes the relaxion of the pelvic ligaments during **birth/parturition**

Oxytocin, Promotes sperm transport in female animals

- Also forces the uterus to contract and expel the embryo during birth
- Stimulates milk letdown

Follicle stimulating hormone, (FSH) it is secreted by the anterior lobe of the pituitary gland, it stimulates the growth of the Graafian follicles which grow into ova

Luteinizing hormone, Secreted by the pituitary gland

- Brings about rapid growth of the Graafian follicles and causes ovulation
- Enables the remains of the Graafian follicles to get filled with a yellow pigment forming a yellow body called the corpus luteum

Pregnancy in cattle

Pregnancy is a condition of the female when the young is developing in the uterus

S**igns of pregnancy in cattle**

- Failure of a cow to come on heat after service
- Enlargement of the belly
- Udders develop thick honey like secretions 4-5 months
- The body weight increases
- The skin becomes smooth and shinny
- Cervix closes
- Udder tissues enlarge
- Body temperature increases slightly
- Pulse rate increases
- Increase in the level of progesterone in the urine and blood
- Abdominal movement of the calf
- Development of milk veins in heifers
- Vet. Doctors can feel the corpus luteum on examination
- The embryo can be felt through the rectum when examined by vet doctors

Signs of a cow about to calve

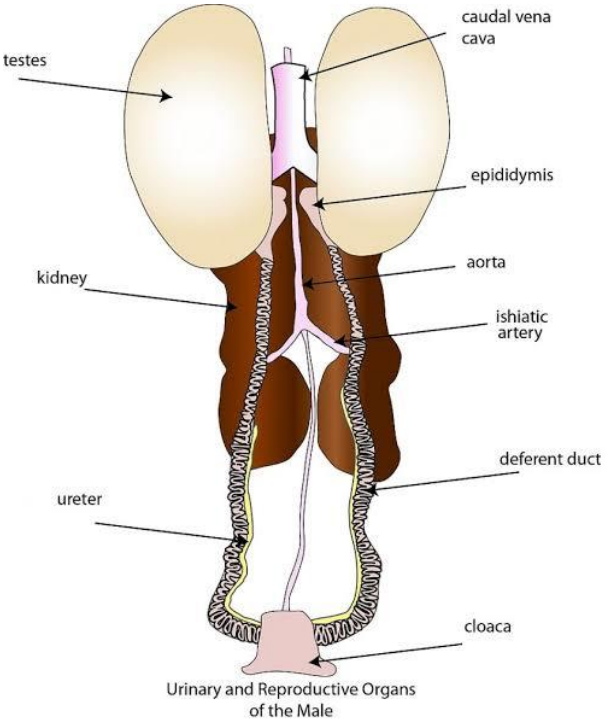
- The cow stays away from the herd
- Udders become filled with milk
- Udder secretions change to yellow colostrum
- The vulva swells
- There is a slimy discharge from the vulva
- Cervix muscles relax
- Relaxation of ligaments that hold pin bones
- Cows repeatedly arches the back

- The cow walks with difficulty
- The water bag comes out

REPRODUCTION IN BIRDS

There are two sexes in birds i.e. male and females, although many features of the male and female chicken are similar they have distinguishing x-tics , the term used to distinguish such x-tics is called sexual dimorphism

Male reproductive system of a bird



Male birds have two testis which are found in the abdominal cavity in front of the kidneys, the size depends on the sexual maturity of the bird

The spermatozoa formed in the testis pass through the spermatic ducts to the cloaca after copulation, the spermatozoa can be preserved in the oviduct of the hen (sperm sac) for a period of about 10 days, a hen therefore does not need a cock every day to lay fertile eggs

There are two functions of the female reproductive system i.e

- Formation of sperms
- Conveying the sperms to the female reproductive system of the bird.

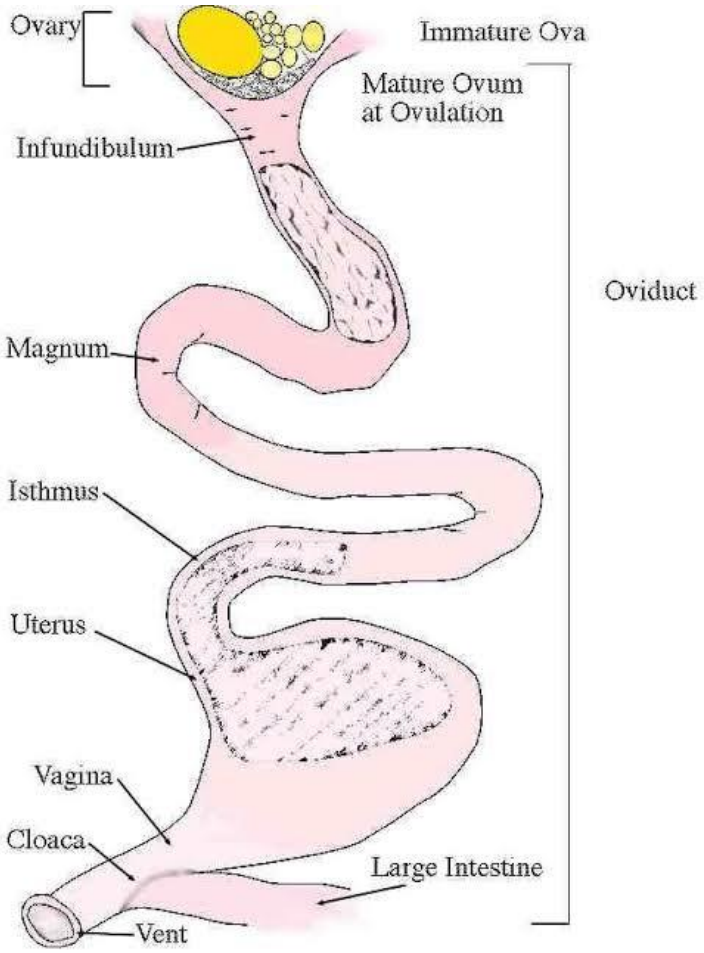
Reproductive system of a hen

It has two ovaries with the functional left ovary functional while the right ovary is rudimentary, the shape of the ovary is similar to a bunch of grapes where egg yolks of varying sizes are found.

When the left ovary stops working due to old age or diseases the rudimentary right ovary at rare occasions may start to develop and produce the male hormone (testosterone) this makes the hen to start crowing

The function of the female reproductive system is to form eggs

Structure of the female reproductive system of a hen



The process of egg formation

Ovary

- The yolks are formed here
- Mature yolk is released from the ovary to the infundibulum

Infundibulum

This is an opening of the ovary which receives the yolk from the ovary

- Fertilization of the egg takes place here
- Chalaza which holds the yolk in position is also formed here .The infundibulum is approximately 11cm long and the yolk spends 1/4hr in the egg funnel

Magnum

- A thick layer of the albumen is secreted and added to the yolk, the magnum is approximately 33.6cm long and the yolk spends three hours here

Isthmus

- In this part a thin layer of albumen is added to the yolk, mineral salts are added and the shell membranes are deposited onto the yolk, the yolk spends 1/4hrs here and is approximately 10.6cm long

Uterus

The calciferous shell is deposited here and it's now an egg, pigmentation of the egg also takes place, the egg spends between 19-20hrs in the uterus

Vagina

It secretes vaginal fluids which reduces friction during oviposition (egg laying) the egg is inverted i.e the small and pointed end faces down while the blunt and broadened end faces up, this minimizes resistance during oviposition, eggs spend about 1min before moving down the cloaca, once the egg is exposed to air, the shell hardens

N.B

The time period between ovulation and oviposition is about 25hrs, the egg can therefore lay one egg per day, a good layer should lay during morning hours i.e between 8am – noon,

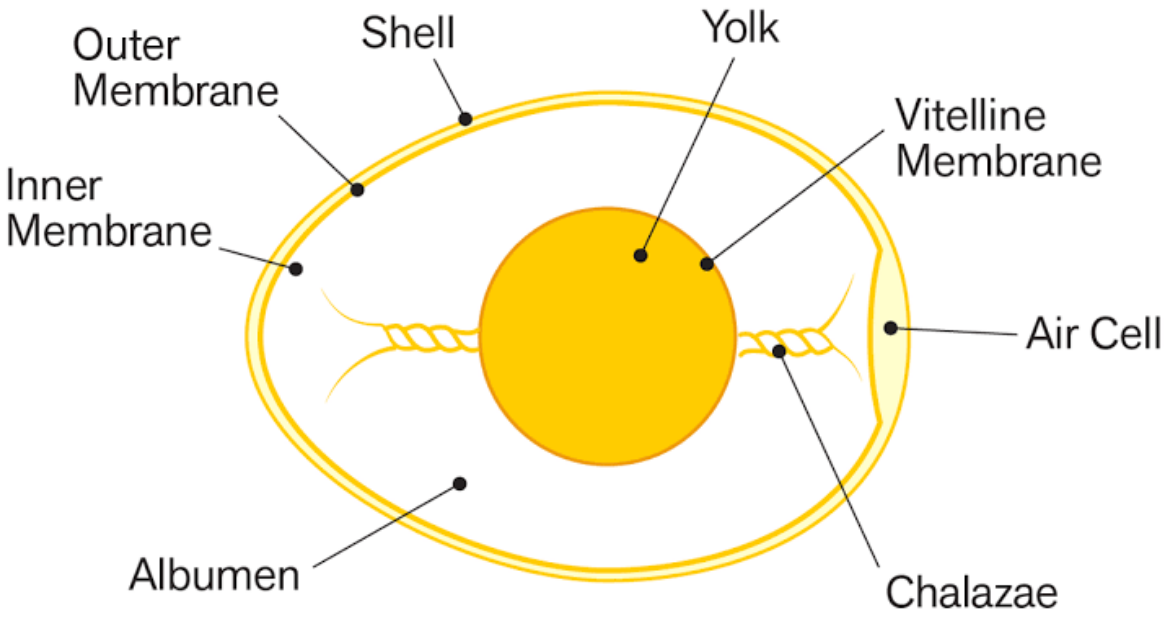
The yolk mature from 7-10 days after stimulation of its growth

The egg passes through the cloaca which is a common passage for eggs and feaces, however the eggs can never be soiled by feaces because the last part of the oviduct, (vagina) remains enclosed around until it is out of the system, therefore a fleshly laid egg from a bird is perfectly clean

The air cavity in the egg (air space) is formed only after it's laid as a result of cooling down of the egg contents

When two yolks are released from the ovary together within a period of three hours, a double yoked egg will be formed , if the egg albumen is formed around the a tiny piece of tissue which may be shed from the system due to one reason or the other , a very small egg without a yolk will be formed.

Diagram of an egg



Functions of the parts

- Cuticle- Avoids the evaporation of the egg content
- Shell- Protection of the inner contents of the egg
- Shell membrane- Separates shell from the albumen
- Air space-Gaseous exchange
- Yolk sac-Holds the yolk
- Germinal disc- Grows into a chick
- Egg white yolk- Provides nutrients to the yolk

Activity

Apply the knowledge of morphology to select an animal to rear.

A farmer can apply knowledge of morphology (study of the form and structure of organisms) to select the best animals for rearing by assessing physical traits that indicate health, productivity and suitability for specific purposes like meat, milk, or draught work.

1. **Assessing physical fitness and health**
    - Body conformation, healthy, well developed animals show strong, symmetrical body structures.
    - Skin and coat, smooth, shiny coats often indicate good health.
    - Eyes, hooves and teeth, clear eyes, strong hooves and well – aligned teeth are signs of a healthy animal.
2. **Selecting for specific production traits**

    (a) Dairy animals (Cows, goats)
        - Well-developed udder with good teat placement.
        - Deep body and strong back for feed capacity and longevity.

    (b) Meat animals
        - Muscular build with broad shoulders and hind quarters.
        - Rapid growth rate visible in body mass.

    (c) Draught animals (Oxen, donkeys)
        - Strong limbs, broad chest, robust frame.
        - Compact, muscular build for endurance.
3. **Evaluating breed characteristics.**
    - Morphological traits help identify the breed of an animal and each breed has known strength. Example a zebu cow (hump on the back, louse skin) is well adapted to tropical climates.
4. **Early identification of defects.**
    - Knowledge of morphology helps farmers detect congenital traits linked to poor performance early on.
5. **Selecting for climate adaptability**.
    - Animals with certain morphological features like skin thickness, ear size, and coat density may be better suited to local climate conditions.

FIELD	FOCUS AREA	EXAMPLE IN FARM ANIMALS
Anatomy	Structure of the body parts	Stomach compartments in ruminants
Morphology	External form and appearance	Horn shape, coat type, body size
Physiology	Function of body systems	Milk production, digestion, hormone digestion