



Agricultural Sciences (Grade 12) paper 1 Guide

Math and Stats for the Natural sciences (University of Johannesburg)



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• **AGRICULTURAL SCIENCES**
• **GRADE 12**
○ **PAPER 1 GUIDELINE**

(2023)

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PAPER 1: COVERS THE FOLLOWING TOPICS.

- (1) ANIMAL NUTRITION.
- (2) ANIMAL PRODUCTION, PROTECTION AND CONTROL.
- (3) ANIMAL REPRODUCTION.

PAPER 1

TERMINOLOGIES

Animal Nutrition

Alimentary canal- The passageway of the digestive system that leads from the mouth to the stomach.

Prehension- The act of putting food inside the mouth.

Animal nutrition- The food that animals eat and how they are digested.

Non-ruminants- Animals with a simple stomach.

Ruminants- Animals with a complex stomach (four components stomach).

Pyloric sphincter- The ring of smooth(involuntary) muscle that controls the movement of semi-fluid(chyme) from the stomach to the duodenum of the intestine.

Cardiac sphincter- The ring of smooth(involuntary) muscle that controls the movement of food from the oesophagus to the stomach.

Mastication- The breaking down of food by teeth.

Salivation- Adding of saliva into stuff food.

Peristalsis- The movement of food from the mouth to the stomach through the oesophagus.

Retro-peristalsis- The movement of food from the stomach to the mouth through the oesophagus.

Rumination- The process whereby food is swallowed, brought back to the mouth and chewed again so that food can be ingested rapidly, and chewing is completed at a later stage.

Regurgitate- The process in which food in the reticulum is returned to the mouth for rumination.

Fermentation- A chemical breakdown by micro-organisms which involves the release of heat.

Digestibility Co-efficient- A measure of digestibility of a feed.

Papillae- A finger-like projection that increases the temperature of a rumen.

Villi- A finger-like tiny folds found in the small intestine.

Rumen-microbes- Single-celled micro-organisms in the rumen that secrete enzymes(cellulase) for the digestion of cellulose.

Bile- An alkaline fluid that is released into the duodenum to assist with digestion of fats.

Roughages- Feeds with a large volume per unit mass.

Concentrates- Feeds with smaller volume per unit of mass.

Hindgut fermentation- Digestive process in non-ruminants where cellulose is fermented by microbes at the end of the gut(caecum).

Foregut fermentation- Digestive process in ruminants where cellulose is fermented at the beginning of the gut(caecum).

Animal production, protection and control.

Extensive production system- A large area (production system) with few inputs and less capital.

Intensive production system- A small are (production system) with more inputs and more capital.

Subsistence farming system- A farming system that is specifically designed to farm for home consumption.

Commercial farming system- A farming system that is specifically designed to farm for profit.

Broilers- Animals that are kept for meat production.

Layers- Animals that are kept for egg production.

Pullets- Chicken at point of lay.

Piglets- Young pigs.

Flight zone- A space around a cow that measure the safe area in which it feels comfortable.

Blind spot- The area around the cow where there is no vision and sudden movement cause stress and anxiety.

Biological value- Index indicating quality of a protein in a feed.

Holding pan- A facility where animals are kept before being handled.

Backyard production system- A facility where animals are kept in large densities and are fed high specialized feeds.

Weaning weight- A weight in which a cow is stopped from milking.

Nutritive ratio(NR)- The ratio between digestible protein and the total digestible non-protein nutrients in a feed.

Pearson square- A mixture of different rations in a feed.

Tail docking- The removal of the tail.

Crutching- Removal of wool on the tail and feet.

Shearing- Removal of wool on sheeps.

Dosing- Giving animals medication via the mouth.

Drenching gun- Method used to give large amounts of liquids to animal.

Crushpan- Facility used to restrict movement of bull and lead towards a loading ramp.

Furrowing- A process by which pigs give birth.

Homeothermic- Animals with constant body temperature slightly higher than their environment.

Stethoscope- Material used to check pulse rate.

Thermometer- Material used to check temperature.

Pathogens- A disease causing organisms.

Vector- Insects or ticks, that carry the disease organism from infected animals to healthy animals.

Quarantine- Keeping animals in isolation for a fixed period.

Vaccination- A chemical injection of animals to prevent a specific disease.

Urea- A cheap nitrogen source used by ruminants to synthesize protein; it is also toxic.

Buired- Non-nitrogen source that is less soluble and safe than urea and it is expensive in costs.

Post mortem- When one cuts open the carcass of dead animal to determine the cause of death.

NB:

All calculations within the content will be covered at the end of the guideline.

Animal reproduction

Sperm- A male gamete.

Semen- A mixture of sperm and secretions from the accessory glands.

Artificial Insemination- A method of collecting semen from a selected bull and placing it into a reproductive tract of a cow.

Pistolette- Material used to deposit semen into the uterus of a cow through the cervix.

Thawing- Removing of ice on a sperm.

Ovulatory failure- Failure of the follicle to rupture and release an ovum.

Infertility- Temporary loss of fertility.

Sterility- Permanent loss of fertility.

Ovulation- A process whereby a mature ova is released from the ovary by LH.

Oestrus- A stage in which a cow is reproductively receptive and ready to conceive.

Oestrus cycle- A hormonally controlled cycle of activity of the female/cow reproductive tract.

Natural Mating- When a healthy bull is used to mate with a cow.

Gestation- A period of pregnancy in a female reproductive tract.

Abortion- The termination of pregnancy.

Parturition- The natural end of birth/ Giving of birth.

Dystocia- The difficult of giving birth.

Lactation- A period at which a cow produces milk.

Lactation- A period of time at which a mother lactates (produce milk) to feed her young offspring.

Dry period – A period from the end of lactation until the mother has another offspring.

Oestrus Synchronisation- The hormonally treatment of changing the oestrus cycle of a female group in a herd.

Monozygous- Twins formed when one ovary is fertilized.

Dizygous- Twins formed when two ovaries are fertilized.

Free martin- A sterile female calf born as a non-identical twin of a male calf.

Embryo Transplantation- The transfer of a fertilized embryo from one genetically superior cow to the uterus of an inferior cow.

Embryo flushing- Removing of a viable embryo from the uterus of a donor cow.

Cloning- Process of producing an identical copy of biological material from an individual gene, cell or whole organism.

Enucleation- The removal of the nucleus on a gamete.

Super ovulation- Producing more egg at ovulation than normal.

Pulse rate- Number of heartbeats in one minute.

Respiratory rate- Number of breaths in one minute.

Mummification- When a foetus die and skin become dry and hard, it forms an dried foetus that can stay in the uterus.

Maceration- When a foetus softer tissues decay, leaving behind the harder tissues.

Hydro-foetus- When a foetus is hydrated.

Mesoderm- A layer that surrounds the embryo from which the heart and skeleton develop.

Lack of libido- A situation in which a bull show no interest to a cow.

Importance- Bull shows interest but lack ability to serve.

Repeat breeders syndrome- Condition where a cow need to mate 3 times or more in order to conceive.

Post mortem- When one cuts open the carcass of dead animal to determine the cause of death.

Dropsy – The accumulation of fluid in the tissues or between the foetal membrane.

Hydrocephalus- Accumulation of fluid in or around the brain, which enlarges the skull.

Congenital defects- A medical condition that occurs at or before birth.

Hermaphroditism- When an animal is born with male and female reproductive organs.

Insulation- Reduce heat loss from the house where animals are kept.

Ventilation- Reduce heat loss by applying curtains in a broiler house.

Dropsy -The accumulation of fluid in the tissues or between the foetal membrane.

Hydrocephalus- Accumulation of fluid in or around the brain, which enlarges the skull.

Congenital defects- A medical condition that occurs at or before birth.

Hypoplasia- A situation in which a bull has underdeveloped testes.

Cryptorchidism- A situation both testes of a bull remain in the abdominal Cavity and fails to hang away.

CONTENT OF PAPER 1

1. Animal Nutrition

Two (2) Types of digestion

- Mechanical digestion: The physical breakdown of food into smaller pieces by teeth.
- Chemical digestion: The breaking down of food into smaller pieces by enzymes.

Difference in feed Utilize:

-Ruminants: Can feed on Roughages because of the presence of rumen microbes that assist with digestion of roughages.

 : Can utilize urea since rumen microbes can change urea into microbial proteins.

-Non-ruminants: Cannot feed on roughages because of the absence of micro-organisms that assist with digestion of roughages.

 : Cannot utilize urea due to absence of micro-organisms that can change urea into microbial proteins.

The 3 Micro-organisms found in the reticulo-rumen:

- Bacteria.
- Protozoa.
- Fungi.

The 3 requirements of micro-organisms found in the reticulo-rumen:

- Enough Mineral nutrients.
- Enough Nitrogen.
- Anaerobic environment.

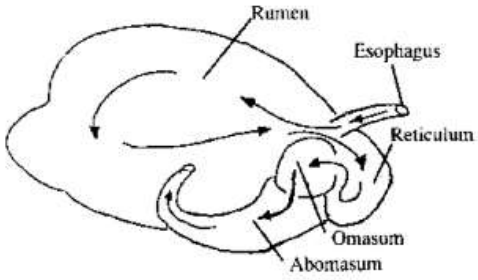
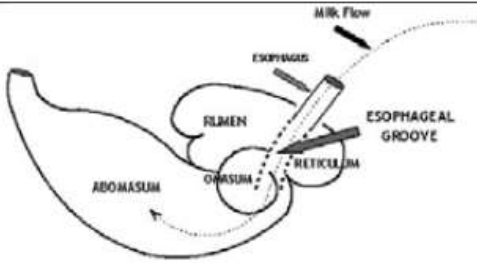
Give the difference between the oesophagus of ruminant (cattle) and non-ruminant (Fowl):

- The fowl's oesophagus has a crop while the cattle's oesophagus has no crop.

Difference between:

Adult ruminant Stomach

Young ruminant stomach

	
<p><u>Rumen:</u> large enough to accommodate or store food.</p>	<ul style="list-style-type: none"> • During suckling, the oesophageal groove is closed and the milk bypasses the rumen and reticulum and passes through the omasal groove directly to the abomasum or true stomach. • Poorly developed since little grazing
<p><u>Reticulum:</u></p> <ul style="list-style-type: none"> • Well developed as part of complex fermentation organ. • Regulates the movement of food particles from rumen to the lower alimentary canal. 	<ul style="list-style-type: none"> • Poorly developed in size as no or little fermentation of food occurs. • No regulation of food particles.
<p><u>Omasum:</u></p> <p>Well developed as necessary for grinding of food and absorption of water.</p>	<ul style="list-style-type: none"> • Underdeveloped since no grinding and absorption of water.
<p><u>Abomasum:</u> Well developed and enzymic digestion of food occurs here.</p>	<ul style="list-style-type: none"> • Well developed and the only properly functioning stomach in digestion of food.

The small intestine is divided into 3 parts which are:

- Duodenum.
- Jejunum.
- ileum.

The different types of enzymes and digestive juices which are stored in the following animal digestive tract and their functions:

- **Mouth** (stores an enzyme)
 - Salivary Amylase=Breakdown starch into maltose.
- **Stomach** (Stores the following):
 - Rennin
 - =Causes the milk to curdle.
 - =Changes soluble caseinogen of milk to insoluble casein.

-Pepsin/pepsinogen

=Enzyme that breaks proteins into peptides.

-Hydrochloric acid (HCl)

=Prevents rotting.

=Changes sucrose into glucose and fructose.

- **Small Intestine** (This is the part where food is broken into simpler molecules(chyle) and later reabsorbed by the body cells.

It stores the following fluids (3)

-Bile (Produced by the liver in the gall bladder)

=Changes the PH from acid to alkaline.

=Promote peristaltic movement in the small intestine.

=Assist with absorption of fat-soluble vitamins A, D, E and K.

-Pancreatic juice (produced by the pancreas)

=Changes the PH from acid to alkaline.

=Trypsin enzyme changes protein into peptides.

=Lipase enzyme changes fats into fatty acids and glycerol.

=Amylase enzyme changes starch into maltose.

-Succus entericus (Intestinal juices).

=Sucrase enzyme changes sucrose into glucose.

=maltase enzyme changes maltose into glucose.

- **Liver**

=Stores the fat-soluble vitamins A, D, E and K.

- **Pancreas**

=Consists of Islets of Langerhans which stores insulin and glucagon.

- **Large intestine**

=Absorbs water.

Two (2) types of sphincters.

-Cardiac sphincter = Controls the movement of food into the stomach.

-Pyloric sphincter = Control movement of food into the small intestine.

Two (2) Adaptation of the small intestine.

- Many folds increase surface area for absorption.
- Involuntary muscle promote peristalsis.

Parts of the large intestine in a fowl:

- Caecum>Where further digestion take place.
- Colon> Absorbs water.
- Rectum

Functions of the Cloaca

- It is used for mating.
- Excretes Faeces and urine.

NB: Be able to:

>*Compare* and *understand* the external structure of the ruminant and non-ruminant stomach.

>*Explain* the functions and adaptation of the various structures.

>*Describe* the internal structures of the ruminant and non-ruminant stomach.

Functions of the Crop

- Moisten food.
- Soften food.
- Store food.

Functions of the gizzard/Ventriculus

- It grinds food and contain stones that help with mechanical digestion.

Function of the Proventriculus (Glandular stomach)

- Has both enzymes renin and pepsin that help with chemical digestion.

Two types of farm animals.

- Ruminants
- Non-ruminants

The Four (4) Chambers of ruminants:

- Rumen
- Reticulum
- Omasum
- Abomasum

Rumination Process:

Mouth-> Oesophagus->Rumen->Reticulum->Mouth->Oesophagus->Omasum->Abomasum->Small intestine->Large Intestine->Anus.

Which Part is functional in young ruminants?

- The Abomasum through the oesophageal groove.

The Four (4) importance of micro-organisms found in ruminants.

- Produce amino acids.
- Produce Vitamins.
- Hydrolyses proteins.
- Synthesize Vitamins.

The six components of feed and their function:

- Water
 - Controls the body temperature.
- Carbohydrates
 - Needed for fattening of farm animals.
- Proteins
 - Needed for growth and reproduction.
- Lipids
 - Act as insulation material.
- Vitamins
 - Needed for vital functions of the body.
- Minerals
 - Needed for normal body functioning.

Four (4) Fat soluble vitamins and deficiencies.

- Vitamin A.
 - Night Blindness.
 - keratomalaise.
 - Poor Vision.
- Vitamin D (For absorption of calcium and Phosphorus).
 - Osteomalacia.
- Vitamin E.
 - Muscular dystrophy.
- Vitamin K.
 - Poor blood clotting.

Three (3) water soluble vitamins and deficiencies.

- Vitamin B1.
 - Polyneuritis.
- Vitamin B2.
 - Curled-toe paralysis.
- Vitamin B12.
 - Wasting disease.
 - poor hatching of chicken.

Seven (7) Minerals and deficiencies.

- Calcium
 - Rickets and osteomalacia.
- Phosphorus
 - Pica (feeding on foreign objects).
- Iodine
 - Goitre.
- Iron
 - Anaemia (low haemoglobin in the blood).
- Zinc
 - Parakeratosis (rough skin in pigs).
 - Keratinization (Hairlessness).
- Copper
 - Swayback.
- Cobalt
 - Wasting disease.

<u>Two (2) types of feed and their sources.</u>	
<u>-Roughages</u> : Lucerne hay.	-Succulent Roughages
: Oat straws.	:Silage.
: Maize stock.	
<u>-Concentrates</u> : (Protein rich).	-Carbohydrate rich
: Fishmeal.	:Maize meal.
: Sunflower oilcake.	:Oatmeal.
	:Sorghum Meal.

Two (2) NR-nutritive Ratio implications and their uses.

- Narrow feed > Digestible protein (DP) is high and crude fibre is low.

:Ratio is 1:5 and less.

Has (3) uses:

- Used for Growth.
- Used for Reproduction.
- Used for Production.

- Wide feed > Has High crude fibre and less Digestible protein(DP).

:Ratio is 1:6 and more.

Has (2) uses:

- Used for Fattening.
- Used for Maintenance.

Four (4) ways to supplement minerals and vitamins.

- Mineral licks.
- Cafeteria/Free choice (Controlled by computers).
- Injections.
- Dosing by mouth.

Four (4) Growth stimulants.

- Growth hormones (GH).
- Thyroid Regulators.
- Antibiotics.
- Tranquilisers.

Six (6) ways to improve digestibility of feeds.

- Grinding.
- Dry rolling and cracking.
- Popping and micronizing.
- Roasting.
- Pelleting.
- Soaking.

Factors to consider when planning fodder flow.(4)

- Availability of resources.
- Animal requirements.
- Cost of feed.
- Season.

Factors affecting digestibility in animals. (4)

- Type of animal.
- Age of plant.
- Individuality.
- Amount of feed.

Cost-effective ways of using available feeds. (4)

- Storage.
- Reduce number of animals (Culling).
- Make hay.
- Cutting.

Importance of planning a fodder flow. (2)

- To manage animal feed.
- To meet animal requirements throughout the year.

Two (2) types of rations

- Maintenance ration > Amount of feed given to animals performing no work and producing no product.
- Production ration > Amount of feed given to animals performing work and producing products.

Importance of Roughages in:

- o *Young ruminants.*
 - Stimulate the development of the rumen.
- o *Adult ruminants.*
 - Prevents bloating.

Difference between Feeds contents.

.Feed	Roughage e.g (Hay)	Concentrate e.g (Meal)
TDN	-Low	-High
Crude fibre	-High	-low
Crude protein	-Low	-High
Cost	-Cheap	-Expensive
Animal Utilize	-Ruminants	-Both
Bulkiness	-High	-Low

2.ANIMAL PRODUCTION, PROTECTION AND CONTROL.

Name (2) Production systems.

- Extensive production system
- Intensive production system.

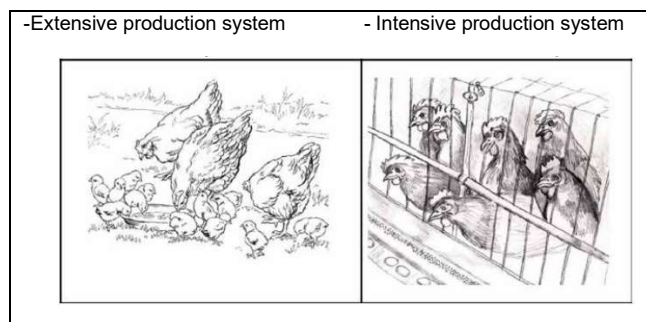
Difference between the two production systems.

Intensive production system	Extensive production system
-More inputs -Small area -More animals -Use of technology -More capital -Diseases spread easily	-Few inputs -Large area -Less animals -No technology -Less capital -Diseases do not easily.

NB:
Be able to identify the two different production systems through pictures.

Examples of intensive production system.

- Battery systems.
- Feed lots.
- Poultry farm.



Four (4) Factors increasing animal production.

- Breeding.
- Feeding.
- Environment.
- Enterprise management.

Ways to reduce effects of heat on animals. (2)

- Animals lay under tree shed.
- Animals get inside dams.

Importance of housing for animals. (3)

- Protects animals against predators.
- Protect animals against theft.
- Protect animals against harsh temperatures.

Equipment used for the following:

- Used to load animals.
 - Loading ramp.
- Equipment in broiler house that ensures maximum consumption of feed.
 - Lighting/Lamb.
- System where chickens are kept on the floor.
 - Deep litter.
- Used to Direct animals.
 - Crush pan.

Aspects to consider when moving animals by the road. (2)

- Move animals early in the morning.
- Red flag must be used.

Importance of straws/sawdust. (2)

- Insulation.
- Provide heat.

Facilities used to provide heat for animals. (4)

- Heaters.
- Aircons.
- Fans.
- Curtains.

Basic requirements of vehicle that transports animals. (2)

- Competent driver.
- Floor must be clean.
- Well ventilated.

Facilities used in production systems.

- Farrowing pen> Enclosure where pigs give birth.
- Holding shed> Place where animals are kept.
- Feed shed> Place where feed of animals is kept.
- Holding pens> Place where animals are kept before being handled.

Tools/Facilities/Structures used to handle animals. (9)

- Nose pliers> Used to lead animals.
- Halter> Tie animals to post.
- Casting harness> Used to make animals lie down.
- Head gate> Trap the head of animals so that they can be managed for various purposes.
- Dehorning iron> Used to dehorn.
- Burdizzo> Used for castrating older animals.
- Elastrator> Used for castrating young animals.
- Loading ramp> Used for loading animals.
- Plywood boards> Manage movement of pigs.
- Branding iron> Identification of animal / Marking.
- Drenching gun> Give large amounts of liquids to animals.
- Plunge/Dip> Dipping animals for controlling ticks.
- Electric prod> Control movement of animals.
- Crush> A permanent facility used to restrict animals.

Types of drinkers.

- Nipple drinkers.
- Bell drinkers.
- Starter cup.

Purposes of crutching. (2)

- Control of parasites.
- Accumulation of fats by the tail.

Methods of testing. (3)

- Checking respiratory rate.
- Checking pulse rate.
- Checking Temperature.

Reasons for handling animals. (3)

- For Feeding.
- For Artificial insemination.
- For health purposes.

Methods of administering medicines. (4)

- Oral (mouth) Administration.
- Topical (wound) Administration.
- Vaginal Administration.
- Injections.

Animal Health, Diseases and Measures to prevent spread.

Types of diseases. (4)

- Viral diseases.
 - Foot and mouth diseases.
 - Rabies.
 - Rift valley fever
 - Avian influenza (bird flu)
 - Swine flu/fever
 - Newcastle diseases
- Bacterial diseases.
 - Anthrax
 - Mastitis
 - Tuberculosis
- Protozoan diseases.
 - Anaplasmosis
 - Redwater
 - Heartwater
 - Coccidiosis

NB:

- Be able to distinguish between the different types of diseases, **Transmission, Host, Symptoms and Treatments.**

- Fungal diseases.
 - Lumpy wool
 - Ringworm

Two (2) types of parasites.

-External Parasites> Parasites that attack the body tissues such as blood, skin and hair of animal.

-Internal Parasites> Parasites that live inside the host and rob it of its food and blood.

Examples of external parasites. (5)

-Ticks

-Nasal worm

-Blowflies

-Lice

-Mites

Examples of Internal parasites. (3)

-Tape worm

-Liver fluke

-Round worm

Life cycles (simplified)

-One-host ticks (Blue tick).

-two-host ticks (Red-legged tick).

-three-host ticks (Bont tick).

Financial implications and detrimental effects of external parasites (3).

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

Basic preventative and control measures (3).

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

Economic implication of animal diseases and parasites (6).

- 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 measures used to promote good animal health and control diseases, pests and parasites: (7)

- 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 parasite.

Plant and metallic salt Poisoning.

Plants poisoning

The most common and important (3) plant poisoning in South Africa can be poisonous to animals are:

- Maize fungus > They grow on maize cobs and produces threads of filaments called hyphae and leads to aflatoxin in animals.
 - 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.
- Poison bulb > This type of poisoning is caused by bulbs and the most common is one-leaf Cape tulip, and the whole plant is poisonous.
 - 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.
- 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.

Measures of preventing plant poisoning. (8)

- Remove poisonous plants from pastures/burn the infested areas/application of herbicides/chemicals.
- Remove animals from camps infested with poisonous plants.
- Feed/water animals well/provide proper nutrition.
- Avoid overgrazing.
- Practice rotational grazing.

NB: Know at least 4.

- Inspect hay kept in stables.
- Knowledge on poisonous plants.
- Do not feed animals moulded hay/cut from areas with poisonous plants.

Salt poisoning.

-The intake of less water and more salts by farm animals results in salt poisoning.

Symptoms of salt poisoning in different farm animals: (3)

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

Treatment of salt poisoning (2).

- Fresh quality water must be provided to animals.
- Remove source of poisoning.

Prevention of salt poisoning (2).

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

Poison by metallic salts

>When metallic salts and inorganic substance mix with animal feed, animals are poisoned.

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 (4)

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

Treatment of Urea poisoning

- Administer vinegar to reduce the effect of alkalosis.

Prevention of urea poisoning (2).

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

The role of the state in animal protection.

-The state plays important role in regulating farming practices.

The following are some of the roles that the state implement:

- Implementing and enforcing legislation such as Animal Health Acts, Animal Diseases Act.
- The state also renders the following services towards animal protection:
 - o Quarantine services
 - o Control measures
 - o Animal health schemes
 - o Duties of owners of animals
 - o Import bans
 - o Exports of animals and animal products
 - o Importation of vaccines
 - o Movement permits
 - o Veterinary services

3. Animal Reproduction.

Name two (2) primary organs found in males and females animals and their functions.

-Testes (found in males)> They produce male gamete (sperm) and male sex hormone.

-Ovaries (found in females)> They produce female gamete (ovum) and female sex hormone.

Important terms in reproduction tract of males and females:

- Ampulla -Site for fertilization.
- 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 where fertilization takes place.
- Gametogenesis- Formation of gametes.
- Oogenesis/ovigenesis- Formation of a mature ovum from a primary oocyte.
- Spermatogenesis- Formation of spermatozoa in the testes.
- Oocyte -An immature ovum that is found in a follicle.
- Ovary -Primary sex organ of a female.
- Ovulation -A release of a mature ovum from an ovary Reproductive organ in cattle.
- Ovum -Female gamete.
- Penis -A male organ of copulation.
- Prostate gland -A gland that lies in the form of a ring around the urethra in males.
- Scrotum -A sac that houses and protects the testes.
- Semen -A mixture of sperm & fluids from the seminal vesicle, prostate gland & Cowper's gland.
- Sperm -Male gamete.

- 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.

Male reproductive organs and functions.

- *Cowper's glands*

- Flushes urine residue from urethra.

- *Urethra*

- Expels urine and semen outside the body.

- *Epididymis*

- Maturate sperm.

- store sperm temporary.

- Transport sperm.

- *Scrotum*

- Protect and regulate the temperature of testes.

- *Testes*

- Males primary reproductive organ that produces sperm and secretes the male hormone (Testosterone).

- *Penis*

- Deposit semen into the vagina and also expels urine.

- *Vas Deferens*

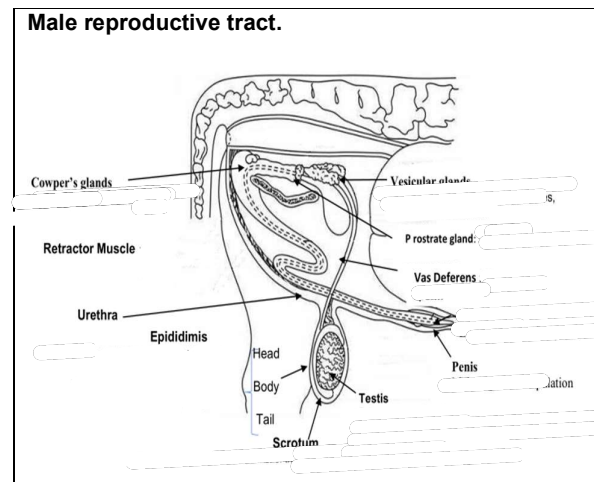
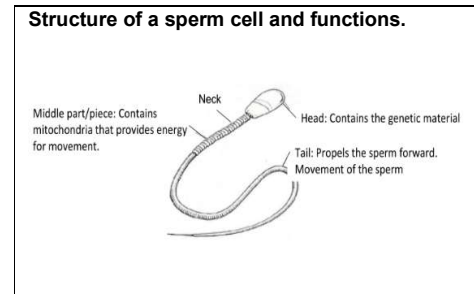
- Transport of sperm.

- *Prostate gland*

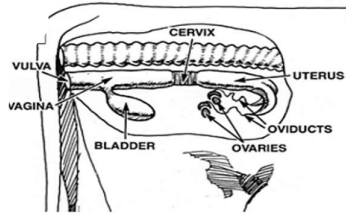
- Secretes milky, alkaline fluid.

- *Vesicular glands*

- Contributes fluid, energy substrates, and buffers to semen.



Female reproductive organs and functions.



- Uterus
 - protects the foetus.
- Fallopian tube/Oviduct
 - Site of fertilization (where fertilization occur).
- Infundibulum
 - Catches the egg(ovum) after ovulation.
- Vagina
 - Receives the penis and sperm during copulation.
- Cervix
 - Prevents microbial infections during pregnancy using the mucus plug.

Functions of the following hormones.

- Testosterone
 - Responsible for the development of the male secondary sex traits.
 - Stimulates the mating behavior of the bull.
- Oestrogen
 - Responsible for the development of the female secondary sex organs.
 - Responsible for signs of oestrus.
- Progesterone
 - Maintains pregnancy.

(4) Factors causing infertility in males.

- Hypoplasia.
- Impotence.
- Lack of libido.
- Poor nutrition.

(4) Factors causing sterility in males.

- Castration.
- Injuries.
- Diseases.
- Deformed reproductive organ.

Why testes move near the body when it cold?

-Sperm require a temperature of at least 2-3 degrees Celsius lower than the body temperature. On a cold day the testes move closer to the body cavity and hangs away on a warm day.

The (3) pituitary hormones found in females and their functions.

- *Follicle stimulating hormone (FSH)*
 - Stimulates follicle development.
- *Leutinising hormone (LH)*
 - Stimulates ovulation.
- *Prolactin*
 - Stimulate milk production.

Four (4) stages of Oestrus.

- Pro-oestrus.
- Oestrus.
- Met-oestrus.
- Di-oestrus.

NB:

Be able to identify what's taking place during these different stages.

The Four (4) Visible signs of oestrus.

- Cow is restless.
- Less feed intake.
- Less milk production.
- Mount others and allow to be mounted.

Four (4) Methods of identifying Animals on heat (Oestrus).

- Kamar heat mount detector.
- Chin-ball marker.
- Tail chalking.
- pedometer.

Factors causing infertility in females.

- Ovulatory failure.
- Abortions.
- Retained placenta.
- Anoestrus.

Senses responsible for mating of farm animals. (3)

- Smell.
- Sight.
- Touch.

Factors causing sterility in females.

- Diseases.
- Hereditary conditions.
- Physiological sterility.

Five (5) stages of mating.

- Courtship.
- Mounting.
- Copulation.
- Ejaculation.
- Dismounting.

Main requirements of Artificial Insemination (AI).

- Trained inseminator.
- Correct timing.
- Correct technique.
- Cow must be on heat (oestrus).

Two (2) Requirements/Methods of collecting semen.

- Electro-ejaculation.
- Artificial vagina.

Five (5) dilutants of semen and their function.

- Egg.yolk> Provide semen with nutrients.
- Milk> Provide semen with nutrients.
- Glycerol> Provide semen with nutrients.
- Buffer> Protects against PH change.
- Anti-biotics> Prevents bacteria's.

Temperatures required for sperm storage. (3)

- Short period> 5°C
- Long period> -196°C
- Thawing temperature should be between 32°C-35°C for 15 seconds.

Characteristics of a good quality semen. (3)

- Opaque.
- Milky white.
- Sticky.

Abnormal colours of semen and their indication.

- Grey> Has infections.
- Reddish> Has fresh blood.
- Dark brown> Old blood.

Timing of Artificial Insemination (AI).

-When cow show signs of oestrus in the morning we inseminate in the afternoon, then if cow show signs of oestrus in the afternoon we inseminate in the next morning.

Four (4) Factors affecting semen negatively.

- Stress level.
- Diseases.
- Poor nutrition.
- High or low temperature.

Treatment of frozen sperm.

-Straws are thawed in water at temperature of between 32-35°C for 15 seconds.

Advantages of Artificial insemination. (4)

- Decrease chances of STI's.
- Superior male can fertilize more females.
- Farmers will not feed bulls during calving seasons.
- Semen from other countries can be used.

Disadvantages of Artificial insemination. (4)

- It is expensive.
- Genetics abnormalities can be spread easily.
- Inexperience inseminator might injure animals' reproductive tract.
- Requires more management.

Purpose of embryo transplantation. (4)

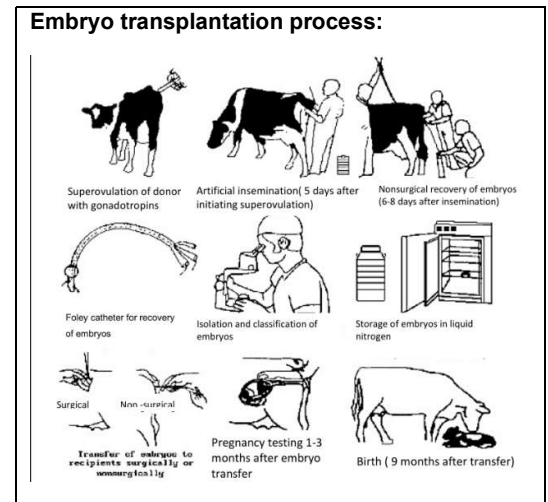
- Increase genetic potential of the herd.
- Genetic preservation (keeping good genes).
- Exportation of embryos.
- Genetic testing.

Steps of Embryo transplantation. (7)

1. **Oestrus synchronisation** of donor and recipient cow.
2. Treating the donor cow with hormones for **Superovulation**.
3. Donor eggs are fertilized with sperm from superior male via **Artificial Insemination**.
4. Developed embryos are **collected** 7 days after Artificial Insemination from the donor cow using saline solution.
5. Embryo may be used immediately or can be **stored** for future use in the **liquid nitrogen**.
6. Embryos collected from the donor are **implanted** into the uterus of the recipient cow.
7. The embryo **develops** in the recipient cow, but does not have genetic traits of the recipient mother.

Advantages of Embryo Transplantation. (4)

- A single cow can produce more calves in a year.
- Productive life of older cows is extended.
- Profit is made from sales of superior genes or quality genetics.
- Top genes are introduced in the herd.
- Preservation of best genetics.



Disadvantages of Embryo Transplantation. (5)

- It is complicated to conduct.
- It is costly.
- It requires more management and training.
- There are chances of abortion.
- Synchronisation of donor and recipient cow might be difficult.

What is used to remove embryos during embryo transplantation?

- Foley catheter.

Name two (2) types of cloning.

-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.

-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 successful and cloned animals commonly have abnormalities, regardless of the type of donor cell or species involved.

The aims of nuclear transfer (cloning): (4)

- To produce large numbers of genetically identical animals.
- To produce offspring from high quality animals.
- To preserve and extend proven, superior genetic.
- To archive high quality meat and dairy products.

Advantages of cloning. (4)

- It offers opportunities to select and multiply animals of specific merit with regards to production – eggs, milk & wool.
- Allows to create large numbers of precise duplicates of an animal in a single generation
- It is applied to increase the population sizes of indigenous species, or to restore them from extinction.
- By reproducing copies of desirable animals, farmers can farm with the best animals.

Disadvantages of cloning. (4)

- It is new technology that requires specific skills.
- It is expensive and mainly used only for elite animals.
- Cloned animals seem to age prematurely.
- Dystocia problems can arise because clones can be very large at birth.

Stages of gestation/Pregnancy. (3)

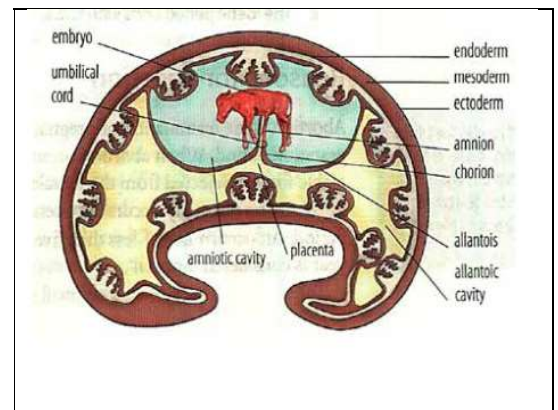
-Ovum period>The zygote (fertilized egg) travels through the Fallopian tube to the uterus.

-Embryonic period>During this time the tissue, organs and systems begins to develop and differentiate.

-Foetal period>The embryos organs develop and grow.

The membrane layers and their function:

- Chorion (Embryonic bag) >The outer membrane that attaches to the uterus.
- Amnion >The inner membrane that contains the amnion fluid, that protects the embryo. The embryo is connected to the amnion by the umbilical cord.



- Allantois >To collect urine from the unborn calf.

Three (3) Stages of parturition (giving birth).

- Preparatory stage - Contractions start, and the foetus moves into the birth position.
 - The vagina, cervix and uterus enlarge to form a common canal.
- Ejection stage - More powerful contractions
 - The head and front legs of the foetus emerge from the vulva.
 - The mother lies down, and the calf is Born.
- Expulsion of placenta - After a period of rest, the muscles of the uterus contract to expel the afterbirth which includes the placenta, umbilical cord and foetal membranes.

Signs of parturition (giving birth) by animals. (4)

- Urinating Frequently.
- Stop eating.
- Make bellowing noise.

Conditions that may prevent the normal parturition process (dystocia). (3)

- Abnormal position of the calve during birth.
- Hydrocephalus.
- Twins.

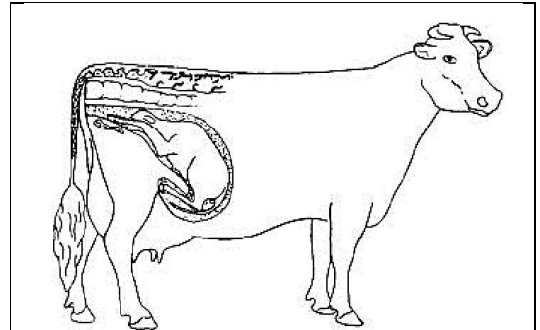
The importance of dry period in cows.

- Allows milk producing tissues in the udder to recover.

Signs of animals experiencing dystocia.

- Exhaustion.
- Pain and discomfort.

Normal position of a calf at birth



During the birth of a calf, the spine should be facing upwards. The head and legs must enter the birth canal first. The bottom of the hooves should face downwards. The correct posture is for the forelegs to stretch forwards towards the pelvis and the hindlegs towards the back

CALCULATIONS

Animal nutrition: Digestibility co-efficient, Pearson square, Nutritive ratio and fodder flow.

Key:

DMI- Dry Matter intake.

DMM-Dry Matter in Manure.

Digestibility Co-efficient:

Example:

- A farm animal consumed 15kg of hay with a dry matter content of 84% and excreted 3.5kg dry manure.

Step 1: Calculate the DMI and DMM.

$$\begin{aligned} \text{DMI} &= 15\text{kg} \times 84\% \\ &= 15\text{kg} \times 84/100 \\ &= \underline{12,6\text{kg}}. \end{aligned}$$

	Amount	DM	M
Feed	15kg	84%	16%
Manure/faeces	3,5kg	-----	-----

DMM= 3,5kg.

Step 2: Calculate digestibility using the formula.

DC = **Dry Matter intake (kg) – Dry Matter in manure (kg) × 100**

Dry Matter intake (kg)

$$\begin{aligned} &= \frac{12,6 \text{ kg} - 3,5 \text{ kg}}{12,6 \text{ kg}} \times 100 \\ &= \frac{9,1 \text{ kg}}{12,6 \text{ kg}} \times 100 \\ &= 72,22\% \end{aligned}$$

Note: This means 72.22% was digested and absorbed by the body while 27.78% was excreted by the body.

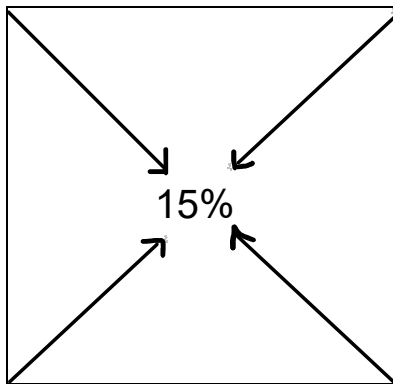
Pearson square

Example: Calculate the ratio at which maize meal and fishmeal should be mixed to get feed with 15% DP.

FEED	Percentage of DP (%)
Maize meal	9
Fish meal	36
Maize stalk	4

Step 1: Draw a square with the parts required as follow:

-Maize meal= 9% Step 2(calculate the difference) Maize meal= 36-15
= **21 parts**



-Fish meal= 36%

Fishmeal= 15-9

= **6 parts**

- Ratio= Maize meal: Fish meal
= 21:6

How to calculate as a percentage%:

$$\begin{aligned}\bullet \text{Fish meal} &= \frac{6}{21+6} \times 100 \\ &= \frac{6}{27} \times 100 \\ \text{Answer} &= \underline{22\%}\end{aligned}$$

$$\begin{aligned}\bullet \text{Maize meal} &= \frac{21}{21+6} \times 100 \\ &= \frac{21}{27} \times 100 \\ \text{Answer} &= \underline{78\%}\end{aligned}$$

Nutritive Ratio (NR)

-Ratio between digestible protein (DP) and digestible non-nitrogen compounds.

Example: Calculating the NR of the following feed:

Feed has a 82% TDN (Total digestible Nutrient's) and 7% DCP (Digestible protein).

$$\text{NR} = 1 : \frac{\text{Total Digestible Nutrients (TDN)} - \text{Digestible Protein (DP)}}{\text{Digestible Protein (DP)}}$$

$$= 1 : \frac{82-7}{7}$$

$$= 1 : \frac{75}{7}$$

$$= 1 : 10.7$$

NB:

The final answer must always be expressed as a ratio e.g 1:10.7 meaning for every one part of digestible protein there are 10.7 parts other digestible nutrients.

Fodder Flow programme

Example:

The table below represents feed requirements and resources available over a twelve-month period.

ITEM	FIRST 6 MONTHS (RAINY SEASON)	LAST 6 MONTHS (DRY SEASON)	TOTAL
Need per cow per day	12 kg	15 kg	
Feed requirements in 6 months	108 000 kg	----	----
Resources available per month (kg)	1,5 ton/ha	0,15 ton/ha	415 800 kg per year
Total area for camps (ha)	42	42	42
Number of animals	50	30	

Consider the following questions about fodder flow programme using the information presented in the table:

Q1: Calculate the total feed required by the animals for a year.

First 6 months (Rainy season).

= **108 000 kg** (as indicated in the table)

Second 6 months (Dry season).

Answer = Amount of feed consumed by each cow per day (kg) x Number of animals

= 15 kg x 30 animals = **450 kg** a day consumed by all animals.

= convert the amount consumed by animals each day into 6 months:

450 kg x 180 days (6months)

= **81 000 kg** for 6 months.

Total feed required by the animals for a year (12 months)

Answer = First 6 months + Second 6 months

= 108 000 kg + 81 000 kg

= **189 000 kg**

Q2: Calculate in Kilograms (kg) the amount of available feed in the camps in dry season.

= 0,15 ton/ha x 1000 x 42 x 6

= **37 800 kg**

NB:

Factor to
convert tons into
kg's is 1000

Sources

The information in this guideline was derived from the following intellectuals:

-*Mind the Gap* CAPS Grade 12 Agricultural Sciences (© Department of Basic Education 2019)

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- The author of this guideline declares to be held liable for any inconsistency within the guideline.

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