Course Name	National Diploma: Animal Production NQF 5 (249 Credits) SAQA ID: 49011
Module Name	Module 6: Livestock Production V Learner Guide
Unit Standards	116388, 116393, 116399
NQF Level	5
Credits	23

LEARNER GUIDE

Part 1 - Livestock Production

Animal Anatomy, Physiology and Animal Health

Table of Contents

Dear Learner

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

Unit standard ID:	Unit standard title:
116388	Evaluate animal anatomy and physiology systems
116393	Evaluate animal health systems
116399	Dissect animals

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

It is your responsibility to complete all the exercises in the Assessor Guide. The facilitator will explain the requirements of each exercise with you. You will also be expected to sign a learner contract in your assessor guide. This contract explains responsibility and accountability by both parties.

On the document "Alignment to NQF", you will find information on which qualification this unit standard is linked to if you would like to build towards more credits against this qualification.

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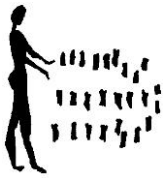
Key to Icons

	Important Information
	Quotes
	Personal Reflection
	Individual Formative Exercise
	Group Formative Exercise
	Summative Exercise
	Activity

Alignment to NQF

Element of programme	
1. Name of programme	Livestock production part I
2. Purpose of the programme	Form part of the qualification to equip learners in Livestock Production
3. Duration of the programme	10 days of formal facilitation; 230 notional hours
4. NQF level	5
5. NQF credits	23
6. Specific outcomes	See Unit Standard Guide
7. Assessment criteria	See Unit Standard Guide
8. Critical cross-field outcomes	See Unit Standard Guide
9. Learning assumed to be in place	See Unit Standard Guide
10. Essential embedded knowledge	See Unit Standard Guide
11. Range statement	See Unit Standard Guide

12. Recognition of Prior Learning (RPL)	RPL can be applied in two instances: ✓ Assessment of persons who wish to be accredited with the learning achievements ✓ Assessment of learners to establish their potential to enter onto the learning programme.
13. Learning Materials	Learner Guide, Assessor Guide with Model Answers, Learner PoE Workbook, Facilitator guide
14. Links of the programme to registered unit standards, skills programmes, or qualifications	Registered qualification: Title: National Diploma: Livestock Production ID: 49011 NQF: Level 5 Credits: 249

Unit 1

Animal Anatomy and Physiology

Unit Standard	
116388	**Evaluate animal anatomy and physiology systems**

Specific Outcomes

SO1: Identify and understand the structures, composition, physical, bio-chemical and biological components and their interrelated activities pertaining to the various anatomical systems.

SO2: Identify, understand and evaluate symptomatic variations and abnormalities within living animals, in the various anatomical systems and their probable causes.

SO3: Utilise the knowledge about animal anatomy, morphology and physiology to determine opportunities for working with animals.

SO4: Utilise the knowledge about animal anatomy, morphology and physiology to create and develop animal production systems.

Learning Outcomes

By the end of this unit you will demonstrate an understanding of:

- The anatomical, physiological, physical and biochemical components of Livestock and their interrelated activities
- Symptomatic variations and abnormalities
- Animal production systems based on anatomy, morphology and physiology

Identifying / Working / Organise	Collecting / Science / Communicating	Demonstrating / Contributing

1. INTRODUCTION: ANATOMY AND PHYSIOLOGY

This Session describes the processes involved within the various anatomical systems of the body, the interaction of the various systems of the body with each other, the biochemical substances that are produced within each of the systems and their purpose. All activities taking place in living organisms are aimed at growth and reproduction. In order to grow the animal needs energy. The source of energy is food, which must be searched for the animal may supply itself or feed to the animal by its caretaker or parent. To be able to search for food the animal needs a locomotor system and also senses in order to smell, see and hear. To make the food available to the body it must first be broken down into more elementary substances (e.g., proteins to amino acids, carbohydrates to glucose and fats to fatty acids). The digestive system, which includes all the structures and organs from the mouth to the anus, is necessary for this.

The digestive system removes the useful parts from food and discards the rest. For the absorbed nutrients (amino acids, glucose and fatty acids) to be changed into energy and thus made available to the body it must first undergo a process, which is called metabolism. The liver plays the biggest role in this process. Before energy can be released from nutrients it must first be "burnt" by the body and oxygen is necessary for this. The respiratory system supplies this oxygen to the body. To transport oxygen from the respiratory organs (lungs) to the rest of the body and also for the distribution of nutrients through the body, the circulatory system is necessary. The circulatory system also transports the waste products of metabolism to organs where it is excreted e.g., the kidneys which is part of the urinary system. To reproduce the animal needs a reproductive system. This complicated system is controlled by the endocrine system, consisting of ductless glands, which secrete their chemicals/fluids called hormones into the bloodstream for distribution to the whole body. When a hormone reaches its target organ, it will have the desired effect on that organ. This is called negative feedback. Production of hormones may be triggered by environmental factors or physiological changes in the animal's body. The endocrine glands control various involuntary processes in the body e.g., metabolism, growth, digestion, etc. To synchronise and control all the systems a nervous system is necessary. The nervous system can be divided into two functional parts, namely, that which controls voluntary processes like walking, vision, hearing, smelling, etc. and that which controls the involuntary processes like heart rate, movement of the intestines etc. A short preview of the anatomy of the different systems of the body will be given in order to know the anatomy of a normal healthy animal. For practical reasons the different systems will be dealt with separately, but it should always be borne in mind that the function of each system is dependent on

that of others and that it is really impossible to study one without having a thorough knowledge of the rest.

1.1. THE LOCOMOTORY SYSTEM

The locomotory system comprises of the skeleton with its joints, which give support to the different bones as well as the muscles and maintains the integrity of the body structure. When the muscles contract and relax under control of the nervous system it causes movement of the body. In addition, there are ligaments in and around joints and tendons, which serve to support and protect the muscles by preventing overstretching.

The Bones of the Body

The bones of the body can be divided into four categories:

- Long bones, e.g., the upper arm bone (humerus), thighbone (femur), etc.
- Flat bones. Examples are the cranial bones, ribs and scapula.
- Short bones such as those found in the carpus (wrist) and tarsus (ankle). These bones serve as shock absorbers.
- Irregular bones. An example is the vertebrae

The Skeleton

The skeleton is a framework of hard structures or bones, which supports and protects soft tissues. It consists of the different bones, cartilage and strictly also speaking ligaments. Anatomically the skeleton can be divided into two parts, i.e.

Axial skeleton:
This part of the skeleton includes:
• The cranium
• The vertebral column,
• The ribs and
• The breastbone (sternum)

Appendicular skeleton:
This part of the skeleton compromises of
• The pelvic girdle
• The hind limbs and
• The front limbs.

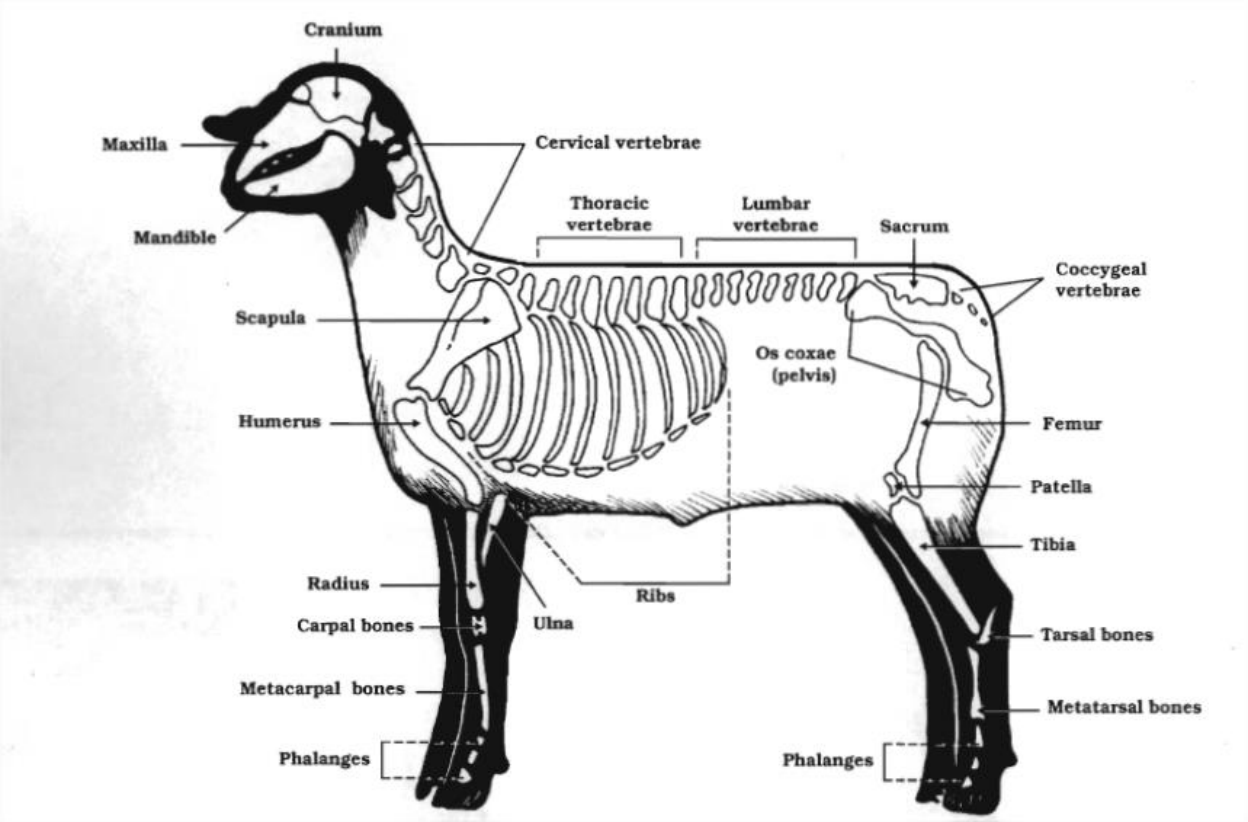


Figure 1: Skeleton of a sheep

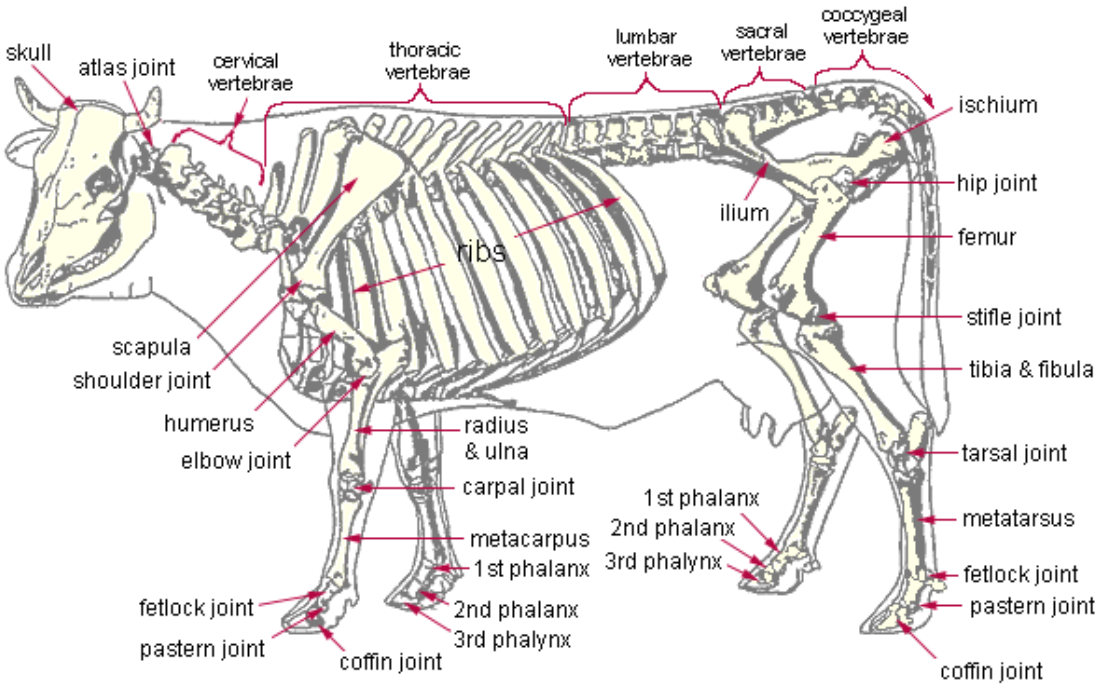


Figure 2: Skeleton of cattle

The Muscles of the Body

The muscles of the body can be divided into three groups:

Voluntary striated muscles:

These include those of the neck, back and limbs and are under voluntary control i.e. the animal can contract these muscles at will. This is the "meat" of the animal.

Involuntary smooth muscles

This group includes muscles of the intestinal tract, urinary bladder, uterus etc. They are not under voluntary control of the animal but controlled by the autonomic nervous system. There is also no sense of pain in smooth muscles. An abdominal operation can consequently be done on domestic animals and humans by the use of local anesthesia only. Involuntary muscles, however, send out an impulse of pain when they are stretched excessively.

Heart (cardiac) muscles (Involuntary muscles)

Cardiac muscles are highly specialised muscle tissue, and although cross-striations are visible microscopically, they are involuntary muscles. The muscles also differ from striated muscles in that there are branches between fibers. The following diagram shows the matrix of muscles of a cow. Each number represents a specific muscle.

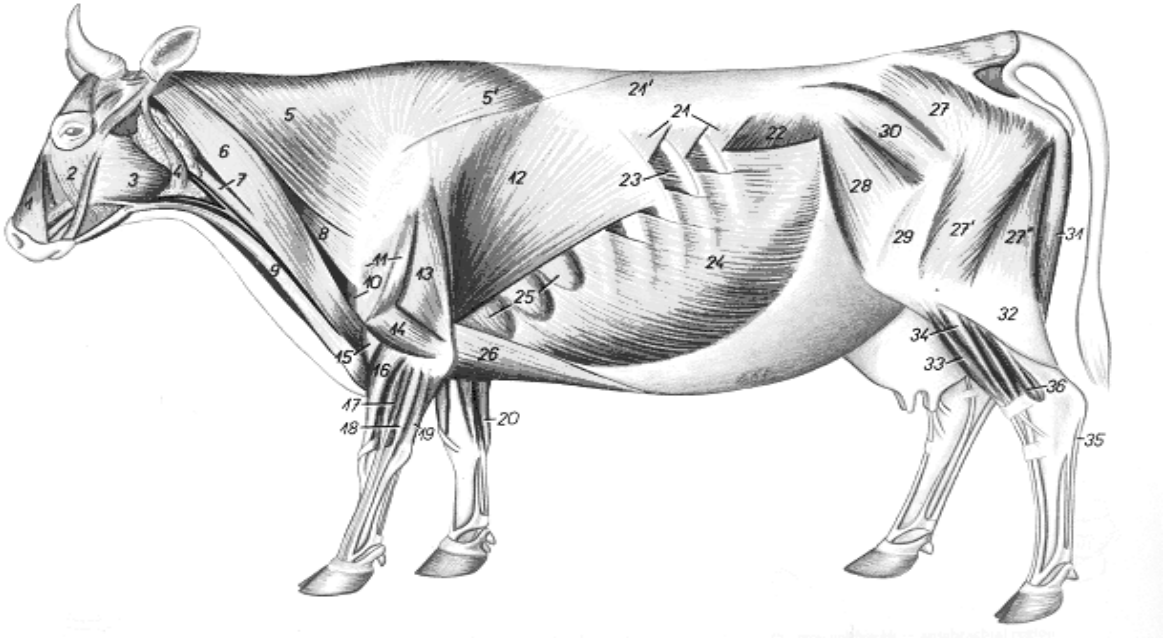


Figure 3: The muscles of cattle

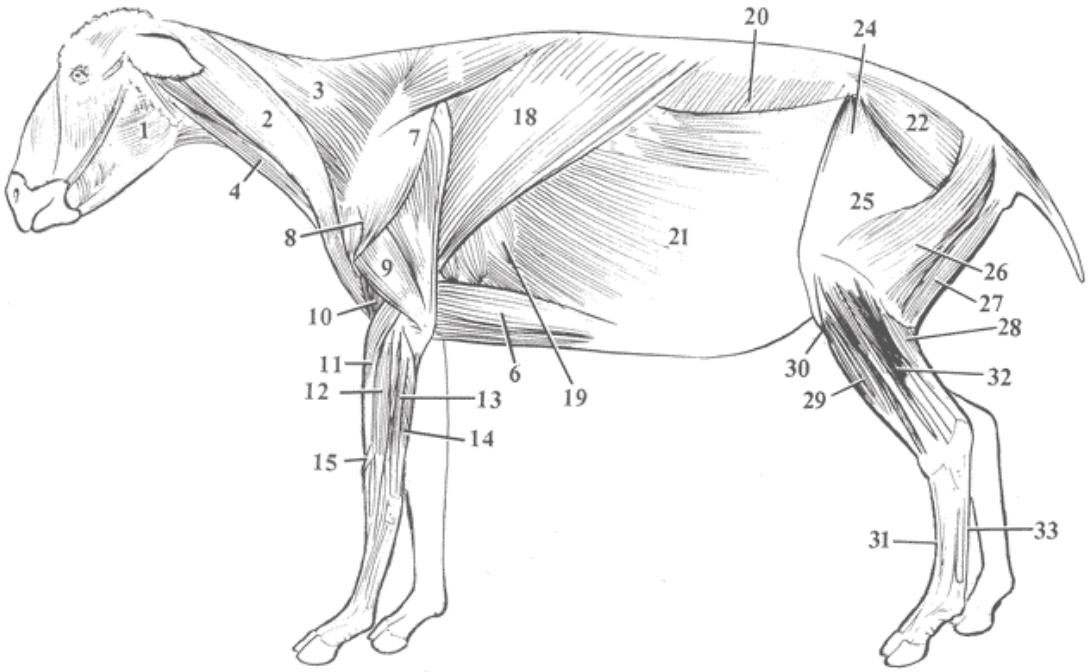


Figure 4: The muscles of sheep

1.2. THE NERVOUS SYSTEM

The nervous system is well protected by bones. When a nerve is injured the process of recovery, also called regeneration, can take a long time e.g., the facial nerve in the horse. Brain cells, however, cannot recover after injury. The nervous system consists of the following:

The central nervous system

Brain

- Cerebrum
- Cerebellum
- Medulla oblongata

Spinal cord

Peripheral nerves

- Voluntary nerves
- Motor nerve fibers
- Sensory nerve fibers
- Autonomic nerves also called involuntary nerves.
- Sympathetic nerve fibers
- Parasympathetic nerve fibers

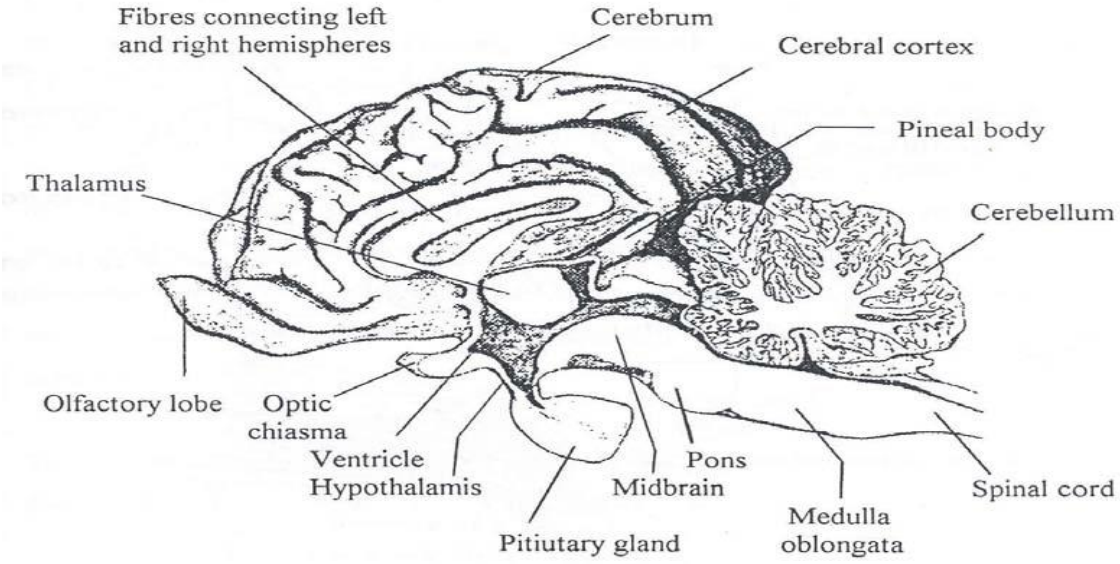


Figure 5: The Brain

The Brain

The brain serves to co-ordinate all the functions of the body. In humans and higher primates, it makes thinking and reasoning possible. It is, however, difficult to prove that other animals can or cannot think. There are also various centres in the brain which control certain functions involuntarily e.g., respiration, blood pressure, heartbeat etc.

The Spinal Cord

The spinal cord transmits the stimuli from the peripheral nerves to the brain and also from the brain back to the nerves branching from it. The voluntary nerves consist of a number of branching fibres running from the brain through the spinal cord to mainly the muscles and skin. Each branch consists of motor fibres carrying stimuli from the brain to an organ and sensory fibres, which carry stimuli from the organ to the brain i.e., the nerve fibres from the skin to the spinal cord, are **sensory fibres** and those from the spinal cord to the muscle are **motor fibres**. The sensory fibres relay stimuli from e.g., the skin to the brain where the animal takes note of them. The brain sends stimuli via the motor fibres to the muscles, which then react. Furthermore, the spinal cord is also the reflex centre. Sometimes a speedy reaction on a stimulus e.g., to prevent tissue damage, is required. In this instance to get a more rapid reaction the stimulus takes a short cut via the sensory nerves through the spinal cord to the motor nerves Without involving the brain. Only after the reaction has taken place does the individual become aware of it. This short cut is called a reflex arc. When, for instance, a hot object is touched, the hand is pulled back before one becomes aware of the heat.

The Autonomic Nervous System

The function of the **autonomic nervous system** is to control the organs, which fall outside the control of voluntary will. This includes control of the heart rate, intestinal peristalsis, etc. In some cases, the organs fall under control of the **autonomic nervous system** as well as the **endocrine system** resulting in a close co-operation between the two systems. The physical appearance of these nerves is identical to that of the voluntary system and the only way we are able to distinguish between the two is in the functions that they perform and the organs that they supply. Because the **autonomic nervous system** causes two different reactions in each organ it supplies, it is divided into two parts namely the **sympathetic** part, which has approximately the same action as the hormone **adrenalin**, and the **parasympathetic** part, which has basically the same action as the hormone **acetylcholine.**

The **receptors** of the nerves can be divided into two groups according to the sensations they induce:

- Those, which provide general sensations:

  These sensations, with the exception of pain, seldom penetrate the conscious mind.

- Those, which provide specific sensations:

  These differ from each other regarding their anatomical structure, the type of stimuli to which they react and the nature of the sensation which they provide. In the next table, **Table I** the most common classification of receptors is given.

SENSE ORGAN	**NATURE OF SENSATION**
Skin	Touch (pain, heat, cold)
Eye	Vision (light, colour, distance)
Ear	Hearing (pitch, intensity, direction)
Tongue	Taste (sour, sweet, salt, bitter)
Nose	Smell

Table 1: Classification of receptors

1.3. BLOOD AND LYMPHATIC SYSTEM

Blood

Blood consists of two fractions namely:

- Plasma (fluid part)
- Blood cells

Blood Plasma

Blood plasma forms approximately 66 per cent of the total blood volume and consists of 92 percent water and 8 percent solids. The latter consists of **Proteins and Serum albumin.** Blood plasma is produced by the liver and plays an important role in stabilising the water content of the blood.

Serum globulin

Is produced by the liver. Globulins play a very important role in the protection of the body against diseases.

Fibrinogen

Is produced in the liver and is important part in the clotting of blood.

Inorganic salts

Consist mainly of salts of sodium, calcium, magnesium, phosphorus and others.

Organic substances

Examples are glucose, urea, fats, etc.

Hormones and antibodies

Apart from the plasma in blood there are also small quantities of plasma in the pericardium, thoracic and abdominal cavities. Under certain disease conditions more plasma is excreted in the three cavities where it can coagulate and cause adhesions. When plasma coagulates**, fibrin** and **serum** are formed.

Cellular elements

- Red blood cells (Erythrocytes)
  Red blood cells are formed in the red bone marrow. The most important constituents of a red blood cell are protein and iron. Iron is not found in free form, but in combination with

other proteins thus forming **hemoglobin.** Hemoglobin is the substance in the red blood cell that is responsible for the transport of gasses such as Oxygen and Carbon dioxide. Hemoglobin + Oxygen = Oxyhaemoglobin (A bright red colour). Hemoglobin + Carbon dioxide = Carboxyhaemoglobin. (A reddish blue colour) Oxygen-rich blood thus has a bright red colour whilst blood poor in oxygen, in other words, carbon dioxide-rich blood, have a reddish-blue colour.

- White blood cells
  The white blood cells protect the body against pathogenic organisms. There are five different white blood cells found in most farm animals, and each with a specific defence mechanism to fight germs and foreign organisms that may cause disease.

- Blood platelets (Thrombocytes)
  Blood platelets are formed in the bone marrow and play a role in the clotting of blood. The clotting ability of blood is of great importance to the body because it prevents the loss of blood from the body after damage to a blood vessel.

Lymphatic System

The process of re-absorption of the intercellular fluid into the blood stream does not take up all the excess intercellular fluid. This is then collected by small very thin-walled tubes, which are called **lymphatic vessels**. These vessels drain the whole body and then unite and open into a vein in the thoracic cavity. On their way to the thoracic cavity, they pass through various **lymph glands**, which serve as filters against infection. White blood cells and other cells in the lymph glands actively destroy germs.

1.4. THE HEART AND THE CIRCULATORY SYSTEM

The mammalian heart has 4 chambers enclosed by muscular tissue. The top two chambers are called the atria (plural of atrium) and the lower two the ventricles. A septum completely separates the right and the left sides of the heart from each other. However, there is a free passage of blood between the atrium and the ventricle on the same side. The right side of the heart is the venous or lung part and the left side is the arterial or systemic part of the heart. The wall of the ventricles is much thicker than that of the atria and the wall of the left ventricle again is thicker than that of the right ventricle.

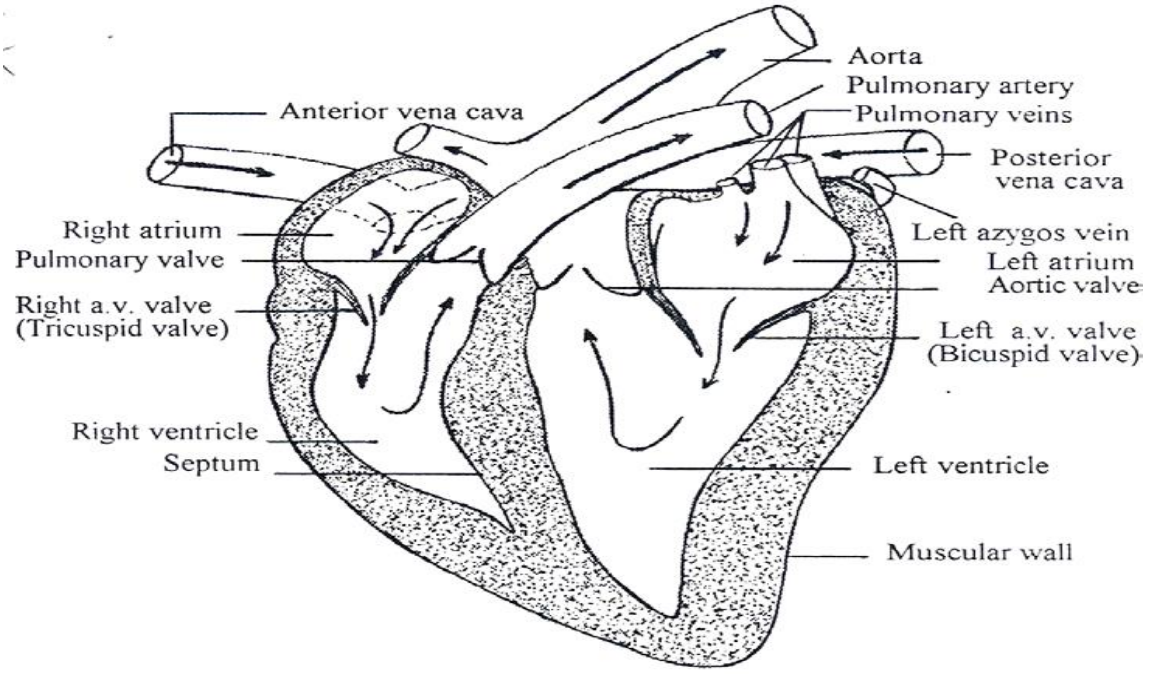


Figure 6: The Heart

The reasons for the difference in thickness of the heart-muscle are:

- The only work that the atria does is to store the blood for short periods and then to force it into the ventricles, thus the walls are very thin.
- The left ventricle works against the resistance of the whole systemic vascular system, whilst the right ventricle only works against the vascular resistance of the lungs.

The heart has four valves, two on each side. They serve to stop any backflow of blood. The valves between the atria and the ventricles are called the atrio-ventricular (AV) valves. The valve that stops the backflow of blood from the aorta to the left ventricle is called the aortic valve and the valve between the pulmonary artery and the right ventricle is called the pulmonary valve (Figure 4). Cardiac muscles are supplied with blood via the coronary arteries.

1.5. THE RESPIRATORY SYSTEM

Cavities of the body

The **diaphragm** divides the body into two cavities namely:

- **The thoracic cavity**, enclosed by the ribs, contains the heart, lungs, and part of the oesophagus and trachea.

- **The abdominal cavity** contains the stomach, intestines, liver, spleen, pancreas and kidneys. **The posterior** part of this cavity is called the **pelvic area** and contains the bladder and the uterus in the female.
-

Definitions:

- **Diaphragm:** A layer of muscle that separates the stomach from the chest and moves up and down when the animal breathes.

- **The Posterior part:** The part pertaining to the rear of the animal.

The respiratory organs

The respiratory organs supply oxygen and remove carbon dioxide from the blood. The following organs are involved: nasal cavity, turbinate bones, larynx, trachea, lungs (consisting of bronchi, bronchiole and alveoli), the ribs, the thoracic muscles and the diaphragm.
The section from the nose to the bronchi not only serves as airways but also have hair on the mucous membranes, which trap, dust particles, etc. The mucous membrane secretes mucus for taking up particles of dust. The airways also supply heat and moisture to incoming air. Like the arterioles the bronchiole can also constrict or expand thus controlling the inflow of air.

The bronchiole eventually forms alveoli (plural of alveolus). Alveoli are thin-walled structures surrounded by capillary blood vessels. Two very thin membranes thus separate the air in the alveoli from the blood and the exchange of gasses (oxygen and carbon dioxide) takes place through these membranes (see diagram below).

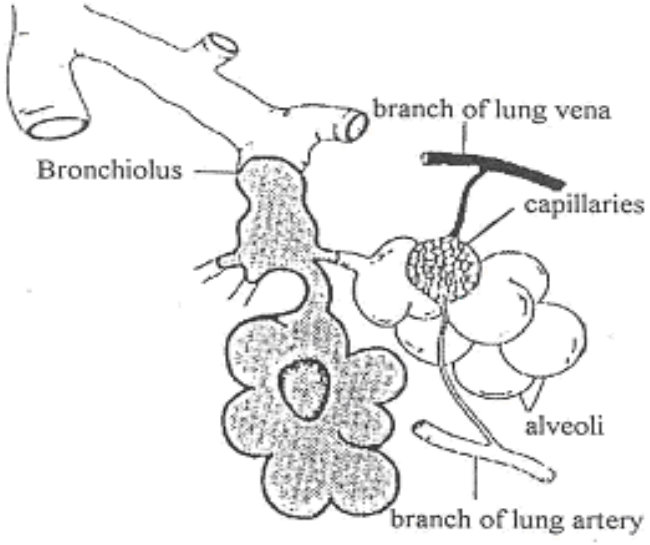


Figure 7: The bronchioli and alveoli of the lungs

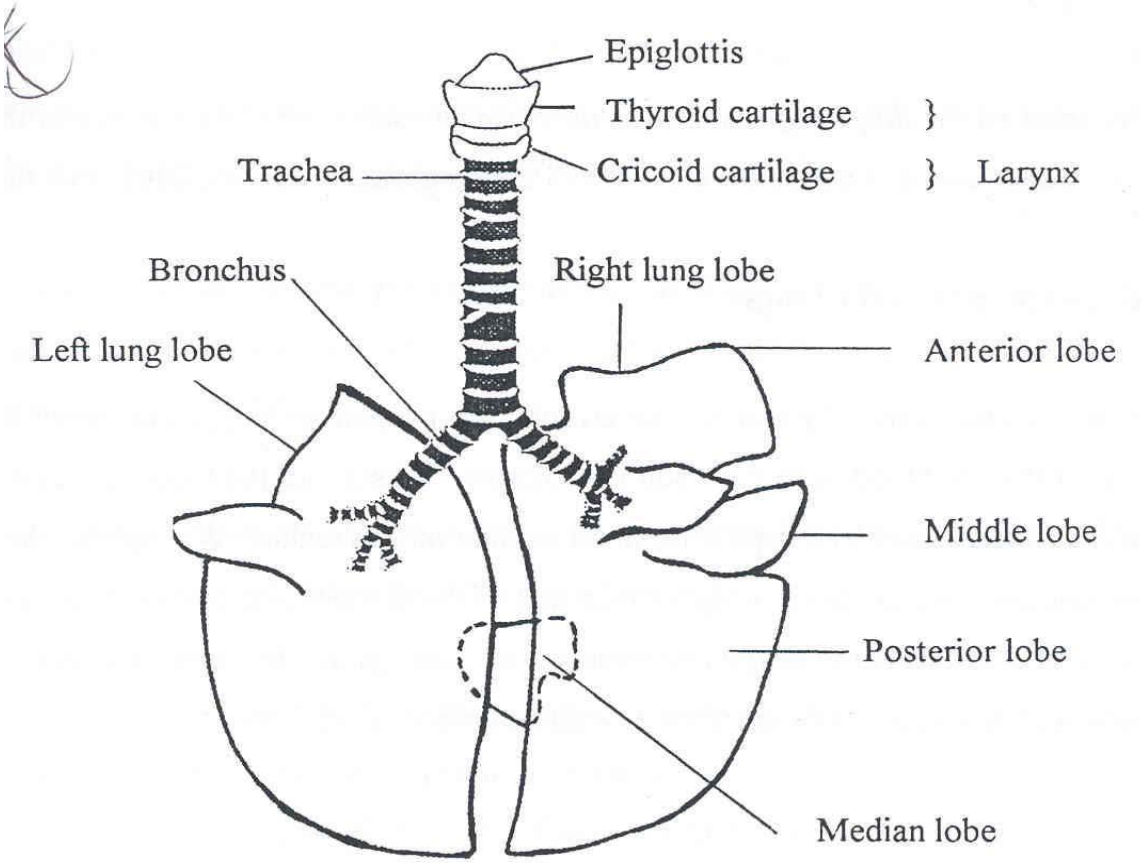


Figure 8: The lungs

The lungs are elastic organs, which hang in the thoracic cavity. They are divided into lobes, are spongy and soft, with a pink colour. When an animal is dead, the lung lobe on the lower side of the body will always be darker than the lobe lying above. Lungs of animals with severe pneumonia as well as the lungs of unborn animals sink when dropped into water. The thoracic cavity is an airtight compartment and when it enlarges a vacuum develops in the thoracic cavity.

The lungs are not closed but are in direct contact with the atmosphere through the airways. When the pressure in the thoracic cavity gets less than the atmospheric pressure (due to the enlargement of the cavity) the lungs will fill with as much air as their elasticity will allow. The chest cavity enlarges when the mussels between the ribs, pull the ribs forward. The diaphragm plays an important role in enlarging the thoracic cavity. It consists mainly of muscles and has a domed shaped form which projects into the thoracic cavity.

When the muscles of the diaphragm contract the dome flattens and the thoracic cavity enlarges. As soon as the diaphragm and the intercostals muscles relax, the volume of the chest cavity decreases and due to the elasticity of the lungs, air is now expelled from the lungs.

Definitions:

- **Mucous membrane:** Membrane that secretes a thick slimy liquid that protects the delicate tissues that line certain parts of the body of animals, for example, inside the nose.
- **Arterioles:** A minute arterial branch.
- **Bronchiole:** One of the finer (mm. or less) subdivisions of the branched bronchial tree of the lungs – having no cartilage plates.

1.6. THE DIGESTIVE SYSTEM

Types of digestive systems

Regarding the digestive system, the domestic animals are classified into two main groups:

- Monogastric ("one stomach")

  Monogastric (Non-ruminants) such as pigs, dogs and cats have a simple stomach, which can hold relatively little food, and they must therefore take in food in a concentrated form. The

digestive process is totally dependent on acids and enzymes. They do not however, have an enzyme which can digest cellulose, so this substance cannot be utilised by these animals.

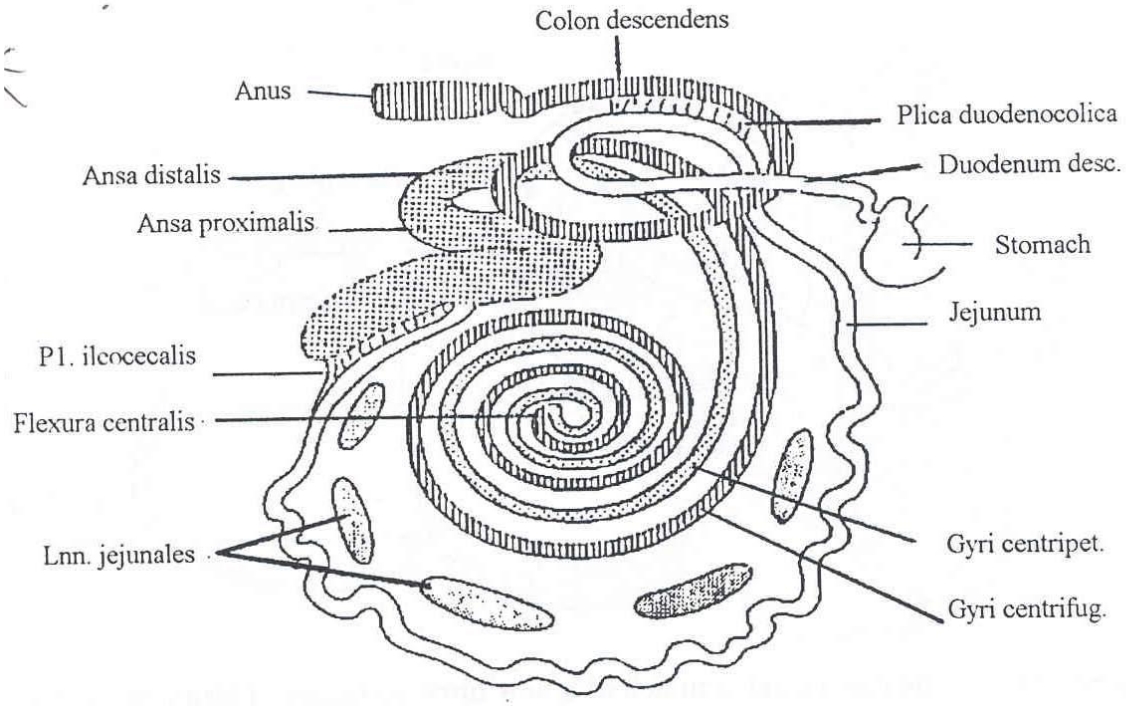


Figure 9: The stomach of a monograstric

- Herbivores

  Non-ruminants e.g., the equine family: The horse has a relatively small stomach, but its large intestine (caecum) can accommodate a large volume of food. Cellulose digestion takes place under the influence of micro-organisms in the caecum of the horse.
  Ruminants e.g., cattle and sheep: Food reaches the rumen where digestion takes place under the influence of micro-organisms. The nutritive value of grass is relatively low, so the herbivore is forced to take in large quantities of it. The end products of digestion by the micro-organisms are of great importance to these animals.

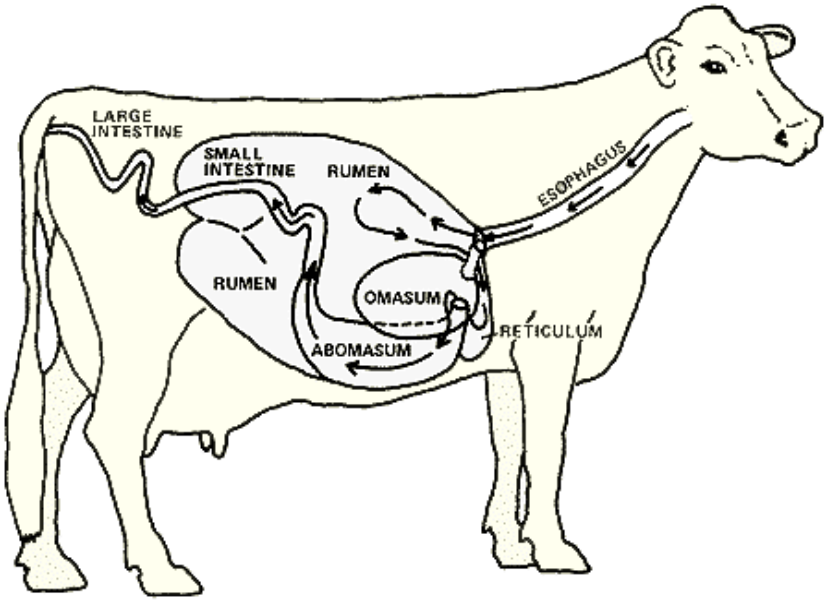


Figure 10: The digestive stomach and lower digestive tract of cattle

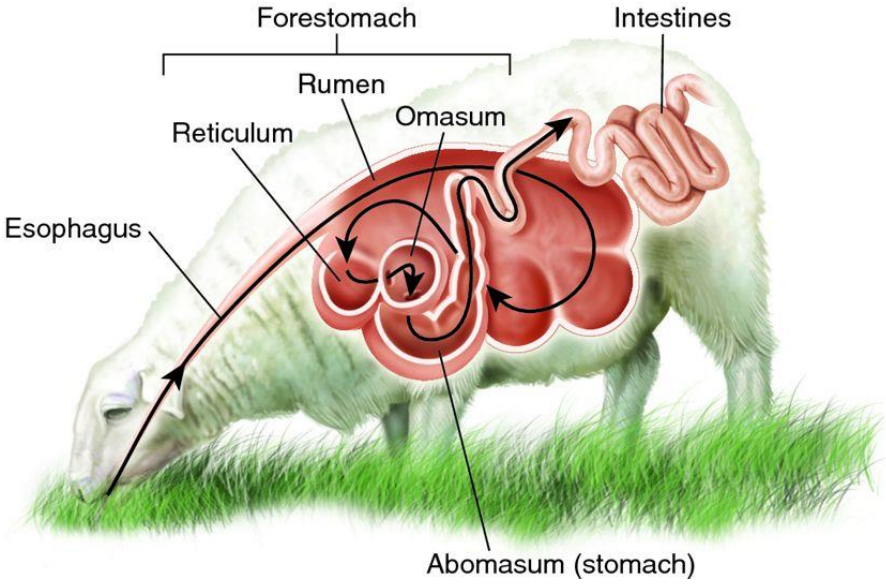


Figure 11: The digestive stomach and lower digestive tract of a sheep

The organs and structures of the digestive tract

Lips and tongue

- In Horses: The lips are strong, sensitive and mobile. During grazing the lips collect the grass, which is then cut by the incisor teeth. When feeding on concentrates the tongue is also utilised to collect the food.
- In Cattle: The lips have a very limited mobility. The tongue has hard protrusions pointing backwards on its dorsal surface. The tongue is curled around the grass and brought into the mouth where it is pressed against the dental pad by the incisors. The incisor teeth cut off the grass with a quick upward jerk of the head.
- In Sheep: Sheep have split upper lips, which make short grazing possible. The grass is taken between the incisors and dental plate and cut off with an upward jerk of the head. The upper lip of goats is not split but flexible to allow for browsing.

Teeth

The teeth are classified as follows:

- Incisors
- Canines
- Premolars
- Molars

The function of the incisors is to cut the food. In carnivores the canine teeth help to grip the food or to tear it off. The function of the molars and premolars is to chew food to a fine consistency. During grazing ruminants do not chew their food thoroughly but swallow it after a few cursory chews. Later, when chewing the cud (rumination), the molars and premolars are used.

The mastication of food is necessary to:

- Expose a greater surface of the food to digestive enzymes in the stomach and small intestine to improve digestion;
- To thoroughly soak it with saliva and thus facilitate swallowing.

By examining the teeth of an animal, the age (in years and/or months) can be determined. It cannot, however, be determined with absolute accuracy. Various changeable factors influence the eruption of both temporary and permanent teeth as well as the wear of the teeth. In general, the temporary deciduous incisor can be distinguished from the permanent incisors by the following.

Each temporary incisor has:

- A definite neck
- Is smaller, smoother and whiter
- Has various ridges and shallow grooves while the permanent incisors only have one or two clear grooves.

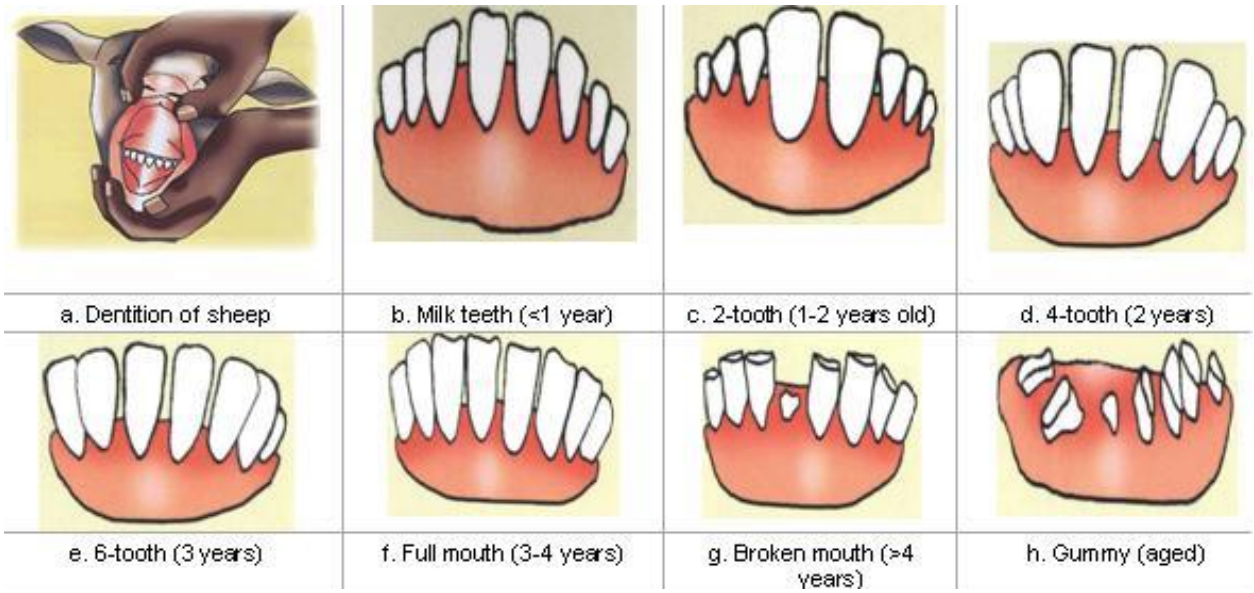


Figure 12: Dentation of Sheep

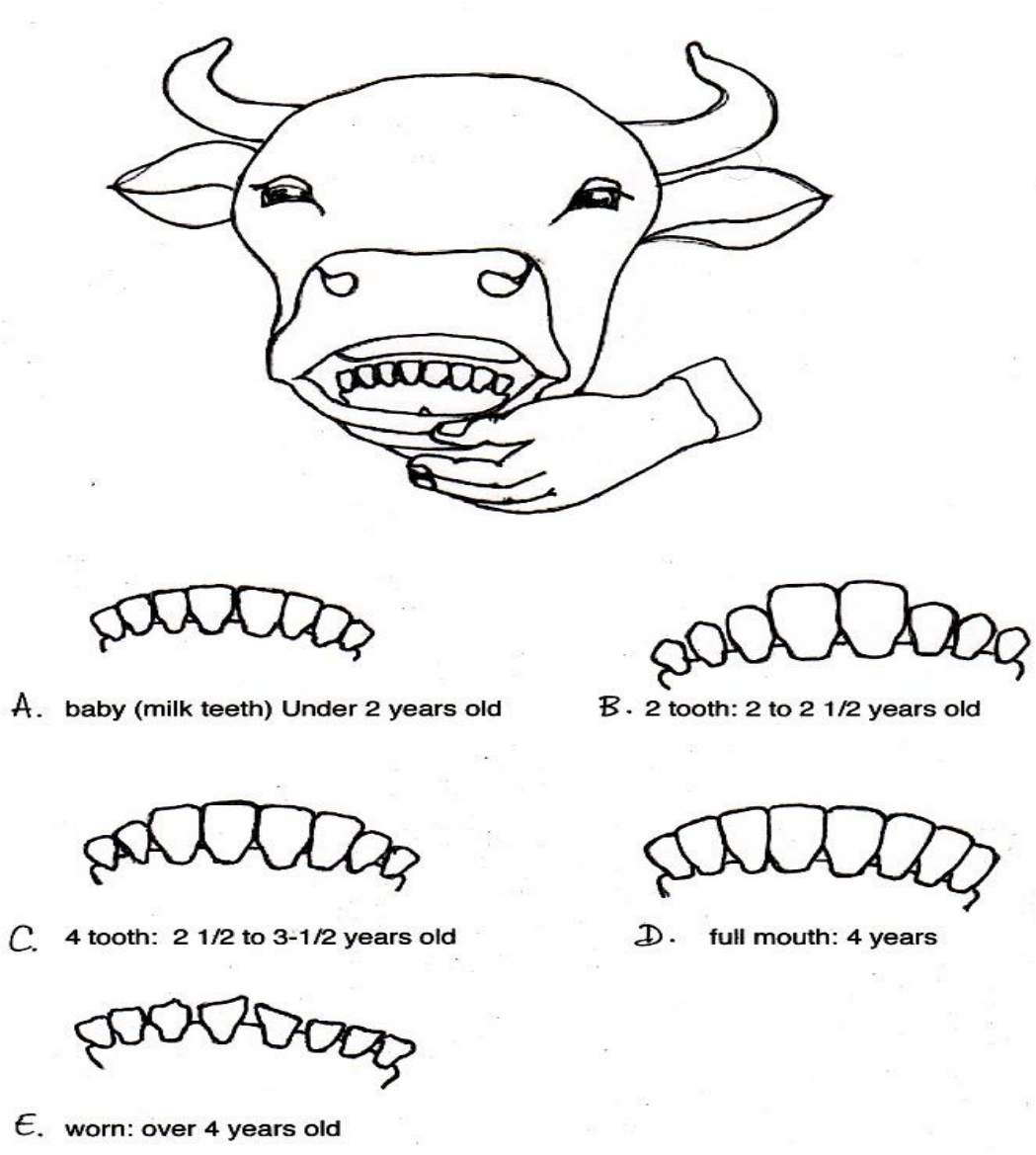


Figure 13: Dentation of Cattle

In the following table (**Table II),** the average age of teeth eruption in the various domestic animals is given.

Tooth	Horse	Cattle	Sheep, Goat	Pig	Dog
Di 1	Birth – 1 week	Before birth	Birth – 1 week	2-4 weeks	4-5 weeks
Di 2	4-6 weeks	Before birth	2 – 3 weeks	6-12 weeks	4-5 weeks
Di 3	6-9 months	Birth – 1 week	2 – 3 weeks	Before birth	5-6 weeks
Di 4	-	Birth – 2 weeks	3 – 4 weeks	-	-
I 1	2 ½ - 3 years	1,5 – 2 years	1 – 1,5 weeks	1 year	4-5 months
I 2	3 1/2 years	2- 2,5 years	1,5 – 2 years	16-20 months	4-5 months
I 3	4 1/2 years	3 years	2,5 – 3 years	-	-
I 4	-	3,5 – 4 years	3,5 – 4 years	-	-
Dc	Does not erupt	-	-	Before birth	3-4 weeks
C	3	-	-	6-10 months	5-6 months
Dp2	Birth – 2 weeks	Birth – 3 weeks	Birth – 4 weeks	5-7 weeks	4-6 weeks
Dp3	Birth – 2 weeks	Birth – 3 weeks	Birth – 4 weeks	1-4 weeks	4-6 weeks
Dp4	Birth – 2 weeks	Birth – 3 weeks	Birth – 4 weeks	1-4 weeks	6-8 weeks
P1	5-6 months	-	-	5 months	4-5 months
P2	2 ½ years	2 – 2,5 weeks	1,5 – 2 years	12 – 15 months	5-6 months
P4	4 years	2,5 – 3 years	1,5 – 2 years	12 - 15 months	5-6 months
M1	9-12 months	5 – 6 months	3 – 5 months	4 – 6 months	4-5 months
M2	2 years	1 – 1,5 years	9 – 12 months	8-12 months	5-6 months
M3	3 ½ - 4 years	2 – 2,5 years	1,5 – 2 years	18 – 20 months	6-7 months

Table II: The average age of teeth eruption in the various domestic animals

Key: Di = Deciduous incisor; I = Permanent incisor; Dc = Deciduous canine; C = Permanent canine; Dp = Deciduous premolar; P = Permanent premolar; M = Molar

Salivary glands

The salivary glands secrete the fluids, which mix with food during the mastication process, and this facilitates swallowing. Ruminants secrete large volumes of saliva (cattle approximately 55 litres per day). This saliva contains sodium bicarbonate which serves to neutralise the acids formed in the fore stomach. Saliva of humans and pigs contains the enzyme ptyalin, which breaks down carbohydrates to maltose. Because ptyalin is active only in an alkaline medium, its action is inhibited almost

immediately in the acid medium of the stomach. This enzyme thus has limited significance to digestion.

Oesophagus

The oesophagus connects the mouth cavity and stomach. It is a tubular structure lined on the inside by a mucous membrane, which again is surrounded by involuntary muscle.

Stomach

The stomach has two parts:

a. Simple stomach

The functions of the simple stomach are as follows:

- Digestive processes under acid conditions.
- Produces the "intrinsic factor" necessary for the absorption of vitamin B_{12} by the small intestine.

The stomach wall is lined with a membrane containing many small glands. These glands are responsible for the secretion of hydrochloric acid, which creates the acid conditions in the stomach. Other glands in the stomach wall secrete various digestive enzymes.

b. Compound stomach (ruminants)

In the stomach of the ruminant four definite compartments occur i.e. **the rumen, reticulum, omasum and abomasum**. The first three develop as evaginations of the oesophagus whilst the abomasum can be likened to a simple stomach. Secretions of the abomasum also resemble that of the simple stomach.

Definition:

- Evagination: An out pouching of a layer or part of (in this case the oesophagus).

Small intestine

The ducts of the pancreas and gall bladder open into the small intestine near the junction of the stomach and small intestine. The small intestine consists of the duodenum, jejunum and ileum and goes over the large intestine at the ileo-caecal valve. As a rule, the length of the small intestine is approximately 7 metres long. In ruminants the small intestine can be much longer between 25 to 28 meters in sheep.

Large intestine

Except in the horse, in which cellulose digestion takes place in the large intestine, water, which is necessary for the digestive processes, is absorbed here mainly in the caecum. The function of the last part of the large intestine i.e., the rectum is mainly to collect faeces before it is passed out through the anus.

The digestion of food in an animal with a simple stomach

<u>Digestion in the stomach</u>

In farm animals with a simple stomach, such as the pig and dog the following enzymes help with the digestion of food:

- Pepsin
  The cells of the mucosa of the stomach secrete the enzyme pepsin for protein digestion. Before pepsin can have any proteolytic effect, it has to be activated by the presence of hydrochloric acid. The activated pepsin then breaks down proteins to peptides. Food does not, however, stay in the stomach long enough for this process to be completed and enzymes in the small intestine has to complete this process.

- Lipase
  Only small quantities are found in the stomach juices. This is an enzyme which breaks down fats to fatty acids.

- Hydrochloric acid (HCl)
  Activates pepsin and rennin and curdles milk.

  <u>Digestion in the small intestine</u>

- Pancreatic juice

The following enzymes are the most important ones formed/produced by the pancreas:

- Trypsinogen
  This is changed to trypsin by enterokinase, which is secreted by the small intestine. Trypsin breaks down protein to peptides and amino acids. Before trypsin can react, the medium in which it is dissolved must be alkaline and the proteins must be digested to a certain stage.

- Pancreatic lipase
  This enzyme hydrolyses fats to fatty acids and glycerol. Most of the fat is absorbed in this form in the small intestine.

- Pancreatic amylase
  This breaks down carbohydrates to maltose. The presence of bile possibly improves the action of amylase.

- Intestinal juice
  Intestinal secretions also contain various enzymes, which, as is the case in the previous group, are responsible for the final steps in the digestion of:

    - Proteins and peptides to amino acids,
    - Compound sugars to glucose and fructose.

The digestion of food in a ruminant stomach

The digestion of milk in the newborn ruminant

- Rennin
  The enzyme rennin is found in the stomach juices of calves and possibly also in other young ruminants and causes milk to curdle. It is also activated by hydrochloric acid. In the newborn calf or lamb, digestion in the stomach is similar to that of the monogastric animal. By virtue of the oesophageal groove, milk consumed by-passes the rumen and reticulum and arrives directly in the abomasum. The milk is then coagulated by rennin and digested as in animals with a simple stomach. At the age of two weeks, calves and lambs will start to nibble and chew pieces of roughage. This intake of roughage is necessary for the development and functioning of the fore-stomachs i.e., rumen, reticulum and omasum.

Digestion of cellulose

After thorough mixing of the food in the rumen the cellulose is broken down by ruminal organisms to fatty acids. These organisms have an optimal activity and multiply only at a pH of 5, 0 to 7, and 0. The fatty acids that are produced, of which acetic acid and butyric acid are the most important, are inclined to increase acidity (lower pH) of the rumen, which would have an adverse effect on the micro-organisms. The sodium bicarbonate secreted by the salivary glands act as a protective agent by neutralizing the acids and keeping the pH constant. The fatty acids thus formed are then:

- Directly absorbed through the ruminal wall into the blood, or
- Moved down to the abomasum and small intestine to be absorbed there, or
- Taken up by the ruminal organisms themselves.

Small quantities of sugar (2 percent) stimulate a more effective digestion of cellulose. When too much sugar is present this process is inhibited because the organisms would rather attack sugar than cellulose. If enough proteins are present, however, up to 6 percent of sugar can be fed with good results (Usually in the form of molasses or bagasse – derivatives of sugar cane). Carbohydrates can be absorbed directly by the organisms to produce glycogen or can undergo fermentation by yeast cells, which are one of the types of ruminal micro-organisms. Gasses, especially carbon dioxide (CO_2), are formed by this process and they collect on top of the fluid layer in the rumen. The yeast cells synthesize vitamins such as vitamin B_1 (thiamine) and vitamin B_{12} so that these vitamins need not be included in ruminant rations.

Digestion of proteins

The micro-organisms in the rumen of the ruminant can make use of two sources of nitrogen to build up their body protein. They either use free nitrogen in the form of non-protein nitrogen or protein-nitrogen from their rations. Some micro-organisms can synthesise protein out of free nitrogen and build up their own systems with these proteins. The organisms are themselves later digested by the ruminant in the abomasum. The ruminant then utilizes the synthesized microbial protein to its own benefit. The ruminant cannot use nitrogen unless enough easily digestible sugar is available to convert it to protein. Therefore urea, which is a good source of non-protein nitrogen, can be used successfully under the right conditions. In the absence of enough sugar, however, urea is converted to ammonia, which is very poisonous. Sugar as such need not be present in the ration. The ruminant can produce its own sugars if enough carbohydrate is present. The appetite of the ruminant is

directly related to the activity of the ruminal microbes. Conditions, which might detrimentally affect these microbes, are:

- Sudden changes in the ration
- Lack of green feed
- Lack of water
- Changes in the pH of the rumen
- Poor quality feed e.g., during the winter
- Phosphate deficiency
- Dosing with antimicrobial drugs.

Luminal movements and the activity of ruminal organisms are also interdependent. If there are not enough active organisms in the rumen, the ruminal movements will cease (rumen stasis). This condition is commonly known as "dry gall sickness". Treatment for these conditions is:

- Sufficient water
- Acetic acid (vinegar) – to restore the pH of the rumen
- Sugar or glycerol – an energy source for the organisms
- Brewer's yeast – replacement of yeast cells in the rumen
- Fresh ruminal fluid can also be dosed

A simple preventative measure is to make any change in the diet gradually so that the micro-organisms can adapt to the changes.

Eructation

The oesophageal opening is not situated at the highest point in the rumen so that the surface of the fluid layer lies above this opening. During the eructation movement of the rumen, the reticulum relaxes to take a greater volume of fluid. The height of the fluid is thus lowered, and it allows gas to escape.

The Kidneys

The functions of the kidneys:

- The kidneys excrete substances, which are formed by metabolism, especially nitrogen- and sulphur-containing substances.
- Conserve the water equilibrium of the body, especially with respect to plasma volume.

- Regulate the acid-based equilibrium (pH) of the body by excretion of non-volatile acid and base radicals.
- Control blood pressure.
- Excrete poisonous substances and medicines, which had been taken in by animal.
- Form specific substances such as ammonia and hippuric acid.

The following diagrams show the cross-sectional structure of the kidney and its internal structure.

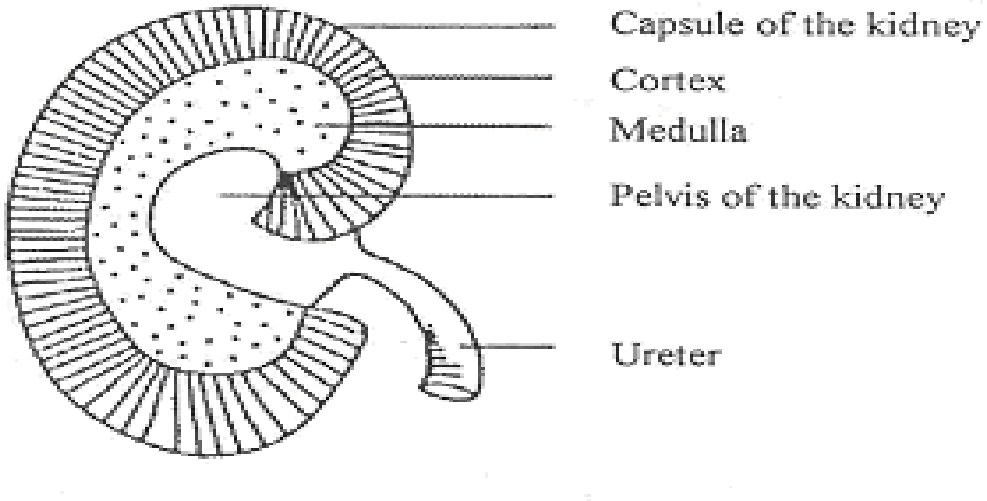


Figure 14: The structure of the kidney

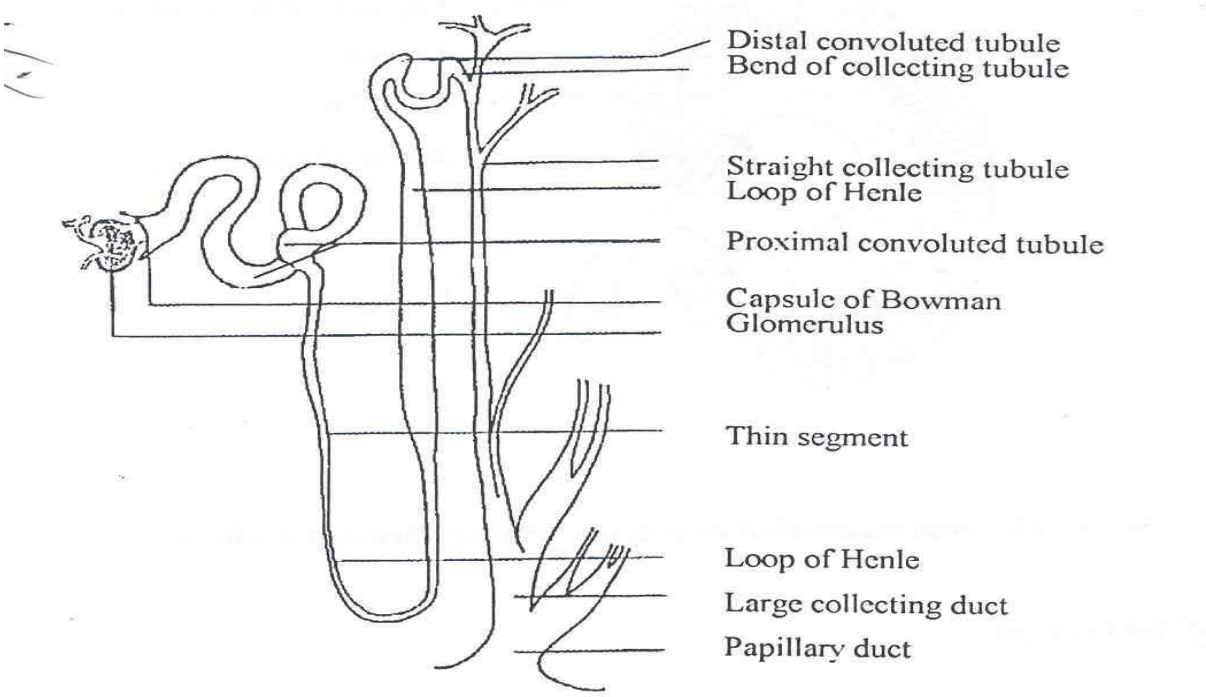


Figure 15: The microscopic structure of the kidney

The following could result from chronic kidney damage:

- Increase in the volume of urine
- Decrease in the concentration of urine
- Protein in the urine
- Presence of glucose and other substances in the urine
- Dehydration

Substances such as glucose can, however, be excreted in the absence of kidney damage e.g. in the case of diabetes mellitus in human beings. The reason for this is that blood glucose reaches such high levels that total resorption cannot take place. The urine produced, leaves the kidneys through the urethras. The urethras join the bladder, where urine is stored, until passed out through the single urethra.

1.7. THE ENDOCRINE SYSTEM

The endocrine system is a system of ductless glands, which secrete chemical substances, called hormones, directly into the blood system. Via the blood circulatory system, they meet the target organ(s) on which they have a specific effect. Hormones have the following general characteristics:

- They regulate reactions rather than initiating them
- They are effective in minimal quantities
- Their levels fluctuate according to demand

The latter characteristic is necessary for integrated systems, which handle the different requirements of growth, sexual differentiation, reproduction and adaptation to environmental changes.

The Hypothalamus and Pituitary

The pituitary (hypothesis) and hypothalamus are morphologically and functionally intimately associated. They represent the centre of highest co-ordination between the endocrine and nervous systems. The hypothalamus is the control centre for the autonomic nervous system whilst the pituitary controls the endocrine system. Together they form a functional unit.
Hypothalamus

The hypothalamus is part of the brain, which lies just below the thalamus, forming the floor of the third ventricle. Numerous releasing hormones or factors are produced by the hypothalamus. These factors are transported to the pituitary where they stimulate the pituitary cells to release their respective hormones into the blood stream. The hypothalamus has a two-way connection with the cerebral cortex. A close association thus exists between the nervous system (which affects rapid co-ordination) and the endocrine system, which is involved in the slower chemical co-ordination of the body.

The Pituitary (Hypothesis) gland
This small structure lies at the base of the brain and is connected to the hypothalamus by a small pedicle. The part of the pituitary that originates from the brain is called the posterior lobe (neurohypophysis) and the part originating from the upper palate is called the anterior lobe or adenohypophysis.

<u>Hormones of the anterior pituitary</u>

- Adreno-corticotropic hormone (ACTH)
  It is secreted by stimulus of the corticotrophin releasing factor (CT- RF) from the hypothalamus. Adreno-corticotropic hormone (ACTH) stimulates the secretion of corticosteroids by the adrenal cortex. On the other hand, corticosteroids inhibit the secretion of ACTH, a process called" negative feedback".

- Growth hormone (Somatotropin)
  Secretion is controlled by the growth hormone releasing factor (GH-RF) from the hypothalamus. The growth hormone controls the general growth of the body (especially the longitudinal growth of the long bones).

- Thyrotropic hormone (TTH)
  Secretion is controlled by thyrotropic releasing hormone (T-Rh). TTH stimulates growth of the thyroid gland. It controls the uptake of iodine by the thyroid and thus also the synthesis and release of the thyroid hormone.

- Follicle stimulating hormone (FSH)
  The releasing hormone from the hypothalamus again stimulates the release of FSH by the anterior pituitary. FSH stimulates the development of the Graafian follicle in the ovary of the female. Oestrogen, which is formed in the follicle, on the other hand, inhibits the secretion of FSH when a certain level is reached.

- Interstitial cell stimulating hormone (ICSH)
  ICSH stimulates the interstitial cells in the testis of the male to secrete testosterone (the male sex hormone).

- Luteinizing hormone (LH)
  LH-RH causes release of LH, which is responsible for ovulation in the female animal. Ovulation takes place as soon as a specific balance between oestrogen from the follicle and LH from the anterior pituitary is reached. After ovulation LH also plays a role in the development of the corpus luteum (Yellow body).

- Prolactin
  Prolactin is responsible for the maintenance of secretion of the corpus luteum and is also involved in lactation. In the male it stimulates the accessory sexual organs.

<u>Hormones of the posterior pituitary (Neurohypophysis)</u>

These hormones are formed in the brain and then transported to the posterior pituitary.

- Antidiuretic Hormone (ADH)
  Antidiuretic hormone decreases the volume of urine by increasing water resorption from the filtration solution in the kidney.

- Oxytocin
  This hormone acts on the mammary gland. It stimulates the flow of milk through its action on the myo-epithelial cells and smooth muscle fibres in the mammary gland – the so-called "let-down reflex". Oxytocin is released as soon as the udder of the cow is stimulated e.g. by the pre-milk washing of the udder. The effect of the hormone only lasts for a few minutes and the cow must therefore be milked as soon as possible, otherwise there is no proper "let-down" of milk. During parturition (birth) it causes contractions of the uterus muscles and in the act of mating, it aids in the transport of spermatozoa and the ovum. The reaction of oxytocin is inhibited by adrenalin (and thus fear or stress).

The Ductless Glands of the Body

Thyroid

The thyroid consists of two lobes, which are situated on both sides of the trachea, near the larynx. In most domestic animals the lobes are connected. The hormone of the thyroid contains large quantities of iodine, which is the active constituent in this case. The formation of the thyroid hormone is controlled by thyrotropic hormone (TTH), which is secreted by the pituitary. Thyroid hormone, in turn, inhibits the formation of thyrotropic hormone, and a balance is thus created between the two hormones in the blood stream.

With a deficiency of iodine in the body the formation of thyrotropic hormone is not inhibited, with the result that the continuous production of this hormone causes the thyroid to enlarge. This enlargement is known as goitre. Further symptoms of decreased production of thyroid hormone (or deficiency of iodine) are:

- Obesity – sugars cannot be metabolised fully
- Dwarfism – in young animals
- Hairlessness or loss of hair – in iodine-deficient areas piglets are often born hairless
- Lowered fertility
- Lowered milk production

Parathyroid

The parathyroid consists of two pairs of glands on, or very near, the thyroid glands. They are much smaller than the thyroids. Parathyroid hormone controls the uptake of calcium by the intestine and resorption of calcium from the bones, as well as the excretion of phosphorus in the blood stream. The parathyroid plays a very important role in high calcium intake in dairy cows before the birth of a calf. If the gland's reaction is lazy, the blood-calcium levels will fall when milk secretion starts, and the cow can get milk fever.

Adrenals

The adrenals lie close to and at the cranial poles of the kidneys. Anatomically a cortex and medulla can be distinguished. Both these areas secrete different hormones.

- Cortex

  Under the influence of ACTH from the pituitary gland a series of hormones are formed. The following are the most important:

  - Mineral corticoid

    Controls Na: K balance in the blood and the fluid balance in the body. Loss of minerals through impaired function of the adrenal cortex causes more water to be excreted by the body with resultant dehydration.
  - Gluco corticoids

    Essential for the control of glucose metabolism (energy) and exert an anti-inflammatory effect.

- Medulla

  The hormone adrenalin is produced by the medulla and is responsible for:

  - Increased heart rate. More work is done by the cardiac muscles than normal.
  - Dilation of the blood vessels of the heart. As a result of the increase in the heart rate and with more forceful contractions a better blood supply is essential.
  - Increase in blood pressure. More blood per time unit is forced through the lungs to increase the rate of gas-exchange.
  - Increased respiration rate.
  - Constriction of blood vessels of the muscles.
  - Dilation of the blood vessels of the muscles.
  - Mucous- and salivary secretion decreases.
  - Increase in blood sugar because more energy is used.

All the above prepare the body for action – the so-called "fight-or-flight" reaction.

Pancreas

In addition to the pancreatic enzymes, which are secreted via the pancreatic ducts into the small intestine, this organ also secretes the hormones **insulin** and **glucagon.** Impairment in the secretion of insulin causes diabetes mellitus. In this case an increase in blood sugar is present, the reason being that **permeability** of cell walls to blood sugar decreases in the absence of insulin, so that blood sugar cannot be made available to the tissues. Notwithstanding the fact that kidneys normally reabsorb 100 percent of the glucose in the urine, the blood sugar is so high that the kidneys are not capable of resorbing all the glucose, leading to the excretion of glucose in the urine. Glucagon opposes the action of insulin by raising blood glucose levels.

Definition:

- **Permeability:** The ability of the cell membrane to transport molecules through.

Ovary

The ovaries are the female reproductive organs that produce ova from the Graafian follicles. A Graafian follicle produces oestrogen. Apart from its role in ovulation (production of ovum) it also causes oestrus.

Testis

The testis is the male organ that produces the hormone testosterone and sperm cells. Testosterone is responsible for the development of the secondary male characteristics in the male animal and stimulates the sexual drive.

Thymus

The thymus is involved in the immune system of the body.

Pineal body

The pineal body regulates the sexual activity of seasonal breeders like sheep and horses. The onset of decreasing day length in autumn stimulates ewes to start cycling. The opposite is true for mares, where increased day length in spring starts the mare cycling.

1.8. THE REPRODUCTIVE SYSTEM

The female reproductive system

The female reproductive system consists of the vulva, vagina, cervix, uterus, fallopian tubes and the ovaries.

Vulva

The cleft like opening on the female reproductive system situated just beneath the anus.

Vagina

Continuous with the vulva and lies in the pelvic cavity. The last part of the large intestine (rectum) lies dorsal to it while the urinary bladder lies immediately ventral to it. There is no definite line of demarcation between the vulva and vagina.

Cervix

The cervix is the connection between the vagina and the uterus. The cervix is thick walled with a narrow tortuous lumen. In the pregnant animal it is sealed off by a mucous plug.

Uterus

The uterus consists of a body of varying length between species, and two uterine horns. The horns are attached to the pelvis by the broad ligaments. On the inside of the horns of the uteri of ruminants, the caruncles are found. Normally they are about the size of a pea, but during pregnancy they enlarge and then have a spongy appearance. These are the sites of attachment between the uterus and the placenta.

Fallopian tubes

The Fallopian tubes, which transport the fertilised ovum and where fertilisation takes place, are anterior extensions of the uterine horns. At the anterior end of the Fallopian tubes the ovaries are found. The free end of the tubes is funnel shaped, the so-called infundibula, which enfolds the ovary at ovulation.

Ovaries

Each female animal has two of these organs, which produce ova. The Graafian follicle containing the ovum is formed in the ovary. When ovulation takes place, the ovum is collected by the infundibulum

and moves through the Fallopian tube in the direction of the uterus. Inside the Fallopian tube the ovum is fertilised by the sperm cells and then moves on into the uterus where it develops into the embryo, later on becoming a foetus.

Oestrus cycle

The oestrus cycle of the female animal starts at puberty and is associated with distinct physiological changes. These changes, which occur rhythmically during the sexually active season is the only time that the female is fertile.

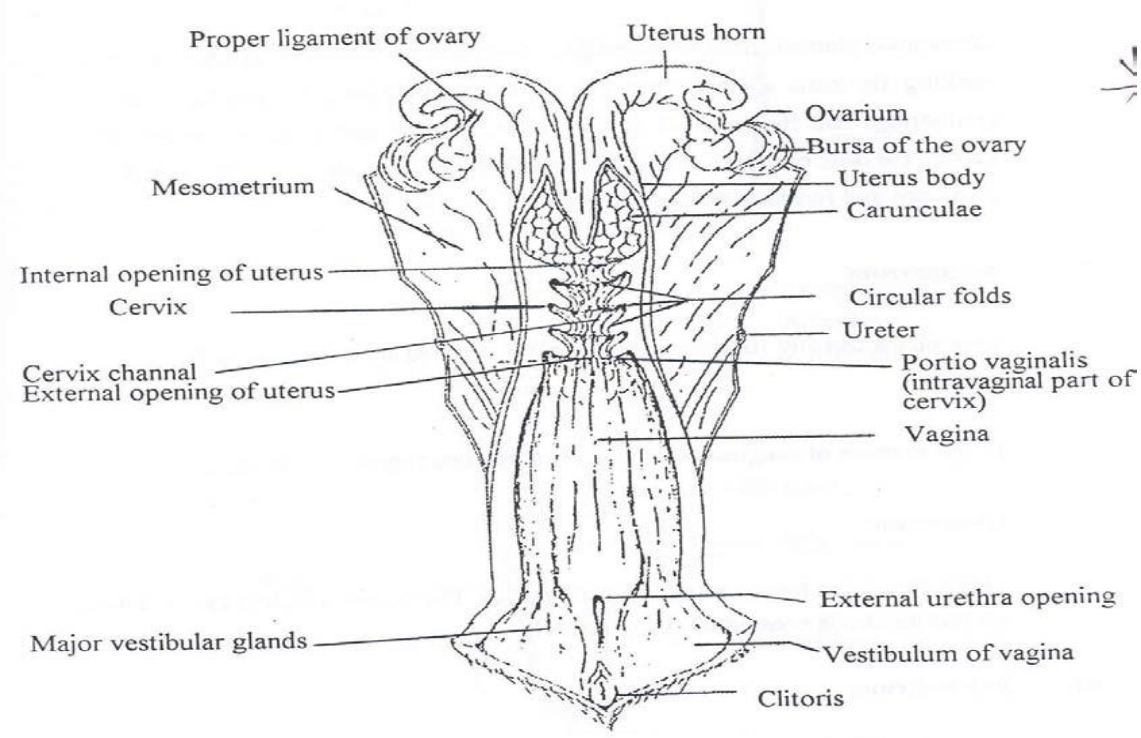


Figure 16: The structure of the female reproductive system

The mammary gland (Udder)

Anatomically the mammary gland is a gland of the skin. In the following discussions the udder of the cow will be used as example. The bovine udder consists of four milk glands or quarters. Each quarter is a separate unit with its own duct system, teat cistern and teat. Where the teat canal goes over into the teat cistern there are a series of four to eight radial folds in the mucous membrane. In the mucous membrane of the teat cistern there are numerous irregular circular and longitudinal folds. The openings of the teats are held closed by a sphincter of smooth muscle and elastic fibres. Basically the udder of the cow differs from that of other domestic animals as follows:

Anatomical characteristic	Cow	Sheep Goat	Mare	Sow	Bitch
Number of functional teats	4	2	2	10-14	8-12
Number of teat openings per teat	1	1	2-3	2	18-20

The following hormones have a direct or indirect influence on the development of the mammary gland:

- Thyrotrophic hormone, Growth hormone, ACTH, FSH, LH, and prolactin.
- From the posterior pituitary:
    - Oxytocin from the hypothalamus via the posterior pituitary plays a very important role in the "let-down" of milk by causing contraction of the smooth muscles and myo-epithelial cells of the mammary gland.
    - Oestrogen from the Graafian follicle also plays an important role in the development of the mammary gland.

The constituents of the milk are produced directly or indirectly from the blood. Although the osmotic pressure of milk and blood is the same, the constituents of these two fluids differ greatly. Milk contains more sugar, lipids, calcium, phosphorus, and potassium, but less proteins, sodium and chloride. The proteins in milk are mainly casein (with small quantities of albumins and globulins), while albumins and globulins are the most important proteins in blood. The components of colostrum also differ from that of milk. In most animals colostrum is the medium by which antibodies are transmitted from the mother to the newborn offspring.

The male reproductive system

The male reproductive system consists of the testis, epididymis, vas deferens, ampullae's, urethra, penis and accessory sex glands.

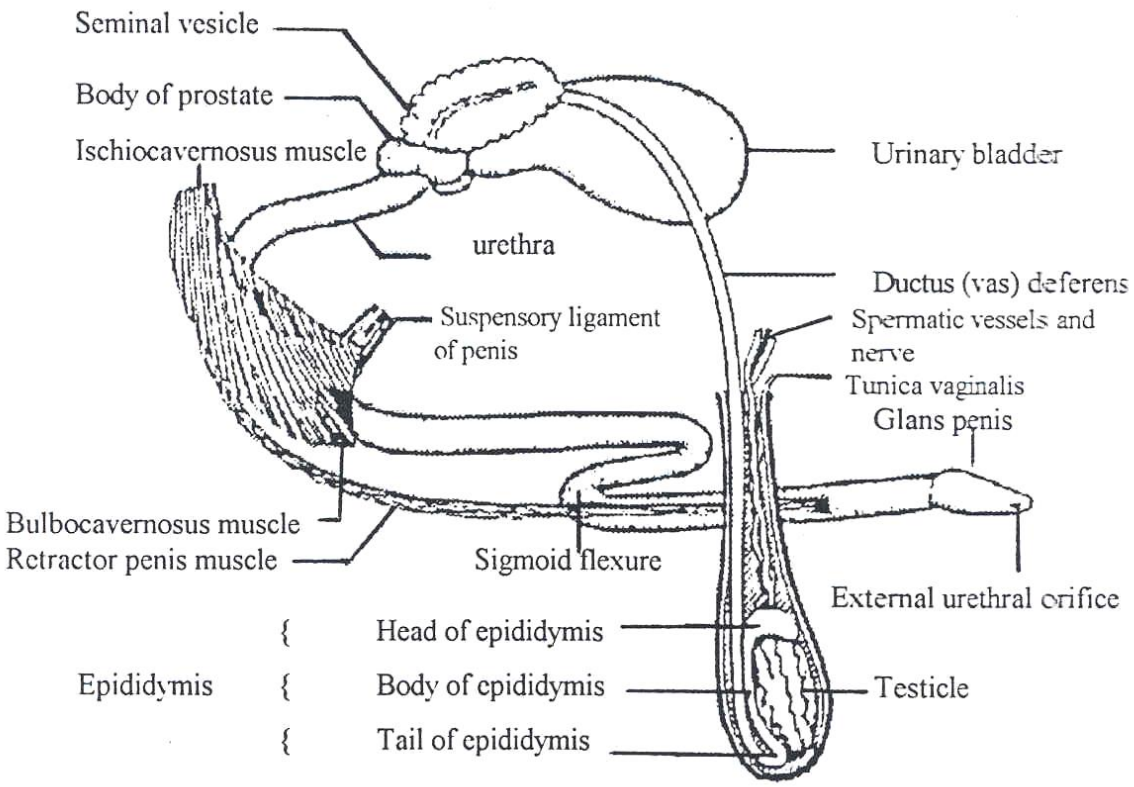


Figure 17: The structure of the male reproductive system

Testis

The testes (two in normal males) are enclosed in the scrotum. The testis itself is oval shaped and the left and right testes are not always of exactly the same size. Most of the testis is made up of fine tubules in whose walls the spermatozoa are formed. By merging, the tubules become larger and eventually form the epididymis. Spermatozoa undergo their final maturation process in the epididymis and are also stored there.

Epididymis

The epididymus is joined to each testis and consists of a head, body and tail. The head is attached to the dorsal part of the testis. The body, a continuation of the head, goes over into the tail, which lies at the base of the testis.

Vas deferens

The vas deferens are paired ducts that carry semen from the tail of the epididymis, via the spermatic cord, to the ampullae's in the pelvic cavity.

Ampullae's

Basically these are thickenings of the last part of the vas deferens. Like the vas deferens, the function of the ampullae's is to transport semen, to store semen and to secrete spermatic fluid. They contract forcefully to expel the semen during ejaculation. The ampullae's lie on top of the urinary bladder and open into the urethra.

Urethra

This single duct starts at the bladder and continues right through the length of the penis. In the male it transports both semen and urine.

The penis

The male sexual organ used for mating. It lies in an invagination of the skin called the sheath. The penis of a ruminant consists of strong connective and elastic tissue and has a characteristic sigmoid flexure. The penis of the horse is spongier. The tip of the penis is called the glans penis.

Spermatic cord

Consists of the cremaster muscles, blood vessels, nerves and vas deferens. The cavity of the scrotal sac is continuous with the abdominal cavity. A network of closely apposed blood vessels cools down the blood going to the testes. This is necessary because spermatogenesis occurs optimally at temperatures approximately 4 degrees Celsius below body temperature.

Definition:

Apposed: Blood vessels packed next to one another to form a cooling network

Accessory sex glands

The functions of these glands are to give volume to the semen and supply nutrients and protection to the spermatozoa. They include the seminal vesicles, prostate and the bulbo-urethral glands.

2. ANIMAL PRODCUTION AND ANATOMY

Knowledge of the anatomy and physiology of the farm animal will allow the farmer to recognise when animals are not doing well. It must be remembered that the farmer who spends a lot of time with his animals will know their habits and appearance better and will be able to spot any unusual behaviour or anatomical differences, which could possibly indicate a sick animal. In a natural, undisturbed state, some animals will usually be eating, some will be lying and chewing their cud, some will be sleeping, but if one or more are lying in a corner of the field, kicking and struggling, you can be sure that they are in some sort of trouble. If a couple of goats lag, the rest of the group while herding them to a new camp, a closer look should be taken at the slower ones. It is important to know the big picture here, because heavily pregnant animals have a tendency of lagging and that is normal.

- Compare the sick animal to the rest of the group – are the others in the same state as it or not. If one animal is in a poorer condition than the others, there may be a problem.
- Consider the conditions under which the animals are managed. What have they been eating? What season is it? How old are they? Are they pregnant? Are they nursing young?
- Animals are just as susceptible to external factors as humans.

There are some situations which lend themselves to the identification of a sick animal in your flock, e.g.

- Observing the flock in an undisturbed state
- While herding the animals
- During the regular inspections in the crush

2.1. CHARACTERISTICS OF GOOD BREED MATERIAL

Condition scoring is done to see if cattle are healthy enough for breeding and production – or if stockmen suspect that animals are sick.

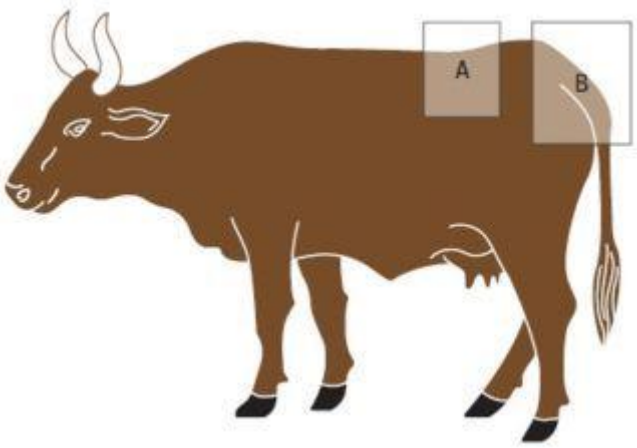


Figure 1: Fat under skin

Scoring cattle condition

1 = too thin

2 = thin, but healthy

3 = ideal condition

4 = fat

5 = too fat

Checking and scoring the condition of cattle is not difficult but requires some experience. First feel the amounts of fat under the skin in the areas marked A and B in **Figure 1:** A is the loin area between the hip bone and the last rib. B is the area around the tail head.

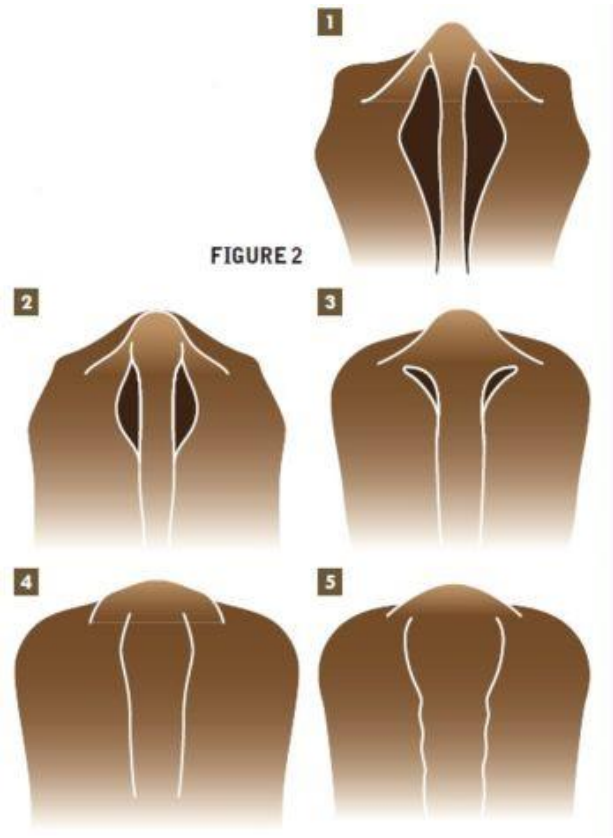


Figure 2: *shows the five possible conditions*

Remember, animals that are too fat can have problems with breeding and calving. A condition score of 3 is ideal, but the score shouldn't drop below 2.

Condition scoring for sheep

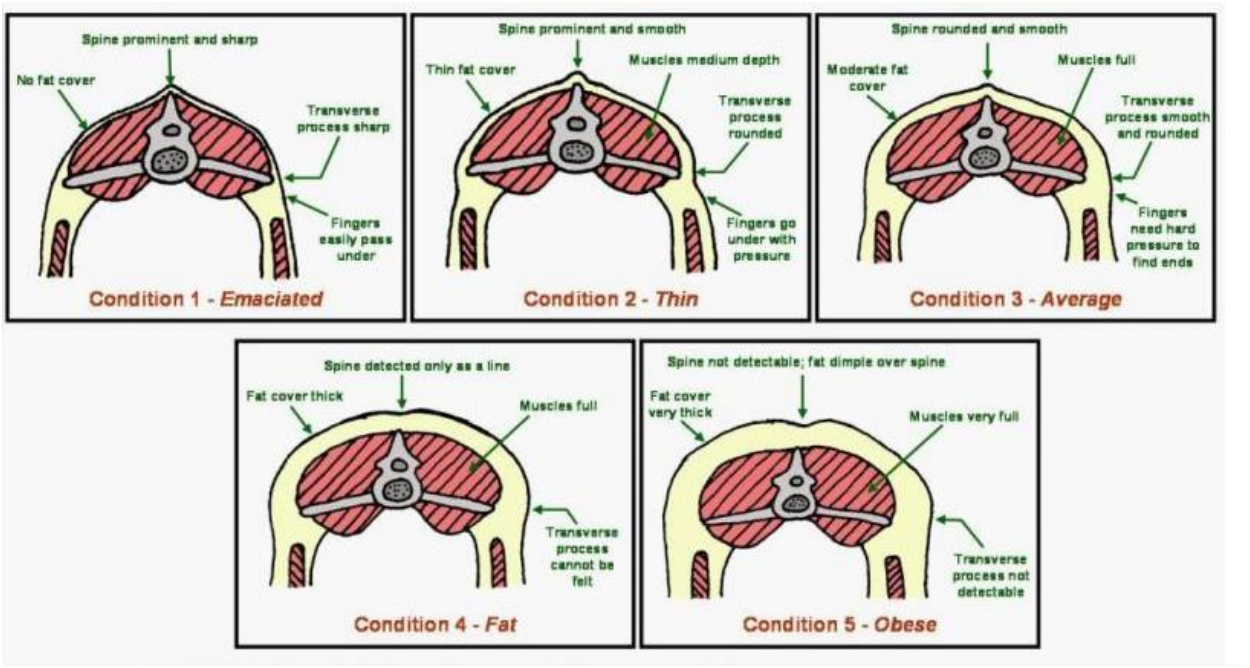


Figure 3: Condition

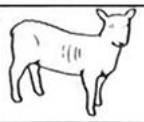
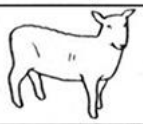
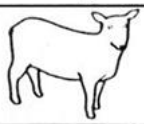
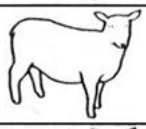
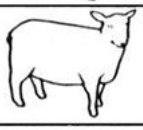
Score		Description	
1		Spine sharp, back muscle shallow,	Lean
2		Spine sharp, back muscle full, no fat	
3		Spine can be felt, back muscle full, some fat cover	Good Condition
4		Spine barley felt, muscle very full, thick fat cover	Fat
5		Spine impossible to feel, very thick fat cover, fat deposits over tail and rump	

Figure 4: Scoring

2.2. MONITORING AND EVALUATING THE ANATOMY OF AN ANIMAL

An examination of an under-performing animal should be done systematically and thoroughly, e.g. from top to bottom, and then from left to right.

1. Look at the head of the animal. Does it have a nasal discharge? Are its eyes clear and alert? Are there cuts or injuries? Are there any swellings? Is the head held normally, or drooping or bent down? Are the eyes bright, clear, and shiny, or are they red, opaque, or weeping? Are the ears alert or drooping? Is there frothing at the mouth or an excess of saliva? Are the mucous membranes around the eye pale, yellow, blue, or dark red?
2. Examine the animal's neck. Are there any abscesses? Is there a swelling (oedema) under the jaw? Open wounds? Are the lymph nodes swollen?
3. The back. Is the back level and sturdy? Does it sag excessively? Is the coat in good condition? Shiny or dull? Does the animal have dandruff? Are there mites or lice? Are there bite marks or lick marks on the coat? Are there patches of hair missing? Is the skin loose or tight, soft or hard?
4. Rump. Are the hipbones sticking out excessively? Do a condition scoring.
5. Shoulder. Are there any cuts, bruises, etc?
6. Ribcage. Are the ribs well covered with flesh? Are they moving rapidly, shallowly, and hardly at all?
7. Rumen and intestines. Can you hear any rumen movement (gurgles)? When you palpate the rumen is it hard, or floppy? Is the rumen bloated?
8. Reproductive organs (male and female). Check for ticks around all reproductive organs. If a female: is there a vaginal discharge? Is the vulva swollen and red? Is the ewe in pain when she urinates? If a male: are the testicles the same size? Is the penis normal, does it have sores? Is the prepuce infected?
9. Front limbs. Are the legs stiff? Is the animal lame?
10. Hind limbs. Are the legs stiff? Is the animal lame?
11. Hooves. Are they the right length? Are there any ticks between the hooves? Does the animal have any infections between the hooves?
12. Is the animal by itself, or with the rest of the herd/flock? Is it alert, or dull and unresponsive? Is it breathing normally? Is it coughing? Is it shivering? Is it eating and drinking normally? Is it ruminating normally?

13. Is it standing up or lying down? Is it lying normally?
14. Examine the faeces and urine. Are the faeces normal or abnormal (is there diarrhoea, mucous or blood)? Is the urine pale yellow, brown or red? Does the animal strain to pass urine or faeces?
15. Recognise pain in the animal. Is the animal bellowing or bleating? Is the animal restless? Does it grind its teeth? Is it grunting? Is it licking a lot? Is it kicking itself, if so, where?
16. What to look for in lactating animals. Are either or both teats inflamed, swollen, and tender? Are the teats injured? Does the milk contain milk clots? Is the milk blood-stained? Has the milk yield fallen?

1A. <u>Individual Formative Exercise</u>:

Before you can complete Formative exercise 1B you need to attend the seminar on Abnormal anatomical systems and read through annexure A and B of this learner guide.

1B. <u>Individual Formative Exercise</u>:

Unit 2

Animal Health systems

Unit Standard	
116393	**Animal Health**

Specific Outcomes

SO1: Evaluate the health of animals.

SO2: Develop, implement and maintain animal disease prevention and management procedures.

SO3: Develop, implement and maintain disease treatment and management procedures.

SO4: Assist with the development of animal disease prevention and treatment and production systems.

Learning Outcomes

By the end of this unit, you will demonstrate an understanding of:

- The evaluation of the health status of animals
- Procedures to maintain animal desease prevention programmes

Identifying	Communicating	Contributing
Working	Demonstrating	Science
Organise	Collecting	

1. INSPECT, IDENTIFY AND REPORT ABNORMAL BEHAVIOUR

1.1. THE ABILITY TO OBSERVE INDIVIDUAL ANIMALS

This is a technique that requires a lot of practise and dedication on the side of the observer. The better the observation is the better the management of the animals. Good observations may eliminate injuries and losses due to poor management.

Access: The observer must have access to a good viewpoint to observe the animals in question. The layout of the confining area must enable the worker to reach the whole area where animals roam. Stock pens and feedlots must not be too overstocked as this will prevent observation of individual animals.

Knowledge: If the person that is doing the observation don't have knowledge of the normal healthy behaviour of the specific animals in question it will be impossible to identify individual animals that express abnormal behaviour.

1.2. EXAMPLES OF ABNORMAL BEHAVIOUR

When dogs become aggressive the hair on the back of their necks and backs rise up. Stallions prick (lift up) their ears and wag their tails. Bulls buck and rams paw the ground with their front feet. Birds and reptiles puff themselves up to look larger than they really are.

Although house pets such as dogs and cats can be very calm and friendly to their masters and friends, they will change their behavior when a newborn litter arrives.

In this case special attention must be given to their behavior as they may sense a threat to their young when suddenly approached. Look out for their warning signals like a grunt or hiss to tell you to back off. In a farm situation, it is necessary to report defensive behavior to the supervisor. Sometimes animals can act defensively for other reasons than the obvious.

Animals can exhibit discomfort in different ways when exposed or kept under stressful and unfavorable conditions. Some of these symptoms can be:

- **Pacing and route tracing**: This happens when animals are kept in a confinement, such as a cage. For example, hens kept in a cage pace because they do not have access to a social environment.
- **Rocking, swaying, and weaving:** This kind of behaviour shows boredom in animals.
- **Rubbing:** Animals such as pigs can start rubbing their heads, or even bang their heads, leading to injuries when restricted in a narrow single sty.
- **Pawing or stall kicking:** When horses are frustrated because of not getting food they will start pawing which can lead to leg injuries.
- **Headshaking and nodding**: Caged domestic fowls or caged birds can start showing this kind of behaviour when their movement are retained. They are unable to escape and obviously they get frustrated.
- **Eye-rolling:** Is shown by calves in pens**.**
- **Sham-chewing:** This behaviour, typical to pigs when no litter or leavings are available for scrounging. (Pigs chew even if there is no feed in the mouth.)
- **Licking or crib wetting:** An animal repeatedly licking its own body, can lead to the abrasion of the tongue. This condition is caused by inadequate food.
- **Drinker pressing:** Caused by boredom. The animal tries to reduce boredom by pressing the drinker repeatedly without drinking the water.
- **Feather pecking:** Often seen in poultry due to social dominance in intensive husbandry caused by poor ventilation, high temperatures, low humidity, excessive population density and insufficient space.

You have thus learnt that animals have different ways of showing discomfort, and animals have different ways of acting defensively. Now, how should you respond to bring defensive behaviour under control?

1.3. IDENTIFY INDIVIDUAL ANIMAL WITH ABNORMAL BEHAVIOUR

When an observer is familiar with the normal behaviour of animals he will be able to identify individuals that behave differently from the group or differently from the norm of the species.

If an animal behaves abnormally, care must be taken to further access the cause thereof. Take care when approaching such an animal because it might be defensive or aggressive. Abnormal behaviour is most commonly caused by:

- **Competition**: When animals are kept in a restricted area they will compete for food and space. This may cause an injury that in return will lead to the abnormal loss of weight.

- **Territory**: Most male farm animals are territorial and will fight for grazing- and breeding rights within their individual areas. It is not the behaviour of the animal that is abnormal when competing, but the secondary effects like injury, malnutrition and abnormally high levels of aggression and defensive behaviour.

Nutrition: In modern commercial farming, farm animals are subjected to artificial foodstuffs that enhance their production performance such as growth hormones and high energy level feedstuffs. Unfortunately, they also have access to materials like plastic and wire that might cause harm their health and behaviour. Poorly managed animals can develop digestive problems caused by an incorrect ration, (the hay-artificial feed ratio.) which results in abnormal behaviour.

➢ **Abnormal behaviour that might be as a result of disease**

Some diseases cause a lot of discomfort in the animal affected. The following are a few examples and behaviour patterns are typical for the disease (Table 1).

Table 1: Behaviour pattern typical to a disease

Behaviour pattern	Animal	Diseases
*Lethargy	Cattle	Gall sickness Heart water Red water
	Horses	Biliary fever
Moving in circles	Cattle	Tzaneen disease
Increased rate of respiration and coughing	Sheep, goats, cattle	Pasteurellosis
Stiffness in the masticator muscle or hind legs spreading to cause spastic contractions of the voluntary muscles of the whole body	All farm animals	Tetanus
Total or Partial Paralysis	All farm animals	Botulism Paralyses tic byte
Abnormal tame or aggressive	All farm animals	Rabies
Kicking to abdomen Looking at flank of the body. Rolling	Horses	Colic
Lack of appetite	All farm animals	Most tick bites Diseases Stomach disorders and tropical diseases, which manifest with fever.

Definition

Lethargy: A feeling that individual has no energy and do not want to do anything

There are many diseases that may have similar symptoms, but this is to name a few important diseases that may occur often and need attention.

When one of the above-mentioned behaviour patterns are observed, one must report it to the supervisor. Describe the behaviour thoroughly and identify the animal to him/her.

It is also important to move the animal to a restraining area where the proper basic procedures can be administrated under supervision.

An example of crush pens and clamps that are designed to handle cattle:

1.4. SUPERVISE MOVEMENT OF ANIMALS

There are a few concepts to understand before moving animals on the farm.

- Most farm animals find security and feel safe within a group. Therefore, it is important not to move individual animals as this will make the animal feel vulnerable and stressed and the animal could become aggressive and defensive. Rather try to move a number of animals to the restraining area and after restraining the specific individual you can return the rest to the herd or wait for the procedure on the individual to be completed.

- Most farm animals will try to flee (run away) as their first mean of defence. Therefore, live stock such as goats, sheep and cattle when moved from one area to the next by man on foot, sheep & cattle dogs or on horseback, must always be done in a relaxed manner because if animals are exposed to too much noise they will became unmanageable and this could result in losses.

- When approaching animals, it must be done from an angle as shown below.

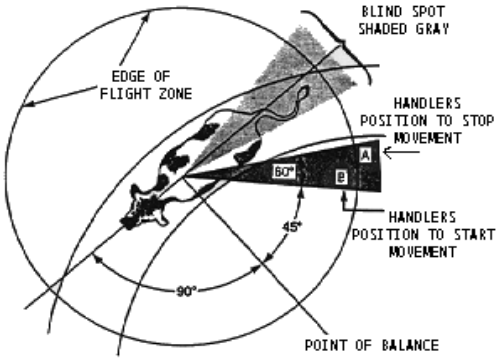


Figure 1

This diagram illustrates the general flight zone of an animal. The actual flight zone of an individual animal will vary depending on how "tame" or calm the animal is. The flight zone gets bigger when an animal becomes excited or when approached "head on" (from the front).

It is much easier to move calmed down cattle. If cattle become excited, it takes 20 to 30 minutes for them to calm down.

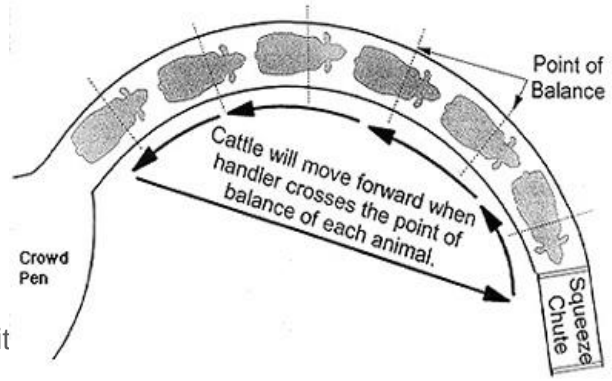


Figure 2

The handler's movement pattern to keep cattle moving towards the squeeze chute in a curved crush system.

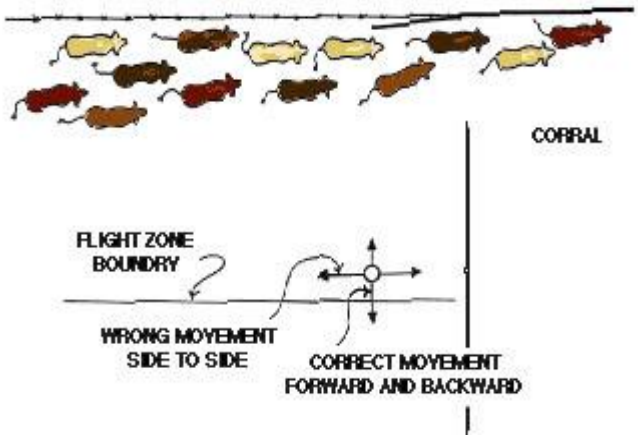


Figure 3

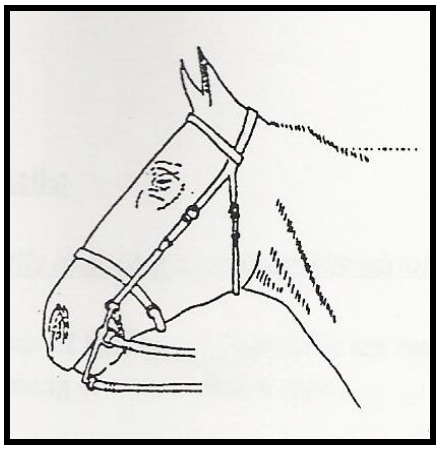
Using the principles of flight zone behaviour, a handler is able to move cattle into a pen in a calm and orderly way. Using the positions shown on this diagram will enable the handler to control the flow of cattle through the gate. Cattle movement can be slowed down or speeded up by moving forward or backward.

1.5. RESTRAIN ANIMALS

1.5.1. Restrain individual animals

➢ **Physical restraint of the animal**

- Halters can be used on horses, cattle and sheep etc. but only relatively tame animals should be restrained in this way



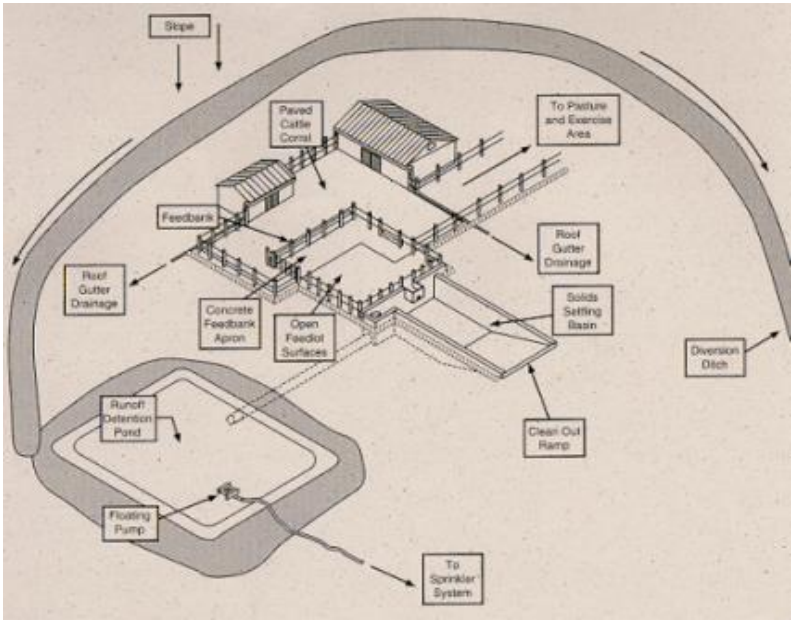
A bridle is used to handle a horse

Example of crush pens and clamps that are designed to handle cattle.

Crush pens can be used to handle strong large stock like cattle. A variety of pens are available on the market today that enables farmers to perform difficult procedures like dehorning, branding and clipping of hooves with relative ease.

1.5.2. Restrain groups of animals

A holding pen or kraal is used to restrain groups of animals and with wildlife a boma is used.



See handout 7 (Sheep Handling) for more information.

1.6. PERFORMING A PHYSICAL EXAMINATION ON ANIMALS

Some illnesses and injuries cause readily apparent discomfort, but many don't. So, if the power of observation is one of the best tools available to the small-scale farmer when caring for animals, what is it you're trying to observe? (These same observations should also be made when you are shopping for animals.)

- **Respiratory rate**

Count the number of chest movements made per minute when the animal is at rest. Normal values for goats are 10 – 20 per minute. Young and old goats have slightly higher respiration rates than normal.

- **Pulse**

Place a hand over the heart area, just under the left elbow, and count the heart beats: alternatively, there is an artery that can be felt on the inside surface of the thigh. Measurements must be taken when the animal is at rest. Normal values for goats are 60 – 80 per minute.

- **Temperature**

The thermometer should be inserted through the anus into the rectum in a slightly upwards direction and held for at least one minute. The normal temperature range for goats is 38.0 – 40.5 degrees Celsius.

Normal temperature range.

Animal	(°C)
Cow	38.0-39.4
Horse	37.3-38.3
Pig	38.1-39.8
Sheep	38.3-39.9
Goat	38.8-40.8

- **Mucous membranes**

Observe the lining inside the eyelids and mouth. If it is pale, the animal is anaemic, probably from gastrointestinal parasites or blood parasites. If it is yellow, there is a liver problem.

- **Rumen contractions**

  Place the palm of your hand firmly in the depression behind the last rib on the left and leave it for two minutes. Normal contractions can be felt at a rate of 1 – 2 per minute.

1.7. OBSERVATION

- **Energy level**

First and foremost, watch for listlessness. Healthy animals are "bright eyed and bushy tailed", as the old saying goes. They are active, moving around freely. Their heads should be held up; their ears and eyes should be responsive to their environments. Their appetites should be good, and they should drink plenty of water. An animal that is just lying around, not eating, or not showing much interest in what's going on around it is probably ill. There are some exceptions to this rule. On hot days, critters may just lie around in the shade looking pretty lethargic – but as the heat of the day breaks, they'll get up and eat again. Still, even if they're lethargic from the heat, their eyes and ears should be responsive to what's going on around them.

Newborns can also be an exception to the listless rule. For the first week or two of its life, a newborn simply eats and sleeps, and its sleep tends to be very, very deep. Sometimes you'll see a newborn baby that you'll think has died, it's in such a deep sleep, but if you look more closely you'll realize it's simply in the black depths of newborn exhaustion. Coming into the world from the safety and warmth of the womb is hard work for a little thing.

- **Hair and coat**

This might be considered a vanity issue, especially if critters were like people, but it's not. Hair or wool should look shiny and healthy, and it should cover the body fairly evenly (unless you are looking at bison, which are always shaggy looking, or animals that are shedding out their winter coats in spring and early summer). Poor-quality coats can indicate nutritional illnesses, external parasites, or other systematic diseases. Also, the coat shouldn't be caked with manure.

Manure that's cakes on the side of the body is often just a sign that the animal has been forced to lie in a manure pile and may not be of great importance. But if the manure is caked around the tail-head and down the backs of the legs, it is a sure sign of diarrhea or scours.

- **Discharge**

Look for suspect discharges from the nose, mouth, ears, or eyes. Sometimes the nose or the eyes may have a little bit of watery discharge, and it isn't anything to worry about. But if a discharge is pussy looking, if there is crusty stuff built up around the muzzle or eyes, if there is excessive slobber or frothiness around the mouth, or finally, if there is any kind of discharge from the ears, the animal is not well.

- **Hydration**

Look at the eyes to see if they appear "sunken". This is usually a good indication of dehydration. Dehydration often accompanies scours, or illnesses that cause a fever. If you can view the gums and the tongue, typically they should be light pink. If they are gray or white, chances are the animal is in shock, either from an injury or from dehydration accompanying an illness.

- **Breath sounds**

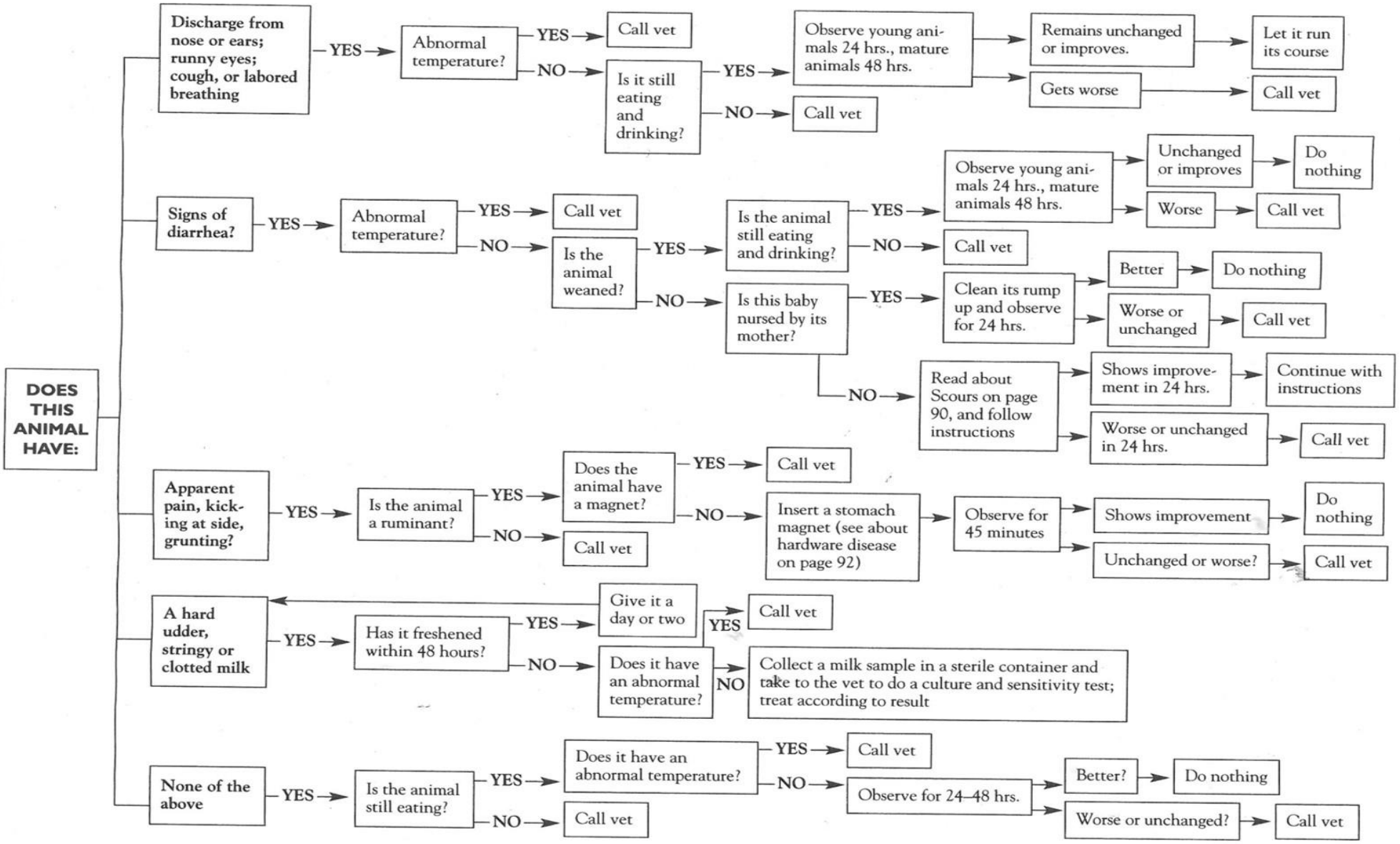
Listen for any coughing or wheezing. Healthy animals breathe easily through their noses, not their mouths.

- **Mastitis**

The last external check is done exclusively on milking animals. Though most common in dairy cows, mastitis can occur in any female animal that is producing milk in her udder – even a pregnant animal that hasn't given birth yet. On rare occasions, a young female that hasn't even bred yet can develop mastitis. A healthy udder should be warm, but not hot; pink, but not red; and soft, but not hard. The milk should flow smoothly and, except for colostrums, should be very liquid with no clots or lumps in it. Colostrums is almost like pudding, it's so thick, but is shouldn't have any lumps in it after the first few squirts.

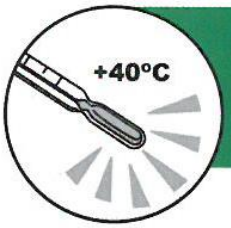
If after making these external observations, you suspect an animal isn't well, remove it to a quiet and secluded location. This will allow further evaluation and treatment, and hopefully reduce the likelihood of an illness being passed to healthy herd mates. If the animal is tractable, check its body temperature. Animal's normal temperatures run in a slightly wider range than ours do, but if your

animal has an elevated or a subnormal temperature according to the table below, it's definitely time to make some decision. The figure shows some criteria we use in deciding whether or not it's time to call the veterinarian. There is, of course, a certain degree of flexibility in applying this, and as your nursing experience and comfort level increase you may wait longer to call. (Some vets or other farmers may disagree with this system, but it has worked for us.)



Reference pages 71 to 89. Extracted from "Live Stock Handler Training Manuals" publilsher AriVet.

1 Examination from the back



Follow a specific structure during examination of an animal

Taking the animal's rectal temperature is the first step when examining an animal showing signs of disease. Do a structured examination of the rest of the animal's backside simultaneously.

Tail

Lift the tail to insert the thermometer. The strength of the tail will also indicate the normal functioning of the tail muscles, which is an indication of normal functioning of the nervous system ending at the tail.

Temperature

Test the core body temperature with a thermometer inserted into the rectum. This is the best way to determine if the animal has a fever – an indication of infectious disease and a sign that the animal requires urgent attention.

Condition

While waiting for the thermometer, evaluate the condition score by feeling the fat reserves under the skin at the point of the pin bone and in the lumbar area (the area just in front of the hipbones). Condition is scored on a scale from 1 to 4.

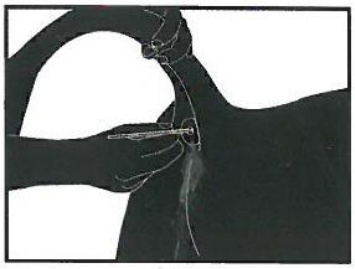
Skin

Evaluate the skin and coat and condition score simultaneously. A healthy skin and coat is a very reliable indication of the general wellbeing of the animal. A dry skin or dull coat is an indication of a problem that has developed over a long time.

Below the tail

When removing and reading the thermometer, examine the rest of the backside including the vulva/sheath, udder/testicles. Examine specifically for any discharges, soiling, swelling, external parasites and wounds.

Taking the temperature



A thermometer must always be available when farming with livestock.

Use a digital or mercury rectal thermometer.

Digital thermometer

Mercury thermometer

The use and reading of a mercury thermometer is a specific skill, acquired through training.

1. Insert the clean thermometer into the rectum.
2. Hold the thermometer there for two minutes.
3. Take the thermometer out, clean it and read.
4. Store thermometer in a cool, safe place.

Average normal temperature early in the morning **38,5°C**

Increased temperature – FEVER **≥40°C**

A temperature of 40°C and higher requires urgent attention

Fever is the best indicator to distinguish between infectious diseases and other causes of disease. Body temperature may increase before other clear signs of disease become apparent.

Other causes of raised temperature that may be confused with a fever are:

- if it is very hot or the animal was lying in the sun
- if the animal was chased before examination
- if the muscles of the animal are contracting because of a disease caused by a toxin such as a dipping compound.

Evaluate the status of the blood supply by checking the colour of the lining inside the vulva. When the blood supply is normal, the lining will be light pink.

2 Examination from the front

Follow a specific structure during examination of an animal

Examining the inside eyelid is the second step in the examination of a sick animal. Do a structured examination of the eyes, nose and inside of the ears and mouth simultaneously.

Inside eyelid

Blood loss is one of the major causes of death. The early stages of this condition are not visible during daily observation. The blood supply status can only be evaluated by examining the lining (mucous membrane) of the inside eyelid, or vulva in the case of cows.

Eye

Examine the open eye for any lesions that were not very clear during observation from a distance. It is very important for an animal to have two normal eyes otherwise sight, grazing, herd pecking order and ultimately production will be severely affected.

Ears

Examine the deep inside of each ear for ticks and abnormal excretions. This is also not visible during daily observation from a distance.

Nose

Closely examine the nose and excretions from the nose, as it is the external opening of the whole respiratory system. Depending on other senses, such as smelling the air breathed out, this also forms part of the examination.

Mouth

Examine the inside of the mouth. Several diseases cause very specific lesions on the lips, tongue, hard palate and gums. Also, look at the front and back teeth. Because cattle eat coarse grass, obstruction of the mouth and throat is common, which presents as salivation during observation.

Examination of the inside eyelid

The colour of the inside eyelid is a visible indication of the status of the blood supply.

The correct method to open and examine the inside eyelid:

Lift the top eye bank with the fingers.

Gently close the eyelid with the thumb.

Push the closed eyeball inwards with the thumb.

Pull the lower eyelid down with the thumb of the other hand until the inside eyelid bulge out.

The normal colour of the inside lining of the eye is pink

Different disease conditions can cause a change in the colour of the inside eyelid:

	White	An indication of blood loss and anaemia.		Yellow	Liver problems or disease that cause break-down of red blood cells.
	Red	If only one eye is affected, it is a sign of eye infection.		Blue	Animal doesn't get fresh air – suffocating owing to lung problems or can't breathe.
	Red X2	If both eyes are red, the whole body system is affected.		Brown	Some plant toxins containing nitrates can cause this.

Examining of the inside of the mouth

Nose tongs are an essential tool in handling cattle but the user must be trained in the safe and correct use to prevent injury.

Safely catching the head, constraining to limit movement and examining the mouth are advanced technical skills, acquired through training and experi-ential learning.

When dealing with cattle, the head movement must be constrained to open the mouth safely and pull the tongue out to examine the inside of the mouth.

3  Rest of the body

Follow a specific structure during examination of an animal

Examine the lymph glands and follow a structured examination of the rest of the body that couldn't be touched during observation from a distance.

Lymph glands	The lymph glands are not easily palpable by the inexperienced examiner except if they are enlarged. The easiest lymph gland to examine is the one at the point of the shoulder, just in front of the shoulder blade.
Chest	The movement of the chest is the result of breathing. The movement of the chest increases when there is an increased rate of respiration. Examination of the chest by a veterinarian includes the use of a stethoscope to listen to the heart and lung sounds.
Abdomen	When examining the abdomen, look for large swellings and an abnormal shape. Examine the hunger groove for any signs of bloating or if it is very sunken, it is a sign that the animal has not eaten for the past 24 hours.
Front legs and feet **Back legs and feet**	Examine the front and back legs. Feel (palpate) for large swellings or any abnormality of all the joints if the animal showed lameness during observation from a distance. Always compare the left limb to the right one to determine if what you see and feel is normal or abnormal. Cattle may kick forward and sideways with the back legs; therefore, the examiner must be very careful when examining the lower legs. Take precaution by using a rope to limit the movement of the hind leg. Examine the hooves of cattle for any abnormal shape and swelling of the joint above the hoof or wounds/infection behind or between the claws. Use the correct ropes for lifting and examining the feet. This is an advanced technical skill, acquired through training and experiential learning.

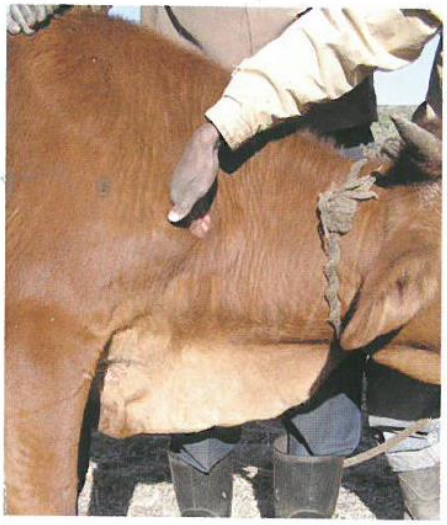
Lymph glands

Swelling of the lymph glands is a specific indication of a number of important diseases such as cattle tuberculosis.

Although this is part of a specialised examination by a veterinarian, the livestock worker can also examine the size of the most accessible lymph nodes.

Examination of the lymph gland under the skin at the point of the shoulder (just in front of the shoulder blade).

Examine the other lymph glands at the inside corner of the jawbone during examination of the head.



Examining lame cattle

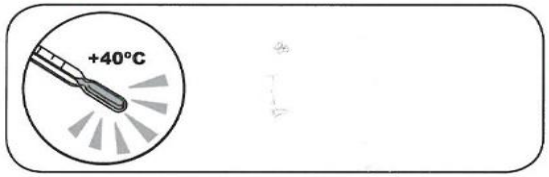
The hoof cannot be properly examined if the foot of the cattle can't be lifted and cleaned for examination.

Most hoof problems can be treated effectively if done as soon as lameness becomes apparent.

If not treated properly, it may progress to severe lameness, which will involve the joint, and cannot be treated effectively in most cases.

Examination checklist and record

1. Temperature:



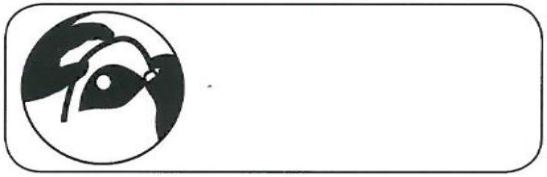
Background Information?

Condition score?

1	2	2,5	3	4

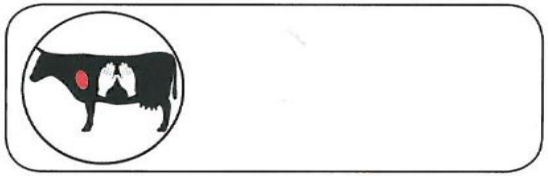
Loin area

2. Inside lining of the eyelid and head:



Background Information?

3. Lymph nodes and rest of body:



Background Information?

4. Background Information:

Actions taken?

Weight:

Product:

Dose:

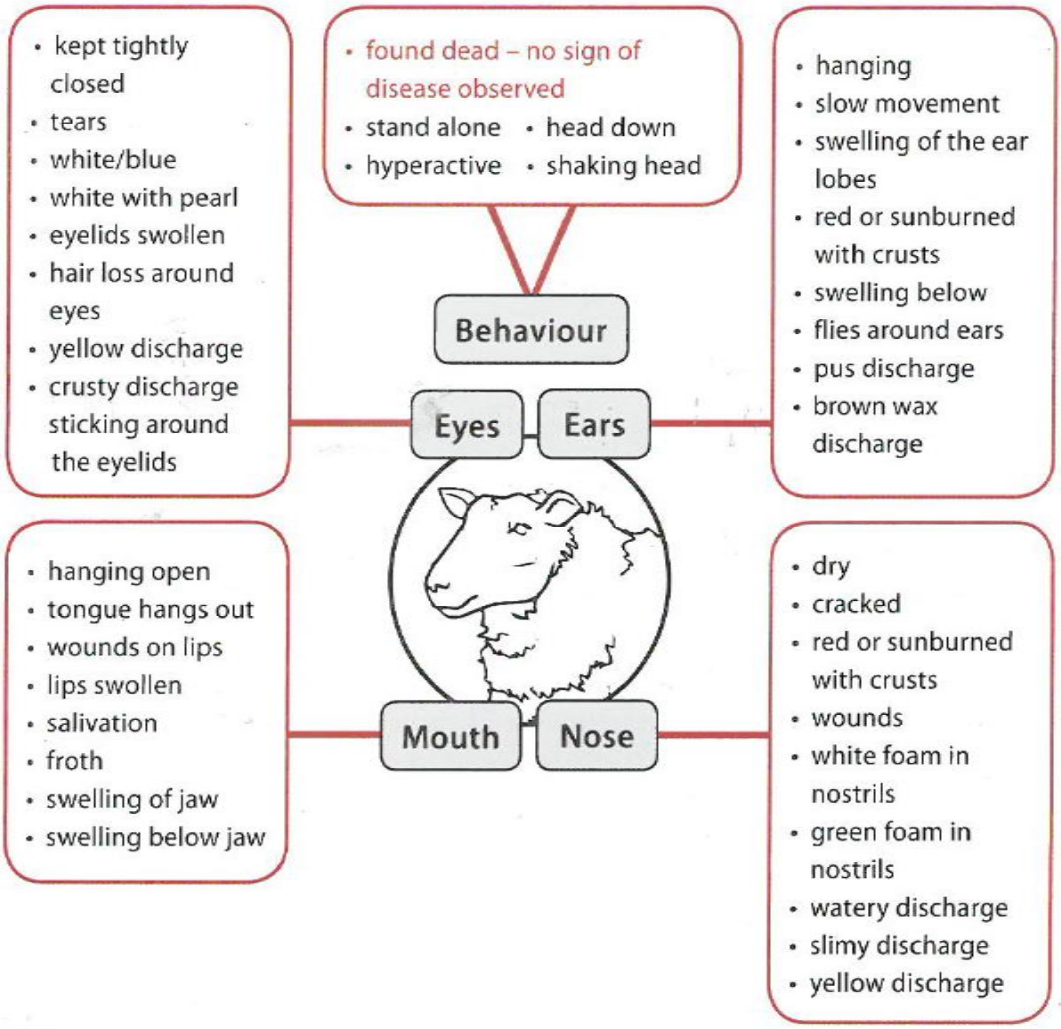
1 Follow a specific process during daily observation.

HEAD

Looking at the head of an animal is the first step in daily observation. Even in a big group of animals, the head is the most visible part of the body. When observing sheep, it must be done early in the morning because when it becomes hot, sheep lower their heads making observation more difficult.

Behaviour	The head houses the brain, which controls behaviour and the body systems. Any disease that has a direct effect on the brain or on the whole body will affect behaviour in different ways.
Eyes	The eyes are a direct extension of the brain. It can be affected by damage to the eye itself or it can indicate diseases within the rest of the body.
Ears	The posture and activity of the external ear are very sensitive indicators of the well-being of animals. A change in posture and/or activity will often be the first non-specific sign indicating that the animal is not well. Many different diseases can also cause swelling of the ears. The inner ear can only be viewed when the animal is examined.
Nose	The nostrils represent the start of the respiratory system. Livestock normally breathe through their noses. The nose can show non-specific signs when the whole body is affected as in the case of fever.
Mouth	The mouth forms the first part of the digestive system. Signs of disease can be caused by lesions in the mouth or lower down in the digestive system up to the big stomach. Most of the problems inside the mouth can only be viewed when the mouth is opened during examination of the animal.

Be very specific when describing the signs of disease observed.



Evaluating the head and behaviour in sheep is not as easy as in cattle.

Sheep lower their heads and change their behaviour when they want to avoid insects such as nasal botflies that deposit their larvae in the nostrils. Sheep also start to pant with a lowered head as soon as it becomes hot in order to cool down.

The livestock handler must understand the normal behaviour of his/her specific sheep flock very well in order to identify any change in behaviour as soon as it happens.

2 Follow a specific process during daily observation.

Rumen fill and body condition

The second immediate area of focus is the hunger groove and an overview of the whole body before dealing with specific observations that may be visible over time.

Rumen fill

Because of the unique digestive system of ruminant animals, the level of food intake during the previous six to 12 hours can be judged by observing the rumen fill in the area called **the hunger groove** on the **left flank**. This is one of the most direct and visible indications of the level of wellness in a period of 12 hours.

Condition

The body condition of the animal is a direct reflection of the wellness of the animal over a longer time (more than 24 hours). Body condition does not change overnight; therefore it is an observation that can identify longer term changes.

Skin/wool/ hair

The skin is the largest organ and provides protection for the whole body.

Changes to or infection of the skin and the wool/hair normally occur over a longer period of time making this observation point important to evaluate longer term problems.

Very quick changes in the skin can also occur, as is the case at the start of sheep scab and blowfly infestations which can cause large lesions within days.

Sheep will aggravate these lesions by pulling on the wool with their mouths or rubbing against a fence or other objects.

Be very specific when describing the signs of disease observed.

- swelling/lumps
- fresh wounds
- infected wounds
- wounds with maggots
- maggots feeding on the skin
- tick infestation
- dull hair coat
- itchiness
- wool/hair loss
- hair standing up
- bleeding spots

Skin/wool/hair

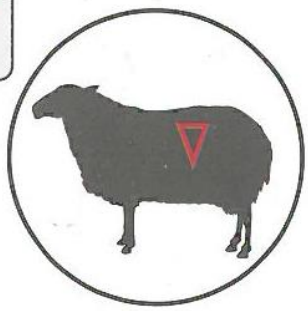
Any sign of itchiness in sheep is extremely important and must be investigated immediately by closer examination.

Ticks are not found on large parts of a sheep's body. Ticks have very specific attachment sites which are not visible during daily observation from a distance. Ticks must therefore be evaluated at the specific observation points where they normally attach such as under the tail, on the udder and between the hooves.

- average condition
- bad condition
- loosing condition very fast

Condition

It is difficult to observe the condition score of sheep with long wool from a distance, therefore it should rather be evaluated during a closer examination.

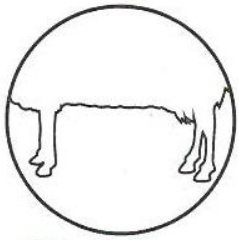


Rumen fill

- very sunken in
- sunken in
- bloated

It is very difficult to observe the rumen fill in sheep that have long wool, therefore it is important to observe their eating behaviour more closely. If there is any suspicion that they are not eating well, sheep with long wool must be examined to evaluate their rumen fill.

3 Follow a specific process during daily observation.

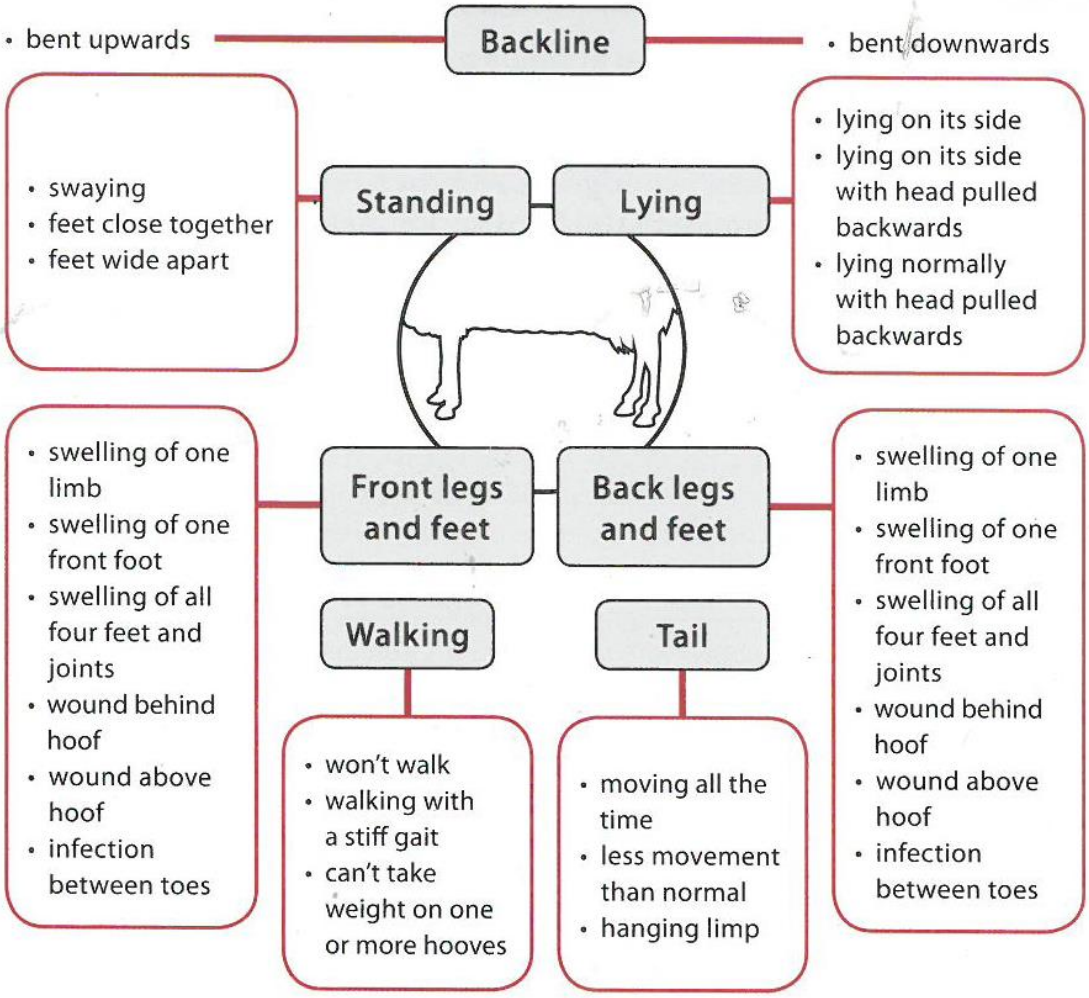


The animals can move around slowly and observed as they leave the pen. This observation can also be done while the animals are being herded.

Walking and movement

Backline	A normal backline posture is an indication that the animal is not in pain. Bending the back while standing or walking is a very specific indication of pain in the body, limbs or feet.
Standing	Healthy animals stand comfortably with all four feet spaced under the four corners of the body and even pressure is placed on all four feet. They stand still without swaying from side to side.
Lying	When sheep are lying down they do so in an upright position, with their necks and heads forward or sideways and front legs bent underneath the chest. They will normally lie on their backsides. As with all ruminant animals, if sheep are lying flat on their sides they cannot get rid of the gas formed in their rumen and will bloat very quickly.
Front legs and feet, and back legs and feet	The front and back legs as well as the joints are smooth with no large swellings. There should be no marks on the skin, matting or loss of hair on the joints. The hooves must be normal with no swelling or wounds above, in between or behind the hooves. When animals are herded, their gait is steady with no jerky movement of the head. During walking the head is lowered in order for them to see where they are going. Lameness is a very common problem and the first sign of lameness is when an animal won't put its full weight on one or more feet while walking.
Tail	The tails of sheep are less active than in the case of cattle and sheep will only move their tails if there are insects bothering them or other causes of irritation under the tail.

Be very specific when describing the signs of disease observed.



When working with sheep, you won't necessarily need a crush pen to examine the animal as when working with cattle. Sheep that show any signs of disease can and must be caught and examined as soon as the first sign of disease is observed.

Lameness

The progression of lameness in sheep is very fast, therefore the cause must be established in order to immediately start the treatment.

4 Follow a specific process during daily observation.

What goes in?

Observing animals breathing, drinking and eating should take place during the day. Because these animals have large stomachs, they eat or graze and then rest while they ruminate the food accumulated in the big stomach.

Breathing

Observation of the ease, speed and depth of breathing should be done before animals are disturbed. In sheep it must be done early in the morning while it is still cool.

Very close observation of the chest and abdomen movement is needed to evaluate breathing. When breathing is difficult, increased chest and abdominal movement is obvious.

Drinking

Animals with large stomachs (ruminants) drink a large amount of water at a time. The drinking process involves the normal working of the muscles of the mouth, tongue and throat to suck the water and to swallow it effectively. Diseases that affect any of these will cause the animal to drink less or not at all.

Eating

A very specific sign of health is the eating (grazing) behaviour of animals. This can be evaluated throughout the day because these animals spend most of their time taking in food to the large stomach. Any change in eating behaviour is important to record. Most diseases that affect the whole body will decrease or stop food intake.

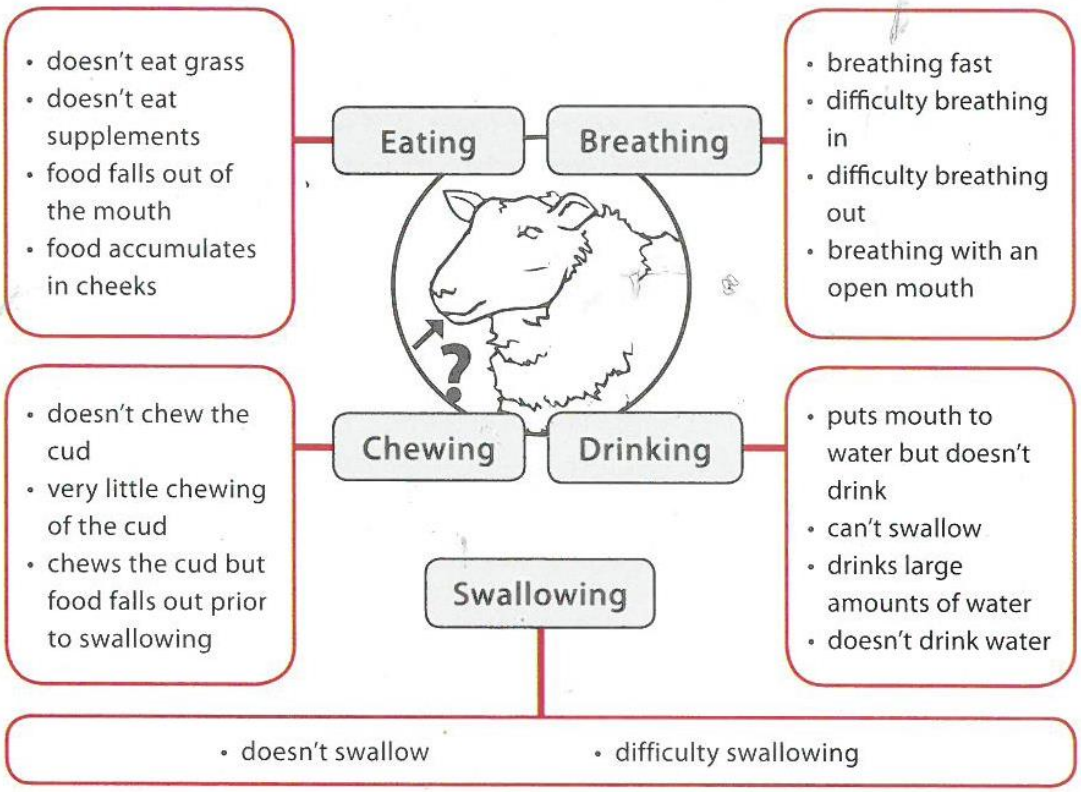
Chewing

When animals are resting, their well-being is best evaluated by the number of animals ruminating. Unhealthy animals stop ruminating.

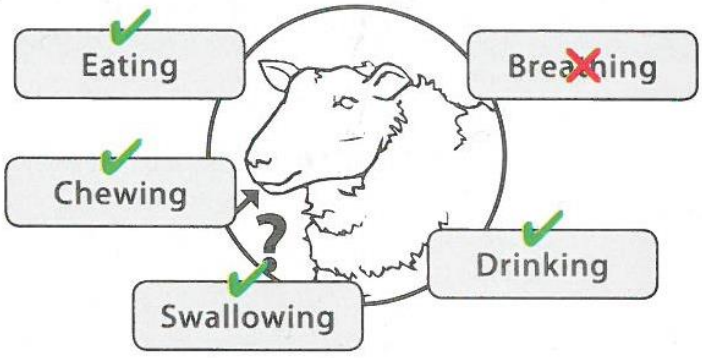
Swallowing

Normal swallowing can be evaluated when the animal is drinking or swallowing the cud. The observer should then also focus on the neck and breastbone while evaluating the swallowing process.

Be very specific when describing the signs of disease observed.



The first step in reporting observations is just to make a cross over the affected areas on the Daily Observation Card (DOC).



Normal (Signs of health)

Abnormal (Signs of disease)

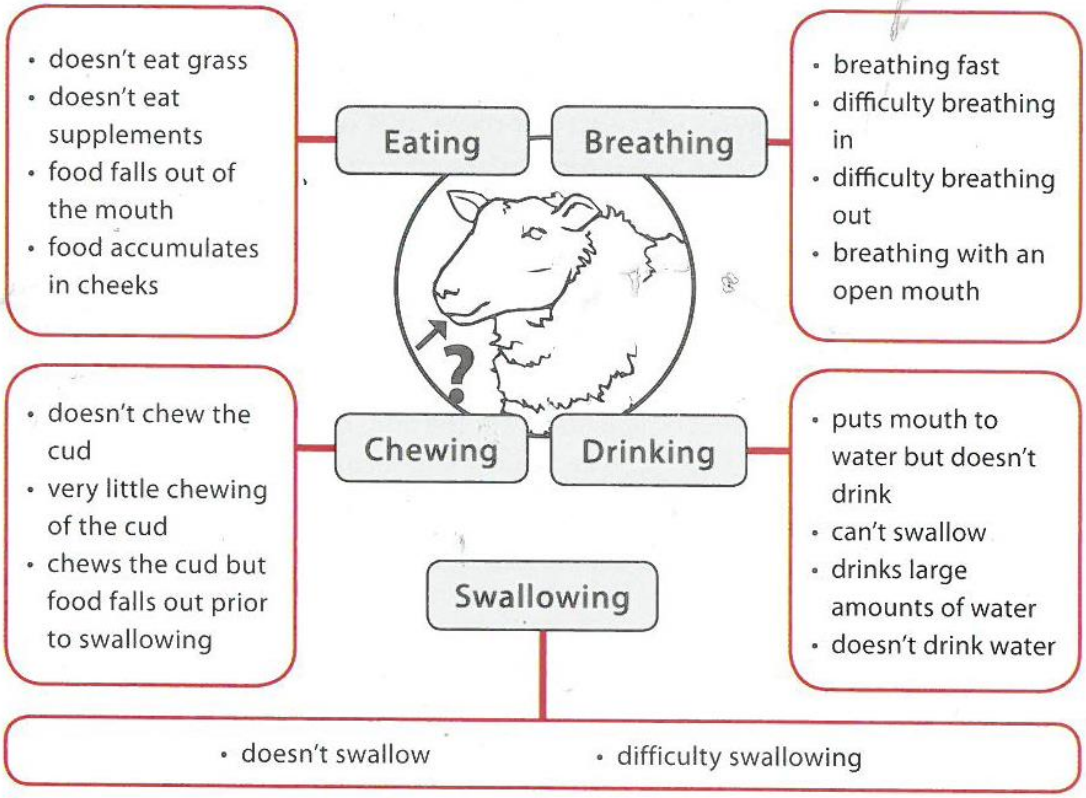
5 Follow a specific process during daily observation.

What comes out?

Because the animals are eating and drinking large amounts of food and water, they produce a lot of dung and urine during the day, which can be observed.

Dung	The consistency and colour of the dung give a good indication of the health and functioning of the digestive system. Sheep dung is in the form of loose pellets. If pellets are sticking to each other or the dung is soft (same as cattle) or watery, it is not normal unless the pasture they feed on is very lush and soft.
Urine	The only evaluation of the functioning of the kidneys and urinary system can be done by observing the animal while it is urinating. The specific colour and clarity of the urine is also a very good indication of the general or specific health of the animal. Any change in the urine is an important observation to make.
Vulva	Observation of the external opening of the reproductive tract of female animals is important before breeding and after birth. This is a specialised observation and is used for breeding management and identification of problems just before, during and after the birth process.
Teats and udder	The observer cannot see the milk but can evaluate the health of the teats and udder on a daily basis. This observation is not as easy as in cattle and if there is any suspicion that something is wrong, the animal must be examined more closely.
Testicles and sheath	In male animals the semen is not visible, but the important male reproductive organs must be observed daily. Ticks, swelling or wounds call for immediate action.

Be very specific when describing the signs of disease observed.



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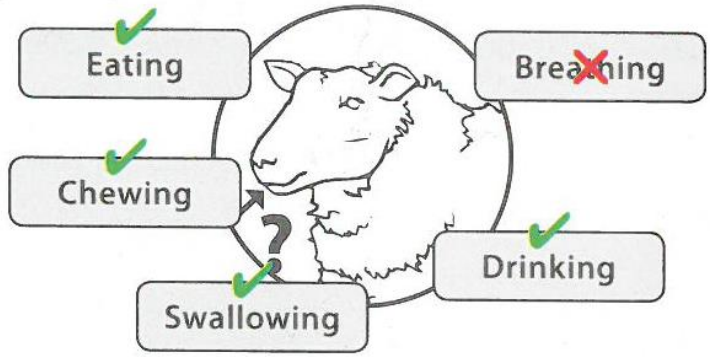
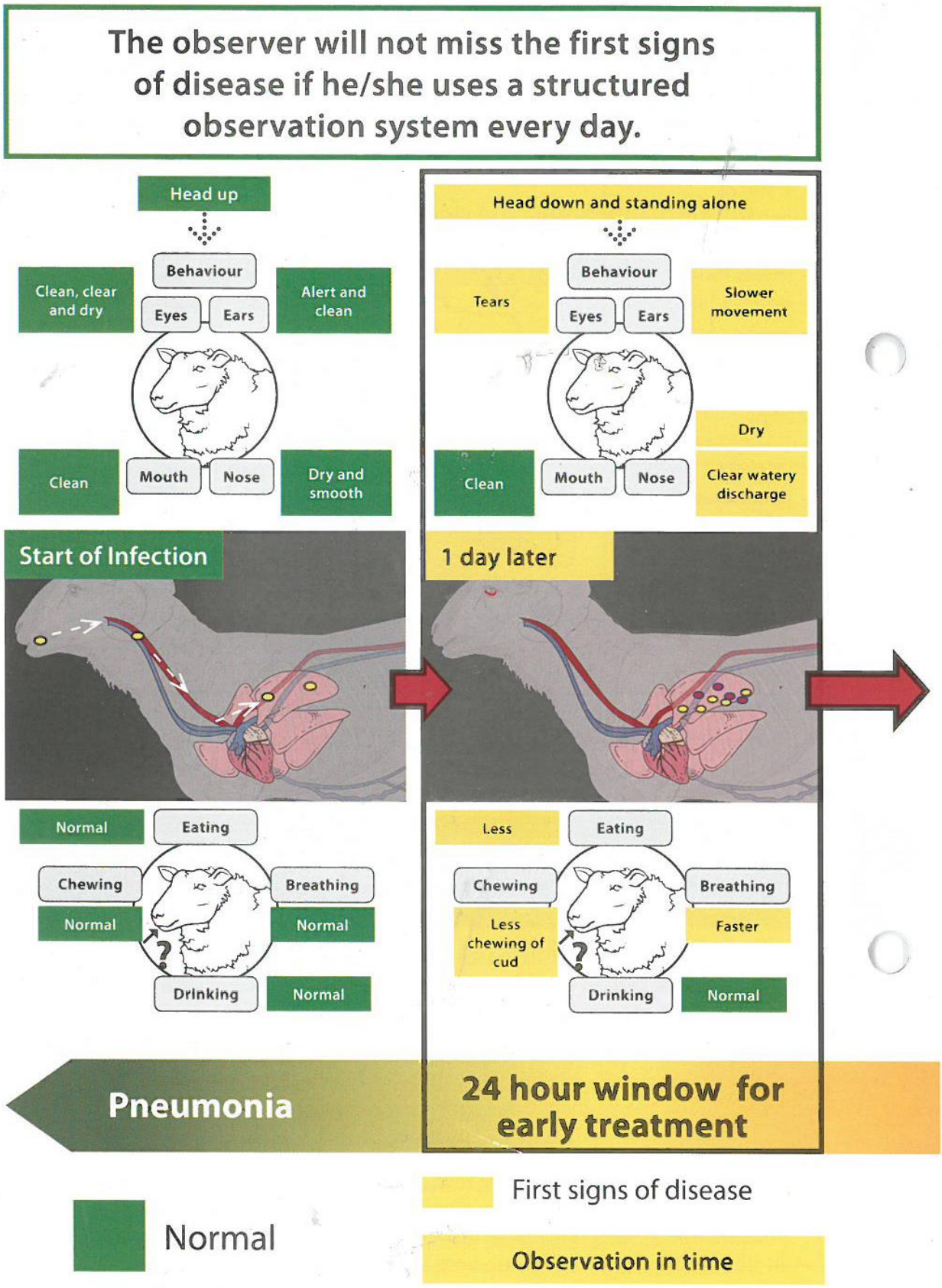
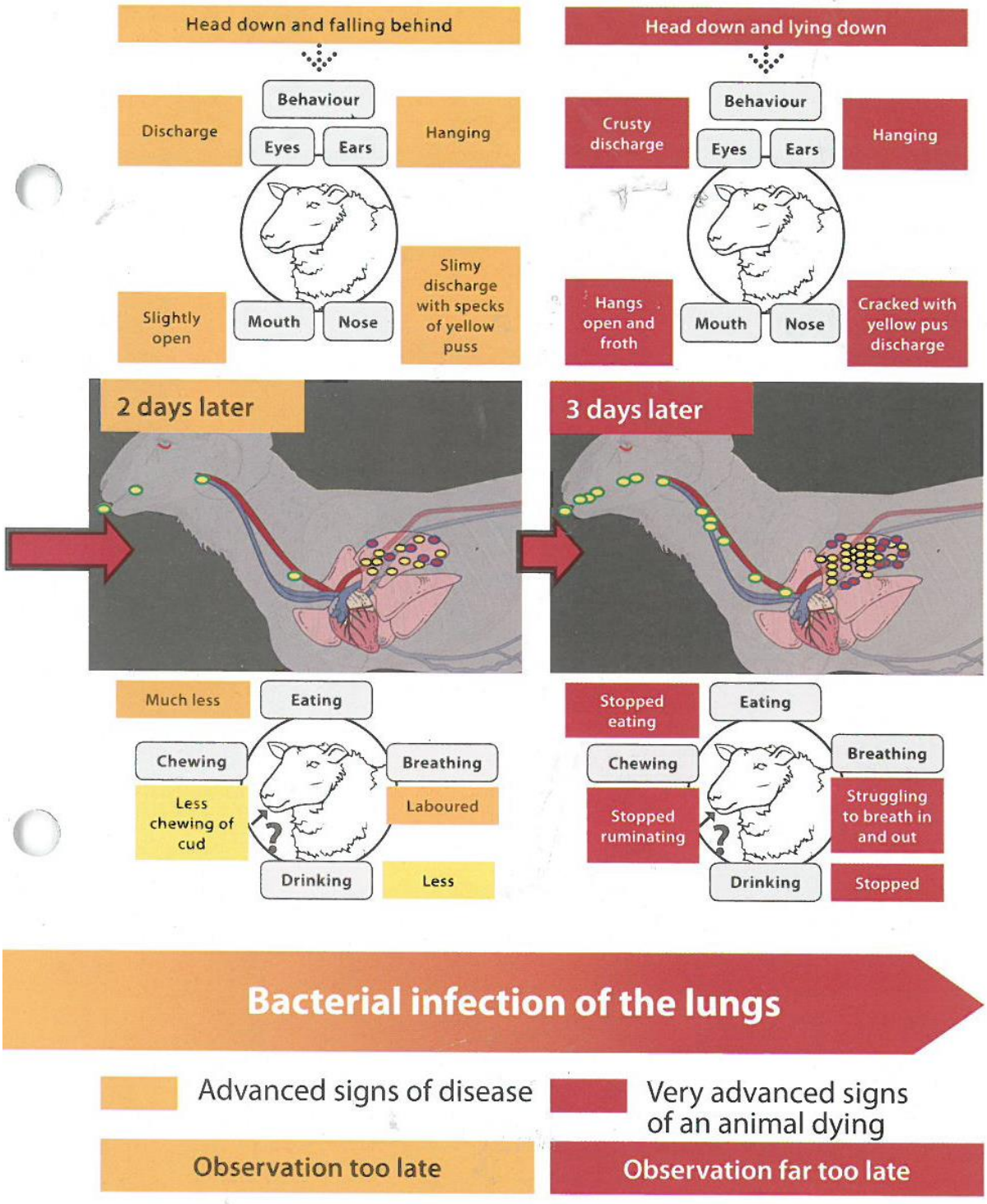


Normal (Signs of health)

Abnormal (Signs of disease)


The observer will not miss the first signs of disease if he/she uses a structured observation system every day.
Head up
Behaviour
Clean, clear and dry
Eyes
Ears
Alert and clean
Clean
Mouth
Nose
Dry and smooth
Head down and standing alone
Behaviour
Tears
Eyes
Ears
Slower movement
Dry
Clean
Mouth
Nose
Clear watery discharge
Start of Infection
1 day later
Normal
Eating
Chewing
Breathing
Normal
Normal
Drinking
Normal
Less
Eating
Chewing
Breathing
Less chewing of cud
Faster
Drinking
Normal
Pneumonia
24 hour window for early treatment
Normal
First signs of disease
Observation in time

Severe production loss will occur if the first signs of disease are missed and/or no action is taken after the observation.



Bacterial infection of the lungs

Advanced signs of disease

Very advanced signs of an animal dying

Observation too late

Observation far too late

2. CAUSES OF HEALTH PROBLEMS

Illness is generally the result of either a chemical or a biological agent, though sometimes it is simply the result of improper diet or a change in diet. As with people, injuries are the result of accidents. Falls and cuts are the two most common injuries livestock suffer.

Disease (also known as sickness) is any process that interferes with the way the different parts of the body work and look. We do not normally consider injuries such as broken legs and cuts as diseases.

There are many causes of disease in animals. Knowledge of what causes disease, and of how animals can get a disease, helps us to know how to prevent disease and to treat sick animals.

You must have knowledge of the normal functions and anatomy of an animal before you can differentiate between the normal and the abnormal.

When clinical examinations are done you should do it systematically and all systems or organs should be examined. It is important to identity the animal and to get the history of that animal before you start with the clinical examination.

Pathogenic organisms, which are those organisms that are harmful to the animal and that cause infection, may enter the body directly or indirectly by an intermediate host.

Bacteria and viruses gain entry to the body through several routes e.g. the intestinal tract, air passages, sex organs, and wounds in the skin. The organisms then enter the bloodstream, which transport them through the body and to target organs. The changes that these organisms cause produce the condition known as disease. If any changes in the physiology of the organ take place the whole body is affected. The animal starts to display abnormal behavior e.g. it stops eating, start coughing, lie down or develop diarrhea that may be linked with fever. Ticks, mosquitoes, midges, etc. act as intermediate hosts for some bacteria.
Prevention is better than cures. Prevention seldom causes interruption in production, while treatment of disease can only start after production has already been affected.

- Prevent contact between the animal and the pathogen through good hygiene and management.
- Dip animals frequently to prevent external parasites
- Dose/deworming animals
- Vaccinate
- Provide good balanced feeding
- Use quarantine camps

You can control external parasites by the application of chemical which are toxic for the ticks etc. but harmless to the animal. There are various methods that you can use to apply these chemicals. Internal parasites can be control by the regular application of dosing remedies to all animals.

It is impossible to prevent exposure to some organisms and in these cases, vaccines are used exclusively.

Diseases like contagious abortion can be diagnosed in apparently healthy animals. During clinical examination symptoms can be identified but laboratory tests are also necessary to confirm diagnoses. These tests can identify infected animals, which do not show any clinical symptoms.

Good feeding provides natural resistance to all diseases and parasites. Deficiencies of nutrients like minerals can cause diseases, which can be rectified by means of nutritional supplements. Supplements are feed that are given as an addition to complement/complete the dietary balance.

It is important that animals undergo a period of quarantine when entering a specific area of production. During this period the animal can be observed for any disease symptoms. Treatment against parasites and the necessary vaccine are administered.

2.1. CHEMICAL AGENTS

Chemical agents cause poisoning. Some chemical agents, such as poisonous plants, may be biological by their nature, but it is the chemical in the plant that is toxic. Although chemical poisoning can happen with livestock, it is less frequently the cause of illness than a biological agent.

To avoid chemical induced illness:

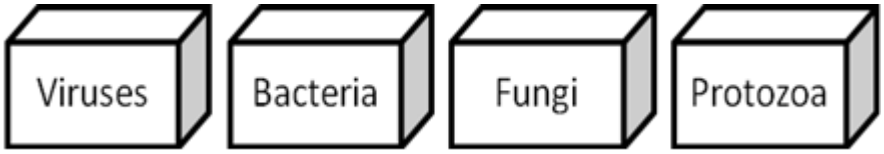
1. Learn about the poisonous plants that grow in your area of the country.
2. Store feed properly, and never store any kind of chemical products – including cleaning products – near your feed or where animals may gain access to it.
3. If you're using any chemical products around your farm, make sure to follow the manufacturer's instructions of containers. A farmer we read about had a number of cows poisoned from eating hay. It turned out that some empty chemical bags had blown out into his windows of hay as they were drying. The bags got baled with the hay. Certainly, this tragic experience could have been prevented by proper disposal of the bags.
4. If animals are kept indoors in an old building containing lead-based paint, lead poisoning may be a problem.
5. When grazing, keep animals away from fields that have recently been sprayed with fertilizers, pesticides, or herbicides. Field contamination from sprays may be the result of someone else's operation.

2.2. BIOLOGICAL AGENTS

Biological agents are the most common cause of illness. Complex organisms such as birds and mammals regularly act as hosts to a rather large menagerie of microorganism guests. In humans, it's estimated that 100 billion microorganisms routinely share our bodies. These regular guests are called normal flora, and for the most part is harmless to their hosts. In some cases, normal flora – like the digestive bacteria that help break down food – are beneficial. But under certain circumstances, these normally benign "bugs" can cause disease. When microorganism causes disease, whether a member of the normal flora or a recently introduced bug that is just passing through, it's called a pathogen.

When conditions are just right for them, pathogens proliferate to the point that their numbers simply overwhelm the animal, like weeds taking over a garden. Some also produce toxins as by-products of their bodily functions; the clostridium bacteria, whose toxins can cause tetanus, botulism, and black leg, are prime examples. These toxin-producing pathogens can cause illness even when only a few are actually present. The biological agents include bacteria, viruses, yeast and other fungi, and worms and other parasites.

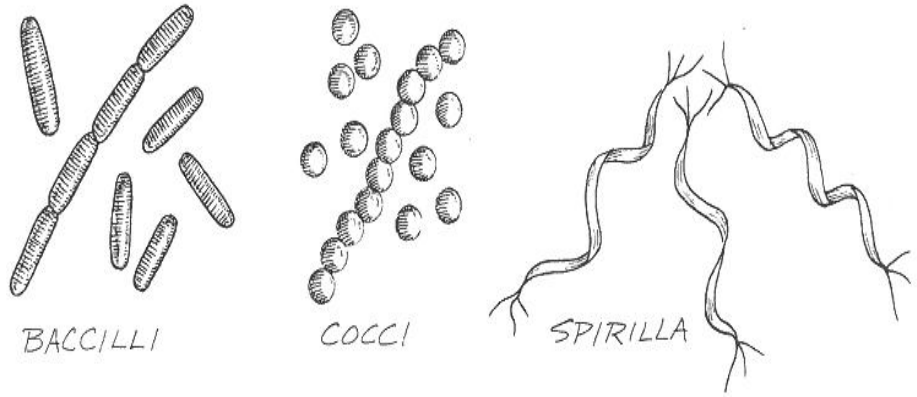
Many different microbes can cause disease in animals, but there are four main types:



2.3.1 BACTERIA

These single-celled organisms are a funny bunch: Some of them are so helpful, but some are so deadly. The beneficial bacteria are known as saprophytes and include bacteria that regularly live in the digestive tract. When the saprophytes are where they're supposed to be and in the right quantity, they help the body keep humming right along. If introduced where they aren't supposed to be, though, watch out. They become pathogens.

Bacteria can be treated with antibiotics; however not all bacteria respond equally to all antibiotics. If bacteria respond to treatment by a particular antibiotic, it's said to be sensitive to the antibiotic; if it doesn't respond to the treatment it's resistant. When treating an animal for a bacterial infection, it's best to have your veterinarian perform a culture and sensitivity test if this is at all feasible (i.e., if you aren't dealing with an immediately life-threatening situation). This test will tell you exactly which antibiotic is most effective against the bacteria that are causing the illness.



There are three major classes of bacteris: bacilli, cocci, and spirilla. These organisms are responsible for many diseases that affect humans, animals and plants. At the same time, many bacteria are beneficial and even necessary, like those in the rumen of ruminant livestock.

	**Virus Infections** Bloutong/ Bluetong

	Wesselsbron Skendal koors

Types of wounds and general bacterial infections

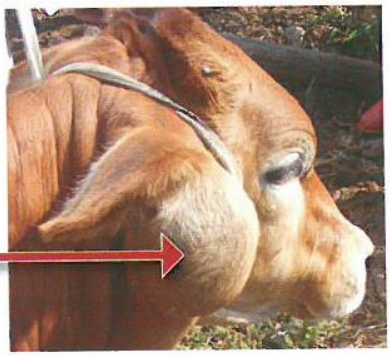
There are many examples of bacterial infection when the body is not properly protected by an intact skin or lining of the internal organs. Here are a number of examples.

Superficial skin wounds

A superficial wound is where the skin has been damaged by injury or parasites with the extent of the wound clearly visible.

Abscesses

An abscess is where there was a very small skin wound that allowed bacteria to enter the tissue underneath. This small wound heals but the bacteria multiply in the tissue under the skin. This process is not visible apart from the swelling or lump that is formed.



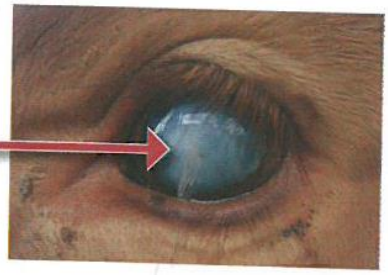
Deep wounds

The skin is broken but the wound extends into the deeper layers of the body such as in or between the deep muscles, organs or organ cavities. The full extent of the injury and/or infection is not visible and it cannot be treated superficially.

As soon as there is an injury, wound or bacterial infection the body will react to initiate the healing process. This causes inflammation and wound healing.

Eye infection

The normally clear parts of the eyeball and inside eyelid get infected and some outward signs of disease can be observed as the body starts to react.

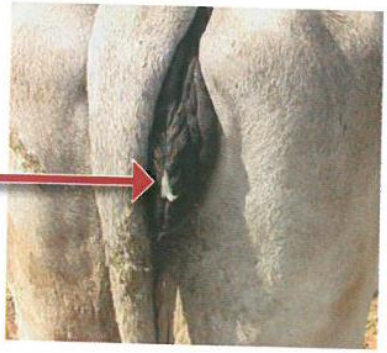


Hoof infection

If the skin between the hooves becomes soft owing to ongoing wet conditions, it can be easily injured by stones and become infected. Ticks can also cause a break in the skin, providing an entry point for bacteria and the start of infection.

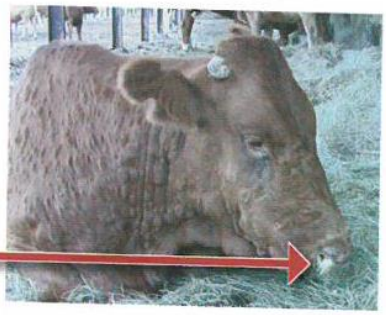
Internal infection

The internal respiratory, digestive and reproductive tracts can be infected by bacteria if the lining is damaged. Specific signs of disease can be observed if the Daily Observation Card is used effectively.



Secondary infections

Specific viral diseases, such as lumpy skin disease and bluetongue, cause lesions in the skin or lining, providing an entry point for bacteria resulting in a secondary bacterial infection which can lead to pneumonia, for example.



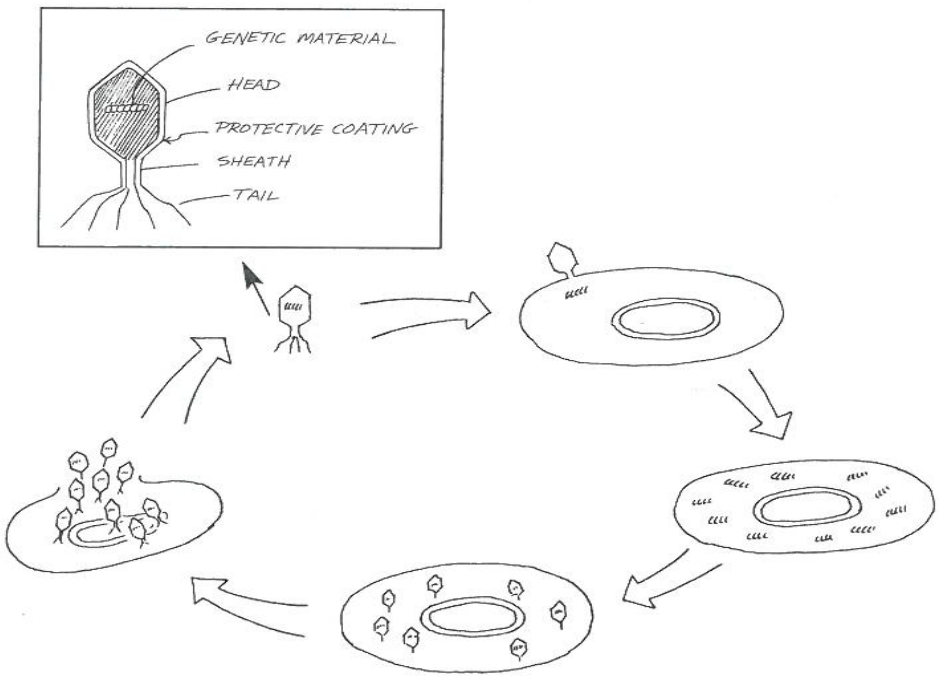
All general bacterial infections have one thing in common. If observed early, they can be treated effectively with an antibiotic and correct actions.

Certain bacterial infections cause specific diseases such as black quarter and pulpy kidney. These diseases are not considered general infections and are discussed in separate training modules.

2.3.2 VIRUSES

What can be said about a thing that is alive by some definitions of lice, but isn't alive by other definitions? Like other types of cells, viruses are made up of proteins. And like other cells, viruses are able to reproduce; generally something that reproduces itself is considered to be alive. But viruses aren't independently living, breathing, reproducing organisms. Unlike any other type of cells, viruses can only reproduce inside a host organism's cells. Without a host cell inside an independently living organism, they do nothing.

Most cells, from the single-celled organisms such as bacteria to the individual cells that make up a tree, a whale, or an emu, are large on a microscopic scale. In fact, they can be seen under a high school biology class microscope. Viral "cells" are much smaller and require an electron microscope to be seen. To put the scope this size difference into scale, consider that one host cell can contain millions of viral cells. When the virus has reproduced to the carrying capacity of the host cell, the viral cells burst out of the host cell, killing it; they then go in search of new cells to infect, and start the reproductive process over again.



Unlike bacteria, there are no good viruses. Viral cells invade a host cell by penetrating the cell wall. They then deposit their genetic material into the host cell, where they use the host's genetic material to replicate. When as many new viral cells have replicated as the host cell is capable of accommodating, the viral cells burst the wall of the host cell and go out in search of new host cells to continue the process.

Living organisms have basic genetic material, which they ordinarily receive from their parents. Here, again viruses are different: They cheat and use genetic material from the host cell to reproduce their own genetic information, repeatedly. This method of replication enables a single viral cell to enter the host cell and create millions of new viruses.

Unfortunately, viruses aren't affected – not even a little bit – by antibiotics. Once a viral infection has begun, the animal's immune system must combat the viral organism with antibodies, or the animal will die. Antibodies are like little warriors that are created in the bodies of all animals to combat alien proteins.

No drugs will cure a viral infection, but that doesn't mean drug therapy is never called for when dealing with a virus; drugs may be given to help alleviate certain symptoms (aspirin to reduce the fever, for example) or antibiotics may be called for to stave off secondary bacterial infections. Bovine viral diarrhea (BVD) is a good example of a viral disease that is highly contagious and causes high mortality levels (large numbers of exposed animals will die). But the virus itself isn't usually the cause of death, secondary bacterial pneumonia is, so as soon as BVD is diagnosed the animals are started on antibiotic therapy.

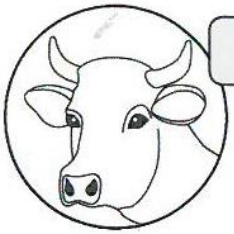
Viruses may not succumb to antibiotics, but many of the common livestock viruses can be prevented from causing illness through the use of vaccinations. Basically, what a vaccine does is teach the body to recognize the protein sequence of a given virus. After the body's immune system has recognized the virus as a foreign invader, it will quickly recognize it again. This preprogramming of the immune system allows antibodies to be instantly deployed when the virus first shows up, cutting down the immune system's response time to a point where the invading virus doesn't have much of a chance to begin reproducing.

- Viruses are the smallest of all microbes.
- They must live inside cells in order to survive and breed.
- Viruses cause about 60 % of disease outbreaks in animals and humans.
- Examples of diseases in animals caused by viruses are rabies, Newcastle disease and three-day Stiff sickness.
- It is difficult to treat diseases caused by viruses because the viruses live inside animal cells. Therefore, any medicine that can kill the viruses will also harm the animals in which the viruses are present.

Cattle – lumpy skin disease

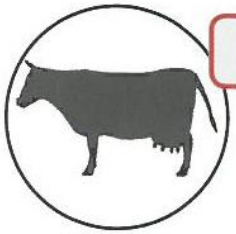
Identification of disease with daily observation card

Observation



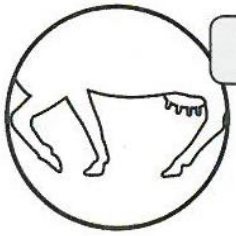
Behaviour

- head down



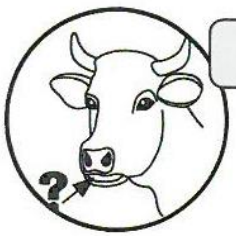
Skin

- lumps in skin, all over the body



Walking

- slow
- with difficulty



Eating

- doesn't eat

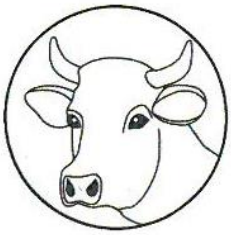
Examination

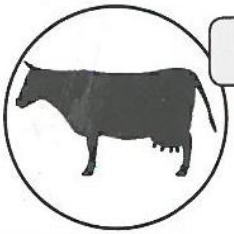
Temperature

- >40°C

Skin

- lumps in skin, all over the body
- lumps attached to underlying tissue





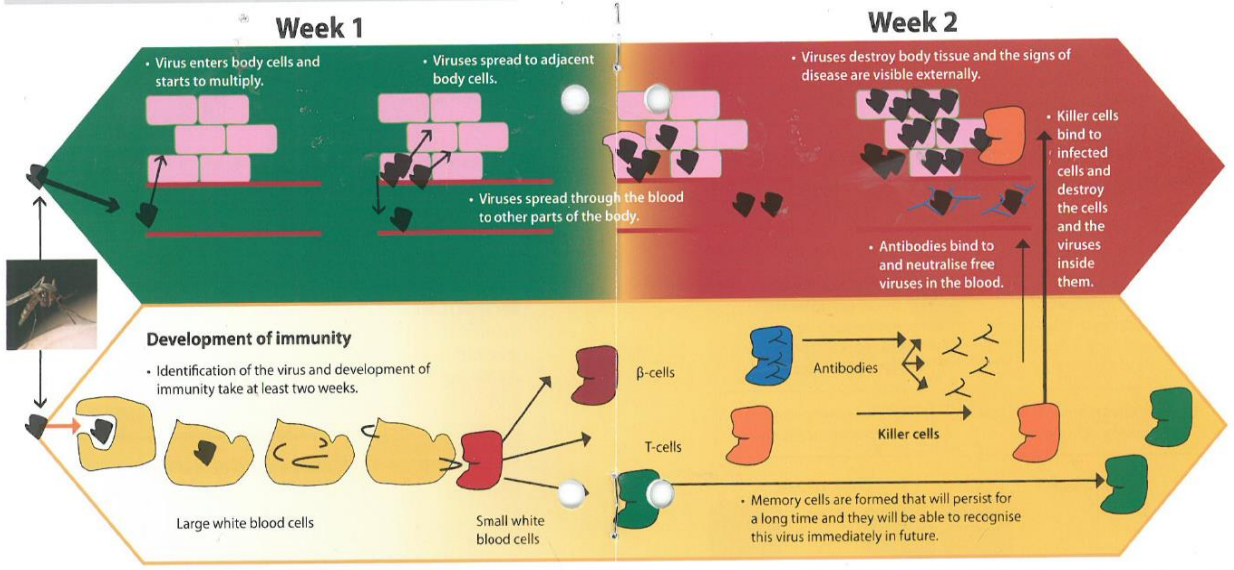
Lymph nodes

- enlarged

Distinctive signs of disease for these conditions are in the red blocks.

Graphical illustration of the disease development process for lumpy skin disease from transmission of the virus (infection) by the biting insect, until the first signs of disease are visible in the animal.

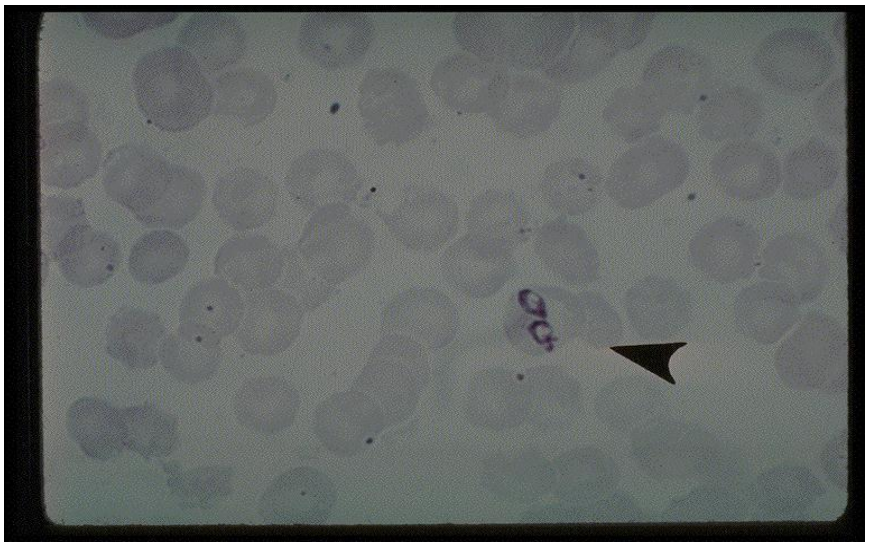
Remember, that the development process and the type of body cells infected differ for each viral disease.



After infection, the body develops immunity against the virus disease, but this takes **at least two weeks.**

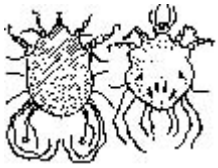
The limitation is that the development of protective immunity takes longer than disease development during which the disease causes damage to the body.

2.3.3 PARASITES



Parasites are organisms that have to live on or in other organisms, such as animals, in order to survive. Most parasites are easy to see, although some mites and the early stages of worms can only be seen under a microscope.

External parasites



Mites, Flies, lice, fleas, ticks and mites can cause serious diseases in animals.

Some live on the animals for their entire lives, others only spend part of their lives there, while others only visit to feed.

They can result in irritation and skin damage in animals. Some parasites can also pass diseases such as Redwater and three- day Stiff sickness between animals.

Internal parasites

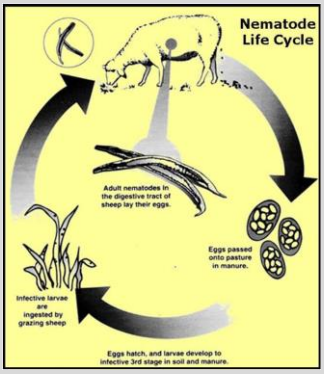
Internal parasites (including roundworms, flukes and tapeworms) can cause serious diseases and loss of production in animals.

They usually live in the stomach and intestines but also in other parts of the body such as the lungs and liver.

Sheep Parasites

In most sheep production areas, parasitism is the most common disease affecting sheep and lambs. Sheep are more susceptible to internal parasites than most other types of farm livestock. Their small fecal pellets disintegrate very easily thus releasing the worm larvae onto pastures, and they graze close to the soil surface and to their feces.

Internal Parasites

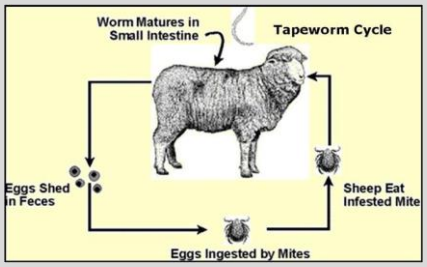


Gastro-Intestinal Nematodes

In warm, moist climates, the parasite that causes the most problems to sheep and lambs is *Haemonchus Contortus*, better known as the barber pole or wire worm. The symptom most commonly associated with barber pole worm infection is anemia, characterized by pale mucous membranes, especially in the lower eye lid; and bottle jaw, an accumulation (or swelling) of fluid under the jaw.

Stomach worms, usually of secondary importance, are *Trichostrongylus* spp. and *Ostertagia* spp. Their significance is typically as an additive effect in mixed infections with *Haemonchus*.

Tapeworms



Although dramatically large numbers of tapeworms may occupy the small intestine, damage to sheep is generally much less than that done by the gastrointestinal nematodes such as Haemonchus and Ostertagia. In extreme cases, tapeworms may cause intestinal blockages. Only certain anthelmintics are effective against tapeworms.

Lungworms

Wet, low-lying pastures and cool, damp weather favor the development of lungworm disease in sheep. Only in severe infestations do lungworms produce clinical disease, causing fever, coughing, nasal discharge, rapid breathing, and poor performance. Secondary infection by bacteria may cause death.

Liver Flukes

Liver flukes can cause death in sheep and lambs or liver damage in sub-acute cases. Liver flukes require snails as an intermediate host. Fencing sheep away from likely snail and slug habitats (e.g. ponds, swamps, wetlands, etc.) may help to prevent the problem.

Coccidia

Coccidia are single-cell protozoa that damage the lining of the small intestine. Coccidiosis is very common in sheep, especially young, growing lambs. Older sheep serve as sources of infection for young sheep.

Clinical signs include diarrhea (sometimes containing blood or mucous), dehydration, fever, weight loss, loss of appetite, anemia, and death. Outbreaks of coccidiosis are usually treated with sulfonamides and amprolium. Feed additives for the prevention of coccidiosis are also used.

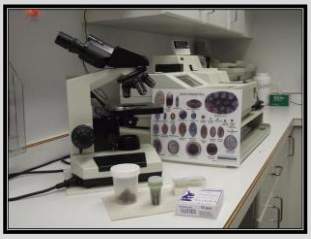
Good Management

Internal parasite control starts with good management and common sense. Sheep should not be fed on the ground. Feeders which cannot easily be contaminated with feces should be utilized for grain, hay, and minerals. Water should be clean and free from fecal matter. Pastures and pens should not be overstocked. When new sheep are acquired they should be isolated from the rest of the flock for 30 days and aggressively dewormed to prevent the introduction of drug-resistant worms.

Fecal Analysis

Fecal egg analysis is an important part of an internal parasite control program. A fecal analysis can tell you how contaminated your pasture is. It is also a valuable tool in determining if you have parasites that are resistant to the dewormers you use.

Proper Anthelmintic Use



Anthelmintics are an important part of parasite control. The weights of sheep and lambs must be known or approximated accurately in order to calculate the proper dosage of medicine. Underdosing results in the survival of worms which become resistant to the anthelmintic used. To lessen drug resistance, anthelmintics should be rotated on an annual basis.

External Parasites

Sheep louse

The sheep louse (*Bovicola ovis*) spends its entire life cycle on the sheep. Lice numbers can build up to create a heavy infestation in autumn and winter. Infected sheep can be seen rubbing against fences and often leave behind tags of wool. A lice infestation downgrades the quality of wool and the pelt. The best way to control lice is by dipping all the sheep on the farm three to four weeks after shearing, or by using a pour-on

insecticide immediately after shearing.

Sheep ked

The sheep ked (*Melophagus ovinus*) is often called a tick, but is a wingless, bloodsucking fly. Its entire life cycle is spent on a sheep, and if dislodged it can survive only about four days. Blood loss from a heavy infestation of keds can cause anemia in young lambs and reduced production in older sheep. Reduced capillary flow to the skin lowers the quality and quantity of wool, while ked feces and pupae give it a dirty appearance. Ked numbers build up in cool weather in full fleeced sheep. Keds can be controlled using a pour-on insecticide immediately after shearing or a saturation dip three to four weeks later.

Fly strike

Flies are attracted to lay their eggs in dirty, urine- or dung-stained wool, and on wounds. The emerging maggots eat the flesh of the living sheep. If untreated, the sheep can die from secondary complications such as septicemia or toxemia. Fly strike can be prevented by crutching to remove dirty wool from the sheep's tail, and by the application of topical insecticides.

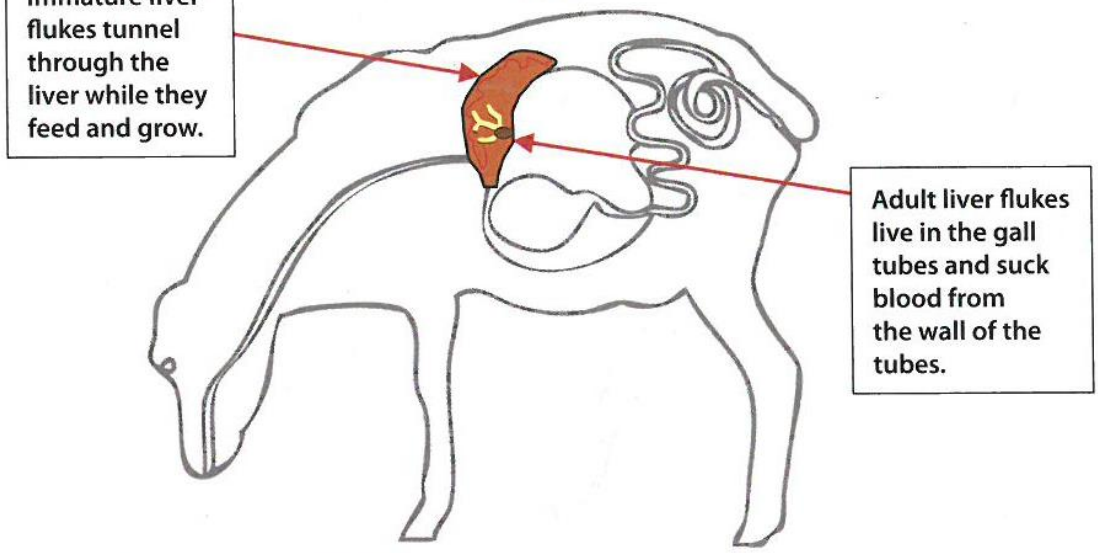
DISEASE OR PRODUCTION LOSS CAN BE TRIGGERED BY FIVE MAIN CAUSES AS DISCUSSED IN PREVIOUS MODULES

In this module, we focus on a specific kind of internal parasite called flukes.

Poisoning	Infection	**Parasites**	Nutrition	Injury

Liver flukes

A parasite that occurs in the liver of cattle, sheep and goats causing damage to this vital organ.

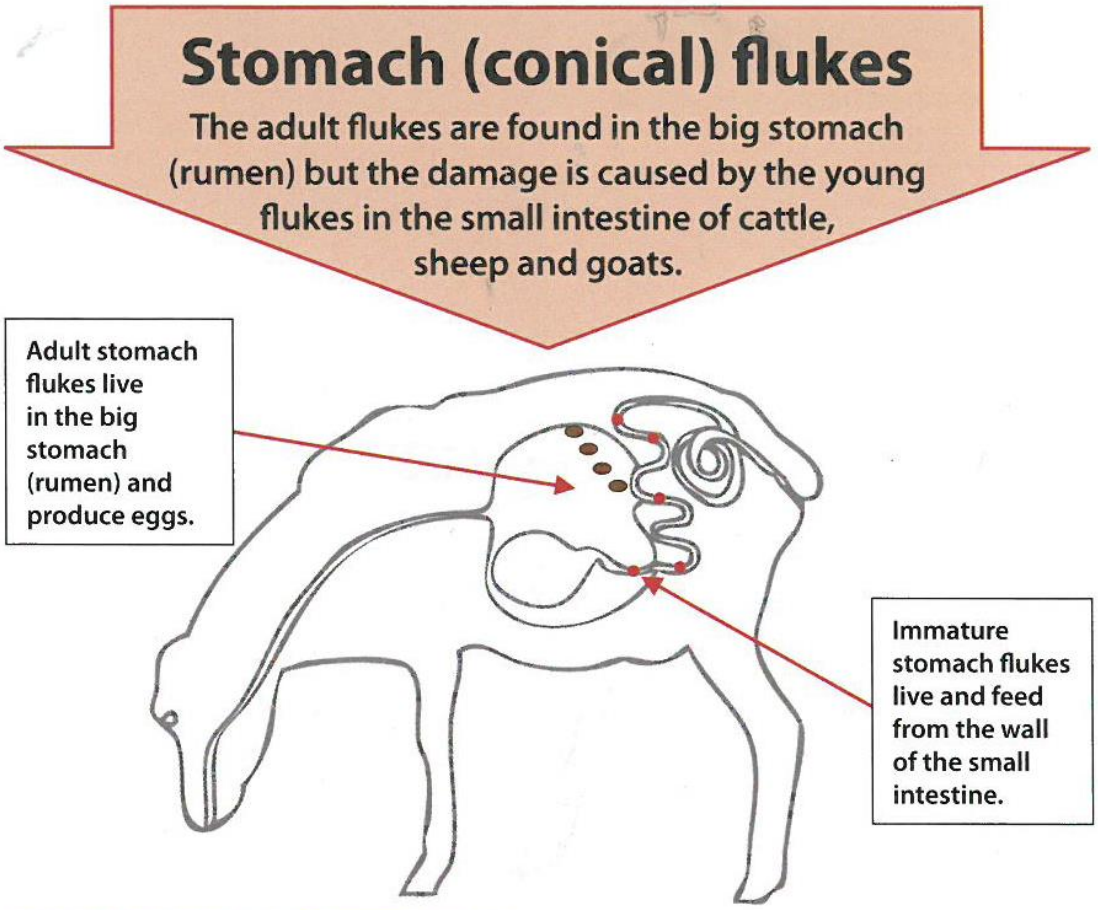


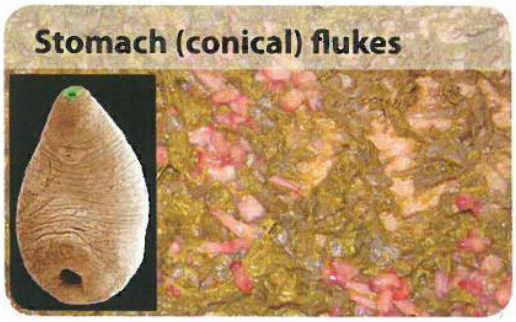
The liver is damaged by the immature flukes that tunnel through the liver tissue. The adult flukes in the gall tubes cause a reaction from the body and the tubes become thickened and can be obstructed by the flukes.

Both these endoparasites cause major continued losses and deaths annually in South Africa. Control can only be improved by a better understanding of these parasites.

Stomach (conical) flukes

The adult flukes are found in the big stomach (rumen) but the damage is caused by the young flukes in the small intestine of cattle, sheep and goats.





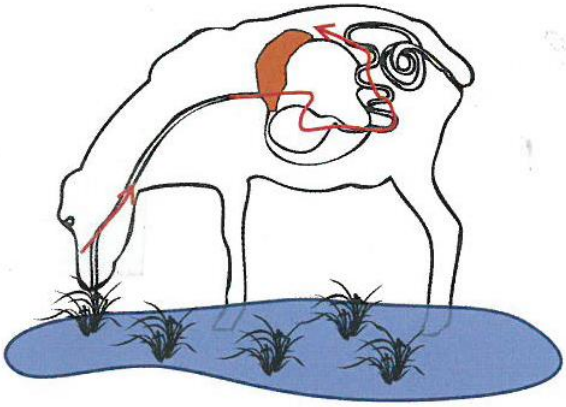
The lining (wall) of the small intestine is severely damaged by the immature flukes, which cause wounds, causing blood components to seep into the intestine, causing foul-smelling, watery diarrhoea.

LIVER FLUKE – DETAILED UNDERSTANDING OF THE

Start of infestation

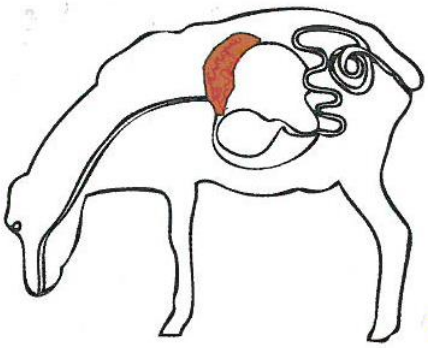
The signs of disease will depend on the number of infective flukes (high, medium or low) ingested by the animal.

The signs that will be seen with a medium to high infection are described here.



Week 1-8

Animals show rapid weight loss, weakness, signs of blood loss and even sudden death if the infestation rate is extremely high.



First signs of disease

Development of liver fluke inside

When the animals graze in wet areas they take in the immature flukes which are attached to plants.

Inside the animal, these immature flukes move through the wall of the small intestine, migrate to the liver and penetrate the liver.

The immature flukes will then start to eat liver tissue, forming small tunnels in the process.

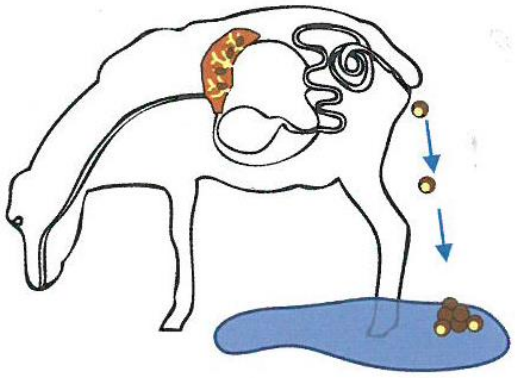
Immature flukes feed on the liver for the next six to eight weeks while growing, causing severe damage to the liver. **Liver damage depends on the number of immature flukes feeding on the liver tissue.**

By week eight, they become adult flukes that enter the small bile ducts (tubes) and migrate to the larger bile ducts.

DISEASE PROCESS THAT TAKES PLACE INSIDE THE ANIMAL

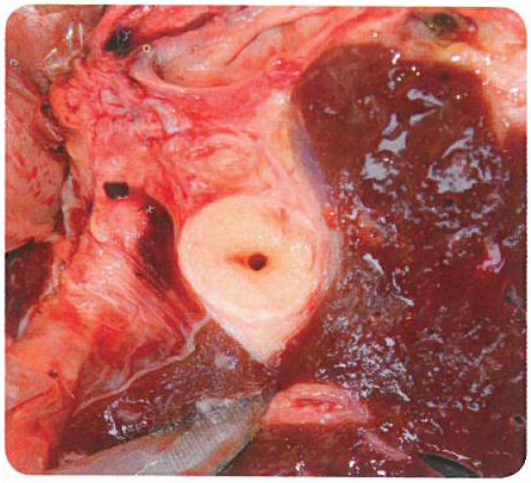
>12 Weeks

Affected sheep can fall behind when herded or develop bottle jaw – a sign of slow blood and protein loss. Continued weight loss especially during the period when the grazing is poor.



Examination of dead sheep

When a veterinarian cuts open the dead sheep he will look for signs of liver damage (thickened gall tubes) and flukes in the gall tubes.



cattle, sheep and goats

The adult flukes attach to the wall of the bile ducts and feed by drinking blood. After a month each adult starts to produce eggs (20 000 per day) which go with the bile into the intestine and out with the dung.

The thin walls of the bile ducts now become thickened and white and the whole liver can become hard (fibrotic) owing to the body's reaction to this infestation.

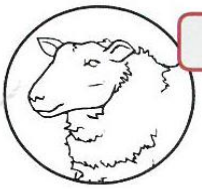
Diagnosis of infestation in the live animals

To confirm infestation in the live animal, dung must be collected and sent to the veterinarian for tests to determine if there is a liver fluke infestation. The newest tests can identify the infestation early (from four weeks after infestation), which will be at the time when the first signs of disease are observed in the case of a very severe infestation.

Sheep – bluetongue

Identification of disease with daily observation card

Observation

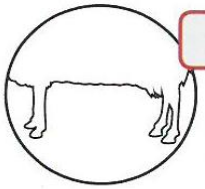


Mouth

- lips swollen
- face swollen

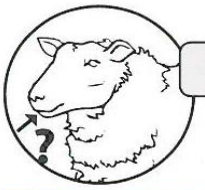
Rumen fill

- sunken in = empty



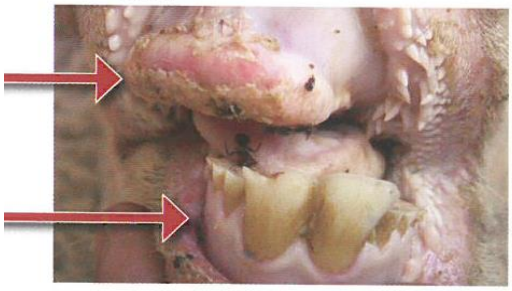
Walking

- lame in all four legs
- with difficulty

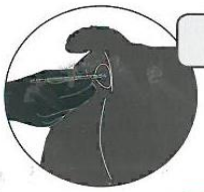


Eating

- doesn't eat

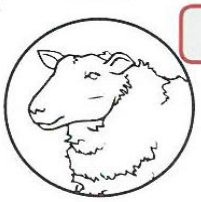


Examination



Temperature

- >40°C



Mouth inside

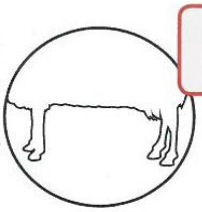
- sores on hard palate
- tongue is dark red/blue
- sores on lips

Nose

- slight excretion

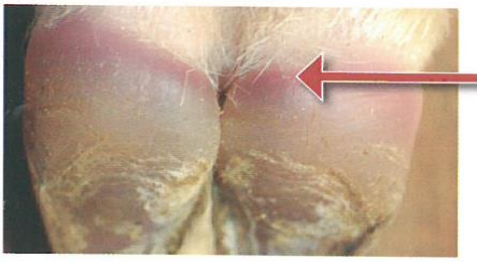
Eyes

- slight excretion



Front and back feet

- red line at the junction of the hoof and skin



Photos: Dr Johan van Rooyen

2.3.4 YEAST AND OTHER FUNGI

Years ago, all living organisms were classified into two kingdoms: plants and animals. Members of the fungus family were considered part of the plant kingdom, but in recent years biologists have decided that two kingdoms aren't adequate for classifying organisms, so they've gone to a five-kingdom system. Under the new system, the members of the fungus family have their very own kingdom. The fungus kingdom includes molds, mushrooms, yeasts, and lichens. Unlike bacteria and viruses, yeast and other fungi are multi-celled organisms. These organisms normally don't cause problems in healthy animals, but when an animal's immune system is already compromised, they can cause a variety of skin problems, respiratory problems, and mastitis (an infection in the udder, or milk-secreting gland, of a female animal). Often, these infections follow the use of antibiotics because the balance of normal flora has been upset, providing an opportunity for the existing yeast to go crazy.

Fungi

- Fungi occur widespread in the environment (soil, air and water) and include mould on stale food and mushrooms.
- Fungi need to grow on organic material in order to feed, and this can include animals and people.
- An example of a fungal disease in animals is ringworm.
- Some fungi are normally harmless, but can cause disease in some situations, especially after prolonged use of antibiotics.
- Some fungi can also produce toxins or poisons which can be a problem when food becomes stale or wet.

2.4. DIETARY ELEMENTS

There are hundreds of different ailments that can cause problems and thousands of different causative agents for those ailments. As you get more involved in animal agriculture, you'll need to get at least one or two books that specifically address animal health. The few illnesses that will be mentioned here are some of the most common problems that farmers deal with, but even these can be the result of myriad causative agents. Read more and talk to your professional veterinarian.

2.4.1 Scours

In adult animals, scours aren't usually fatal. Most often, adult diarrhea is the result of a change in diet or of consuming very lush pasture. Cases of diarrhea caused by diet change will clear up in two or three days, and don't have many other symptoms than the diarrhea itself. Lush-pasture diarrhea will continue for as long as the high-quality, moist feed lasts; but, like change-of-diet cases, it doesn't tend to have other symptoms associated with it. If you haven't adjusted the animal's diet, or it's not on lush pasture, the next most common cause of adult scours is excessive parasite loads. Parasitic scours typically aren't accompanied by a fever, but the animal will appear lethargic, and its coat may be dull. Diagnosis of parasitic scours require a stool sample to be checked by your vet (unless you actually see worms in the stool). If an adult animal is both suffering from diarrhea and running a fever, it's probably time to call your veterinarian. The animal is either suffering from a viral or a bacterial case of scours.

Scours in baby animals – say, less than a month old – is always a very serious and life-threatening situation. Normal baby animal stools are yellowish and tend to be kind of gooey, life soft Silly Putty. Sometimes the stools may stick to the tail-head for the first day or two – during fly season this should be wiped away, if possible, to prevent screw flies from laying their eggs in the mess. The eggs develop into maggots, and the maggots don't stop eating when the manure is gone. In short order, they can do terrible damage to the baby animal, possibly even causing death.

With scours in very young animals, the stool becomes watery, or sometimes slimy, and if left untreated the baby will die within a few days. Scours is quite common in bottle babies – those being fed by humans instead of their mothers. The most prevalent cause of scours in bottle babies is overfeeding, especially of milk. The scours caused by overfeeding is the most easily cured kind, but without treatment it can take an otherwise healthy baby animal out in just a few days.

Other causes of scours in babies include the bad guys: bacteria, viruses, and parasites. One of the worst bad guys that we've had personal experience with is K-99 Escherichia coli. E. coli is a

common and generally beneficial bacterium found in the gut of most animals. There are many strains of E. coli, but the strain that microbiologists have dubbed K-99 is highly contagious in baby animals during the first few days of life, and it's very deadly. Once we knew what the problem was, we were able to treat all the rest of the calves that were born that summer with a colostrums supplement of K-99 antibodies. K-99 scours sets in within the first 3 or 4 days of life. Common causes of scours in the 5- to 15-days-of-life range include rotavirus and coronavirus; at 2 to 6 weeks of life, salmonella species of bacteria are the primary culprits.

Treatment for scours

Treatment of scours should be instituted as soon as the problem is recognized. The first thing to do is replace fluids and electrolytes. Electrolytes are basically the "salt" molecules that are normally found in the bloodstream and include such elements as calcium, potassium, sodium, and magnesium. Commercial electrolyte solutions are available at most feed stores, farm supply houses, or from your vet. We always made a homemade concoction. Electrolyte therapy is good not only for scours but also for any illness that might cause dehydration. With an adult animal, simply provide a pan of water that has electrolytes mixed in.

If you're treating a baby animal, dilute its normal milk ration by half with water. Between the milk feedings, feed it a comparable ration of your electrolyte solution. For example, if an 80-pound (36.3 kg) calf is receiving 4 quarts (3.8 L) of milk per day (a whole-milk ration that weighs approximately 10 percent of its body weight) during two feedings, mix 1 quart (0.95 L) of whole milk with 1 quart of water at each feeding. Between the two daytime feedings, and again just before bed, feed it 12 quarts (1.9 L) of electrolyte. Don't feed the electrolyte with the milk, because the digestive process interferes with absorption of the electrolytes into the animal's system. Babies suffering from the overeating version of scours require no more treatment than this, but you should continue it for 2 to 4 days or until the stools return to normal. If you do suspect that the scours is being caused by a pathogen, antibiotics may be in order – check with your vet.

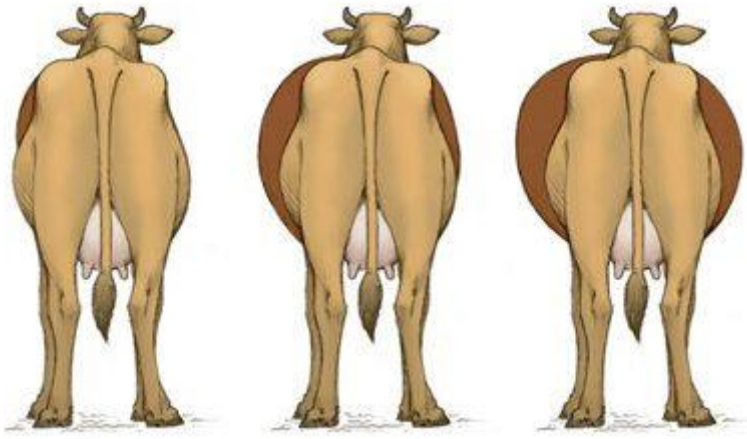
If the animal you are treating for scours is a ruminant, helping its normal flora return is crucial. The best way I know of, if you can get close up to a healthy herd mate that is chewing its cud, is to reach into its mouth and grab out the bolus of cud before the animal knows what hit is (yes, it's gross the first time you do it); then insert the bolus as far as possible down the throat of the ill animal, so that it swallows the bolus. The bolus from the healthy animal is full of good bacteria, and acts to recharge the ill animal's system.

2.4.2 Bloat

Limited to ruminants, bloat is a hazard when you're using a grazing system. Bloat is caused when excessive quantities of gas become trapped in the rumen; in extreme cases, it can be deadly within an hour or two. It is usually the result of eating lush, leguminous pasture, and is aggravated by moisture from dew or rain. It is most common on alfalfa, slightly less common on clover, and doesn't happen on bird's-foot trefoil pastures. Pastures with a high percentage of grass compared to legumes are the least likely to cause bloat, but even these can do it in early spring.

The most prominent symptom of bloat is a bulge on the animal's left side, just below the spine and in front of the hip bone. This area usually appears caved in, but in a bloating animal it sticks out. Bloating animals also quit eating and quit belching.

Ruminants on pasture need to be watched for the first signs of bloat, especially in spring. To avoid it in the first place, limit access to lush pasture first thing in the morning, or right after rain, until the animals are well acclimated to the pasture. Feed some hay prior to turning them onto pasture and leave them on pastures for short periods of time – 45 minutes to an hour is good to start.



Cattle bloat can range from mild to heavy to dangerous.

Treatment for bloat

Normally you have cases of bloat at the start of each grazing season. For cows, administer a mixture of 1 cup (236 ml) cooking oil, 1 cup (236 ml) water, and 3 tablespoons (44 ml) baking soda, mixed well. (A squirt water bottle – the kind bike riders and hikers use – works well, just dribble the contents into the animal's mouth over a few minutes. They don't get it all, but they get enough.) Sheep and goats are much less likely to suffer bloat, but if they do, administer about one-fourth of the above mixture. After the animal drinks its "medicine", tie a stick in its mouth – sort of like a bit. This gets the tongue working, which helps kick-start the belching process.

As soon as the animal begins belching, you can watch its side go back down. In serious cases, a stomach tube can be passed down the animal's throat and into the rumen; the gas escapes out the tube. Stomach tubes can be purchased, but in a pinch use 10 feet (3.1 m) of garden hose, with any sharp edges filed smooth.

The last resort, and it should be used only in life-or-death situations, is to cut right through the animal's side and into its rumen. Vets carry a two-part tool for this purpose, called a trocar and cannula. In lieu of the trocar and cannula, a sterilized knife (boil in water, or soak in bleach, for about 5 minutes) might save the animal's life. In either case, the animal will need to be placed on antibiotics, because infection is bound to follow cutting into the rumen.

2.4.3 Hardware disease

Unless you purchase a piece of completely bare land that has never had any buildings on it, chances are that you will, at some point, come up with hardware disease if you have any cows. Even baby calves can suffer from it. Sometimes it can happen in other ruminants, but it's most prevalent in livestock.

Hardware disease is caused when the animal eats a sharp piece of metal, such as a nail or a small hung of wire. The piece becomes trapped in the reticulum and can puncture the wall. Symptoms include obvious pain, kicking at the side, a slight rise in temperature, and getting up and lying down repeatedly. If left untreated, death may result.

Treatment for hardware disease

The cure, at least, is simple. Insert a cow magnet in the cow's stomach to "catch" the hardware. Some livestock men insert magnets as a matter of course into all their animals; we simply kept magnets on hand, in our vet supplies, and inserted them when an animal showed the signs. If the problem is indeed hardware disease, the animal recovers almost immediately when the magnet is inserted.

Inserting a magnet can be done by hand or with the help of a bolus, or balling, gun. Much like feeding a pill to a dog, the goal is to get the magnet all the way down the back of the animal's throat so that it swallows the magnet. When done by hand on a full-grown cow, you must insert your arm into the cow's mouth, halfway up to the elbow! The magnet remains in the animal's reticulum for the rest of its life and attracts and holds onto any pieces of metal the animal swallows.

2.5. OTHER HEALTH PROBLEMS

2.5.1 Pneumonia and other respiratory disorders

Respiratory illnesses can occur in all species and are often caused by some of the normal flora that has gotten out of control when an animal is stressed. Stress caused by poor management (such as drafts or ammonia fumes in buildings, and poor nutrition) or transportation of animals is often the underlying cause of respiratory illnesses. It is very common in young animals of all species.

Treatment for respiratory disease

If mature animals have no fever and are still eating well, we simply keep an eye on them, but respiratory illness in young animals is again far more serious. Keep them warm, administer electrolytes, and call the vet if the problem persists for more than 24 hours or seems to be getting worse.

If your animals are going to come into contact with other animals – for example, if you plan to show then, or if you'll be bringing new animals in and out of your herd – many contagious respiratory diseases can be prevented through vaccination.

2.5.2 Poisoning

Animals can be poisoned by chemicals (such as insecticides and dips), poisonous plants and fungal toxins. They can also be bitten by snakes, scorpions and spiders.

2.5.3 Dietary problems

Lack of enough food or lack of a particular part of the food (such as phosphorus) can also cause disease. Malnourished animals may develop other diseases because they are weak.

2.5.4 Metabolic diseases

Metabolic diseases are an upset in the normal functioning of the animal (that is not caused by infection, poisoning or feed deficiencies) and usually result from intensive animal production. An example is milk fever in highly productive dairy cows.

2.5.5 Congenital diseases

In some cases, animals can be born with a disease. Some of these may be inherited (passed on from the parents). This is rare, and inherited diseases are usually seen at birth. An example is congenital hydrocephalus, which is a swelling of the brain caused by fluid, and can be clearly seen as a swelling of the head.

2.5.6 Environmental diseases

Environmental problems, such as littering, contribute to some diseases, for example, animals may eat plastic bags or wires, and this can harm the animal's health.

2.5.7 Cancer

Cancer occurs when some of the cells in the body grow in a way that is different from normal. Illness occurs because of the pressure of the growth on other parts of the body and the fact that affected parts of the body cannot function normally.

Cancer can also cause signs such as fever and loss of condition. In some instances, viruses can cause cancer.

2.5.8 Allergies

Some diseases are caused by allergies, which is when the body's own immune system attacks part of the body.

2.5.9 Degenerative disease

Some diseases are caused by parts of the body breaking down, particularly as an animal becomes older.

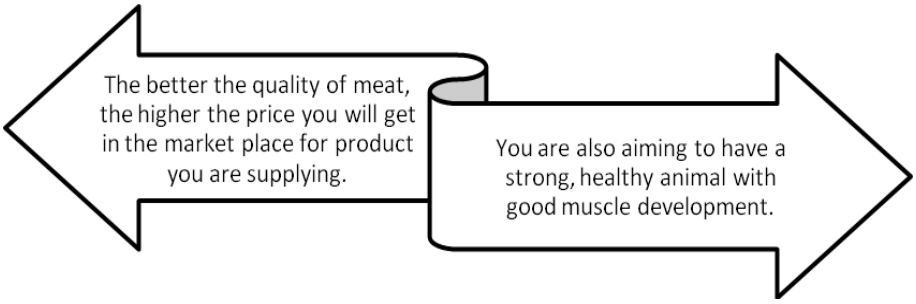
In order to make decisions about administering treatments such as vaccines or physical interventions, it is necessary to think carefully about the possible effect that the treatment might have on a diseased animal. It is very important to know what signs to look for in order to ensure that animals that are not entirely healthy are not treated with unnecessary preventive health vaccines. In some cases, the treatments that are administered may even be a veterinary response to ensure that the animal is treated for disease.

1.C. <u>Individual Formative Exercise</u>:

3. Keep Livestock Healthy and Safe

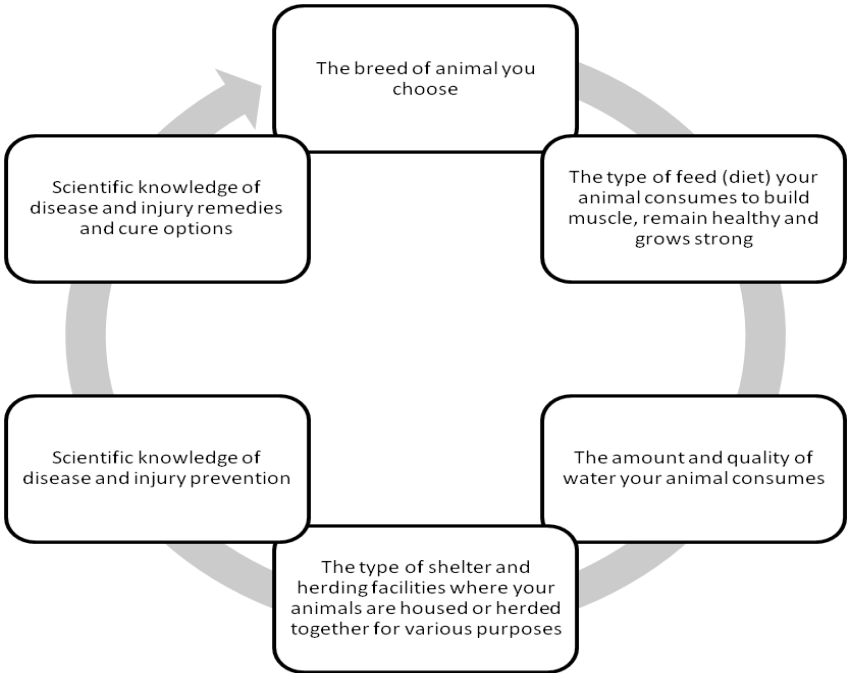
3.1. WHY IS IT SO IMPORTANT TO KEEP YOUR BEEF HERD AND SHEEP FLOCK SAFE, HEALTHY AND STRESS FREE

The main purpose of farming with livestock is to raise an animal that can be slaughtered to provide high quality, healthy meat to feed humans.



Remember that the muscle development is what allows for weight and volume of the meat product that you are producing.

In order to ensure that your livestock are fit, well muscled, and healthy and that you can eventually harvest the best quality meat from the carcass, you need to consider various factors in keeping the animals happy, healthy, safe and stress free.



Factors to consider in heard management for livestock

Understanding the concept of livestock treatments

Definition:

Livestock treatments: are any human, mechanical or chemical actions or interventions that take place during the production phase to ensure that the animal remains safe, identifiable and healthy. It also includes actions concerned with minimising problem animal behaviour that might cause injury to animals.

3.2. DIFFERENT TYPES OF LIVESTOCK TREATMENT

Activity

Can you think of something you could do to:

- ✓ Keep livestock from injuring themselves in a feedlot?
- ✓ Ensure that livestock (especially calves and steers), do not get injured due to

  natural aggression?

	✓ Keep your livestock safe and secure and prevent them from getting lost or stolen? ✓ Keep livestock from getting sick or poisoned? ✓ Ensure that livestock do not get sick or injured whilst being transported, moved or herded? ✓ Ensure that the crop (meat) does not get contaminated or poisoned, by unnecessary chemicals or poisons whilst the animal is still alive, and is safe for human consumption? ✓ Ensure that you optimise the meat quality and volume in beef livestock to ensure the best possible grade and volume of meat?

Options available for livestock treatments:

Safety and identification of animals in the herd	Injury prevention	Preventive and curative health
✓ Marking and / or Branding ✓ Erecting fencing ✓ Erecting pens and feedlots	✓ Thinking carefully about herd selection ✓ Castration of steers to prevent natural male aggression ✓ Dehorning of calves and steers to avoid injury during aggressive behaviour or when animals are closely confined (e.g., during transportation or in crushes).	✓ Vaccines ✓ Grazing and feeding systems ✓ Scientific supplements to diets ✓ Volume and quality of watering systems ✓ Medicines and other vet nary interventions such as selective breeding practice, artificial insemination, etc.

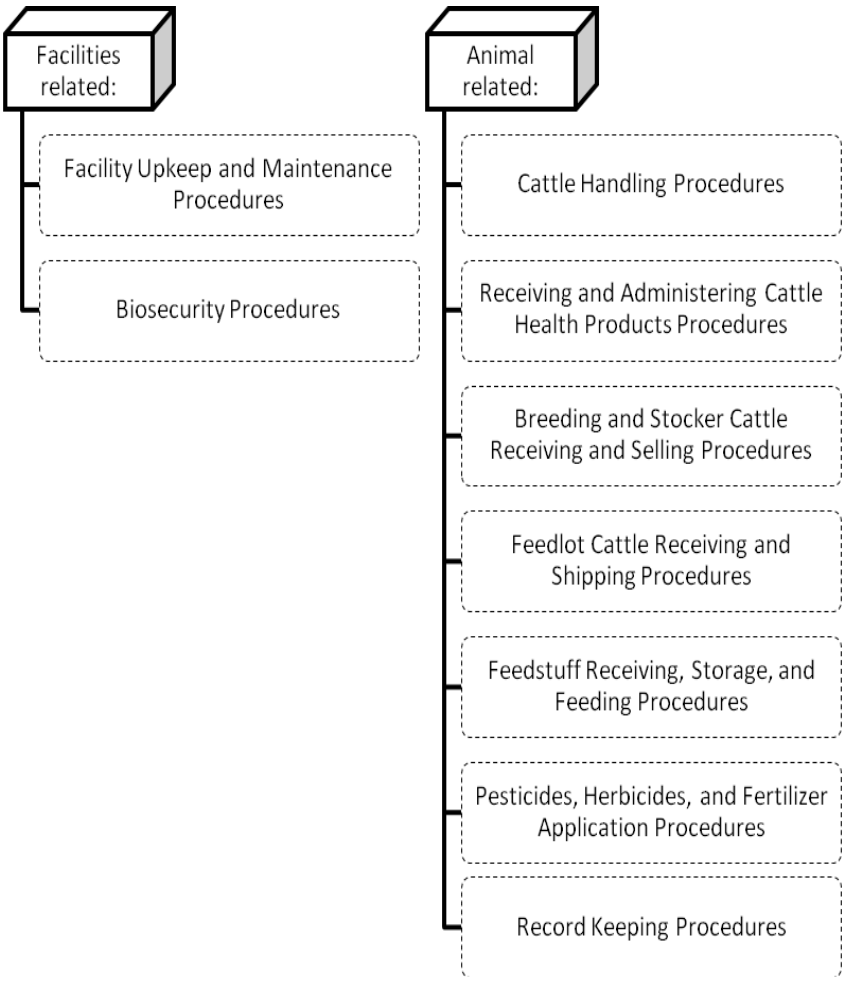
	✓ Considering the design and layout of housing, feedlots, crushes and vehicles for transportation	

3.3. STANDARD OPERATING PROCEDURES FOR LIVESTOCK TREATMENTS

In order to understand all the elements related to livestock treatments, we have adapted information from the Samuel Noble Roberts foundation to create a comprehensive "best practice" checklist of all the procedures and elements to consider when administering livestock treatments for beef livestock.

This checklist is a practical working document, and we have attached it below in your learner study guide and have labelled it *Attachment A: Checklist for livestock treatment procedures.*

The main areas included in the checklist are as follows:



Livestock medicines are an important tool in the treatment and prevention of diseases. Correct treatment methods assure the safety of food products and insure an effective response to treatment.

Consider the following points before treating livestock.

- **Drug selection**

  Select the correct therapy. Consult your veterinarian for advice on the correct medication, the route of treatment, the treatment dosage, the time between treatments and the number of treatments. Veterinarians should leave clear written instructions with the herd owner identifying the treated animal and giving information on the treatment protocol. The veterinarian also plays an important role in monitoring the response to treatment.

- **Treatment method**

  Treatment must be given correctly to be effective and to prevent complications. Use the following guidelines to develop good treatment habits.

  - Wash your hands before and after handling livestock medicines.
  - Use proper equipment: Choose the correct syringe and needle size for the dosage and the type of injection to be given.
  - For intramuscular injection use a 1 ½", 16 or 18 gauge needle to insure the drug reaches into the muscle and not just under the skin. Before injecting, pull back on the plunger to ensure the needle tip is not in a blood vessel. Select appropriate injection sites with the help of your veterinarian. Read the label for the maximum amount to be injected in one site.
  - For subcutaneous injection use a ½" to 1", 16- or 18-gauge needle. Check that the needle tip is moveable. Inject a small amount of drug to see if a bulge is formed in the area of the needle tip. This will verify that the needle is under the skin and not in the muscle. Inject only in sites recommended by your veterinarian.
  - Inject only in clean body sites.
  - Use clean equipment. Singly used, sterile, disposable needles and syringes are preferred.
  - Give repeated injections in different body sites.
  - Before infusing antibiotics into the udder, wash the teat and your hands and dry with singly used paper towels. Disinfect the teat with an alcohol swab provided in the medication package. Avoid touching the infusion canula at the end of the treatment tube. Only use single dose infusion productions in disposable syringes. Dip the teat after infusion of medication.

- **Dosage calculation**

  To calculate the correct dosage, you must know the weight of the animal and the dosage rate. For example, treat a 600 kg cow with procaine penicillin.
  Prescription on the label: dosage = 2.5 ml per 100 kg of body weight once a day.
  Calculation: 600 kg bodyweight divided by 100 x 2.5 ml = 15 ml

  One millilitre (ml) and one cubic centimetre (cc) represent the same volume and are interchangeable in calculating drug dosages.

3.4. ROUTES OF ADMINISTERING TREATMENTS: EXTERNAL

The choice of drug and route of administration are determined by the disease, the species, breed, size, etc. Different routes can be used for administering a drug.

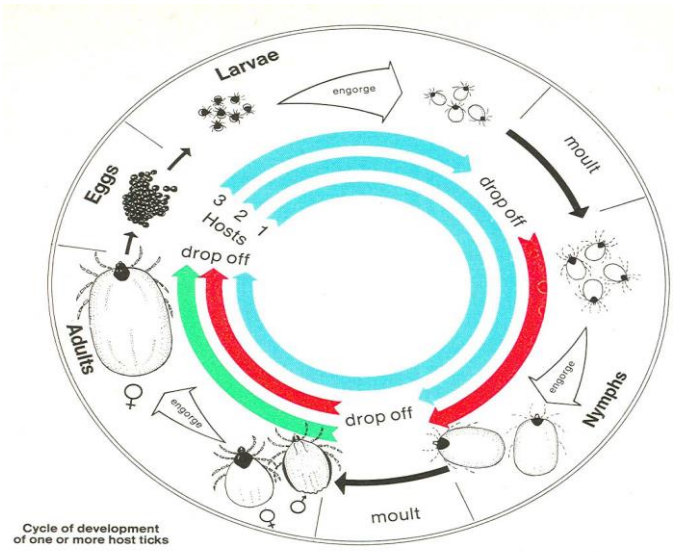
3.4.1 External application

Treatment of animals for external parasites

For the treatment and control of external parasites, local application of certain substances (e.g. dipping compounds) to the skin by means of various methods, are discussed forthwith.

External parasites (dipping)

Engorging tick; some tick species are stated to ingest up to 4 ml of blood



Cycle of development of one or more host ticks

Cattle

- Plunge dip
- Spray-races
- Hand spraying
- Hand dressing
- Pour-on solution

Sheep

- Plunge dipping
- Foot-and belly dipping

Horses

- Dip or spray
- Hand spraying
- Dusting with dip powders

Livestock Cattle

Plunge-dip

Previously, when arsenic was the most important dipping-substance, large dipping tanks were generally used as it forced the animal to swim through, thus ensuring it to be in contact with the dipping-fluid for a longer period. Nowadays only proper wetting of the animal with the modem organic dipping-compounds is necessary.

Smaller dipping-tanks are now recommended (± 15 000 litre) as this helps in keeping costs down when making use of the more expensive dipping-compounds. For efficient control of parasites, it is essential to wet the whole animal with a properly constituted dip-wash at the correct strength. (To obtain this the label on the container should always be read carefully). The dipping-tank must be constructed in such a way that there are 5 to 6 steps at the entrance leading down to the water-level. This provides the animal with something to kick against when jumping into the tank, positioning the animal's body in such a way that the head is forced below the water surface when it plunges, ensuring complete wetting with the dip wash.

To maintain the dip-wash of modern dips at the correct strength, (tank tests are time consuming or not available) it is easy and fairly accurate if done in the following way:

- Calibrate the tank and mark each 500 litres on the wall of the tank as well as on the dipstick.
- After preparing the contents of the dipping-tank correctly at the fresh filling rate, record the tank level when the day's dipping is completed.
- Before commencing the next dipping, measure the tank-capacity and compare this with that at the end of the previous dipping to establish whether rain has diluted the dip-wash.
- If the latter is the case replenish with dipping fluid necessary for the volume of extra water which has entered the tank.

This easy, on the spot check, when done regularly at each dipping, will ensure a fairly accurate dip-strength.

To protect the dip-wash in the tank as much as possible, avoid dirt and exposure to the sun. A footpath, 3-5 meters long, through which the animals have to walk before plunging, is of great help to clean the hooves and avoid soiling of the dip-wash. A well constructed roof over the tank, to avoid evaporation and to prevent dilution by rain, is just as essential as a footbath.

Spray-races

The spraying of livestock was adopted with the introduction of modem organic chemicals which were more costly and more difficult to test than arsenic; and so the development of the spray-race. Spraying of livestock has the advantage that the dip is freshly made up at full strength before it is used, thereby giving maximum control and at the same time any uncertainty regarding the dip strength is eliminated.

The spray-race has an advantage to plunge-dips, provided the following point are observed:

- Only use a manufactured spray-race approved by a pharmaceutical company.
- These are synchronised with regard to the size of the nozzle, type of nozzle, speed of the pump, size of the pump, the pressure and position of the pipes and nozzles in order to ensure proper wetting of all parts of the animal,
- Mix enough dip required for the day's spraying so that no dirty dip remains in the sump or pump until the next dipping.
- Flush all pipes and the sump with clean water after use to prevent blocking.
- Ensure that the pump pulley runs at $\pm$ 2 000 rpm. When all nozzles deliver freely, this ensures a delivery rate of 700 litres per minute at a pressure of 1, 4 bar.
- Ensure that all the nozzles and the strainer are clean before spraying is started. Use clean water only.

- Never build a spray-race near to or under trees, as seeds and leaves may block the strainer and nozzles.
- Build the spray-race with the entrance facing north, if possible. In doing this, the animals, when entering, will walk away from the sun and not facing it. Also keep in mind the prevailing winds when erecting a spray-race.
- Wetting of the ears and under the tail is not always as efficient as in a plunge dip, necessitating special attention to these parts (e.g., hand-dressing).

Hand-spraying

This should only be used when less than 25 animals are involved. It has been proved over and over again. When herds (larger than 25 head) were hand-sprayed weekly, the affectivity is greatly diminishing. It must be remembered that for hand spraying at least 10 litres of dip-wash is required per animal in order to wet it properly. It is also very difficult to wet all parts of beast standing still. Moreover, a high-pressure spray pump is needed to ensure thorough wetting of the skin.

Hand-dressing

This method is sometimes used where animals cannot be brought to the dipping-tank or where a sever infestation of ticks are present, clustering the ears and underneath the tail.

Only apply hand-dressing materials (patch-treatment) to parts where ticks are clustering. Never treat large areas of the animal, as the animal may become poisoned.

Products such as "Tick dressing S" (chlorphenvinphos) can be used for livestock.

- Pour-on solutions

  Products that can be poured on or painted on the infected parts of livestock and sheep/goats include: "Drastic Deadline", "Clout" and "Swift Pour-on".
- Aerosol

  An aerosol product such as "Bacdip aerosol" can be applied to heavily infected body parts.

Calibration of dip- or spray-tanks

The most accurate way to fill a dipping-tank is by using an open oil drum as a measure. When filled to the top of the drum contains 200 litres.

The dipping-tank is filled with this container. Every time a container is emptied into the dipping-tank's sump, the dipstick is marked (calibrated) clearly at the same time. The dipstick is ten used to measure the remains after a day's dipping session.

The following formula can be employed:

Dipping tanks:

Measure

a. = length at water-level
b. = length at bottom
c. = breadth at water-level
d. = breadth at bottom
e. = depth of water

Now calculate as follows:

$\frac{a+b}{2} \times \frac{d+c}{2} \times e$ = cubic capacity of dip-tank

NB: 1 cubic metre = 1 000 litres

Spray-races: Measure:

a. = length of sump
b. = width of sump
c. = depth of sump

Now calculate as follows:

a x b x c = cubic capacity of the spray-race sump. Add the capacity of the sump foot valve.

Livestock Sheep

Plunge-dipping

Two types of dipping-tanks are recommended: the oblong dipping-tank and the circular dipping-tank. Both types work extremely well, provided the following requirements are full filled:

- The draining-pen must be well constructed to facilitate draining and should be large enough to allow complete draining without delaying the dipping-process.
- The sheep handling-facilities (i.e., kraals etc.) must be adequate in order that it do not slow down the dipping process.
- The exact capacity of the dipping-tank should be known to ease the preparation (correct concentration) of dip-wash for the dipping process.
- The dipping-tank must be calibrated to facilitate accurate replenishing.
- The presence of a replenishing tank next to the dip will speed up the dipping process and ensure that the dip-concentration is maintained.
- Ensure that each sheep is plunged underneath the fluid level at least twice for proper wetting.

NB: There is a distinct advantage in dipping sheep when the wool is short, i.e., 10-14 days after shearing – both as far as thorough wetting and economy are concerned.

Food- and belly-dipping

Foot-dipping is recommended for the control of the paralysis ticks. The depth of water through which the animals walk, should be 15 to 30cm. Belly-dipping is recommended for the control of the paralysis ticks. The depth of the dip-wash should be 50-60cm.

Maintenance of dip-strength

This point cannot be overstressed when dipping sheep. Whether it is plunge, foot or belly dip, the following points must be kept in mind:

- The exact capacity of the dipping-tank must be known to establish the dip-wash's correct strength initially.
- Replenishing must be done regularly and continuously to maintain the correct strength.
- This will ensure that the first as well as the last animal dipped will come into contact with the correct concentration of dip-wash to ensure good results.

  Larger dipping-tanks (4 000 to 5 000 litres capacity) are replenished less often than smaller tanks (2 000 to 3 000 litres). Nevertheless, it is essential to replenish with fresh water and

dipping-compound at the prescribed replenishing rate, before one third of the dip wash has been removed by the animals.

- There is a lot of merit in constant replenishing from a replenishing tank standing next to the dipping-tank. In the case of belly-dipping or foot-dipping where the dip-wash depth is of the utmost importance. The constant replenishment method is also recommended. This ensures both correct strength and depth of dip-wash throughout the dipping process.

ROUTES OF ADMINISTERING TREATMENTS: ORAL

- By means of food or water
- By means of a tablet pistol
- Dosing of fluids by means of a dosing syringe
- Drenching by means of a stomach tube

ROUTES OF ADMINISTERING TREATMENTS: VACCINATIONS

The basic principle of vaccination is that a disease-causing agent is given to an animal in a killed or weakened form (or in the form of proteins genetically engineered to look like a disease-causing agent), in order to stimulate the production of antibodies to fight off the disease.

Why do we vaccinate livestock? Of course, the reason is to attempt to prevent disease. However, if our timing is wrong, we can actually make the conditions worse.

Vaccination isn't the same as immunization. When we vaccinate, we hope that immunization occurs — but this isn't always the case. In order to have good immunity, the calf must be able to respond to vaccination. This simple premise is often overlooked because we tend to take immunity for granted. There are several reasons that vaccinations may not result in immunity, but the most common is probably stress- related.

These stressors cause the release of a host of hormones that will hamper the immune response. Cortisol is possibly the most important of these hormones. It's so effective in shutting down the immune system, it's commonly used to control hyper immune reactions (allergic reactions) in people.

In order for the stressed animal to respond to vaccination, we must allow the animal time to recover from his stress episode. Wait at least 12 hours after arrival before processing.

Vaccinating livestock while they're still under stress is kind of like swinging the bat before the pitcher releases the ball. It's simply going through the motion. We can say the job is done, but we can't say it was done well or done right.

If the job is to be done well, we must apply the principles of good animal husbandry: clean water, high quality feed, a comfortable place to rest and time to rest. If these are provided, the animal will be able to clear these excessive stress-related hormones from the bloodstream. Once this occurs, the animal will have a greater chance of responding to the vaccines and should actually become immunized.

Immunity isn't automatic. It shouldn't be taken for granted that just because we administered a vaccine to an animal, it is immunized. We have to give the animal the best opportunity we can to develop immunity.
When you look at the vaccines available for a particular disease, it's tempting to view them as equal, but there may be vast differences in what they actually do or are designed to do.

Many producers are well versed in the tradeoffs between using killed (inactivated) and modified-live virus (MLV) vaccines. Generally, killed vaccines work by stimulating humoral immunity — where viral or bacterial antigens induce an immune response. The result is the production of antibodies that circulate in the bloodstream and bind with the disease-causing bacteria or virus and neutralize them.

MLV vaccines, on the other hand, stimulate cell-mediated immunity (CMI), as well as humoral immunity. In simple terms, CMI works at the cellular level to destroy viruses that take over normal cellular function in order to replicate themselves.

Depending on how a particular disease organism works, killed vaccines may be sufficient. In other cases, MLV vaccines may be required to offer adequate protection. Hollis says a classic example is infectious bovine rhinotracheitis (IBR). Managing the disease requires CMI attacking and killing the virus within the cells; humoral immune response isn't effective by itself.

But even vaccines of the same type can provide different levels of protection. In fact, vaccine labels describe the level of protection.

- Injections (parental administration) and vaccination of animals.

  This implies injecting a substance into the body of the animal. The administration thereof also requires, with a few exceptions, the cleaning of the skin (with a disinfectant) as well as the disinfection of the lid of the bottle containing the drug which is to be used. Care must be taken when working with live vaccines. (e.g., vaccines against virus diseases) so as not to destroy the vaccine in the process of cleaning. Sterile needles and syringes should be used (sterilisation should preferably be done by boiling the instruments in soft water for 20-30 minutes). The person giving the injection should possess a sound knowledge of the anatomy of the animal regarding the muscles, veins and nerves. The animal must be effectively restrained for the correct technique of administration. After the needle has been pushed into the injection-site, it is advisable to connect the syringe and draw back the plunger to ensure that the needle is correctly placed. (Withdrawal of blood into the syringe is an indication that a blood vessel has been penetrated). Where possible, a clean needle should be used for every animal to prevent transmission of diseases and germs.

Routes used for injections

There are various methods for vaccinating livestock:

- Subcutaneous
- Intramuscularly
- Intravenous
- Intra-mammary
- Intra-vaginal and intra-uterine
- Rectal

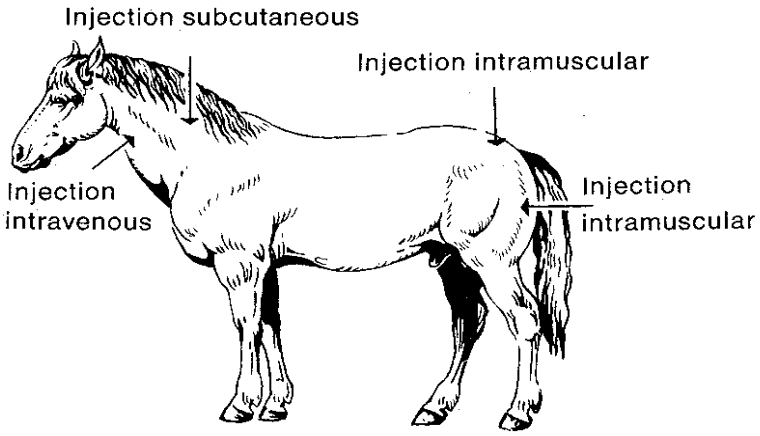
Subcutaneous	Here the drug or vaccine is injected under the skin. The drug is taken up slower and over a longer period, as is the case with the other routes. Irritant drugs should not be injected subcutaneously. A site is chosen where the skin is loose and thus easily pulled away from the muscle or carcass. Most of the vaccines are administered just under the skin by lifting up the skin between the thumb and forefinger and injecting the prescribed amount (usually 1-5cm) in the space between the skin and muscle or rest of the body.
Horses, livestock, sheep and goats	The loose skin in the region of the dewlap or breast, the side of the neck or over the shoulder is used.

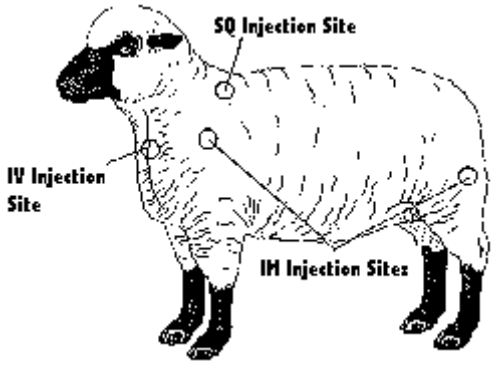
Pigs	Just behind the ear.
Intramuscular	Here the drug is injected into the muscles. A sufficiently long needle should therefore be used to penetrate into the muscle. Small volumes should be injected in any one site (not more than 20ml per site in the case of large animals). Pain and lameness may occur when large quantities are injected at one site. Absorption of the drug is rapid due to a good blood supply to the muscle. You must make sure that the correct muscle is used and that the needle does not enter or damage the nerves and arteries. The choice of the injection site depends upon the thickness of the muscles at that site.
Horses	Preferably in the breast muscles at the bottom of the neck, although, the neck muscles may also be used (see illustration).
Livestock, sheep, goats and pigs	The muscles of the neck, rump or buttocks are the most suitable. Piglets are injected in the neck muscles behind the ear.
Poultry	Inject into the breast muscle.
Intravenous	In this caste the drug is introduced into a vein, in other words, directly into the blood. Various advantages derive from this as the drug is immediately available to the body and larger volumes and more irritant substances may be administered at one time. Drugs are usually introduced slowly, while the animal is kept under control. The technique of administration is as follows: If the jugular vein is used, place a rope around the neck just in front of the shoulder and tighten the rope. This causes the blood to accumulate in the vein, rendering it clearly visible. The needle (not connected to the syringe) is pushed through the skin with a stab-movement into the vein. If the needle entered the vein (and not into the wall of the blood vessel or the subcutaneous tissues) blood will flow freely through the needle. Fit the syringe, release the cord and inject the drug slowly.
Horses, livestock	Jugular vein.
Sheep and goats	Jugular vein and also the vein on the inside of the front leg, just above the knee.
Pigs	Vein in the ear. The technique is the same as for large animals

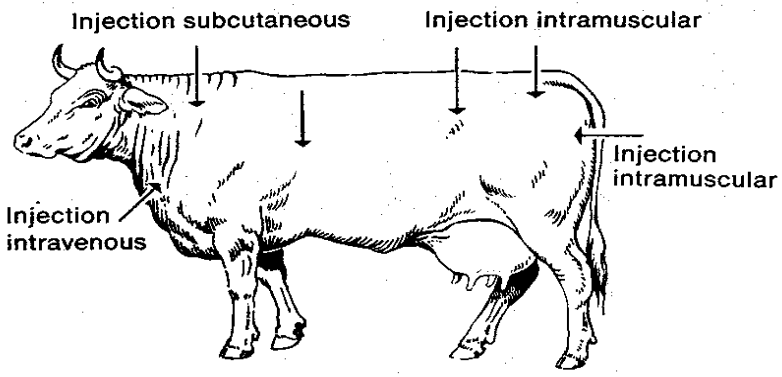
	except that the cord is placed at the base of the ear.
Dogs	Front leg.
Poultry	Into the vein of the wing.

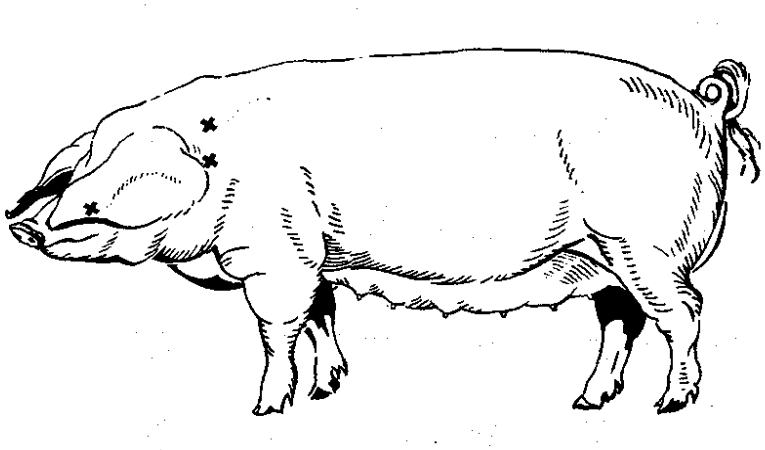
- Intro-mammary

  This method is used for the treatment of mastitis. Clean the teat thoroughly. The nozzle of the tube or plastic syringe (specially designed for this type of injection) is inserted into the teat canal. The contents are then squeezed into the udder, which is massaged upwards a few times. Special teat cannulas can also be used.

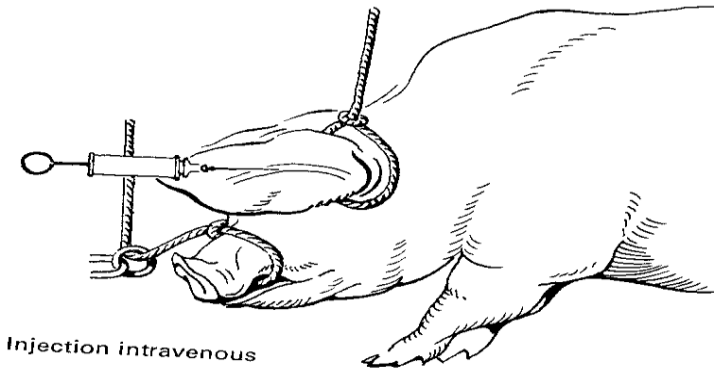








Injection sites in pigs



- Intra-vaginal and intra-uterine

  In this case the drug is introduced into the vagina or the uterus by hand. Absolute hygiene is necessary, and the hand being used in the operation, must be washed and disinfected, or a sterile glove should be worn. If it is impossible to insert the drug by hand (e.g. fluids) is should be deposited by means of a sterile tube or catheter that is used in the same manner/technique as for artificial insemination.

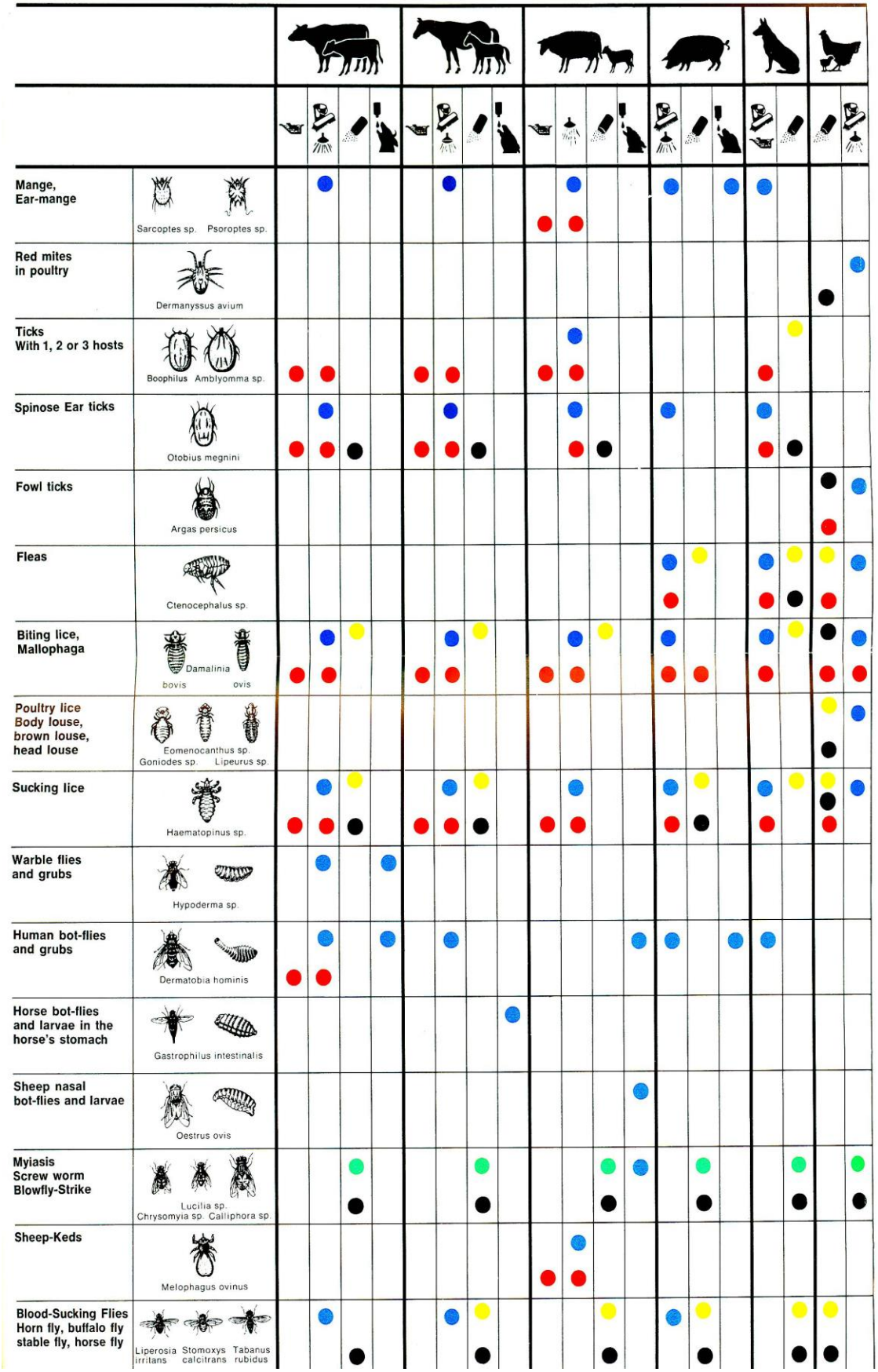
- Rectal

  This means the introduction of suppositories, tables or liquid medicaments into the rectum, mainly for the treatment of constipation.

- Complications following injections are as follows:
  - Abscesses may develop at the injection-site, especially when proper hygiene has not been maintained.

- Anaphylactic shock or allergic reactions may follow the administration of certain antibiotics or biological substances e.g. antisera.
- When irritating drugs were injected into a vein but leaks into the subcutis, large areas of the skin may peel off leaving unsightly wounds.
- The use of certain vaccine (pyrogenous) substances may cause a fever.
- Administration of incompatible substances may result in severe systematic reactions.

Route of application to treat the parasites



Understanding vaccine labels

Vaccines are an essential tool for aiding in the prevention and control of infectious diseases in livestock. There are 100's of vaccines and vaccine combinations available for livestock producers. Selecting and using the right vaccines is an essential part of any successful livestock operation.

With all the choices available, it's important to understand the labelling guidelines.

There are 5 possible levels of protection:

- Prevention of infection.
- Prevention of disease.
- Aid in disease prevention.
- Aid in disease control.
- Other claims.

In each instance, data generated by the vaccine manufacturer must fully support label indications and accurately reflect the expected performance of the product.

In deciding on a vaccine program for your livestock, consult with a veterinarian, who can help you choose the most effective products and develop the best program for your operation. We also encourage you to read vaccine labels and become knowledgeable on what they are indicated for and what their limits are.

Prevention of infection — Approved for products able to prevent all colonization or replication of the challenge organism in vaccinated and challenged animals. If such a conclusion is supported with a very high degree of confidence by convincing data, a label statement such as, "for the prevention of infection with (specific microorganism)," may be used.

Prevention of disease — Allowed only for products shown to be highly effective in preventing clinical disease in vaccinated and challenged animals. The entire interval (95%) estimate of efficacy must be at least 80%. If so, a label statement such as, "for the prevention of disease due to (specific microorganism)," may be used.

Aid in disease prevention — Allowed on products shown to prevent disease in vaccinated and challenged animals by a clinically significant amount that may be less than required to support a claim of disease prevention (see above). If so, a label statement such as, "as an aid in the prevention of disease due to (specific microorganism)," may be used.

Aid in disease control — Claim exclusive to products shown to alleviate disease severity, reduce disease duration or delay disease onset. If so, a label statement such as, "as an aid in the control of disease due to (specific microorganism)," or a similar one stating the product's particular action, may be used.

Other claims — Products with beneficial effects other than direct disease control, such as the control of infectiousness through the reduction of pathogen shedding, may make such claims if the size of the effect is clinically significant and well-supported by the data.

A label is the information printed on the outside of the vaccine bottle. This same information is also on a printed piece of paper that comes in the box containing the bottle. The label contains instructions for administering the vaccines and other key information.
The three most important sections of the label are "indications," "directions" and "precautions."

Example:

Let's examine what each of those sections is about, using Vira Shield® 6 as an example. Vira Shield 6 is a vaccine that prevents several respiratory and reproductive diseases in livestock.

Indications—This section tells you what disease or diseases the vaccine prevents and what types of cows should receive the vaccine.

INDICATIONS: For use in healthy livestock, including pregnant cows and heifers, as an aid in the prevention of disease caused by infectious bovine rhinotracheitis (IBR), bovine virus diarrhea (BVD Type 1 and BVD Type 2), parainfluenza Type 3 (PI3), and bovine respiratory syncytial (BRSV) viruses. Produced from non-cytopathic (BVD Type 1 and BVD Type 2) and cytopathic (BVD Type 1) isolates.

Directions—This section explains how to give the vaccine to the cow, including the quantity or volume of vaccine a cow should receive. The two most common routes of vaccine administration are intramuscular, which means injecting directly into the

muscle, and subcutaneous, which means injecting just under the skin.

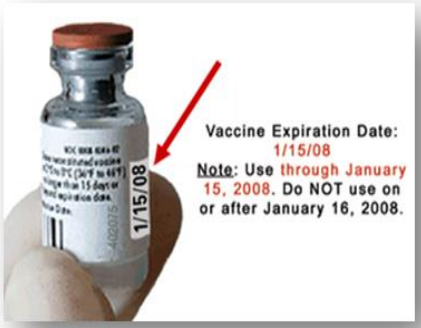
DIRECTIONS: Shake well before using. Administer 5 mL subcutaneously. In accordance with Beef Quality Assurance guidelines, this product should be administered subcutaneously (under the skin) in the neck. Revaccinate in 4-5 weeks. Vaccinate dairy cows at dry-off. Revaccinate annually or as recommended by your veterinarian.

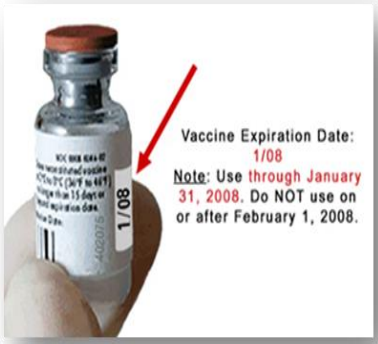
Precautions—This section includes warnings and safety information about storage, handling and any types of cows that should not be given this vaccine due to safety reasons. Pay close attention to this section. If the vaccine is not safe for certain types of cows – like pregnant cows or young calves – that information will be included in this section. Vira Shield is safe for all cows and calves, so there are no such warnings on its label.

PRECAUTIONS: Store out of direct sunlight at 2°-7°C (35°-45°F). DO NOT FREEZE. Use entire contents when first opened. Do not vaccinate within 60 days prior to slaughter. Transient swelling may occur at the site of injection. Anaphylactic reactions may occur. Symptomatic treatment: Epinephrine. Contains amphotericin B, gentamicin, and thimerosal as preservatives.

Vaccine expiration

All vaccines and diluents have expiration dates. The expiration date is the date by which the vaccine or diluent should be used. This date is printed on all vaccine and diluent vials and boxes. Expiration dates vary by the type of vaccine or diluent, and by the lot number. The vaccine or diluent may be used up to and including this date **unless** otherwise stated in the product package insert. Vaccine and diluent should not be used after this date has passed. When the expiration date is marked with only a month and year, the vaccine or diluent may be used up to and including the last day of the month indicated on the vial. Any unused vaccine or diluent should not be used after this month has passed.





Expired vaccine and diluent, even if they are only 1 day past the expiration date, should **never** be administered. Likewise, vaccines that have been mishandled and lost their potency because of inappropriate storage conditions should not be administered. If a dose of expired or mishandled vaccine is given by mistake, the dose should not be counted as valid and should be repeated, unless serologic testing indicates that an adequate response to the vaccine has been achieved. Promptly remove expired or mishandled vaccine and diluent from the refrigerator or freezer and dispose of it appropriately. Contact the vaccine supplier, which may be the vaccine manufacturer for specific policies regarding the disposition of mishandled or expired vaccine.

The expiration date printed on each vial or box assumes the vaccine has been properly transported and stored at all times and that it has not become contaminated. If vaccine has been inappropriately exposed to excessive heat, cold, or light, its potency may be reduced **before** the expiration date is reached. The only way to determine if proper transport and storage conditions have been maintained is to monitor vaccine and diluent temperatures during every link in the cold chain and to safeguard HPV, MMR, MMRV, rotavirus, varicella, and zoster vaccines from exposure to light. The expiration date printed on each vial or box may also be invalidated after the vial is opened or reconstituted.

Multidose premixed vaccine vials contain bacteriostatic agents that prevent the growth of bacteria. These vaccines can be used until the date of expiration printed on the vial unless they become contaminated.

Single-dose vials are meant for one-time use only. Once the protective caps on single-dose vials have been unsealed, it may not be possible to determine if the rubber seals have been punctured. Therefore, do not open single-dose vials until you are ready to use them. To avoid needless waste of vaccine, **always** check the vial before removing the cap to make sure you have the correct vaccine

type, and remove the cap only when you are ready to draw up and administer the vaccine. Single-dose vials without their protective caps should be discarded at the end of the clinic day.

The vaccine coordinator should ensure that someone rearranges the placement of vaccine and diluent supplies according to the expiration dates on a weekly basis and each time a vaccine shipment arrives. The vials and boxes with the earliest expiration dates should be placed in front of other vials and boxes of the same type with later expiration dates. This practice avoids waste by ensuring that vaccines and diluents with the shortest expiration dates are easily accessible and will be used first, thereby limiting the amount of unused vaccine that has passed its expiration date.

Expired vaccine and diluents should never be administered. Promptly remove expired vaccine from the refrigerator or freezer to avoid accidental use.

5.6. PRE-PLANNED TREATMENT PROGRAMMES

Vaccines should be given at strategic times of the year or season. These times vary depending on the vaccine and particularly on the disease, which you are trying to control.

The response to this question depends on the individual farm, age of an animal, previous disease problems, whether the herd/flock is open or closed, geographic region of the country, soil type, diet, and the flock economics.

Vaccination and dosing programmes according to the Agricultural College, Grootfontein, Middelburg

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pulpy Kidney	All weaned-lambs	Goats	Whole flock			Whole flock & Angoras				Order	Whole flock	
Pasteurellosis	All weaned-lambs	Goats	Whole flock			Whole flock & Angoras					Whole flock	
Black Quarter	Whole flock Pre-shearing				Goats Pre-shearing		Hamel shear group & demo-ewes			Order		
Rift Valley Fever								Order		Whole flock		
Blue tongue A											Whole flock 1st week	
Blue tongue B											Whole flock 3rd week	
Blue tongue C												Whole flock 2nd week
Lumpy skin disease Supavax (blackleg, milt & botulism)		Cattle								Order		
CVD (respiration disease)		Cattle								Order		
Enzootic Abortion	Order		Breeding ewes				Last week pregnant ewes					
Blue udder & multivaxP	Order		Breeding ewes Multivax P				Pregnant ewes					
Rev I	Ram- and ewes lambs at weaning										Order	
Dose	Tapeworm Lintex-weaning Lams & calves	Whole flock goat and sheep liver fluke and tapeworm	Breeding rams Nose worm	Wide-spectrum Whole flock				Wide spectrum whole flock			Tapeworm lambs	Wide spectrum whole flock
Multimin	At weaning	Breeding ewes						Ewes and lambs				

Vit ADE		Whole flock			Whole flock			Pregnant ewes			Order	
Deadline			Cattle, sheep & Goats			Cattle, goats and sheep						

5.7. RECORD KEEPING

It is advised that records must be kept for animals on the farm. These records are essential for traceability of diseases; animals with poor performance, animals that has chronic disease disorders and to have a database as reference, should a certain animal be examined in the future.

Most farmers keep a file for each animal, recording all necessary information. This record enables the farmer to make a practical assessment concerning the productivity of each animal in the heard. Such a file would include: the pedigree of each animal, a record of all medical treatments and diseases and dates when it occurred and was administered, and a record of the number of calves/lambs produced as well as the lactation periods. Very important, in dairy, the milk production performance of each animal is recorded daily!

A spreadsheet an excellent way to create record of treatments. The identity of all treated animals and the date and time should be clearly visible.

Keep a permanent, detailed treatment record for reference and management purposes. Write this in the herd's health book or in the individual animal's record files. This record should identify the animal, the product and dosage administered the date of treatment and in dairy the milk-withholding period. Before shipping any animal for slaughter, check this record to insure pre-slaughter treatment withholding requirements are met.
Correct usage of livestock medicines, recording of treatments, and clearly identifying treated cows are essential practices.

Example of a record card

Treatment Record **Animal Identity: _____**						
Date	**Diagnosis**	**Treatment**	**Dosage**	**Duration of Treatment**	**Dairy cows Only**	
					Label Withdrawal (no of milking	**Milking returned to tank**

I.D. <u>Group Formative Exercise</u>:

4. TREATMENT OF AILMENTS

4.1. LOCAL EXAMINATION AND TREATMENT

Injuries to and diseases of the skin, eye, ear and nose.

Medicaments are applied to the skin, eye, ear and nose in the form of powders, lotions, sprays and water or oils solutions. The use of water solutions requires repeated applications (every 2 hours) while ointments act over longer periods, requiring application of smaller amounts after longer intervals. Medicaments for the eye and ear should preferably be in the form of an ointment or a water base. This method of application can be used for the local treatment of wounds, rheumatism and disease of the skin, eye and ear.

Local treatment of animals with skin wounds may often be frustrating as the animals constantly lick the wounds and can thus be poisoned by the medicaments. The local application of medicaments often require constant securing, large collars around the neck or the administration of sedatives.

The medicament must be applied thinly and rubbed in well into the wound. Sprays are convenient in the sense that they dry fast and thus diminish the chances of the drug being rubbed off or washed away.

Some ailments that need treatment on the farm without consulting a veterinarian

- Wounds
- Bleeding
- Abscesses
- Diarrhea
- Bloat

Wounds

Wounds can be caused by various objects and infected with bacteria. If wound is older than eight hours, it should be regarded and treated as infected.

Treatment: Bleeding should be stopped. Remove all foreign material such as sand, grass, faeces, etc. Wash the sound with disinfectants such as salt water. Clip the hair around the wound, dry the surface and keep the wound dry.

Abscesses

It is an accumulation of pus in a cavity. It is hard and painful.

Treatment: Allow the abscess to ripen before it is opened by an incision. Treat the animal with antibiotic injections afterwards.

Bleeding

Slight bleeding is beneficial because it tends to clean the wound. Severe bleeding must be stopped.

Methods: Apply a pressure bandage.

Difficult births

When an animal is on the point of giving birth, it must be left undisturbed. If there is a delay in normal birth the cause should be examined. If you cannot find the cause within five minutes a veterinarian should be contacted. If the veterinarian cannot be found, you should attempt to do it yourself to safe the cow and the calf. It however takes experience to identify if a cow is experiencing difficult birth. Do not assist too soon or too late.

Long rubber gloves that cover your arm must be worn to protect the cow from injury and you from infections. The vaginal and anal area must be washed and disinfected before an internal examination is attempted. The arm must be lubricated. You must work carefully. If traction is used it must be applied in the same direction as normal birth.

After assistance has been given, afterbirth suppositories must be inserted deep into the uterus to neutralize any infections.

4.2. EQUIPMENT REQUIRED FOR TREATMENTS

To perform elementary procedures on animals there are a few very important aspects that must be kept in mind. At first, we will discuss a few of the procedures before we attempt to perform it. Make sure you understand how the apparatus work before you use it. Especially instruments like a

Burdizzo can cause the animal a lot of discomfort and damage the animal permanently if applied incorrectly.

Thermometer

To take the body temperature of an animal you only need a good clinical thermometer. The temperature is normally taken in the anus of the animal. Normally the animal will feel no discomfort and will not react too much. Large untamed animals can be difficult and needs a little bit of restraint just to insert the thermometer and take it out again.

Veterinary supplies

Over time and as your experience increases, you will accumulate more vet supplies than I've listed here, but this is a good starting kit.

- **Antiseptic and sanitizing fluids**

  The ones we find regular use for are alcohol, iodine, and peroxide. The alcohol is good for sanitizing thermometers and other supplies, and for cleansing skin prior to giving an injection. Iodine (7%) is a good general wound cleanser and works well for cleaning navels on newborns. The peroxide is the best thing to use for cleaning wounds in which maggots reside.

- **Aspirin boluses**

  (or the extra-large economy-size bottle of generic people aspirin), for relief of aches, pains, lameness and fever. If you use people aspirin, one tablet per hundred pounds of body weight works well (1 tablet per 45 kg).

- **Clean blankets, towels and cloth "rags"**

  Old towels and blankets come in handy when drying off animals (like newborns) and when warming animals that are in shock. The rags have many uses, including cleaning wounds, cleaning caked manure from young animals' tail-heads, and other clean-up chores. The ideal rag is cut from old bath towels – 12-square-inches (30 cm^2) seems to be a good size. Thrift stores and yard sales are a good source for used blankets and towels.

- **Needles and syringes**

  Keep several disposable needles (size 18 gauge – 1.5" is the most versatile) and several syringes 6cc, 20cc and 60cc) on hand at all times. Syringes come in handing for feeding very weak animals (like newborns). To feed with a syringe, slowly dribble milk, electrolyte, or colostrum into the mouth.

- **Cow magnet**

  If you plan to keep livestock, keep several cow magnets on hand. Cow magnets are about the size of an adult's pinky, rounded on both ends, and have no sharp edges.

- **Stomach tubes**

  About 6 feet (183 cm) of soft rubber tubing works well. If you are using a tube to force-feed fluids, make sure that you insert it in the animal's stomach and not its lungs, or you'll drown the animal. To confirm that the tube is in the stomach, blow into the end of it – if you are on target, you'll see the animal's side expand.

- **Thermometer**

  Absolutely the most important item in a vet box! Purchase a rectal veterinary thermometer with a ring top and tie about 2 feet (60 cm) of string to it. While taking an animal's temperature, either hold the end of the string or wrap it several times around the critter's tail. This prevents "losing" the thermometer inside the animal, or having the thermometer fall out, only to be crushed by a hoof.

Unit 3

Dissecting Animals

Unit Standard	
116399	**Dissect animals**

Specific Outcomes

SO1: Demonstrate the use and understanding of humane animal killing techniques and methods.

SO2: Demonstrate the use and understanding of how to use dissection equipment and implements.

SO3: Demonstrate knowledge of what is to be dissected.

SO4: Demonstrate knowledge of how to dissect a specific animal.

Learning Outcomes

By the end of this unit you will demonstrate an understanding of:

5 Humane Killing techniques

6 Dissection Instruments

7 Dissecting an animal

Identifying	Collecting	Demonstrating
Working	Science	Contributing
Organise	Communicating	

INTRODUCTION

When studying animal anatomy and physiology, dissecting a animal can be a good learning experience to see firsthand how the animal is formed and how different systems fit together.

Definition: Dissecting an animal means to cut apart or separate (tissue), especially for anatomical study. Alternatively, to 'separate into pieces and expose part of the animal for scientific reasons

Reasons why livestock animals will be dissected include:

8 Disease management: If animals die of contagious/unknown diseases, vegetarians could learn from dissection to prevent further spread/deaths

9 Promotion of improved health programmes: If health problems detected during dissections can be linked to environmental/ human intervention reasons, these could be eliminated/managed to improve animal health.

10 Meat analysis: Dissection of meat is often done to improve the end product

In order to study dissection, we will look at three main areas:

- Humane killing techniques
- Instruments used in dissection
- Steps in dissecting an animal

HUMANE KILLING GUIDELINES

Livestock pens, driveways and ramps.

(a) Livestock pens, driveways and ramps shall be maintained in good repair. They shall be free from sharp or protruding objects which may, in the opinion of the inspector, cause injury or pain to the animals. Loose boards splintered or broken planking, and unnecessary openings where the head, feet, or legs of an animal may be injured shall be repaired.

(b) Floors of livestock pens, ramps, and driveways shall be constructed and maintained so as to provide good footing for livestock. Slip resistant or waffled floor surfaces, cleated ramps and the use of sand, as appropriate, during winter months are examples of acceptable construction and maintenance.

(c) U.S. Suspects and dying, diseased, and disabled livestock shall be provided with a covered pen sufficient, in the opinion of the inspector, to protect them from the adverse climatic conditions of the locale while awaiting disposition by the inspector.

(d) Livestock pens and driveways shall be so arranged that sharp corners and direction reversal of driven animals are minimized.

Handling of livestock.

(a) Driving of livestock from the unloading ramps to the holding pens and from the holding pens to the stunning area shall be done with a minimum of excitement and discomfort to the animals. Livestock shall not be forced to move faster than a normal walking speed.

(b) Electric prods, canvas slappers, or other implements employed to drive animals shall be used as little as possible in order to minimize excitement and injury. Any use of such implements which, in the opinion of the inspector, is excessive, is prohibited. Electrical prods attached to AC house current shall be reduced by a transformer to the lowest effective voltage not to exceed 50 volts AC.

(c) Pipes, sharp or pointed objects, and other items which, in the opinion of the inspector, would cause injury or unnecessary pain to the animal shall not be used to drive livestock.

(d) Disabled livestock and other animals unable to move.

(1) Disabled animals and other animals unable to move shall be separated from normal ambulatory animals and placed in the covered pen.

(2) The dragging of disabled animals and other animals unable to move, while conscious, is prohibited. Stunned animals may, however, be dragged.

(3) Disabled animals and other animals unable to move may be moved, while conscious, on equipment suitable for such purposes; e.g., stone boats.

(e) Animals shall have access to water in all holding pens and, if held longer than 24 hours, access to feed. There shall be sufficient room in the holding pen for animals held overnight to lie down.

(f) Stunning methods approved shall be effectively applied to animals prior to their being shackled, hoisted, thrown, cast, or cut.

Chemical; carbon dioxide.

The slaughtering of sheep, calves and swine with the use of carbon dioxide gas and the handling in connection therewith, in compliance with the provisions contained in this section, are hereby designated and approved as humane methods of slaughtering and handling of such animals under the Act.

(a) Administration of gas required effect, handling.

(1) The carbon dioxide gas shall be administered in a chamber in accordance with this section so as to produce surgical anaesthesia in the animals before they are shackled, hoisted, thrown, cast, or cut. The animals shall be exposed to the carbon dioxide gas in a way that will accomplish the anaesthesia quickly and calmly, with a minimum of excitement and discomfort to the animals. In swine, carbon dioxide may be administered to induce death in the animals before they are shackled, hoisted, thrown, cast, or cut.

(2) The driving or conveying of the animals to the carbon dioxide chamber shall be done with a minimum of excitement and discomfort to the animals. Delivery of calm animals to the anaesthesia chamber is essential since the induction, or early phase, of anesthesia is less violent with docile animals. Among other things this requires that, in driving animals to the anaesthesia chamber, electrical equipment be used as little as possible and with the lowest effective voltage.

(3) On emerging from the carbon dioxide tunnel, the animals shall be in a state of surgical anaesthesia and shall remain in this condition throughout shackling, sticking, and bleeding, except for swine in which death has been induced by the administration of carbon dioxide. Asphyxia or death from any cause shall not be produced in animals before bleeding, except for swine in which death has been induced by the administration of carbon dioxide.

(b) Facilities and procedures--

(1) General requirements for gas chambers and auxiliary equipment; operator.

(i) The carbon dioxide gas shall be administered in a tunnel which is designed to permit the effective exposure of the animal. Two types of tunnels, based on the same principle, are in common use for carbon dioxide anaesthesia. They are the "U" type tunnel and the "Straight Line" type tunnel and are based on the principle that carbon dioxide gas has a higher specific gravity than air. The tunnels are open at both ends for entry and exit of animals and have a depressed central section. Anesthetizing, or, in the case of swine, death- inducing, carbon dioxide concentrations are maintained in the central sections of the tunnels. Effective anaesthetization is produced in these central sections. Animals are driven from holding pens through pathways constructed of large-diameter pipe or smooth metal and onto continuous conveyor devices that move the animals through the tunnels. The animals are either compartmentalized on the conveyors by mechanical impellers synchronized with the conveyor or they are otherwise prevented from crowding. While impellers are used to compartmentalize the animals, mechanically or manually operated gates are used to move the animals onto the conveyors. Surgically anaesthetized animals, or killed swine, are moved out of the tunnels by the same continuous conveyors that moved them into and through the carbon dioxide gas.

(ii) Flow of animals into and through the carbon dioxide chamber is dependent on one operator. The operation or stoppage of the conveyor is entirely dependent upon this operator. It is necessary that he be skilled, attentive, and aware of his responsibility. Over dosages and death of animals can be brought about by carelessness of this individual.

(2) Special requirements for gas chamber and auxiliary equipment. The ability of anesthetizing equipment to perform with maximum efficiency is dependent on its proper design and efficient mechanical operation. Pathways, compartments, gas chambers, and all other equipment used must be designed to accommodate properly the species of animals being anesthetized. They shall be free from pain-producing restraining devices. Injury of animals must be prevented by the elimination of sharp projections or exposed wheels or gears. There shall be no unnecessary holes, spaces or openings where feet or legs of animals may be injured. Impellers or other devices designed to mechanically move or drive animals or otherwise keep them in motion or compartmentalized shall be constructed of flexible or well-padded rigid material. Power activated gates designed for constant flow of animals to anesthetizing equipment shall be so fabricated that they will not cause injury. All equipment involved in anesthetizing animals shall be maintained in good repair.

(3) Gas. Maintenance of a uniform carbon dioxide concentration and distribution in the anaesthesia chamber is a vital aspect of producing surgical anaesthesia. This may be assured by reasonably

accurate instruments which sample and analyze carbon dioxide gas concentration within the chamber throughout anesthetizing operations. Gas concentration shall be maintained uniform so that the degree of anaesthesia in exposed animals will be constant. Carbon dioxide gas supplied to anaesthesia chambers may be from controlled reduction of solid carbon dioxide or from a controlled liquid source. In either case the carbon dioxide shall be supplied at a rate sufficient to anesthetize adequately and uniformly the number of animals passing through the chamber. Sampling of gas for analysis shall be made from a representative place or places within the chamber and on a continuing basis. Gas concentrations and exposure time shall be graphically recorded throughout each day's operation. Neither carbon dioxide nor atmospheric air used in the anaesthesia chambers shall contain noxious or irritating gases. Each day before equipment is used for anesthetizing animals, proper care shall be taken to mix adequately the gas and air within the chamber. All gas producing, and control equipment shall be maintained in good repair and all indicators, instruments, and measuring devices must be available for inspection by Program inspectors during anesthetizing operations and at other times. An exhaust system must be provided so that, in case of equipment failure, non-uniform carbon dioxide concentrations in the gas tunnel or contamination of the ambient air of the establishment will be prevented.

Mechanical; captive bolt.

The slaughtering of sheep, swine, goats, calves, cattle, horses, mules, and other equines by using captive bolt stunners and the handling in connection therewith, in compliance with the provisions contained in this section, are hereby designated and approved as humane methods of slaughtering and handling of such animals under the Act.

(a) Application of stunners required effect; handling.

(1) The captive bolt stunners shall be applied to the livestock in accordance with this section so as to produce immediate unconsciousness in the animals before they are shackled, hoisted, thrown, cast, or cut. The animals shall be stunned in such a manner that they will be rendered unconscious with a minimum of excitement and discomfort.

(2) The driving of the animals to the stunning area shall be done with a minimum of excitement and discomfort to the animals. Delivery of calm animals to the stunning areas is essential since accurate placement of stunning equipment is difficult on nervous or injured animals. Among other things, this requires that, in driving animals to the stunning areas, electrical equipment be used as little as possible and with the lowest effective voltage.

(3) Immediately after the stunning blow is delivered the animals shall be in a state of complete unconsciousness and remain in this condition throughout shackling, sticking and bleeding.

(b) Facilities and procedures--

(1) General requirements for stunning facilities; operator.

(i) Acceptable captive bolt stunning instruments may be either skull penetrating or no penetrating. The latter type is also described as a concussion or mushroom type stunner. Penetrating instruments on detonation deliver bolts of varying diameters and lengths through the skull and into the brain. Unconsciousness is produced immediately by physical brain destruction and a combination of changes in intracranial pressure and acceleration concussion. No penetrating or mushroom stunners on detonation deliver a bolt with a flattened circular head against the external surface of the animal's head over the brain. Diameter of the striking surface of the stunner may vary as conditions require. Unconsciousness is produced immediately by a combination of acceleration concussion and changes in intracranial pressures. A combination instrument utilizing both penetrating and no penetrating principles is acceptable. Energizing of instruments may be accomplished by detonation of measured charges of gunpowder or accurately controlled compressed air. Captive bolts shall be of such size and design that, when properly positioned and activated, immediate unconsciousness is produced.

(ii) To assure uniform unconsciousness with every blow, compressed air devices must be equipped to deliver the necessary constant air pressure and must have accurate, constantly operating air pressure gauges. Gauges must be easily read and conveniently located for use by the stunning operator and the inspector. For purposes of protecting employees, inspectors, and others, it is desirable that any stunning device be equipped with safety features to prevent injuries from accidental discharge. Stunning instruments must be maintained in good repair.

(iii) The stunning area shall be so designed and constructed as to limit the free movements of animals sufficiently to allow the operator to locate the stunning blow with a high degree of accuracy. All chutes, alleys, gates and restraining mechanisms between and including holding pens and stunning areas shall be free from pain-producing features such as exposed bolt ends, loose boards, splintered or broken planking, and protruding sharp metal of any kind. There shall be no unnecessary holes or other openings where feet or legs of animals may be injured. Overhead drop gates shall be suitably covered on the bottom edge to prevent injury on contact with animals. Roughened or cleated cement shall be used as flooring in chutes leading to stunning areas to reduce falls of animals. Chutes, alleys, and stunning areas shall be so designed that they will comfortably accommodate the kinds of animals to be stunned.

(iv) The stunning operation is an exacting procedure and requires a well- trained and experienced operator. He must be able to accurately place the stunning instrument to produce immediate

unconsciousness. He must use the correct detonating charge with regard to kind, breed, size, age, and sex of the animal to produce the desired results.

(2) Special requirements. Choice of instrument and force required to produce immediate unconsciousness varies, depending on kind, breed, size, age, and sex of the animal. Young swine, lambs, and calves usually require less stunning force than mature animals of the same kind. Bulls, rams, and boars usually require skull penetration to produce immediate unconsciousness. Charges suitable for smaller kinds of livestock such as swine or for young animals are not acceptably interchanged for use on larger kinds or older livestock, respectively.

Mechanical; gunshot.

The slaughtering of cattle, calves, sheep, swine, goats, horses, mules, and other equines by shooting with firearms and the handling in connection therewith, in compliance with the provisions contained in this section, are hereby designated and approved as humane methods of slaughtering and handling of such animals under the Act.

(a) Utilization of firearms required effect; handling.

(1) The firearms shall be employed in the delivery of a bullet or projectile into the animal in accordance with this section so as to produce immediate unconsciousness in the animal by a single shot before it is shackled, hoisted, thrown, cast, or cut. The animal shall be shot in such a manner that they will be rendered unconscious with a minimum of excitement and discomfort.

(2) The driving of the animals to the shooting areas shall be done with a minimum of excitement and discomfort to the animals. Delivery of calm animals to the shooting area is essential since accurate placement of the bullet is difficult in case of nervous or injured animals. Among other things, this requires that, in driving animals to the shooting areas, electrical equipment be used as little as possible and with the lowest effective voltage.

(3) Immediately after the firearm is discharged and the projectile is delivered, the animal shall be in a state of complete unconsciousness and remain in this condition throughout shackling, sticking and bleeding.

(b) Facilities and procedure--

(1) General requirements for shooting facilities; operator.

(i) On discharge, acceptable firearms dispatch free projectiles or bullets of varying sizes and diameters through the skull and into the brain. Unconsciousness is produced immediately by a

combination of physical brain destruction and changes in intracranial pressure. Caliber of firearms shall be such that when properly aimed and discharged, the projectile produces immediate unconsciousness.

(ii) To assure uniform unconsciousness of the animal with every discharge where small-bore firearms are employed, it is necessary to use one of the following type projectiles: Hollow pointed bullets; frangible iron plastic composition bullets; or powdered iron missiles. When powdered iron missiles are used, the firearms shall be in close proximity with the skull of the animal when fired. Firearms must be maintained in good repair. For purposes of protecting employees, inspectors and others, it is desirable that all firearms be equipped with safety devices to prevent injuries from accidental discharge. Aiming and discharging of firearms should be directed away from operating areas.

(iii) The provisions contained in § 313.15(b)(1)(iii) with respect to the stunning area also apply to the shooting area.

(iv) The shooting operation is an exacting procedure and requires a well- trained and experienced operator. He must be able to accurately direct the projectile to produce immediate unconsciousness. He must use the correct caliber firearm, powder charge and type of ammunition to produce the desired results.

(2) Special requirements. Choice of firearms and ammunition with respect to caliber and choice of powder charge required to produce immediate unconsciousness of the animal may vary depending on age and sex of the animal. In the case of bulls, rams, and boars, small bore firearms may be used provided they are able to produce immediate unconsciousness of the animals. Small bore firearms are usually effective for stunning other cattle, sheep, swine, and goats, and calves, horses, and mules.

Electrical; stunning or slaughtering with electric current.

The slaughtering of swine, sheep, calves, cattle, and goats with the use of electric current and the handling in connection therewith, in compliance with the provisions contained in this section, are hereby designated and approved as humane methods of slaughtering and handling of such animals under the Act.

(a) Administration of electric current required effect; handling.

(1) The electric current shall be administered so as to produce, at a minimum, surgical anaesthesia, i.e., a state where the animal feels no painful sensation. The animals shall be either stunned or killed before they are shackled, hoisted, thrown, cast, or cut. They shall be exposed to the electric current in a way that will accomplish the desired result quickly and effectively, with a minimum of excitement and discomfort.

(2) The driving or conveying of the animals to the place of application of electric current shall be done with a minimum of excitement and discomfort to the animals. Delivery of calm animals to the place of application is essential to ensure rapid and effective insensibility. Among other things, this requires that, in driving animals to the place of application, electrical equipment be used as little as possible and with the lowest effective voltage.

(3) The quality and location of the electrical shock shall be such as to produce immediate insensibility to pain in the exposed animal.

(4) The stunned animal shall remain in a state of surgical anaesthesia through shackling, sticking, and bleeding.

(b) Facilities and procedures; operator--

(1) General requirements for operator. It is necessary that the operator of electric current application equipment be skilled, attentive, and aware of his or her responsibility.

(2) Special requirements for electric current application equipment. The ability of electric current equipment to perform with maximum efficiency is dependent on its proper design and efficient mechanical operation. Pathways, compartments, current applicators, and all other equipment used must be designed to properly accommodate the species of animals being anesthetized. Animals shall be free from pain-producing restraining devices. Injury of animals must be prevented by the elimination of sharp projections or exposed wheels or gears. There shall be no unnecessary holes, spaces or openings where feet or legs of animals may be injured. Impellers or other devices designed to mechanically move or drive animals or otherwise keep them in motion or compartmentalized shall be constructed of flexible or padded material. Power activated gates designed for constant flow of animals shall be so fabricated that they will not cause injury. All equipment used to apply and control the electrical current shall be maintained in good repair, and all indicators, instruments, and measuring devices shall be available for inspection by Program inspectors during the operation and at other times.

(3) Electric current. Each animal shall be given a sufficient application of electric current to ensure surgical anaesthesia throughout the bleeding operation. Suitable timing, voltage and current control devices shall be used to ensure that each animal receives the necessary electrical charge to produce immediate unconsciousness. The current shall be applied so as to avoid the production of haemorrhages or other tissue changes which could interfere with inspection procedures.

Tagging of equipment, alleyways, pens, or compartments to prevent inhumane slaughter or handling in connection with slaughter.

When an inspector observes an incident of inhumane slaughter or handling in connection with slaughter, he/she shall inform the establishment operator of the incident and request that the operator take the necessary steps to prevent a recurrence. If the establishment operator fails to take such action or fails to promptly provide the inspector with satisfactory assurances that such action will be taken, the inspector shall follow the procedures specified in paragraph (a), (b), or (c) of this section, as appropriate.

(a) If the cause of inhumane treatment is the result of facility deficiencies, disrepair, or equipment breakdown, the inspector shall attach a "U.S. Rejected" tag thereto. No equipment, alleyway, pen or compartment so tagged shall be used until made acceptable to the inspector. The tag shall not be removed by anyone other than an inspector. All livestock slaughtered prior to such tagging may be dressed, processed, or prepared under inspection.

(b) If the cause of inhumane treatment is the result of establishment employee actions in the handling or moving of livestock, the inspector shall attach a "U.S. Rejected" tag to the alleyways leading to the stunning area. After the tagging of the alleyway, no more livestock shall be moved to the stunning area until the inspector receives satisfactory assurances from the establishment operator that there will not be a recurrence. The tag shall not be removed by anyone other than an inspector. All livestock slaughtered prior to the tagging may be dressed, processed, or prepared under inspection.

(c) If the cause of inhumane treatment is the result of improper stunning, the inspector shall close down stunning activities until the inspector receives satisfactory assurances from the establishment operator that there will not be a recurrence.

INSTRUMENTS USED IN DISSECTING OF ANIMALS

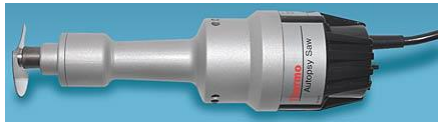
On the next two pages you will find photographs of the typical equipment used when dissecting an animal.

As part of your formative exercise you will observe and identify the tools and equipment while an expert performs a dissection.

Dissection Tools

 Blades (down page)	 Needles, Probes and Picks	 Dissection Kit and Suture Removal Kit	 Scalpels
 Forceps - Hemostat	 Forceps - Dissecting Forceps	 Grossing and Trimming Tools	 Tweezers

 Scissors - Replaceable Blade	 Scissors - Highest Quality, Aesculap®	 Scissors - High Quality	 Scissors - General Lab
 Spatulas and Spoons (Micro)	 Scissors - Micro	 Tongs, PTFE Coated	 

			Dissecting and Trimming Boards Mincing Dish
  Oscillating Autopsy Saw  Extra Fine Bone Saw	 Surgical Loupes	  Applicator Sticks, Wooden Picks, Bamboo Splints, Cotton Swabs	 Shur-Sharp Microtome Blades

FETAL PIG DISSECTION:

External Anatomy

1. Determine the sex of your pig by looking for the urogenital opening. On females, this opening is located near the anus. On males, the opening is located near the umbilical cord.

If your pig is female, you should also note that urogenital papilla is present near the genital opening. Males do not have urogenital papilla.

Both males and females have rows of nipples, and the umbilical cord will be present in both. What sex is your pig? _____

2. Make sure you are familiar with terms of reference: anterior, posterior, dorsal, ventral. In addition, you'll need to know the following terms

Medial: toward the midline or middle of the body
Lateral: toward the outside of the body
Proximal: close to a point of reference
Distal: farther from a point of reference

*label the sides on the pig picture above

3. Open the pig's mouth and locate the hard and soft palate on the roof of the mouth. Can you feel your own hard and soft palates with your tongue?

Note the taste buds (also known as sensory papillae) on the side of the tongue. Locate the esophagus at the back of the mouth. Feel the edge of the mouth for teeth. Does the fetal pig have teeth? _____
Are humans born with teeth? _____

Locate the epiglottis, a cone-shaped structure at the back of the mouth, a flap of skin helps to close this opening when a pig swallow. The pharynx is the cavity in the back of the mouth - it is the junction for food (esophagus) and air (trachea).

4. Gestation for the fetal pig is 112-115 days. The length of the fetal pig can give you a rough estimate of its age.
11mm - 21 days | 17 mm - 35 days | 2.8 cm - 49 days
4 cm - 56 days | 22 cm - 100 days | 30 cm -- birth

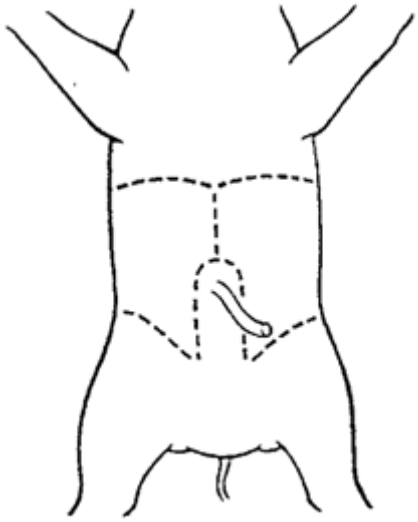
5. Observe the toes of the pig. How many toes are on the feet? _____
Do they have an odd or even number of toes? _____

6. Observe the eyes of the pig, carefully remove the eyelid so that you can view the eye underneath. Does it seem well developed? Do you think pigs are born with their eyes open or shut?

_____

7. Carefully lay the pig on one side in your dissecting pan and cut away the skin from the side of the face and upper neck to expose the masseter muscle that works the jaw, lymph nodes, and salivary glands. The salivary glands kind of look like chewing gum and are often lost if you cut too deeply.

Make sure you know the locations of all the bold words on this handout



The Anatomy of the Fetal Pig (internal)

In this activity, you will open the abdominal and thoracic cavity of the fetal pig and identify structures. Remember, that to dissect means to "expose to view" - a careful dissection will make it easier for you to find the organs and structures. Be sure to follow all directions.

The Incision

Place your fetal pig in the dissecting pan ventral side up. Use string to "hog-tie" your pig so that the legs are spread eagle and not in your way. Use scissors to cut through the skin and muscles according to the diagram. Do not remove the umbilical cord. In the first section, you will only examine the abdominal cavity (the area below the ribcage).

After completing the cuts, locate the umbilical vein that leads from the umbilical cord to the liver. You will need to cut this vein in order to open up the abdominal cavity.

Your pig may be filled with water and preservative, drain over the sink if necessary and rinse organs. Locate each of the organs below, check the box

1. **Diaphragm**. This muscle divides the thoracic and abdominal cavity and is located near the ribcage. The diaphragm aids in breathing.

2. **Liver**. This structure is lobed and is the largest organ in the body. The liver is responsible for making bile for digestion.

3. **Gall bladder**. This greenish organ is located underneath the liver; the bile duct attaches the gall bladder to the duodenum. The gall bladder stores bile and sends it to the duodenum, via the bile duct.

4. **Stomach**. A pouch shaped organ that rests just underneath and to the pig's left. At the top of the stomach, you'll find the esophagus. The stomach is responsible for churching and breaking down food.

5. At each end of the stomach are valves that regulate food entering and leaving the stomach. At the esophagus is the **cardiac sphincter valve**, and at the duodenum is the **pyloric sphincter valve**. View the inside of the stomach by slicing it open lengthwise.

6. The stomach leads to the **small intestine**, which is composed of the duodenum (straight portion just after the stomach) and the **ileum** (curly part).

7. The ileum is held together by **mesentery**. In the small intestine, further digestion occurs and nutrients are absorbed through the arteries in the mesentery. These arteries are called **mesenteric arteries**.

8. **Pancreas**: a bumpy organ located along the underside of the stomach, a pancreatic duct leads to the duodenum. The pancreas makes insulin, which is necessary for the proper uptake of sugars from the blood.

9. **Spleen**: a flattened organ that lies across the stomach and toward the extreme left side of the pig. The spleen stores blood and is not part of the digestive system. On the underside of the spleen, locate the splenic artery.

10. At the end of the ileum, where it widens to become the large intestine, a "dead-end" branch is visible. This is the **cecum**. The cecum helps the pig digest plant material.

11. The large intestine can be traced to the **rectum**. The rectum lies toward the back of the pig and will not be moveable. The rectum opens to the outside of the pig, or the anus. The large intestine reabsorbs water from the digested food, any undigested food is stored in the rectum as feces.

12. Lying on either side of the spine are two bean shaped organs: the **kidneys**. The kidneys are responsible for removing harmful substances from the blood, these substances are excreted as urine. (More on this later)

13. Two **umbilical vessels** can be seen in the umbilical cord, and the flattened **urinary bladder** lies between them.

Identify the structures on the diagram.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

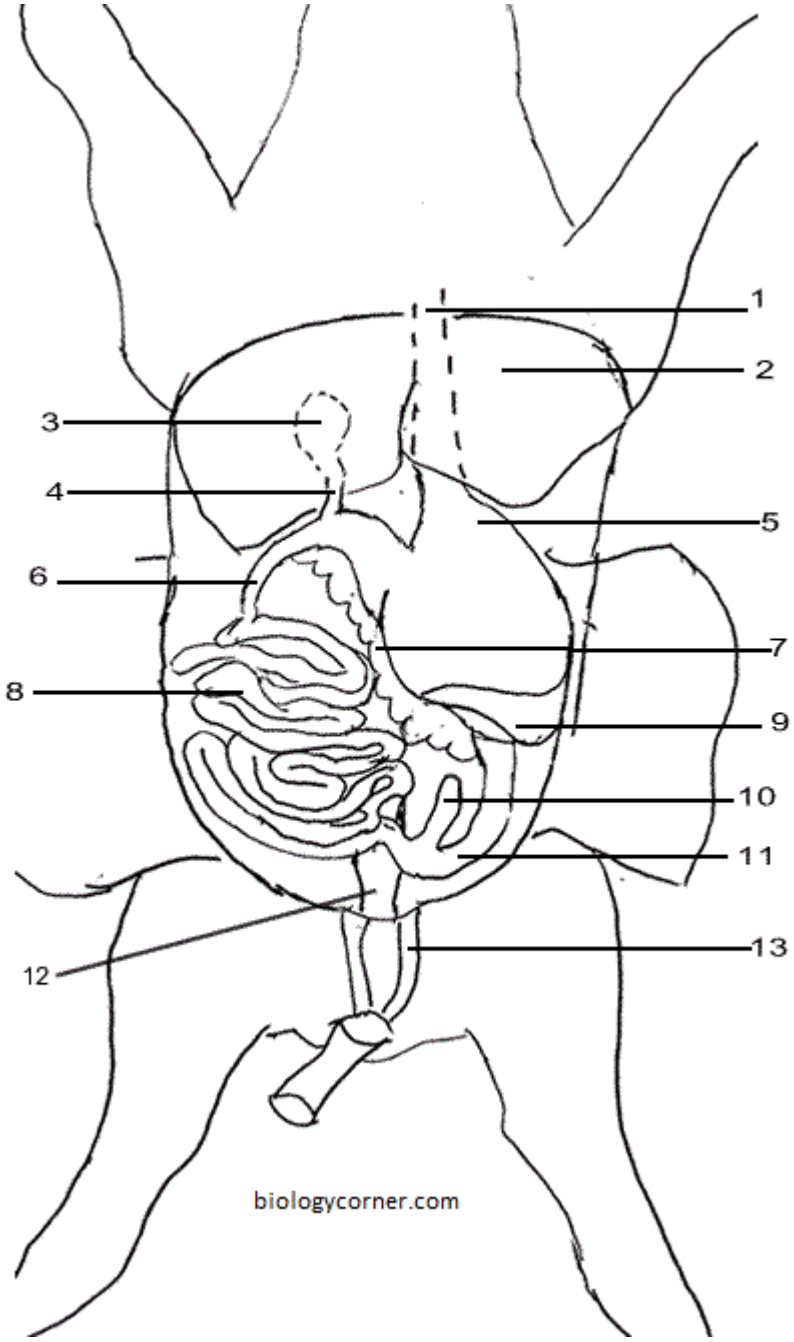
9. _____

10. _____

11. _____

12. _____

13. _____



Identify the organ (or structure)

14. _____Opening (valve) between stomach and small intestine.
15. _____Stores bile lies underneath the liver.
16. _____ A branch of the large intestine, a dead end.
17. _____ Separates the thoracic and abdominal cavity; aids breathing.
18. _____ Membrane that holds the coils of the small intestine.

19. _____ The straight part of the small intestine just after the stomach.

20. _____ Empties bile into the duodenum from the gall bladder.

21. _____ The last stretch of the large intestine before it exits at the anus .

22. _____ Bumpy structure under the stomach; makes insulin

23. _____ Lies between the two umbilical vessels.

Urinary and Reproductive Systems

1. Locate the kidneys; the tubes leading from the kidneys that carry urine are the ureters.
2. The ureters carry urine to the urinary bladder - located between the umbilical vessels. Lift the bladder to locate the urethra, the tube that carries urine out of the body.
3. Note the vessels that attach to the kidney - these are the renal vessels

Male

1. Find the scrotal sacs at the posterior end of the pig (between the legs), testis are located in each sac. Open the scrotal sac to locate the testis.

2. On each teste, find the coiled epididymis. Sperm cells produces in the teste pass through the epididymis and into a tube called the vas deferens (in humans, a vasectomy involves cutting this tube).

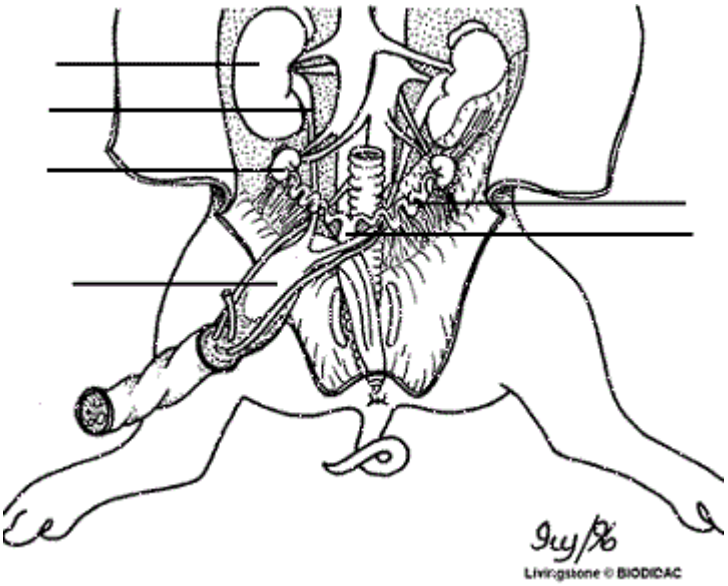
3. The penis can be located by cutting away the skin on the flap near the umbilical cord. This tube-like structure eventually exits out the urogenital opening, also known as the urethra.

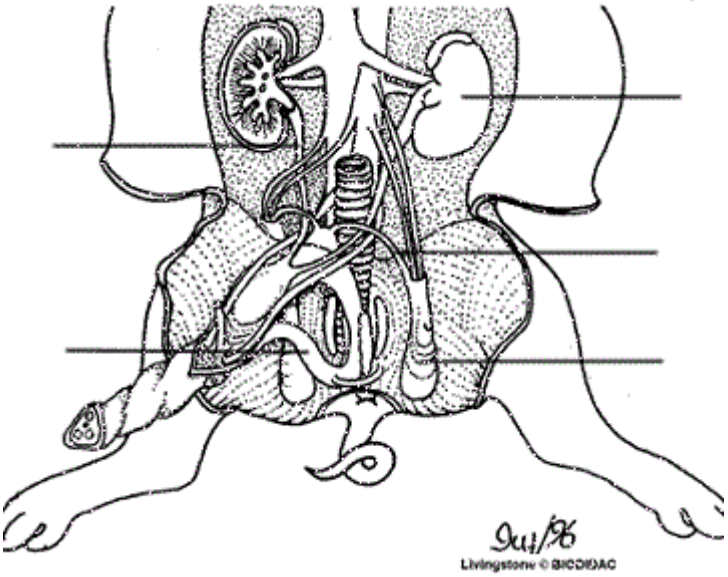
Female

1. In the female pig, locate two bean shaped ovaries located just posterior to the kidneys and connected to the curly oviducts.

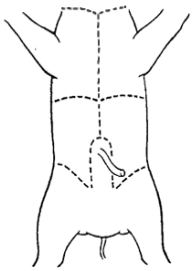
2.Trace the oviducts toward the posterior to find that they merge at the uterus. Trace the uterus to the vagina. The vagina will actually appear as a continuation of the uterus.

LABEL THE DIAGRAMS





Dissection of the Thoracic Cavity



You may need to cut through the pig's sternum and expose the chest cavity (thoracic cavity) to view. You will need to cut all the way up into the pig's neck, almost to the chin and open the thoracic cavity. Identify each of the following organs.

1. Find the diaphragm again. Remember that the diaphragm separates the abdominal cavity from the thoracic cavity, and it aids in breathing. Above the diaphragm, center of chest, is the heart.
2. Remove the pericardium, which is a thin membrane that surrounds the heart.
3. The structures visible on the heart are the two atria (12,13), the ventricle (14) which has two chambers not visible from the outside.

4. The most obvious vessel on the front of the heart is the pulmonary trunk (1) . It curves upward and joins the aorta (2) - a vessel which arches from the heart and curves around to go to the lower part of the body -where it is called the abdominal (dorsal) aorta (9). The aorta supplies the body with blood.

5. The aorta will curve back and then branch in two spots - the right brachiocephalic (3) and the left subclavian (5)

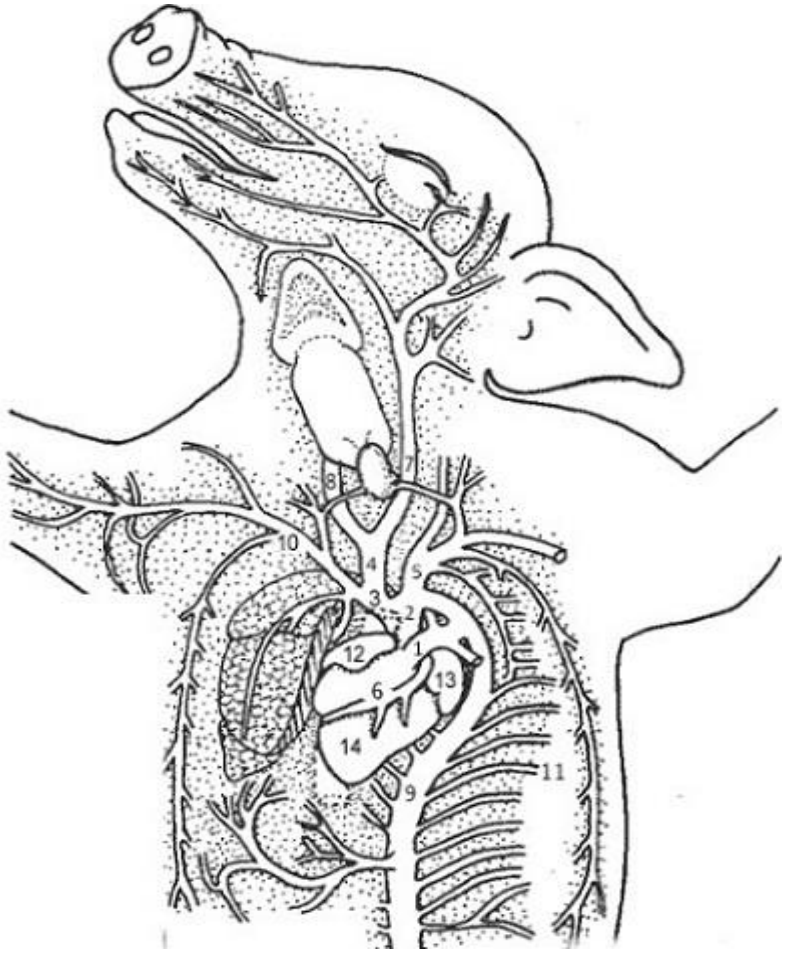
6. The right brachiocephalic then branches into arteries - the common carotid (4) and the right subclavian (10) The subclavians supply blood to the arms and follow the clavicle bone

7. The common carotid (4), which will branch into the left (7) and right carotid arteries (8). The carotid arteries supply blood to the head and neck.

8. Observe the coronary vessels (6) on the outside of the heart - these vessels supply blood to the muscle of the heart.

9. Easy arteries to find are the ones that run near the ribs. These are the intercostal arteries (11).

10. Lift the heart to look on its dorsal side (toward the back), you should be able to see the anterior and posterior vena cava, which brings blood from the body back to the heart. In addition, you should also be able to find the left and right jugular veins that drain blood from the head and run parallel to the carotids.



11. Push the heart to the side to locate two spongy lungs located to the left and right side. The lungs are connected to bronchial tubes (not visible) which connect to the trachea (forming a Y).

12. The trachea is easy to identify due to the cartilaginous rings, which help keep it from collapsing as the animal inhales and exhales. The trachea should be located in the chin area above the heart.

13. Lying atop the trachea, locate the pinkish-brown, V shaped structure called the thyroid gland. This gland secretes hormones that control growth and metabolism.

14. At the anterior (toward head) of the trachea, you can find the hard light colored larynx (or voice box). The larynx allows the pig to produce sounds - grunts and oinks.

Identify by number:

Aorta ____ Dorsal Aorta ____ Pulmonary Trunk ___

Common carotid ____ Left & Right Carotid ____

Coronary vessels ___ Left Subclavian_____

Right Subclavian _____ Right Brachiocephalic _____

Right Atrium _____ Left Atrium _____

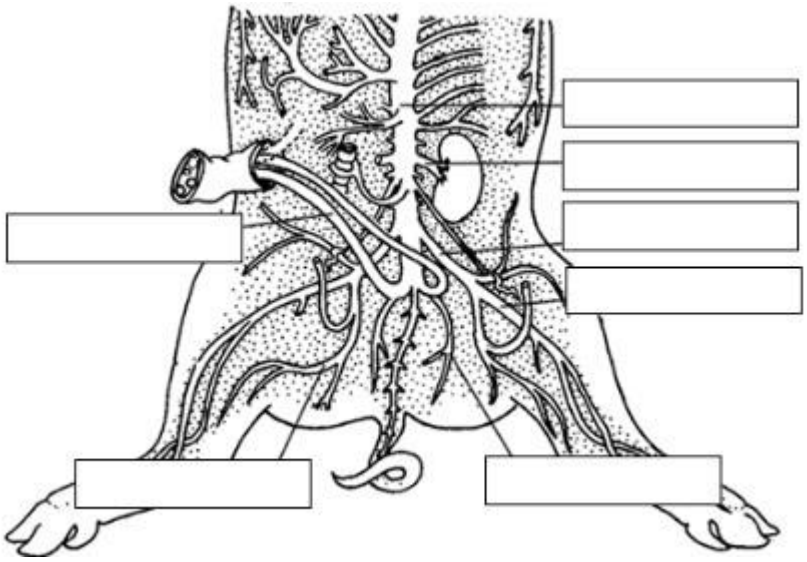
Intercostal _____ Ventricle _____

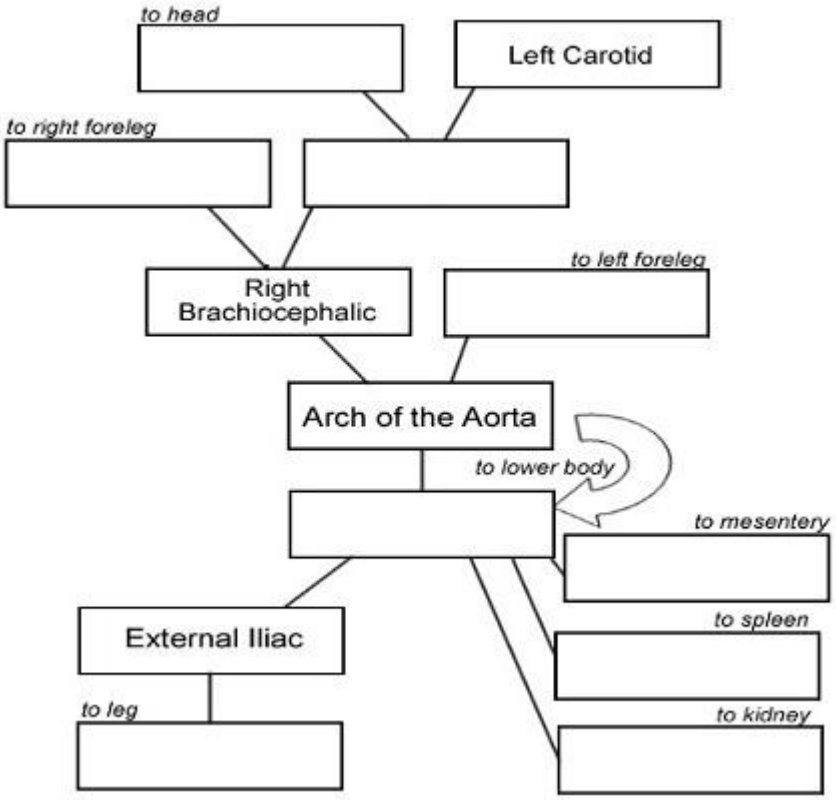
IDENTIFY THE STRUCTURE.

1. _____ Membrane over the heart.
2. _____ Airway from mouth to lungs
3. _____ Blood supply to head
4. _____ Lower heart chambers
5. _____ Blood supply to lower body
6. _____ Muscle to aid breathing
7. _____ Returns blood to heart
8. _____ Large vessel at top of heart
9. _____ Used to make noises
10. _____ Arteries on heart surface.

Fetal Pig - Dissection of the Lower Arteries

1. Trace the abdominal aorta (also called the dorsal aorta) to the lower part of the body, careful tweezing of the tissue will reveal several places where it branches, though some of the arteries may have been cut when you removed organs of the digestive system.
2. The hepatic artery leads to the liver. (may not be visible)
3. The splenic artery leads to the spleen (may not be visible)
4. The renal arteries lead to the kidney.
5. The mesenteric artery leads to the mesentery and branches into many smaller vessels. Look in the small intestine to find this artery.
6. Trace the abdominal aorta and note where it joins the umbilical arteries. You will need to cut the muscle in the leg to trace the next vessels. Use a pin to carefully tease away the surrounding muscle and tissue.
7. The abdominal aorta splits into two large vessels that lead to each leg - the external iliac arteries will turn into the femoral arteries as they enter the leg
8. Follow the umbilical artery toward the pig, you'll find that it branches, and a small artery stretches toward the posterior of the pig - this is the ilio-lumbar artery.
9. Follow the external iliac into the leg (carefully tease away muscle), it will branch into two arteries: the femoral (toward the outside of the leg) and the deep femoral (toward the back of the leg)




to head
Left Carotid
to right foreleg
to left foreleg
Right Brachiocephalic
Arch of the Aorta
to lower body
to mesentery
to spleen
External Iliac
to leg
to kidney

IE. Individual Formative Exercise:

Animal Dissection: Visit a Vetenary Clinic

IE. Individual Summative Exercise:

Develop a Disease prevention programme

Annexure A: Abnormal Anatomical Systems I

Introduction

Congenital defects can cause abortion or be present at time of birth. They are uncommon but do occur in most breeds of cattle. Defects are abnormalities in skeleton, body form, and body functions. Abnormalities may result from genetic or environmental causes. When the environment is the cause, adjustments can reduce further economic losses. However, genetic (inherited) causes are much more complex and difficult to correct.

Environmental Causes

Environmental or non-genetic causes have the same economic results as genetic causes but are far easier to rectify. Simply correcting the environment will remove the problem. There are many environmental factors, including disease and diet.

Certain conditions show that an abnormality is likely to be environmental in nature:

1. The abnormality coincided with an environmental factor and was absent upon removal of the factor.
2. The abnormality occurred in groups of non-related individuals.
3. The symptoms are similar to those of an abnormality known to result from environmental factors.

Genetic Causes

Chromosomes inherited from parents determine an animal's genetic make-up. There are many genes in each chromosome. Genetic abnormalities occur when genes are missing, in excess, mutated or in the wrong location (translocation). A few genes can directly cause an abnormality; however, these are rare. Usually, these genes are recessive, meaning two must be present to cause an abnormality. Both parents must be carriers of the gene for a calf to be abnormal. In this case, only one of every four offspring will be abnormal. Two will be carriers and one will be normal.

Certain conditions show that an abnormality is likely to have a genetic origin:

1. The abnormality is more common in a group of related animals.
2. The symptoms are similar to those of an abnormality identified through test matings. Study of an animal's chromosomes using blood samples can identify several genetic defects.

Common Genetic Defects

Hypotrichosis (Hairlessness)

Hairlessness occurs in several breeds of beef cattle. It expresses itself as complete or partial loss of hair. Calves are often born with no hair but will grow a short curly coat of hair with age. Affected individuals are prone to environmental stress (cold and wet) and skin infections are more prevalent. A recessive gene causes hairlessness.

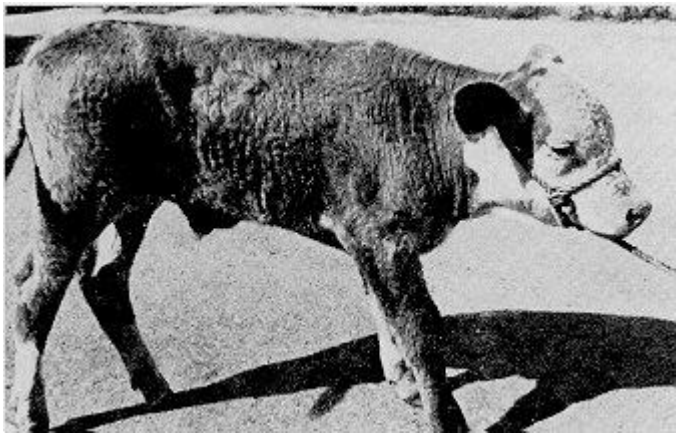


Figure 1. Partial Hypotrichosis.

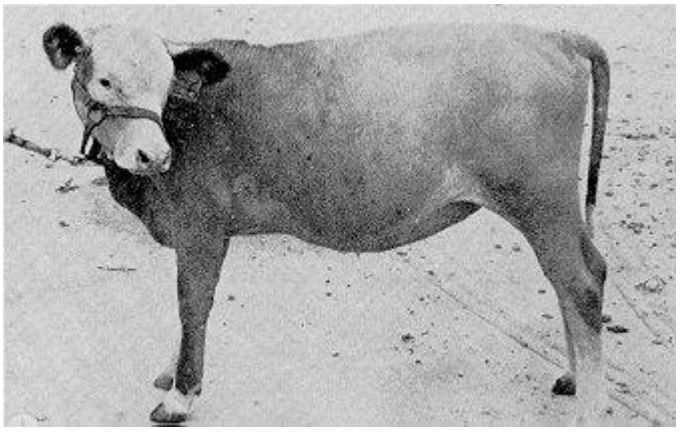


Figure 2. Complete Hypotrichosis.

Alopecia Anemia

This syndrome has recently been identified in the Polled Hereford breed. At the time of birth, alopecia anaemia may be mistaken for hairlessness. Affected calves are often small at birth, have a dirty-faced appearance, and have protruding tongue and eyes. Hair is wiry, tightly curled or absent while wrinkled skin gives the appearance of advanced aging. Calves are lethargic, cannot tolerate stress and are very prone to disease. Few survive past six months of age. Malfunction of the skeletal structure results in reduced red blood cell production (anaemia). Alopecia anaemia occurs in families, but the exact mode of transmission is unknown.

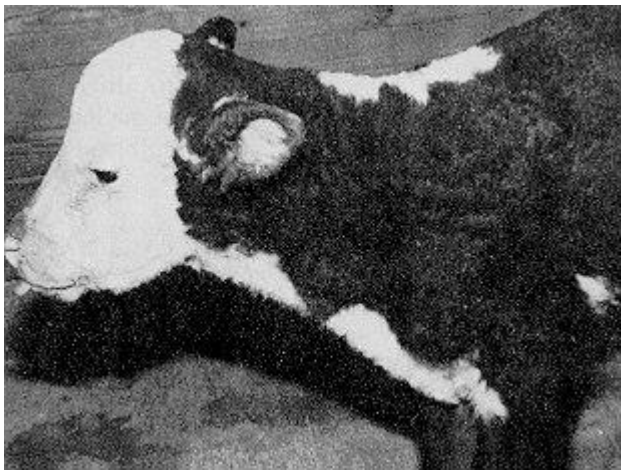


Figure 3. Three-day-old calf affected with congenital alopecia and anaemia. Note the appearance of the hair and skin and the dirty face and protruding tongue.

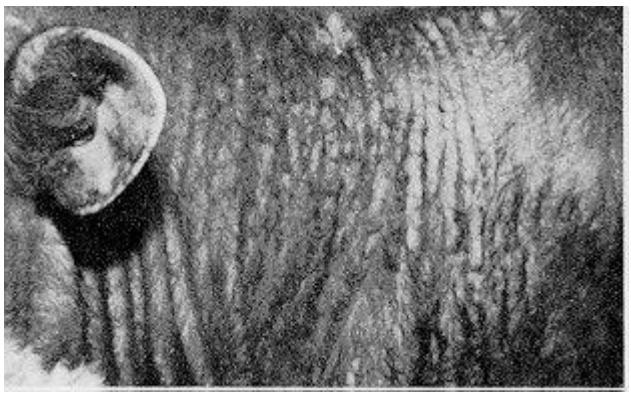


Figure 4. Six-month-old calf, neck and shoulder. There is marked wrinkling of the skin.

Translocations

A translocation occurs when part of a chromosome breaks off and attaches to another chromosome. The 1/29 translocation has been identified in the Simmental, Charolais and

Blonde D'Aquitaine breeds. The 14/20 translocation occurs in most Continental breeds. Translocations affect fertility but no other production traits. Carriers of translocations have reduced conception rates and increased abortion rates. Blood analysis allows easy identification of carriers.

Beta-mannosidosis (Beta-man)

The Beta-man disorder is due to a recessive gene that produces a defective enzyme. The result is the birth of calves that never get up and eventually die. The syndrome occurs in the Salers breed and a blood test is available for identifying carriers.

Syndactyly (Mulefoot)

Syndactyly refers to the fusion of the two toes of the foot. Caused by a recessive gene, mulefoot most often affects the front feet. This condition occurs in the Aberdeen Angus breed.

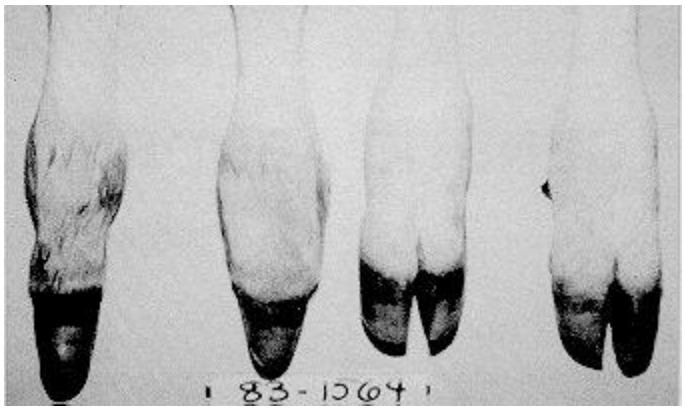


Figure 5. Syndactyly and normal hooves.

Other genetic defects exist, most being of very low frequency.

What Should You Do?

When you suspect that you have a problem calf, consult your veterinarian and OMAFRA extension specialist. Investigate all symptoms and possible causes before concluding the problem is genetic or environmental. When the cause is genetic, contact the breed association and give them a full report of the findings. Progressive breed associations are working to reduce the frequency of genetic abnormalities within their breed.

To avoid further abnormalities in your herd without culling female carriers, use non-carrier bulls unrelated to your herd. Practice no inbreeding within the herd. Crossbreeding to a different breed is another alternative.

Summary

Genetic abnormalities are not common. When they do occur, they cause economic losses. Genetic and environmental factors cause abnormalities. Environmental causes are quickly corrected while genetic causes require longer term solutions. If an abnormality occurs on your farm, take immediate action.

Source: www.omafra.gov.on.ca

Breeders may see various genetic abnormalities in cattle from time to time. Examples are albinism, hairlessness, mulefoot and dwarfism. Usually they are harmful and we may want to eliminate them, but occasionally there can be some advantages associated with even such harmful characteristics.

What types of genetic abnormalities are found?

Any defect that is inherited is described as a genetic abnormality, and may take one of many forms - the extreme being where it is visible and lethal. Other effects can be less obvious and can vary from premature abortion and early embryonic death, to animals that are weak or poor doing, slow growing and inefficient, with lower vigor, fertility, and longevity.

What are the causes of genetic abnormalities?

Genetic defects usually show what is called recessive inheritance. A parent can carry the

defective gene and appear normal; the parent is then known as a carrier. If both parents pass the defective gene to the offspring, the genetic defect shows up and the genetic condition in the offspring is called homozygous recessive. The defective gene in the carrier animal is present along with the normal gene and this condition is termed heterozygous. The underlying problem of genetic defects is that parents that appear to be perfectly normal can be carriers and so can produce offspring that are defective. Parents that never produce defective progeny are in the majority and are called homozygous normal.

At first glance it seems that if we could identify carrier animals and eliminate them from the breeding population the problem of recessive genetic defects would be solved. However, it is necessary to explore the problem a little further before deciding that identifying carriers is necessarily worth the money and effort.

There are a few defects that exhibit dominant inheritance, which means that a carrier animal with one defective gene can be identified directly. Cattle breeders are unlikely to retain animals carrying such genes. Some embryos with severe genetic defects are never seen, since they are lost soon after fertilisation and we would normally assume that the cow had not conceived. So far we have discussed single gene defects. All genes, normal or unfavourable, are organised onto chromosomes and these are arranged in pairs. There are 30 pairs in cattle cells. Occasionally a major defect has been noted that is attributable to the mispairing of chromosomes, but there are few defects in cattle that can be explained in terms of such chromosomal abnormalities.

Although it is possible to see chromosomes under the microscope, the genes which they carry cannot be seen. Thus, it is not possible at present to screen individual animals for all known genetic defects by chromosome studies (karyotyping).

The criteria for deciding what defects are best studied and perhaps controlled by karyotyping are as follows:

- ☐ that there is evidence that a chromosomal abnormality causes a particular production defect, rather than just happening to be associated with it
- ☐ that the abnormality actually occurs in the nation's cattle population

- ☐ that there is no simpler means of studying or controlling the defect.

While karyotyping is unlikely to be of benefit in individual herds, there are circumstances where the procedure is of value. Many aspects of semen 'quality' of AI bulls are checked at the AI centre, including the karyotype, and this is sound practice because of the possible widespread use of semen from a particular bull.

How widespread are defective genes?

Every animal species, breed and individual animal carries some genes that, when in the pure or homozygous condition, may prove to be harmful. Furthermore, no individual or breed is genetically pure or homozygous for all gene positions on the chromosomes. Inbreeding increases the amount of homozygosis and results in decreases in vigour and general fitness. Our livestock are not meant to be homozygous and cannot stand being homozygous.

Two forms of recessive genes

Two kinds of genes that can lead to problems of recessive genetic abnormalities can be defined. One kind, which is not wanted, shows no effect in the heterozygous form, but when it occurs pure in the homozygous form, the defect shows up. The other kind of gene may have a beneficial effect when present in the carrier or heterozygous animal, but when it occurs as a homozygote a deleterious effect is visible.

Unwanted genes are usually present in very small numbers and kept in a breeding population by chance, recurring mutations, and by migration of new animals into the population. Examples are those that cause mannosidosis, spastic paresis and albinism. Such unwanted genes can increase in frequency if a particular animal that happens to carry them is used too extensively, as may often occur when linebreeding is followed. The result is that some genetic defect will result further down the line, which may not have been encountered before in that strain.

The best way of keeping the number of individuals affected by unwanted genes down is to prevent inbreeding, or conversely, to use outbreeding. In small herds of say less than 50 cows, this is best accomplished by examining the pedigrees and avoiding mating animals that

have common ancestors in their pedigree at least in the two or three most recent generations of their pedigree.

In the absence of a monitoring plan for defects and in the absence of outbreeding, it is necessary to identify the carrier animals if any control is desired. In larger herds, 'turning over' sires in the herd as quickly as possible and not taking too many replacement sons from any one sire will be important in minimising inbreeding. Using fewer cows per bull will also help, although there is an optimal level because some selection intensity would be forfeited at the same time.

The other kind of gene, which shows some advantage in the heterozygous condition, creates a special problem. This type of gene complements its partner gene in the heterozygote, producing some superiority over the homozygous normal; but when it is paired with one of its own kind in the homozygous recessive, there is some loss of function and abnormality results.

Such genes can increase in frequency because of the relative advantage they confer on the carrier animals. Among all known genetic abnormalities, however, these are rare. If they confer a very strong advantage on the farm or in the marketplace they may increase in frequency very rapidly.
Such was the case with dwarfism in beef cattle a couple of decades ago in North America. The heterozygote had the type that was favoured by breeders and show judges at that time. When two carriers were mated the result could have been a dwarf calf. This was expected to occur in 25% of joinings. Eventually dwarfism was eliminated because the characteristics preferred in the carrier became unfashionable. Higher performing, faster growing animals were preferred to the dwarf carrier animal and as a result, the dwarf genes in the population were diluted by new bloodlines being introduced.

Depending on the particular characteristic and the economics involved, it may be desirable to utilise genes that produce an advantage in heterozygotes. This can be done by consciously producing carriers. Special test matings with known carrier females are the most appropriate method for detecting carriers of such specific genes.

Thus we see that there are two kinds of genes that might be considered defective. The first, arising by mutation or migration, has no observable effect in the heterozygote, but is deleterious as a homozygote in its pure form. It merely spreads by chance brought about by excessive use of particular animals. The second kind of gene shows an improvement in performance in the carrier condition, and its spread is brought about because of the advantage conveyed to any individual that is a carrier.

Source: www.petalia.com.au

Annexure B: Abnormal Anatomical Systems II

Managing Genetic Defects in Beef Cattle Herds

Congenital defects are abnormalities present at birth. They are abnormalities of structure or function that can result in calf losses before or after birth. These defects can be caused by genetics, environment, or a combination of these two factors. In some cases, the cause of defects is unknown.

Genetic defects are the result of an abnormal or mutated gene. They may impair animal health or cause a condition of abnormal function or structure. Hereditary defects occur in all breeds of cattle, but some defects are strongly associated with certain breeds. More than 200 different genetic defects have been identified in cattle. Most of them occur rarely and are of minor concern, but some increase in frequency to the point that they become a significant economic concern and need to be selected against. Genetic abnormalities may contribute to poor animal performance, structural unsoundness, semi-lethal disease, or lethal disease.

Specific Genetic Abnormalities

Genetic abnormalities in beef cattle differ in trait expression, mode of inheritance, and incidence rate. Examples of genetic defects include these:

- achondroplasia (bulldog dwarfism)
- alopecia
- ankylosis
- arthrogryposis (palate-pastern syndrome, rigid joints)
- arthrogryposis multiplex (AM, curly calf syndrome)
- brachynathia inferior (parrot mouth)
- cryptorchidism
- dermoid (feather eyes)
- double muscling
- fawn calf syndrome
- hypotrichosis (hairlessness)
- hypotrichosis ("rat-tail")
- idiopathic epilepsy (IE)
- mannosidosis
- neuraxial edema (maple syrup urine disease)
- neuropathic hydrocephalus (NH, "water-head")
- oculocutaneous hypopigmentation (white eyes)
- osteopetrosis (marble bone disease)
- polydactyly (extra toes)
- progressive bovine myeloencephaly (weaver calf)
- prolonged gestation
- protoporphyria (photosensitivity)
- pulmonary hypoplasia with anasarca (PHA)
- syndactyly (mule foot)
- tibial hemimelia (TH)
- translocations

Table 1 details defect names, descriptions, modes of inheritance, and breeds affected for several known genetic defects in cattle.

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Identifying Causes of Defects

When an abnormal calf is born, first try to determine if the defect is hereditary. Congenital defects that are not inherited, but are instead environmentally caused, often occur during a short period in a group of cattle managed the same. Malnutrition, toxic factors, infectious disease, or extreme weather may be to blame for these congenital defects.

For example, when a pregnant cow consumes the lupine plant between days 40 to 60 of gestation, her calf may be born with crippled-calf (crooked-calf) disease, a crooked-leg condition. Two-headed calves and calves with extra legs may be the result of fetal development mistakes. Bovine virus diarrhea (BVD) infection during pregnancy can lead to some hydrocephalus. Flexed pasterns can be caused by a large fetus developing in a small uterus. Each of these conditions may at first appear to be genetic defects but are actually caused by environmental conditions. In the cases of crippled-calf disease and flexed pasterns, the causes could be either environmental or genetic. Once it is determined that a specific environmental cause is responsible for a defect, management changes can be put in place to address these problems and reduce the risk of future incidence.

Some congenital defects are inherited. Most genetic abnormalities are simply inherited and determined by a single pair of recessive genes. See the example in **Figure 1**. In this instance, both parents are "carriers" (heterozygous; one desired and one undesired allele or gene copy) for the defect.

Figure 1. Simple Inheritance example.

Mate two carrier animals (Dd)
Heterozygous x Heterozygous
Carrier Sire x Carrier Dam
Dd x Dd

D = normal allele
d = affected allele

	½ D	½ d
½ D	¼ DD	¼ Dd
½ d	¼ Dd	¼ dd

Resulting offspring

Percent of calves	Genotype	Phenotype
25%	DD = homozygous dominant, non-carrier	Unaffected, normal
50%	Dd = heterozygous carrier	Unaffected, normal
25%	dd = homozygous recessive	Affected

Genetic tests for DNA markers can usually help identify these simply inherited defects. Genetic tests for simple traits that are controlled by one gene are able to accurately assess whether an animal is a carrier or will "breed true" (homozygous; two same alleles) for the marker alleles that result in a certain phenotype (physical manifestation of a trait). Breed associations and genetic testing companies can provide testing protocols for genetic defects associated with a certain breed. Tests for a specific genetic defect generally cost around $30 per animal. Combined tests that provide information on multiple genetic disorders are also available for slightly higher fees.

If a defect is dominant, no test is needed because the animal would display the defect even if only one dominant allele were present. A small number of congenital defects are caused by genes with incomplete dominance, and a few are caused by two or more sets of genes. If the defect is inherited as incomplete dominance, an animal that has only one undesired allele can usually be identified, and testing is not needed.

Genetically caused defects tend to run in families. The sire and dam of a calf will likely have at least one common ancestor. The occurrence of multiple affected calves in a herd often results from a situation where the sire is the same and the dams are closely related.

Breeders must have good records to determine the cause of defects. These records must include calf parentage, abnormality descriptions and photos or videos when possible, and causes of death. If parentage is not known from records, it can be determined via DNA testing. When cause of death is not obvious, request veterinary assistance to obtain necropsies immediately on dead cattle. Necropsies are valuable for investigating possible causes of death and ties to congenital defects. Management groups and movement among paddocks or pastures should be recorded, as well. Feed and forage analysis reports, notes of toxic plant presence, and herd health records will also help in diagnosing the cause of any congenital abnormalities.

Managing Genetic Defects

Once carrier and affected animals are identified, producers can make selective breeding and culling decisions to manage a genetic defect within a herd. When a carrier animal is extensively used for breeding purposes, as in the case of sires for artificial insemination purposes, several thousand calves may be sired by the carrier bull before the abnormality expresses itself. Even more matings using the carrier sire may take place before affected calves are associated with the sire and genetic testing confirms the sire as a carrier.

In some cases, a genetic test may not be available at the time of the initial occurrences of the condition in the cattle population. A diagnostic test may then

need to be developed based on data submitted from producers observing the defect in their herds. Therefore, it is prudent to test sires from which semen will be marketed as well as donor dams in embryo transfer programs for known potential genetic defects. Furthermore, producers must remain vigilant about observing calf crops for congenital defects, collecting appropriate records and animal samples for diagnostics, and reporting problems with defect occurrence to breeding animal suppliers and breed associations as appropriate.

Consider the value of a carrier's genetic worth to the breeding program. An animal with one undesirable recessive gene may also have thousands of very desirable genes. With carriers with superior genetics, strategically mate these animals to non-carriers in a terminal crossbreeding program where all calves are marketed for beef production and not for breeding purposes. Alternately, a superior son could be produced for use as a herd sire that does not carry the defect.

In most cases, defect carriers should not be used to produce breeding animals. Therefore, do not keep replacement heifers that are defect carriers. When other cattle with similar or superior genetic merit that do not carry the defect can be utilized, systematically work carrier females out of the herd and replace them with cattle that do not carry the defect. Be sure to send carriers directly to harvest to avoid transferring the defect to another breeding herd.

Purebred breeders and breed associations share responsibility for control of genetic defects in seedstock populations. In seedstock herds, use available DNA diagnostic tools to test suspect animals or those known to have ancestors that are carriers. When carriers are retained in the breeding herd, test all progeny to determine carrier status before marketing them as breeding animals.

Seedstock producers have an obligation to the customers they supply with breeding animals as well as their respective breed associations to be honest and notify them when carriers of genetic defects become known. Many breed associations mandate genetic defect reporting among their members. Breeders should photograph any calf born with a suspected defect and then contact the breed association to arrange for tissue collection and reporting. Breed associations may also have rules regarding registration eligibility or required denotations on registration papers for animals carrying or affected with genetic defects.

Make sure buyers understand the consequences of using offspring from known carriers. Serious ethical and legal problems can be involved in marketing known carrier cattle or progeny of known carriers. Marketing carriers without informing the buyer can not only harm breeder reputation but may also reflect negatively on the entire breed.

Good monitoring and control measures by seedstock operations will help control the incidence of genetic defects in commercial cattle populations. Even with seedstock level management of genetic defects, commercial cattle producers may still need to cull carrier animals within their herds if the incidence rate of a genetic defect rises to a level where it becomes an economic problem. Yet in most cases, careful sire and/or breed selection can be an effective approach for managing genetic defects in a commercial herd without the need for extensive cow herd culling. For more information about beef cattle genetics or specific genetic defects, contact an office of the Mississippi State University Extension Service.

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Table 1. Genetic defects in cattle.

Condition	Description	Inheritance	Breeds Affected[1]
Achondroplasia (bulldog dwarfism)	Homozygous calf may be aborted at 6 to 8 months gestation; has compressed skull, nose divided by furrows, and shortened upper jaw for a bulldog facial appearance; heterozygous calf is small and heavy-muscled	Incomplete dominant	
Alopecia	Lethal abnormality very similar to hypotrichosis; takes laboratory analysis to distinguish; calves have kinky, curly hair that is soon lost in patches around the head, neck, and shoulders; skin changes and anemia occur in all cases; death before 7 months of age due to anemia	Simple recessive	Polled Hereford
Ankylosis	Abnormal union of any joints in calf; cleft palate frequently occurs	Recessive	
Arthrogryposis (palate-pastern syndrome; rigid joints); Arthrogryposis Multiplex (AM; curly calf syndrome)	Pastern tendons are contracted; joints of all four legs fixed symmetrically; upper part of mouth not properly fused together (cleft palate); calves usually die shortly after birth; AM in Angus includes twisted malformation of spine and fixed leg joints	Simple recessive; many environmentally caused forms	Angus (AM), Red Angus (AM), Charolais, many other breeds
Brachynathia inferior (parrot mouth)	Cattle have a short lower jaw; under- or overshot jaw with varying degrees of expression when polygenic	Simple recessive; polygenic (more common)	Angus, Simmental
Cryptorchidism	Retention of one (unilateral) or both (bilateral) testicles in body cavity instead of descending into scrotum	Sex-limited trait; polygenic	Many breeds
Dermoid (feather eyes)	Skin-like tissue masses occur on eye or eyelid; cattle may become partially or completely blind	Polygenic	
Double muscling	Muscle enlargement with large grooves between muscle systems; particularly evident in hind leg; cattle usually grow slowly; fat deposition (internal and external) is reduced; typically fine boned; considerable variation in expression	Simple recessive; dominant in Piedmontese	Belgian Blue, Piedmontese, Angus, Red Angus
Dwarfism	At least three types in cattle; snorter dwarfism: most common; short, blocky appearance; deformed bone growth in nasal passages causing difficult breathing; long head dwarfism: small size but normal nasal passages; compress dwarfism: extremely compressed body conformation with one compress alleles and one normal gene; dwarf and death at or soon after birth with two compress alleles	Simple recessive (snorter dwarfism; long head dwarfism); incomplete dominance (compress dwarfism); environmental causes	Angus, Hereford, Brahman, Dexter
Fawn Calf Syndrome	Abnormal crouched posture at birth, resembling a deer fawn, with the feet placed more to the rear than normal, hocks pulled up and back and the spine slightly arched; flat down on pasterns during first days of life; tend to be taller and more slender with poor foot conformation; poor muscle development; difficulty in some with movement and suckling; can result in calf death but most can walk, suckle, and survive; poor growth performance; early onset of degenerative arthritis	Simple recessive	Angus
Hypotrichosis (hairlessness)	Partial to almost complete lack of hair; hair grows in and falls out, so appearance varies over time; non-lethal	Simple recessive; low frequency	Hereford
Hypotrichosis (rat-tail)	Form of congenital hypotrichosis; colored hair anywhere on body is short, curly, malformed, and sometimes sparse; abnormal tail switch; often confused with premature birth; slower post-weaning weight gains	Interaction between two loci where at least one gene is for black color and must be heterozygous at the other locus involved	Matings of Simmental with Angus; Hereford can carry

Condition	Description	Inheritance	Breeds Affected[1]
Ideopathic Epilepsy (IE)	Neurological disorder causing seizures	Simple recessive	Hereford
Mannosidosis	Lethal nervous disease; failure to thrive; progressive incoordination; aggressive disposition when disturbed; death typical before sexual maturity reached	Simple recessive	Angus, Murray Grey, Galloway, Salers
Neuraxial edema (maple syrup urine disease)	Calf is normal size at birth but may not be able to stand or lift head; sudden touch or loud noise may cause vigorous extension of the legs and neck; muscle spasms of neck and legs may last for 1 to 2 minutes; death typical within 5 days	Simple recessive	Hereford, Shorthorn
Neuropathic Hydrocephalus (NH; water head)	Fluid accumulation in brain ventricles (internal: water head) or cranium (external); bulging forehead; calves usually die shortly after birth	Simple recessive; environmental causes	Angus, Red Angus (external), Hereford (internal), many other breeds
Oculocutaneous Hypopigmentation; Heterochromia Irides (white eye)	Hair coat is bleached color; iris is pale blue around pupil with tan periphery	Simple recessive	Angus
Osteopetrosis (marble bone disease)	Bone tissue fills marrow cavity of the long bones; brittle bones that break easily; calves have short lower jaws, protruding tongues, and impacted molar teeth; calves usually born dead 2 to 4 weeks preterm	Simple recessive	Angus, Red Angus, Simmental, Holstein
Polydactyly (extra toes)	One or both front feet or sometimes all four feet have outer dew claw develop into extra toe	Polygenic	Simmental, Holstein
Progressive bovine myeloencephaly (weaver calf)	Calves develop a weaving gait at 6–8 months of age and get progressively worse until death at 12–20 months of age	Simple recessive	
Prolonged gestation	Fetus fails to trigger parturition; calving must be induced or the calf removed; calf is often extremely large and often dies	Simple recessive	
Protoporphyria (photosensitivity)	Sensitivity to sunlight; development of scabs and open sores upon sunlight exposure; liver function affected; seizures possible	Simple recessive	Limousin
Pulmonary Hypoplasia with Anasarca (PHA)	Fluid collection in skin and body cavities at birth; lethal to calves; usually causes dystocia because of added weight; lungs underdeveloped	Simple recessive	Shorthorn, Maine-Anjou, Chianina, Simmental
Syndactyly (mule foot)	One or more hooves are solid in structure rather than cloven; front feet most often affected; can occur in all four feet; cattle cannot tolerate hot temperatures; high mortality rate in calves	Simple recessive	Chianina, Angus, Simmental, Holstein
Tibial Hemimelia (TH)	Calves born with twisted legs with fused joints, large abdominal hernias, and skull deformity	Simple recessive	Shorthorn, Maine-Anjou, Chianina, Simmental, Galloway
Translocations	Part of a chromosome breaks off and attaches to another chromosome; carriers have reduced conception rates and increased abortion rates	Simple recessive	1/29 in Simmental, Charolais, and Blonde D'Aquitaine; 14/20 or 14/21 in most Continental breeds

[1]Specific defects have been noted in the breeds listed. However, these defects could occur in other breeds.

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