Describe livestock management and livestock physiology important to this management

90154 (v2)
External Achievement Standard
Credits: 4

This achievement standard involves knowledge of ruminant and non-ruminant digestive systems and reproductive systems that are important to livestock management practices, and of livestock management practices such as feeding programmes, vaccinations, drenching, stock identification, breeding, selection and recording, and artificial breeding

Achievement	Achievement with Merit	Achievement with Excellence
Describe the physiology of body systems important to livestock management practice(s).	Explain the physiology of body systems important to livestock management practice(s).	Explain the physiology of body systems important to livestock management practice(s).
Describe livestock management practice(s).	Explain livestock management practice(s).	Explain livestock management practice(s).
		Select and justify management practice(s) used to solve a livestock production problem.

Explanatory Notes

Body systems are restricted to the ruminant and non-ruminant digestive systems and reproductive system. Knowledge of enzymes and hormones is not required.

Explanation of management practices will include scientific principles that explain:

- feeding practices, e.g. digestibility and levels of food constituents, feed quality and quantities to meet different physiological states such as pregnancy, lactation and growth
- breeding practices, e.g. simple Mendielian genetics, variation and artificial breeding
- simple Mendielian genetics is limited to dominant and recessive alleles, genotypes and phenotypes and the use of Punnett squares to predict the result of a monohybrid cross
- artificial breeding refers to the collection, dilution and storage of semen, and the insemination of animals
- health practices, e.g. actual and predisposing causes of disease, minimising chances for infection, and building resistance in health programmes.

Livestock management practices could be selected from: feeding programmes, vaccinations, drenching, stock identification, breeding, selection and recording, artificial breeding.

Describe questions will focus on ‘what’ aspects and Explain questions will focus on ‘why’ and/or ‘how’ aspects.

SLO's

Students Learning outcomes:	I have learnt	I have mastered
Digestive systems: Ruminant Mouth/teeth 4 chambers of stomach Small intestine Large intestine Caecum Rectum/anus Monogastric Mouth/teeth Single chambered stomach Small intestine Large intestine Caecum Rectum/anus		
Reproductive systems Male Female Genetics Punnett squares Breeding practices Artificial insemination/artificial breeding Collection and storage of semen Selection Natural breeding Selection Selection and Recording Identification methods		
Pregnancy: Stages of development (foetus) Gestation length Special requirements Pregnancy testing Birth Lactation		
Feeding practices: Digestibility Growth/development requirements (quantity and quality needed) Young stock (growing) Pregnant females Lactating females Males Maintenance Feed constituents Quality vs quantity Feeding programmes		
Health practices: Actual causes of diseases Bacteria Virus Fungi Protozoa Predisposing causes of diseases Environment Genetics Reducing infection Increasing resistance Health practices Drenching Dipping Vaccination		

digestive systems

There are 2 main types of digestive systems that we will be studying:

- Ruminant: 4 chambered stomach system. Ruminant farm animals include: sheep, goats, deer and cattle
- Monogastric: single chambered stomach system. Monogastric farm animals include: pigs, horses and dogs

Ruminant Digestive systems

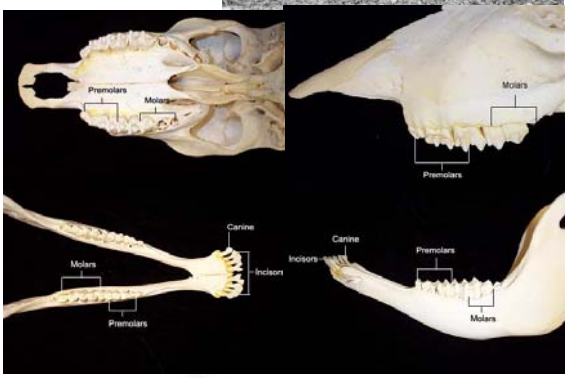
Ruminant digestion uses physical, chemical and microbial means to breakdown large fibrous particles into small soluble nutrients that the animal can use.

Ruminants graze on plant material, in NZ this is most commonly grasses and other pasture species.

Because of this, they need to be eating a constant supply of fresh (or dried) pasture. Though ruminants can digest grain (starch), their more natural diet is forages: grass, weeds, hay, and silage. Ruminants (such as cattle and sheep) can utilize plant fibre material that monogastrics cannot digest because they have microbes to help them break down the fibre.

Cattle digestion:

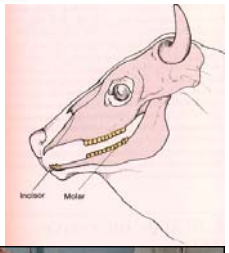
The digestive tract begins with the mouth where feed is ingested. The tongue of the cow is strong and rough and easily pulls feed into the mouth.



In grazing, the tongue pulls the forage in, and the plant material is cut off by the eight incisor teeth on the bottom jaw and the rough dental pad of the upper jaw. A cow does not have upper incisor teeth or canine (eye) teeth. A cow has 24 chewing (cheek) teeth, three premolars and three molars on each side of the upper and lower jaws.

The chewing teeth grind the feed, breaking whole grain and forage particles into smaller, more digestible particles.

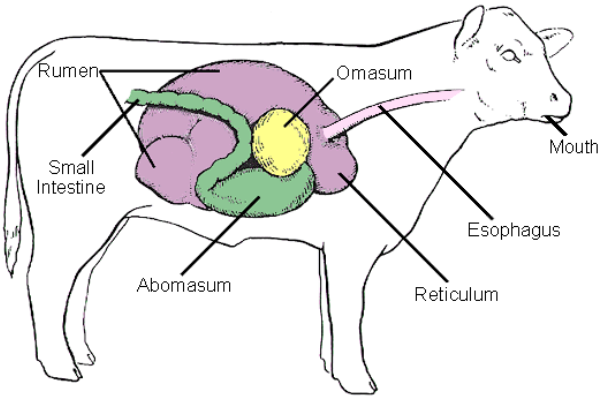
During chewing (mastication), salivary glands, located in the rear of the mouth and along the jaw, are stimulated to secrete saliva, in some cases 160-180 L per day. Saliva is mixed with feed during mastication this moistens and lubricates the feed. In addition to lubricating the feed, saliva contains minerals and urea that are utilized by micro-organisms present in the rumen. Saliva also contains sodium bicarbonate and phosphate salts that buffer acids, such as ethanoic (acetic) acid and propionic acid, produced by rumen microbial fermentation. Saliva is important in achieving optimal intake and digestion as well. Microbial growth, activity, and rumen enzyme activity is highest within a rumen pH range of 6.2 to 6.8. Fermented feeds, such as silages and high moisture grains, have a lower pH. Therefore, in order to maintain proper rumen function, salivation is essential.



As feed becomes mixed with saliva and pushed to the back of the mouth by molar grinding, a ball of feed, the bolus, slowly forms. Periodically, this bolus is swallowed and passes down the oesophagus to the rumen. The oesophagus is a muscular tube about 1m long and 6cm in diameter, in the mature cow. The oesophagus not only carries food to the rumen during swallowing; it serves as a pathway for regurgitated feed to return to the mouth for re-chewing (commonly called "cud-chewing").

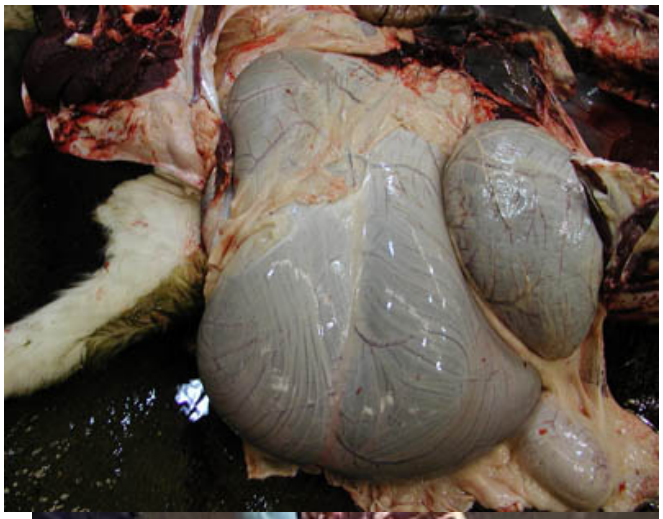
The food bolus passes down the oesophagus and into the first chamber of the stomach, the rumen.
A ruminant animal has a 4 chambered stomach. The rumen is the largest chamber and the first.
The 4 chambers in order are:

- Rumen
- Reticulum
- Omasum
- Abomasum



The rumen, reticulum, and omasum are non-glandular muscular sacs. Thus the digestion that occurs within these first three stomach sections is a result of microbial enzymes and fermentation. The abomasum is also referred to as the “true stomach” as it contains HCl and digestive enzymes.

Rumen:



The rumen occupies a large percentage of the abdominal cavity of the ruminant animal, in a mature dairy cow the rumen is approx 80% of the stomach area. It is a large storage space for food that is quickly consumed, then later regurgitated, re-chewed, and re-swallowed in a process called cud-chewing.
The rumens inner surface is a lot like a shag carpet, made up of thousands of papillae.
Rumination reduces particle size of fibre and exposes sugars to microbial fermentation.
The rumen is basically a large fermentation vat that can contain as much as 100 to 120 kg of digesting material. It contains billions of micro-organisms, including bacteria and protozoa, which allow ruminants to digest fibrous feeds such as grass, hay, and silage that other animals cannot efficiently utilize. The relationship between the cow and microorganisms is a symbiotic relationship where each benefits from the other. For instance, the cow provides a suitable environment and feed for the microbes while the microorganisms yield nutrients such as VFA's (volatile fatty acids) for the cow. The rumen provides a suitable environment with generous food supply for microbes to grow and reproduce. The absence of air (oxygen) in the rumen favours the growth of some particular species of bacteria (anaerobic), among them are those that can degrade plant cell walls (cellulose) into simple sugars (glucose). The microbes ferment glucose to obtain energy to grow and they produce volatile fatty acids (VFA) as end-products of fermentation. The VFA cross the rumen wall and become the major sources of energy to the cow, in other words the cow can absorb VFA’s through the rumen wall. As ruminal microbes grow, they make amino acids, the building blocks of proteins. Bacteria can use ammonia or urea as nitrogen sources to build amino acids. Without bacterial conversion, ammonia and urea would be useless to the cow. However, bacterial proteins made in the rumen are digested in the small intestine and constitute the major source of amino acids for the cow.

Fermentation in the rumen produces enormous quantities of gas (methane) that ruminants must get rid of by belching (burping). Anything that interferes with belching is life threatening to the ruminant and may result in a condition called "bloat." (see animal health section)
Fibre particles remain in the rumen from 20 to 48 hours because bacterial

fermentation of fibre is a slow process. However, particles that digest faster tend to stay in the rumen for a shorter period of time.
Food particles that are still too large in size are later regurgitated, re-chewed, and re-swallowed in a process called cud-chewing. Rumination or cud-chewing occurs predominantly when the animal is resting and not eating. Healthy mature cattle will chew their cud for several hours each day. Chewing the cud helps reduce the surface area so microbial fermentation has a greater surface area on which to act. A good sign on a dairy farm is: 1-2 hours after being put onto new pasture, the majority of the cows are sitting down ruminating.
After the rumen the food particles head into the:

Reticulum

The contents of the reticulum is mixed with that of the rumen almost continuously (once every minute). Both stomachs, often referred to as the reticulo-rumen, share a dense population of micro-organisms (bacteria, protozoa, and fungi). It looks like a "honey comb."
The reticulum is the "crossroad" where particles entering or leaving the rumen are sorted. Only particles that are small is size (< 1-2 mm) and dense (> 1.2 g/ml) may move on to the third stomach.

Problems:

1. Where does digestion begin? _____
2. What type of digestion occurs in the mouth? _____
3. What type of animal is a sheep? _____
4. How can we tell this by looking at its teeth? _____
   _____
   _____
5. What is the function of the horny pad in a cows mouth? _____
   _____
   _____
6. How big (%) is the rumen? _____
7. Why does it need to be so big? _____
   _____
   _____
   _____
8. What type of digestion occurs in the rumen and reticulum? _____
9. Why is this type of digestion so important? _____
   _____
   _____
   _____
10. What nutrients are absorbed through the rumen wall? _____
11. Where do these nutrients come from? _____
    _____
12. What do the animals need to do when the particles are too big? _____
    _____
    _____

The reticulo-omasal orifice is a small opening in the reticulum that joins the reticulum with the third stomach section, the omasum. The reticulo-omasal orifice acts as a sieve, allowing small particles to flow into the omasum with the rumen fluid. Large particles are held back in the reticulum and formed into a bolus which is regurgitated. Rumination, the regurgitation and rechewing of the feed, allows the cow to decrease the particle size as it increases surface area available for microbial digestion. Rumination also stimulates salivation which is important as discussed earlier. The chewed particles are returned to the rumen for further microbial breakdown before flowing into the

Omasum

The omasum is the third stomach and is approximately 10L in capacity. The omasum is a small organ with great absorption capacity. It allows the recycling of water and minerals such as sodium and phosphorus which return to the rumen through the saliva. Since the modes of digestion in the rumen and the abomasum differ drastically, the omasum acts as an organ of transition between these two organs.

Within the omasum, large muscle flaps contract around the digesta, squeezing out water and VFA's. The water and VFA's are absorbed across the muscular walls of the omasum. The removal of water is important so digestive enzymes present in the abomasum, the last stomach compartment, will not be diluted. Some grinding may occur in the omasum but is significant only in that the grinding action forces the digesta, or partially digested feed particles, into the abomasum.

When enough water has been removed (absorbed) by the omasum, the digesta passes through into the

Abomasum

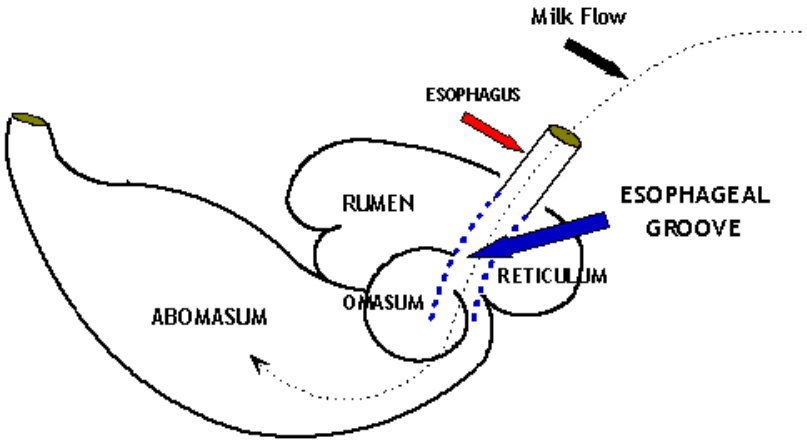
The fourth and final area of the stomach is the abomasum. This stomach is like the stomach of nonruminants (monogastrics) and is often referred to as the “true stomach”. It secretes a strong acid and many digestive enzymes. In nonruminants, ingested feeds are first digested in the abomasum. However, the material entering the abomasum of a ruminant is made up primarily of unfermented feed particles, some end-products of microbial fermentation and microbes which grew in the rumen.

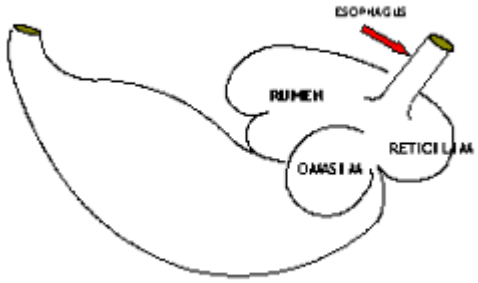
Like the omasum, holds 20 L (about 8% of the stomach's volume). The abomasum's function is to begin chemical digestion of digesta not degraded in the rumen, in particular the proteins produced by the microbes in the rumen/reticulum. The abomasum wall secretes hydrochloric acid (HCI), which activates digestive enzymes also secreted by the abomasum wall. These enzymes break down nutrients into smaller molecules that can be absorbed across the abomasum or small intestinal wall and transported to tissue for use by the cells for milk and tissue synthesis. When the pH of the abomasum reaches about 2.0, digesta flows through the abomasum pylorus into the small intestine.

young ruminant animals

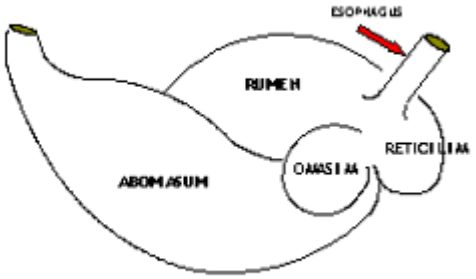
With very young ruminant animals the milk they are ingesting by-passes the first 3 stomach chambers. It goes directly to the abomasum via the oesophageal groove. Once the young animal starts on solid food, the rumen begins to develop and the oesophageal groove becomes defunct. It takes 6-8 weeks for the microbes to be fully functioning.

The milk by passes the rumen, reticulum and omasum because they are primarily designed to ferment food. Milk doesn't need to be fermented before it is digested.

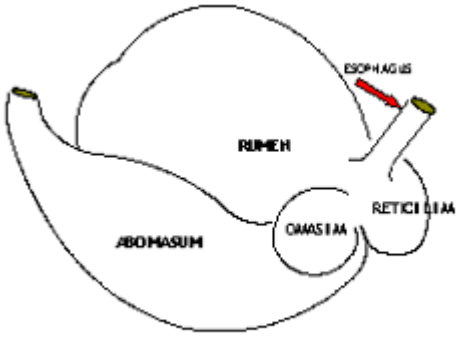




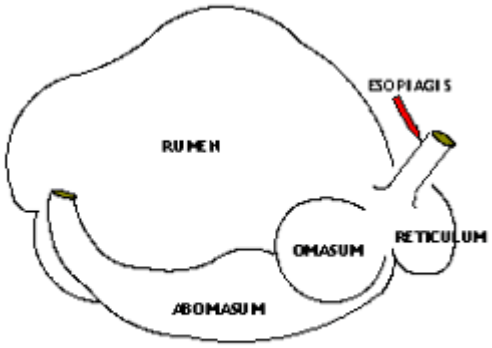
Birth to 2 weeks



8 weeks



3 – 4 months



Mature

Table 1. Relative Size Of Stomach Compartments From Birth To Maturity

Percentage Of Stomach Capacity		
Age	Abosmasum	Rumen/Reticulum/Omasum
Birth to 2 weeks	70	30
8 weeks	50	50
3 - 4 months	25	75
Maturity	<10	>90

Task: Collect a text book. Read pg 105-110

Answer the following questions:

1. Name 3 ruminant animals: _____, _____, _____
2. How does a ruminant break down cellulose? _____
   _____
3. Why is saliva so important? _____
   _____
4. Name the 4 chambers of the stomach in order: _____, _____,
   _____, _____
5. Which 2 chambers have the same function? _____, _____
6. What 3 organisms live in the rumen? _____, _____, _____
7. Which stomach is the true stomach? _____
8. Discuss the 2 stages of the breakdown of carbohydrates in the rumen: _____
   _____
   _____
   _____
   _____
   _____
   _____
9. What is rumination? _____
   _____
   _____
10. Where does protein digestion occur? _____
11. How does protein digestion occur? _____
    _____
    _____
    _____
    _____
12. Draw fig 6.9 pg 108 dynamic agriculture book

small intestine

As the digesta enters the small intestine it is mixed with more digestive enzymes. The small intestine is lined with villi (small hair like projections). The villi increase the surface area of the small intestine, thus increasing absorption of nutrients

They also aid in the mixing of enzymes with the digesta.

Bile salts are secreted by the liver to aid with digesting fats– this bile is added to the digesta in the small intestine.

The digesta is pushed along the small intestine by peristaltic waves (contractions of the smooth muscles lining the small intestine). The small intestine is approximately 40m long and 5 cm diameter.

Pancreatic juices are released, they make the food alkaline and assist with the final digestion and absorption. Enzymes finish breaking down carbohydrates into simple sugars (used for energy, milk

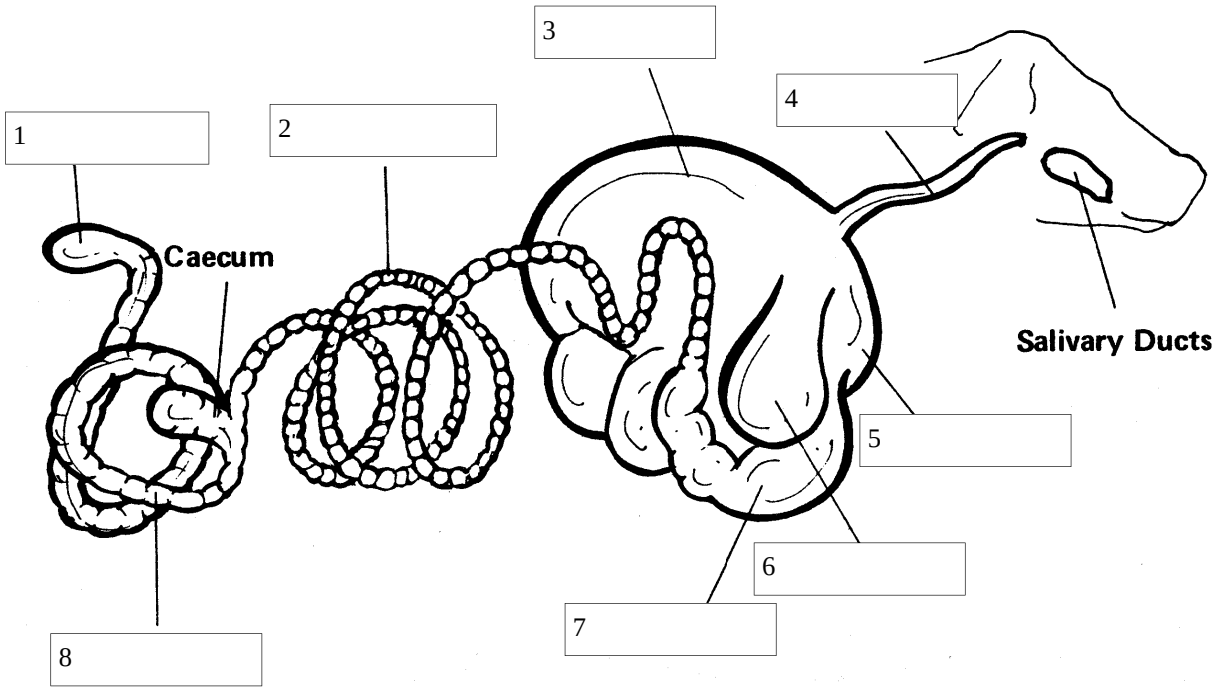
production and if excess amounts are present, adipose), while other enzymes finish breaking down proteins into amino acids (used to make milk and muscles).
Bile from the gall bladder helps to emulsify the fats in the digesta. This means they are made into smaller “pieces” so enzymes can have a greater surface area to break down fats into 3 fatty acids and a glycerol molecule. Fatty acids are used in the production of milk and adipose tissue (fat storage in the animal)
The small intestine is the main place that absorption occurs. Simple sugars, amino acids and minerals are absorbed through the villi. The absorbed nutrients are transported around the body via the circulatory system.
Milk production is extended in dairy animals, with other animals they only lactate while feeding their young.

Problems: Complete the following table:

part	**Type of digestion**	**What happens in this part (list everything, starting food, finishing)**
Mouth	_____ _____ _____	
Rumen/ reticulum	_____ _____	
omasum		
abomasum	_____ _____	
Small intestine	_____ _____	

Ruminant Digestion System

Label the following diagram:



Large intestine

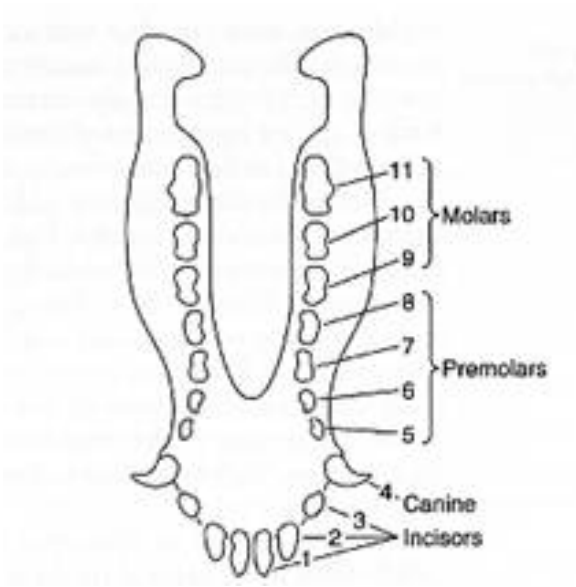
Before the digesta passes into the large intestine it may go through the **caecum**. The caecum is a blind pouch like organ off the side of the small intestine. If there is any undigested cellulose (fibre) type digesta left, it may undergo further microbial digestion in the caecum.
The large intestines main purpose is the reabsorption of water and the concentration and storage of undigested material until elimination (defecation).

Summary!

Ruminant digestion relies on the symbiotic relationship between the microbes and the animal. Neither can survive without the other.
Complete the flow diagram showing the steps in ruminant digestion.

monogastric digestion

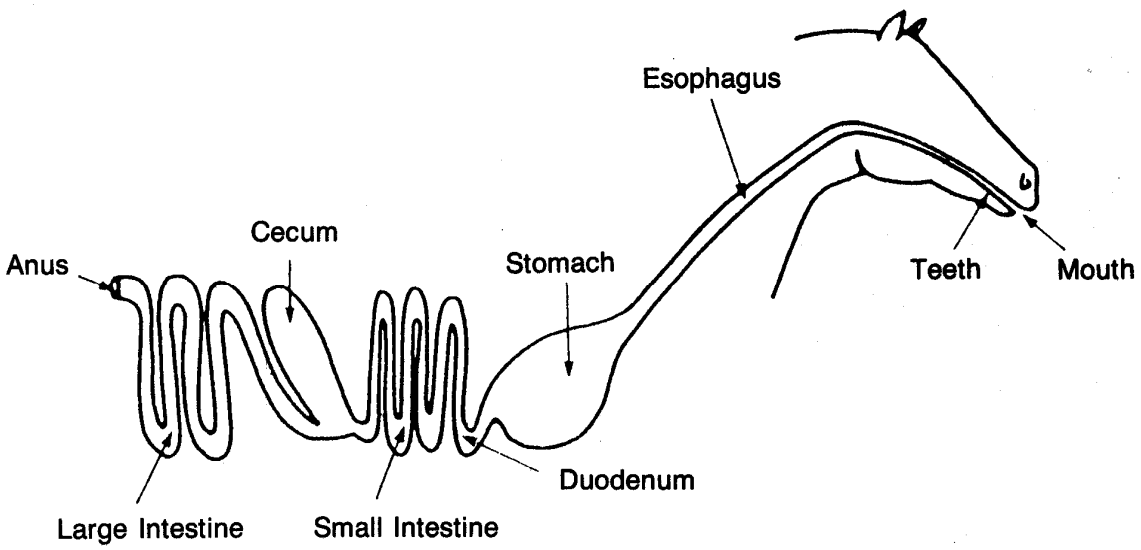
Common animals found on farms with monogastric digestion are: pigs, dogs, horses, chickens and humans.
Monogastric animals only have one chambered stomachs. Hence mono=one.
As with ruminants digestion begins in the **mouth**. The mouth of a monogastric animal is different to that of a ruminant in that monogastric animals don't have a dental pad, they have teeth. Depending on the type of diet they have, the types of teeth they have can vary.



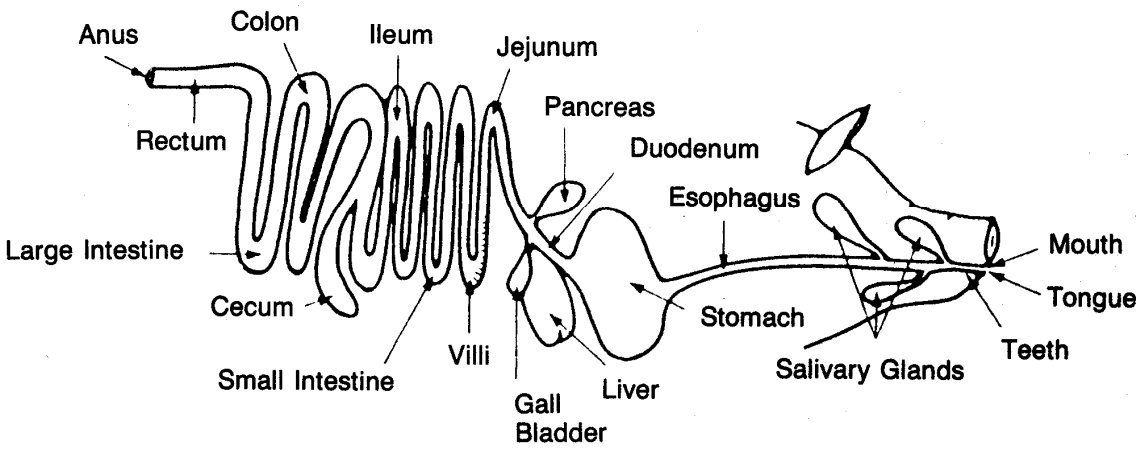
Monogastric animals bite off their food using top and bottom incisors (when compared to ruminants, they only have bottom incisors and a dental pad on the top).
They then chew their food using their molars (at the back of the mouth). While chewing they are breaking large food particles down into smaller particles. Saliva is also being mixed in with the food. There are 2 reasons for saliva being mixed in with the food, the first is that is makes the food bolus more moist and easier to swallow, the other reason is that the saliva contains enzymes that begin chemical digestion, in particular the digestion of starch into simpler sugars (amylase). Horses are the exception, they don't have enzymes in their saliva.
The food passes from the mouth to the stomach via the **oesophagus**. When the animal swallows, the food passes into the oesophagus, it is no longer under the conscious control of the animal from that point on. The bolus of food moves along the oesophagus via peristaltic waves.
The food bolus enters the **stomach**. The stomach releases hydrochloric acid and enzymes. The hydrochloric acid has a couple of functions: stop the action of amylase in the saliva, kill off any bacteria or germs the animal may have eaten, and to activate pepsin (the enzyme that breaks down proteins into amino acids).
While the bolus is in the stomach it is churned and mixed with the hydrochloric acid and pepsin (enzymes). Both chemical and physical digestion is occurring. When the digesta is broken down into small enough particles, it passes through into the **small intestine** (duodenum).
The small intestine continues the chemical digestion of the digesta. The enzymes are released from the pancreas in the pancreatic juices. The pancreas also contains bicarbonates to neutralise the acid (low pH) from the stomach. The release of bile aids in emulsifying fats (lipids).
The enzymes in the small intestine help to break down:
Lipids into: 3 fatty acids and a glycerol molecule
Carbohydrates into: simple sugars e.g. glucose

Absorption of nutrients happens in the small intestine through the villi. Remember the villi help to increase the surface area for absorption. The simple sugars are used for energy and adipose tissue development. Amino acids are used in the production of muscles. Fatty acids are used for energy and the formation of adipose tissue. All 3 can be used for the production of milk if the animal is lactating and feeding its young.
In some monogastric animals the digesta then passes into a **caecum**. The caecum is large in some monogastric animals (pigs, horses). It contains microbes that help digest cellulose (fibre).
The final place that the digesta needs to travel is the **large intestine**. The large intestine absorbs the final nutrients that have been released in the caecum. The large intestine also reabsorbs water. In the rectum part of the large intestine, the storage of faeces occurs.

Digestive System of a Horse

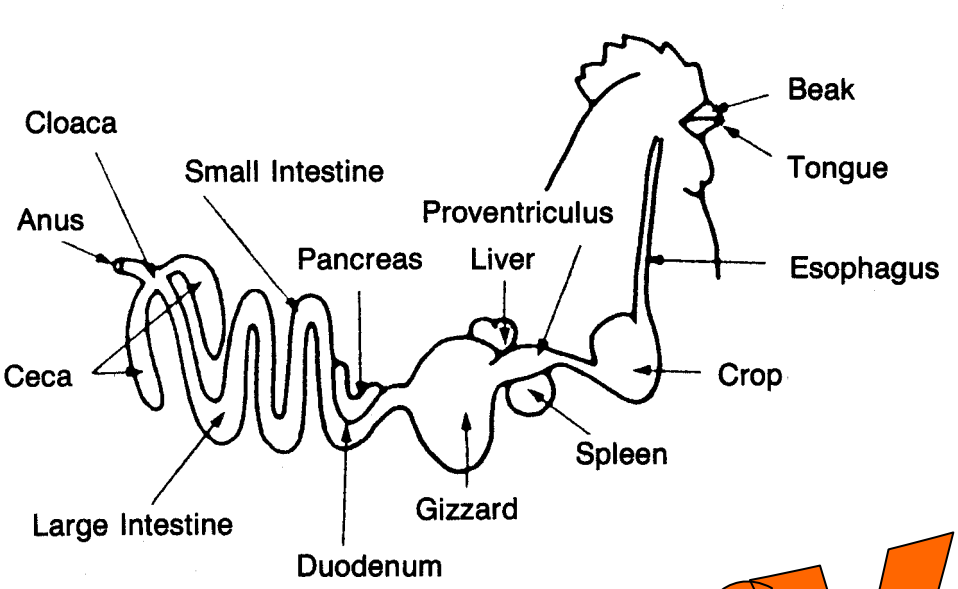


Digestive System of a Pig



Chickens have a slightly different monogastric digestive system.
Collect a worksheet (6.1: animal nutrition — monogastric digestion) read and complete the table at the bottom of the page. Staple to the top of this page.

Digestive System of a Chicken



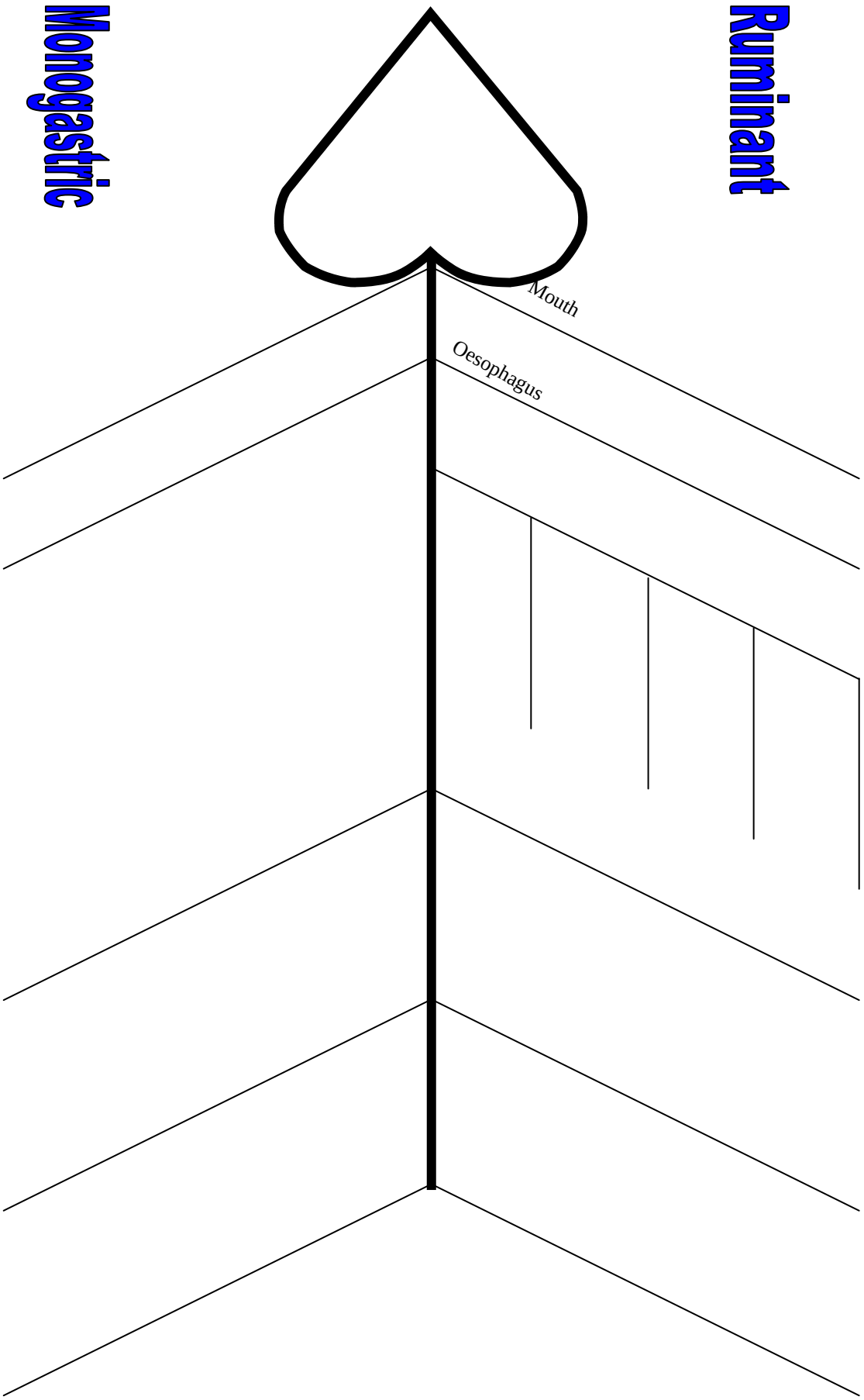
Summary

Complete the following chart showing what happens with monogastric digestion

mouth	
Large intestine	

comparison

You need to be able to compare monogastric and ruminant digestion. Complete the following diagram comparing the 2 different systems.



Monogastric digestive system

Ruminant digestive system

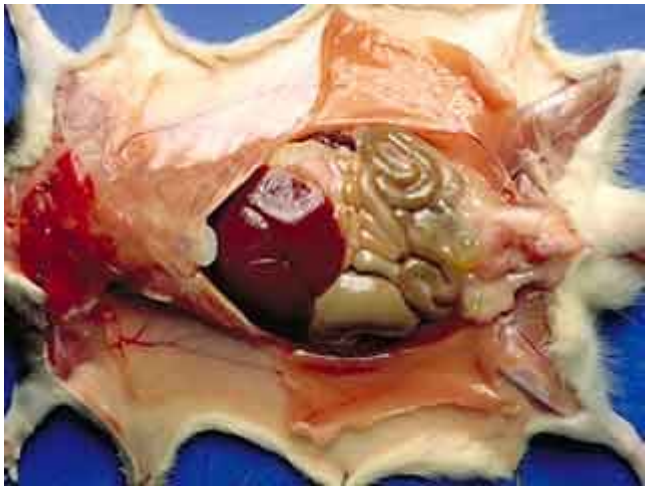
Different

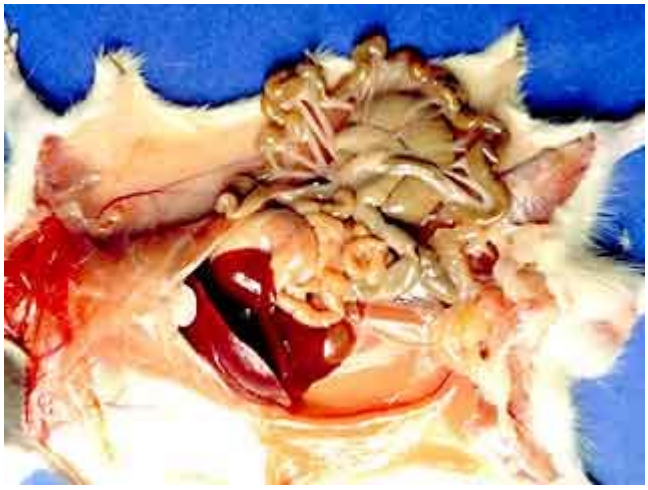
Same

Different

mouth

Dissection





You must wear gloves when doing this experiment. Care is needed not to puncture the digestive tract as it will be even more smelly.

1. Pin your rat onto the cardboard.
2. Carefully cut open the skin. Don't go too deep with your scissors.
3. Peel the skin back from the abdominal area
4. Carefully cut up through the abdominal muscles and peel the muscles away.
5. Look at the placement of the organs
6. Carefully remove the digestive tract from inside the abdominal cavity.
7. Look at how the intestines are convoluted so they will fit inside a smaller area.
8. Remove the pins holding the rat
9. Fold up your cardboard containing the rat and all the "bits"
10. Place into a plastic bag.
11. Put all dissecting equipment in the appropriate places.
12. Remove your gloves and place in the plastic bag, carry plastic bag over to incinerator for burning.

Feeding Practices

To maximise animal production you need to maximise the use of the food supplied for your animals. The whole idea of farming is to make a profit. To do this you need to grow animals for meat, wool, milk etc. Animals need food to survive. For them to make you money they need to have extra food so they can make extra wool, make extra milk, make extra muscle (meat).

Animals use food for:

- Energy for all life processes (MRS C GREN)
- Materials for maintenance and growth, e.g. bone, muscle, fat
- Materials to regulate body processes, e.g. hormones
- Materials for additional demands e.g. pregnancy, lactating, growth

There are several issues that the farmers need to consider when deciding on what their animals need in the way of food.

The first one is how much feed do the animals need?:

- Are they growing (young animals)?
- Are they pregnant?
- Are they at maintenance?
- Are they lactating?
- What sex are they?
- What time of the year is it?

The next thing to consider is the time of the year, what is happening with the plants?:

- What is the grass doing? Is it in vegetative or reproductive growth?
- How much is the grass growing?
- How much feed is needed?
- How many animals are you feeding?
- What quality is the feed?
- What residual feed do you want to leave?
- What kind of rotation will be best?
- How fast will the rotation be?

Once the farmer has some of these answers, then they can plan out their feed budget. Just like a financial budget, farmers need to ensure that they have enough feed for all their animals for the whole year.

When there is a surplus, it gets stored (e.g. hay, silage) for when there could be a deficit. Farmers need to plan for the tough times that may happen. This is not always possible, but the effects should be minimised through careful planning.

Feed quality and quantity needs to be taken into consideration when planning the feed budget.

Food is made up of:

- Carbohydrates: fibre, cellulose, starch, sugars
- Fats: lipids, fatty acids, glycerol
- Proteins: amino acids, peptides
- Water
- Vitamins
- Minerals

WATER:

75-95% of the animal is made up of water. It is also needed by the animals for:

- Maintaining body fluids, e.g. blood
- Making milk
- A place for chemical reactions to take place
- Helps keep the animal cool (sweating, panting)
- Helps dilute waste products, e.g. urine

CARBOHYDRATES:
Carbohydrates are the main source of energy in animals.
Carbohydrates also provide the roughage the animals need to keep a healthy digestive system, especially with monogastrics.
Carbohydrates are made up of: C, H, O; hence carbohydrates as their name.
Carbohydrates are broken down into simple sugars.
Glucose is needed in cells for respiration to occur.

$$C_6H_{12}O_6 + 6O_2 \text{ —> } 6CO_2 + 6H_2O + \text{energy}$$
Glucose + oxygen —> carbon dioxide + water + energy

Carbohydrates form the majority of the feed eaten.

PROTEIN:
Proteins are needed for growth, especially of muscles. Proteins are also needed for the health and maintenance of nerves, enzymes, blood and connective tissues.
They are made up of: C, H, O, N and sometimes S.
Approximately half of the animal is made up of proteins.

LIPIDS (fats):
These are a concentrated source of energy for an animal. Lipids are made up of C, H and O.
These are easily stored in animals if there is a surplus provided. They are stored in the body as adipose tissue (fat), or they can be put into making a better product e.g. milk.

VITAMINS & MINERALS:
These are needed by animals in very small amounts. Often they need to be eaten on a daily basis as some can't be stored in the body.
Without a certain amount provided in the diet the animal can suffer from a deficiency. Deficiency diseases cause a lot of problems with the animals.
Some of the macro-minerals (larger amounts) needed by animals include:
- Ca, P, K, Na, Cl, S

Some of the micro-mineral (small amounts) needed by animals include:
- Fe, Zn, Cu, Mn, I

Some of the vitamins needed by animals include:
- Vitamin A, B, B2, B6, C

Collect a Dynamic Agriculture text book: read pg 96-103. Answer the following questions.
1. What is food? _____
   _____
2. What do animals need food for? _____
   _____
3. What is water used for? _____
   _____
4. Where do animals get water from? _____
   _____
5. What do animals use carbohydrates for? _____
   _____
6. Which animals can use cellulose? Why are they the only ones? _____
   _____
   _____
7. What could happen to an animal if it doesn't have enough carbohydrates in their diet? _____
   _____
   _____

8. Proteins are made up of? _____
9. Which animals can make some amino acids? _____
_____
10. Where do they make these amino acids? _____
_____
_____
11. Where is protein obtained from? _____
_____
12. What is protein used to make? _____
_____
13. What could happen if there is not enough protein in an animals diet? _____
_____
14. How much more energy does fat have when compared to carbohydrates? _____
_____
15. What are the 3 essential fatty acids? _____
_____
16. What happens when an animal is deficient in fatty acids? _____
_____
17. What is the difference between saturated and unsaturated fats? _____
_____
_____
18. What happens if there is too much fat in the diet of an animal? _____
_____
19. What are the 2 main kinds of vitamins? _____
_____
20. Which kind do you think could be stored in the body? _____

Look at the following table to do with vitamins and minerals and read pg 99-101. Make notes on the following vitamins. Include where they are found, what the animal uses them for, what are the signs and treatment for deficiencies?

Vitamin A: _____
_____
_____
_____

Vitamin D: _____
_____
_____

Vitamin E: _____
_____
_____
_____

Vitamin K _____
_____

Vitamin B's: _____
_____
_____
_____
_____

Types of vitamins and their functions

vitamin	function	Deficiency symptoms	How to fix it
A	H transfer, growth, eye function	Retarded growth, scaly skin, night blindness, infertility	Green feed and fish oils (e.g. pigs)
B (thiamine)	Carbohydrate metabolism, functioning of nerves and muscles	Reduced appetite, emaciation and polyneuritis (in chicks)	Synthetic vitamins and brewer's grain
B2 (riboflavin)	H transport and carbohydrate metabolism	Reduced appetite, eye abnormalities, reduced hatchability	Yeast, liver oils and green crops
Nicotinamide	Glycolysis and respiration	Digestive disorder and dermatitis	Legumes and liver extracts
B6 (pyridoxine)	Protein metabolism and production of antibodies	Anaemia in pigs and poor growth in chicks	Normally adequate supply
Pantothenic acid	Carbohydrate metabolism	Slow growth and diarrhoea in pigs. Poor growth and dermatitis in chicks	Yeast, liver and milk
biotin	Carbon dioxide fixation	Dermatitis and hair loss	Seldom occurs
choline	Fat metabolism	Slow growth	Seldom occurs
Folic acid	Protein metabolism	Anaemia and poor growth in chicks	Green leaf feed and liver
C	Oxidation/reduction reactions	Nil	Nil

Minerals and their characteristics

mineral	function	Deficiency symptom	How to fix it
Ca	Essential for skeleton, teeth, nervous system, muscle contraction and blood coagulation	Rickets, enlarged joints, lameness, weak bones, thin eggshells and reduced egg production	Add legumes, ground limestone or dicalcium phosphate to diet
P	Part of bone and necessary for metabolism of energy	Rickets, muscular weakness, reduced appetite and reduced growth rates	Add cereals, fish and meat products to diet (for chickens and pigs)
Na	Acid base balance and osmotic regulation	Poor appetite and growth rates, reduced mild and egg production	Add salt licks to diet
Mg	Carbohydrate metabolism	Hypomagnesaemia (grass staggers) in cattle and high death rates	Use Mg fertilisers or add Mg to diet (drenching)
Cu	Part of enzymes and blood, pigmentation in wool	Anaemia, poor growth rates, scouring, light coloured wool, muscular incoordination (sway back) in lambs, steely wool	Use lick blocks or injections of Cu
I	Thyroid gland function and metabolic rate	Swollen thyroid gland (goitre), lower reproductive rates, lambs born dead	I supplement
Co	Microbes in rumen use it to make vitamin B12	Reduced appetite and growth, muscular wasting, anaemia and death	Add Co to fertiliser, Co bullets into rumen.

Read pg 101-103 and make notes on the following minerals. Include where they are found, what the animal uses them for, what are the signs and treatment for deficiencies?

What are the major minerals? _____
What are the trace minerals? _____
Calcium: _____
_____
_____
_____
Phosphorus: _____
_____
_____
_____
Sodium: _____
_____
_____
Iron: _____
_____
_____
Copper: _____
_____
_____

Collect worksheet: 6.3 animal nutrition questions. Complete answers on the sheet and stick in below.

Digestibility:

This is how much of the food is "useable" by the animals. There are certain parts of the plant material that is not digestible, even by ruminants. This is the indigestible part of the plant.

Digestibility is the proportion of pasture or feed that once consumed can be utilised by the animal. Digestibility is written as a percentage and is related to the energy content of the feed. In other words: the more digestible a pasture is the more energy it gives the animals.

Protein has an effect on the digestibility of feeds. When digestibility is high, protein content is also high.

Plants with higher digestibility are digested more rapidly by the grazing animal (food moves faster through the digestive system) and this leads to greater intake of food and this leads to a greater production of animal products such as meat, wool, or milk.

Pasture digestibility and energy content	
Digestibility (%)	**Energy content (MJ ME/kg DM)**
40	4.8
50	5.7
60	8.2
70	9.9
80	11.6

Digestibility is influenced by:

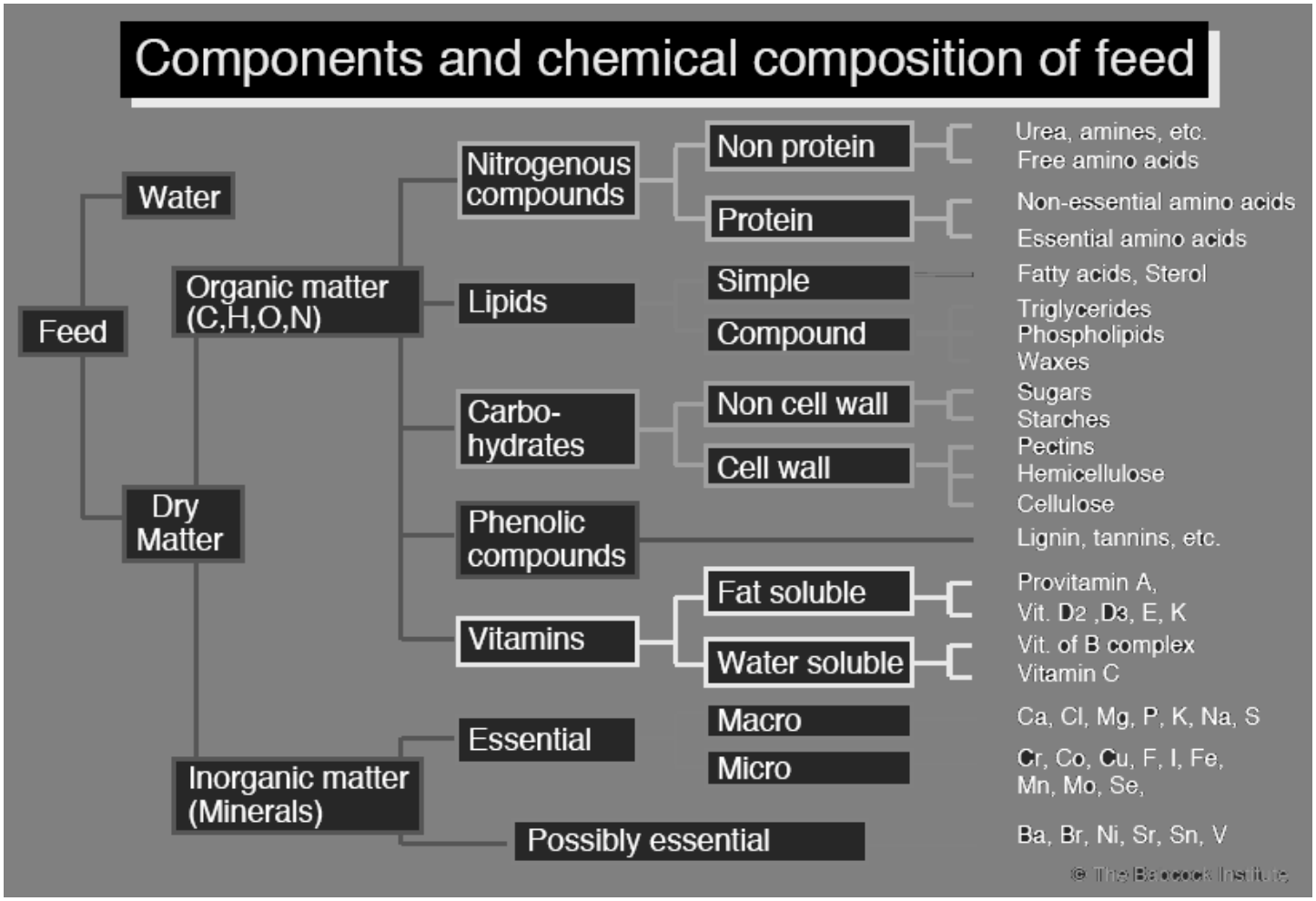
- the pastures stage of maturity: plants in a vegetative stage has a higher digestibility than a reproductive plant, this is because as a plant age the levels of sugar, starch and protein reduce and greater amounts of cellulose are built up, making the plants more tough due to the lignin
- the species in the pasture some plants are more digestible than others e.g. Timothy is more digestible than Crested dog's tail because it has a greater amount of leaf and remains leafy longer. Plants with less cellulose and more protein e.g. clovers are more digestible
- parts of the plant eaten: leaves are more digestible than stalks, related to the age and maturity of the plants. When in a vegetative stage the plants have a lot more leaf and less stalk for the animals to eat.
- The season of the year: plants are more digestible in spring and autumn because they are usually in a vegetative growth stage and have a greater water content in the leaves.
- Treatment: turning pasture into silage increases the digestibility of the feed, this is because some of the fibre (cellulose) has been broken down during the anaerobic fermentation.

Types of animal food					
Types of food	**Fibre content**	**digestibility**	**protein**	**moisture**	**examples**
roughages	High (30%)	low	low	nil	Pasture, hay, Lucerne hay
succulents	low	high	low	85%	Root crops, silage, pasture
concentrates	low	low	high	low	Cereals, peas, seed products

Stage of maturity	**% of protein**	**% of cellulose (fibre)**	**% of carbohydrates (sugar, starch)**	**Live-weight gain per day for sheep**
Short leafy pasture	25	31	55	400
Long leafy pasture	20	39	45	350
Pre-flowering pasture	16	48	15	200
Flowering pasture	10	57	10	100

Animals have an effect on the digestibility of feeds.

- The type of digestive system: ruminants are able to utilise the energy contained in cellulose because they have a fermentation system that uses microbes breaking down cellulose. With monogastrics, only a small amount of cellulose can be digested in the caecum, the rest passes out undigested as faeces.
- The size of the digestive system: animals can only eat as much as their digestive system can handle. The higher the fibre content, the harder it is to digest, the more filling the feed is. Thus the animal gets full quicker and is unable to maximise the utilisation of the feed energy as it has a full stomach and needs to digest this first.
- The age of the animal: young animals eat milk. This is because their digestive systems are unable to process plant material. Thus the digestibility of pasture is limited until they have developed the enzymes (and microbes in the case of ruminants) for digestion of plant material. Milk is very digestible and almost all of it is utilised by the young animals. Ruminant animals have an oesophageal groove for bypassing the first 3 stomach chambers. As they suckle, the groove closes to form a tube that goes directly into the abomasum. This bypass enables the full utilisation of the milk as it is not good for it to be fermented. The young animals develop their digestive system as they begin to nibble on plant material. To aid this transition farmers can use feed such as Moozlie (contains ruminant starters, bacteria etc), or ensure that young stock is fed the best young tender pastures.
- Animal health: if an animal is sick, especially with scours (diarrhoea) they are unable to utilise all the energy in a feed as it is passing through the digestive system too fast. Worms are another problem, they use the energy from the feed, this means the animal is not getting all the energy from the feed.



Forage versus concentrates

		Forage	Concentrate
1)	Bulk (volume) Density	High Low	Low High
2)	Particle size	Long	Short
3)	Energy content	Low (0.8 to 1.5 Mcal NEl)	Low/High (0.8 to 2.2 Mcal NEl)
4)	Fiber content	High	Low
5)	Protein content	Legumes 15 - 23 % Grasses 8 - 18% Crop residues < 4%	Variable (<10% >90%)
6)	Mineral content Calcium, Potassium, Phosphorus, Micro.	 Higher Low	 Lower Low
7)	Vitamins	Higher	Lower
8)	Speed of fermentation	Slow	Rapid
9)	Palatability	Low/High	Higher
10)	Extent of digestion	< 45 to 65%	> 80%

C
R M Z
G K F I L
Y T Z L M V P
P A S T U R E A C
P C E R G
V G S H E E P
T Z Q S F Z T I W
S V N D P A R A O Y E
E E R E W T T
E T G G L L I I A
W E M R A A L V G I I
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L B S I M N G O E Y K
Z Y A T N J E U S F H F S
B A A S U A M R T I E F O K P
E A R N I E T O R P O
G G L E T N P P N L X A N
I C E P H W P A E V E Q O Q U
D N V R W G P U U K K Z X J Y H R
T P X
S X D
J F D

WORD FIND:

- Annual
- Basal
- Digestibility
- Erosion
- Foliage
- Graze
- Herbage
- Inputs
- Leaf
- Moisture
- Pasture
- Perennial
- Protein
- Ruminant
- Run-off
- Sheep
- Vegetative
- Weeds

Growth/development requirements:

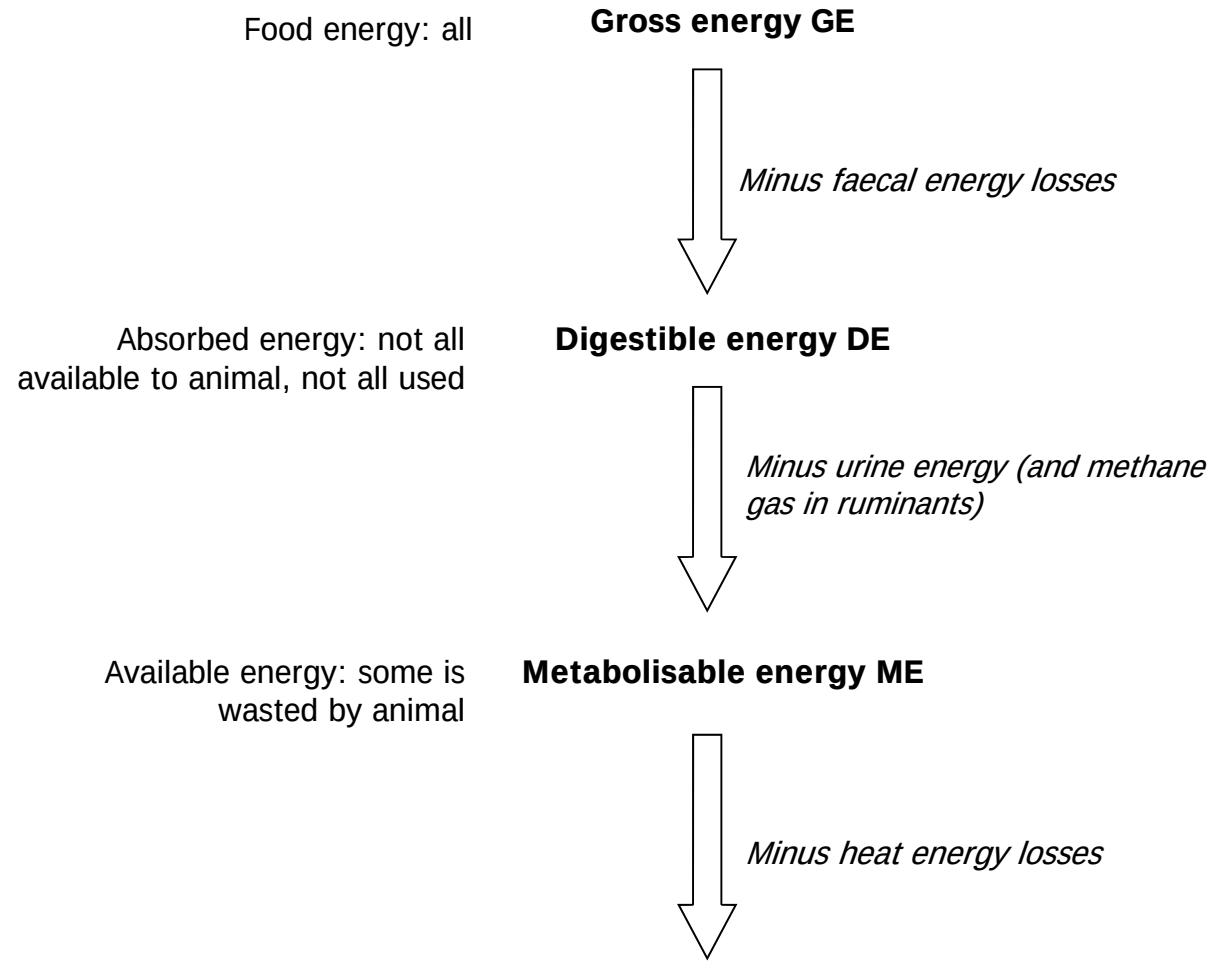
Food provides animals with energy for all life processes (MRS C GREN). e.g. muscular work (walking, breathing etc), keeping warm, storage of chemical potential energy (fat), providing energy to make milk.

Food consists of:

- Total energy/gross energy: this is all the energy contained within a food. This is not necessarily available for the animals use.
- Digestible energy: the proportion of total (gross energy) that is available for the animals to use, not all of it is used by the animal. The digestible energy is the total energy minus the energy lost through the faeces.
- Metabolisable energy: this is the energy that is available and is used by the animal. This energy is the digestible energy minus the energy lost in urine and methane gas.
- Net energy: this is the energy used by the animal for the maintenance of bodily functions. It is the metabolisable energy minus the energy lost through heat loss. If an excess of net energy is available it is used to produce milk, wool, meat and fat.

Different types of animals require different amounts of energy. E.g. a cow needs more feed than a ewe, simply because a cow is bigger. A bull requires more energy than a cow, once again because a bull is bigger than a cow.

Different stages in an animals life require different amounts of energy. An animal at maintenance needs less energy than an animal that is lactating.



Task: collect a Dynamic Agriculture text book. Read pg 109-114, answer the following questions:

1. List 3 uses of the energy from food: _____, _____, _____
2. What is maintenance energy? _____
_____
_____
3. What is production energy? _____
_____
_____
4. What does ME stand for? _____ _____
5. What is the ME system? _____
_____
_____
_____
6. Complete the table:

Animal type and its production state	**Daily metabolisable energy requirements (MJ)**
Sheep, 40kg at maintenance	
Sheep, pregnant, 40kg, 2 weeks before lambing	
Sheep, lactating, 40kg, with single lamb	
Beef steer, 200kg, maintenance	
Beef steer, 450kg, maintenance	

7. How much feed is needed by a pregnant ewe (40kg) 2 weeks before lambing? _____
_____
how do you know this? _____
_____
8. What factors affect the energy requirements of an animal? _____
_____
_____
_____
_____
_____
9. What is the difference between chicken and ruminant ME values? _____
_____
_____
10. What factors affect the protein requirements in chickens? _____
_____
_____
11. What is the difference in protein requirements between lactating cows and dry pregnant cows?
_____
_____
why is there a difference? _____
_____
_____
12. What is the difference in protein requirements between lean sheep and fattening sheep?
_____
_____
why is there a difference? _____
_____
_____

13. What does the word ration mean when talking about feeds? _____
_____
_____

14. How does the diet of pigs and chickens differ to that of sheep and cattle? _____
_____
_____
_____

15. What needs to be considered when designing/formulating a ration?
_____
_____
_____
_____
_____

16. What is important to think about when designing a ration? _____
_____
_____
_____
_____

summary

The amount of food required by an animal depends on the following factors:

AGE: young animals require a _____ amount of energy per kilogram of body mass. This is because they are using it to: _____, _____ and to _____. Older animals that have finished growing need the energy from food only to _____their body weight. The exceptions to this are when the animals are _____ or _____. Proteins are made up of _____ _____. These are used for _____
Ruminants make the proteins from the micro-organisms (_____) that have been digested. Monogastric animals can only get their proteins from _____
_____

BREED: the larger the breed the _____the energy requirements

SEX: males need _____ energy than females. Pregnant and lactating females need more energy because _____
_____

STRESS: what do you think will happen to the energy requirements of a stressed animal? Why? _____
_____
_____

Feed Types:

Forage Vs Concentrates:

	Forage	Concentrate (meals)
Bulk (volume) density	High low	Low high
Particle size	long	short
Energy content	low	Low/high
Fibre content	high	low
Protein content	Legumes: 15-23% Grasses: 8-18% Crop residues: <4%	Variable (<10->90%)
Mineral content: • Ca, K • P, micronutrients	 Higher low	 Lower low
Vitamins	higher	lower
Speed of fermentation	slow	rapid
palatability	Low/high	higher
Extent of digestion	<45-65%	>80%

How does the density of forages and concentrates compare:

- Forages: large volume (take up lots of space) per unit of weight.
- Concentrates: small volume per unit of weight

Task:

Measure the mass of 3 x 250mL beakers; record the mass:

Beaker 1: _____

Beaker 2: _____

Beaker 3: _____

In beaker 1, collect 150mL of cut grass and measure the mass of beaker + grass, work out the mass of the grass: _____

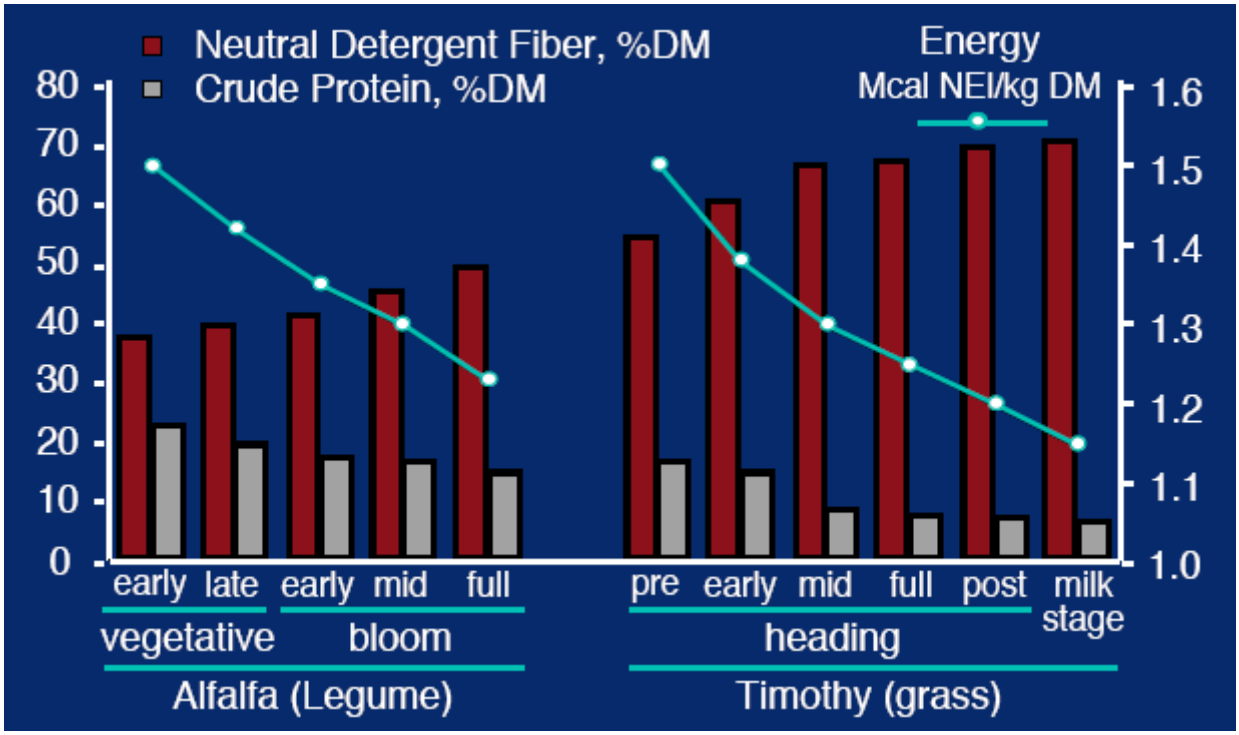
In beaker 2, collect 150mL of creamota and measure the mass of beaker + creamota, work out the mass of the grass: _____

In beaker 3, collect 150mL of wheat seeds and measure the mass of beaker + seeds, work out the mass of the seeds: _____

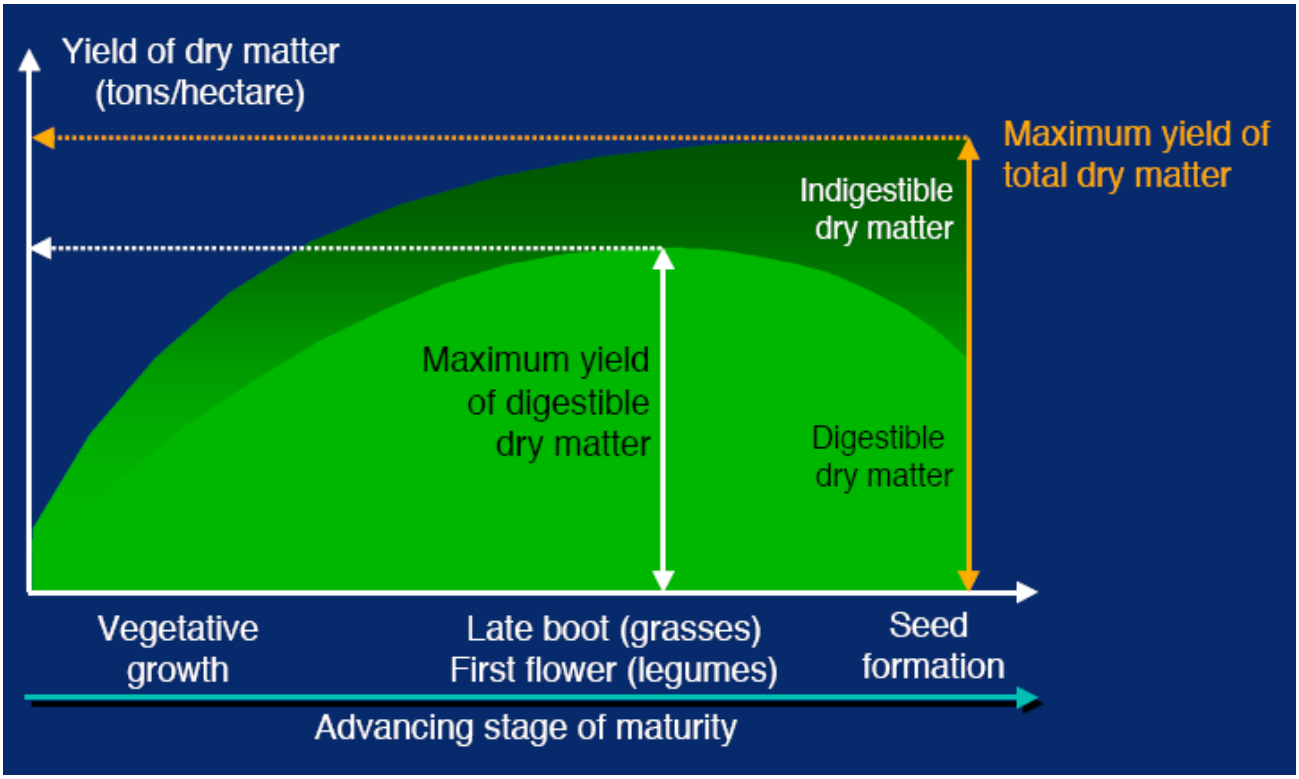
Which had the greatest mass? Why?

What happens to the quality of forages over time?
As green plants mature the quality decreases because of:

- A decrease in available energy
- An increase in fibre content
- A decrease in protein content



What is more important, quality or quantity?
It depends on the levels of feed required. If the animals are at maintenance, then they can survive on quantity rather than quality. If the animals are lactating, or supposed to be gaining liveweight, then quality is more important. This is because the digestive system can only digest a certain amount of dry matter per day. So to maximise production, better quality means that the animals can remove more nutrients and energy from the feed for less digestive work.



What happens to the feed requirements of different sized animals at different stages of the year?

Body Weight, kg	 400	500	600	700	800 
	Dry matter intake (kg/day)				
At maintenance (open, non-lactating)	5.7	6.8	7.8	8.7	9.6
Dry and pregnant (dry period)	7.4	8.8	10.1	11.3	12.5
In mid- and late lactation*					
Milk yield (kg/day)					
2	7.0	8.1	8.9	10.0	11.0
10	11.7	12.5	13.0	13.9	14.9
20	15.9	16.6	17.0	17.7	18.8
30	19.3	20.1	20.5	21.1	22.3
40	22.2	23.1	23.6	24.2	25.4

* In early lactation, dry matter intake may be reduced by as much as 18%.

What trends can be seen on this table?

What happens when the fibre content rises?
To much fibre limits the intake of energy from the feed, thus the milk production, wool production, meat production drops.
What about the effects on milk production?

Task: collect a worksheet from the teacher: 6.2: animal nutrition—energy requirements. Complete the problems and staple to this page.

Feeding programmes:

When sorting out the feeding programme to use, you will need to consider the requirements of the stock and the availability of feed on the property. The availability of feed also includes the types of feed available.

When changing from one type of feed to another, the farmer must introduce the animal (especially ruminants) to the new feed slowly over a long period of time. This is because it takes time for the microbes in the rumen to change and adapt to the new feed type. If a change is not done over a long enough period of time the animal can suffer from "red water" disease. This is when the animal starts producing red coloured urine. It can cause death. For more details see the health section.

The growth rate of the pasture will dictate the best rotation. The farmer will want to keep the plants in a vegetative growth stage for as long as possible. This is partially possible through grazing management. The weather and water supply also has an effect on when the plants move into reproductive phase.

Pasture production is directly influenced by the intensity and frequency of its immediate past grazing. The pressure applied by the grazing is a critical factor in determining pasture structure, species competition and the condition of the pasture. To obtain high animal productivity from the utilisation of pasture, you need to maintain productive pasture species. When the feed supply from pasture is restricted or of poor quality, the production per animal will decline. When there is no restriction of feed supply and there is a high quality pasture available, the animal productivity of meat, milk, wool etc will be high.

Nutrition/Feeding of livestock in New Zealand

Various feeds are used in New Zealand agriculture. Predominantly **pasture** is used.

A good pasture consists of;
- A mixture of grasses-usually ryegrass (75%)
- Legumes- the most common is white clover (25%)

There are many varieties and strains of grasses and legumes available and they all have different requirements for growth, that is, some grow better in spring, summer, autumn, or winter. If you can take advantage of this you can extend the growing season and thus the production season of your cows.

Advantages of pasture are:
- It grows throughout the year in most of NZ
- It's persistent-grows for many years
- It's easy to grow
- It's low cost compared to the alternatives
- It's palatable-animals like it
- You graze it "in situ"-not a lot of fertility transfer
- Little harvesting cost
- The growth pattern largely follows animals feed requirements
- You don't have to house the animals
- It's less labour intensive than other feeds

Disadvantages are;
- Lower feed value, therefore production levels are lower
- Harder to ration to animals requirements
- Can be difficult to maintain palatability/digestability
- Needs conservation to meet animal requirements in periods of deficit

Alternatives to pasture as a feed

Hay and silage are the most common alternative feeds. When pasture growth exceeds the

requirements of the stock you can conserve the surplus as hay or silage for periods of feed deficit.

Silage is usually made earlier in the season than hay, and is a better quality feed, as silage has a higher moisture level and therefore doesn't require prolonged dry weather to harvest it.

Silage has advantages in areas with long dry summers, it is a more moist feed which cows can milk reasonably well on (milk is about 95% water) and is harvested early in the season allowing the paddocks time to recover, develop a pasture cover before the dry spell arrives. It also has higher food value than hay.

Hay is generally only suitable as a maintenance ration. Hay does have the advantage of being easier to handle and doesn't require the same amount of mechanisation.

Maize silage

Some farmers grow a crop of maize for silage. This is a high energy, very palatable feed but it contains less protein than pasture silage. (Protein is one of the things in milk you get paid for).

Maize silage has extra costs associated with it;

Extra costs

Cultivation
The paddock isn't available for grazing while it is growing
Requires specialist harvesting equipment
It isn't harvested until autumn
Paddock is out of action until it can be resown in the spring at the earliest
A large time delay between resowing and the paddock being grazable.

Concentrates

Concentrates are normally grained based and generally only economical in NZ for housed animals such as pigs and chickens.

In Canterbury and other areas where there are many Arable farmers concentrates maybe economical in years when arable farmers have poor harvesting conditions resulting in a lot of reject grain which is sold cheaply.

Forage Crops

If you anticipate a feed shortage or have a paddock that need renovating you may decide to grow a crop to maintain stock.

There are two types of forage crops; -

Greenfeeds
Brassicas

Greenfeeds are specialist pastures, and cereals such as maize, oats, barley, and ryecorn. They are all fed "in situ"

Brassicas are all of the cabbage family and include Chou Mollier, swedes, turnips, kale, and rape. Different varieties suit different times of the year.

Kale, white fleshed turnips and rape are usually sown for use in late summer and autumn.

Kale, swedes and yellow fleshed turnips are usually used to bridge the feed gap in winter.

Because of improved ways of handling grass and because of the costs involved in preparing the land for crops much less land is cultivated for summer and winter crops than use to be the case.

Lucerne

On light free draining soil and in areas of low rainfall such as Canterbury and Hawke's Bay, lucerne is a valuable crop for grazing or for hay and silage. Lucerne is a very deep rooting plant and therefore can reach soil moisture when pasture plants can't. It has high feed value, approximately 0.96kg of lucerne DM providing the same feed value as 1kg pasture DM.

Lucerne is relatively hard to manage in the grazing situation. You must graze the crop at the stage just before new shoots are coming away at the crown. Often about 50% of the crop will be

flowering at this time.

It responds well to quick on off grazing about every 20-25 days. It doesn't like prolonged grazing where the young tender new regrowth gets eaten. Lucerne is also winter dormant.

Feed value assessment

Feeds are assessed according to the energy levels they contain. Typically the measurements used are metabolisable energy, measured in Megajoules, and Dry Matter measured in Kilogram's.

Dry Matter (DM)

This is a standardized measure of feed quantity. It is the weight of feed after all moisture has been removed from it. For example, dry stalky ryegrass pasture has a DM of 28%. Dry matter for pasture and crops is usually measured in kiolgram's per hectare, Kg DM/ha.

Metabolisable Energy (ME)

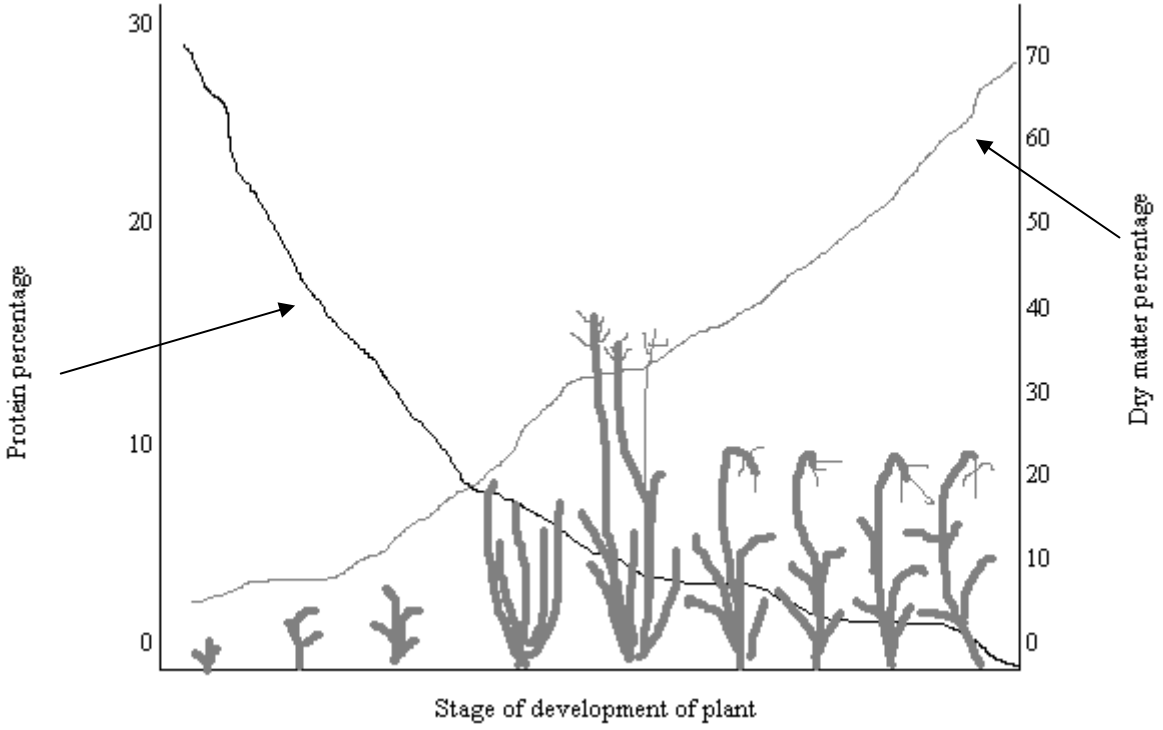
This is a good measure of the nutritive value of a feed. ME is the proportion of energy absorbed from the feed by the digestive tract and retained for metabolic purposes. The units for ME are megajoules. All feeds can be ranked on their ME content as a proportion of feed dry matter, expressed as MJME/kgDM to indicate their value to ruminants. This may also be called the "ME concentration". Dry stalky ryegrass pasture has a ME concentration of 8.

Converting Metabolisable Energy to Dry Matter.

Assume all stock are grazed on mixed length, leafy, ryegrass/white clover pasture which has a ME concentration of approximately 11.0 MJME per kg DM. If the feed requirement of an animal is 1 kg DM per day, this figure can be converted into MJME by multiplying by 11. If stock are to be fed on higher quality feed, e.g. short, leafy, spring pasture with a ME concentration of 11.8 they will require less feed (11.0¸11.8=93%, ie, 7% less). If the feed is of lower quality, e.g. autumn saved pasture, with a ME concentration of 10.0, they will require more feed (11.0¸10.0=110%, ie 10% more is required.

Task: collect a dynamic agriculture text book: read pg 400-402, 404-407. answer the problems on the next page

The following graph shows: the changing nutritional value of an annual grass



Problems:

1. What is rotational grazing? _____
   _____
   _____
2. What is strip grazing? _____
   _____
   _____
3. Find out about set stocking: _____
   _____
   _____
   _____
4. Why do we not carry out zero grazing on a regular basis in NZ? _____
   _____
   _____
   _____
5. How does the nutritional effects of pasture affect animals? _____
   _____
   _____
   _____
   _____
6. What kind of grazers are sheep and cattle? Why? _____
   _____
   _____
7. Draw fig 21.10 and explain what is happening in it:

   _____
   _____
   _____
   _____
   _____
   _____
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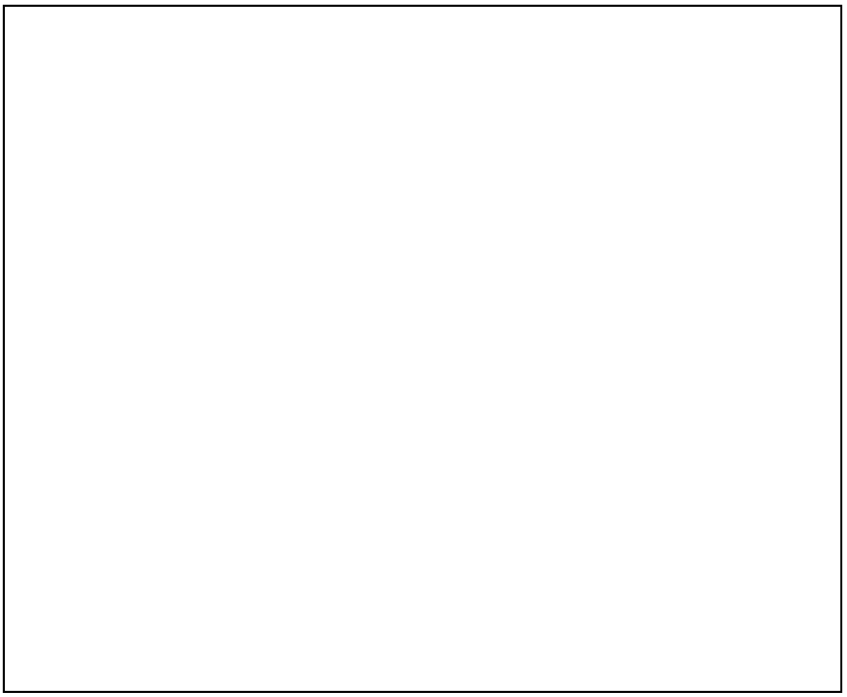
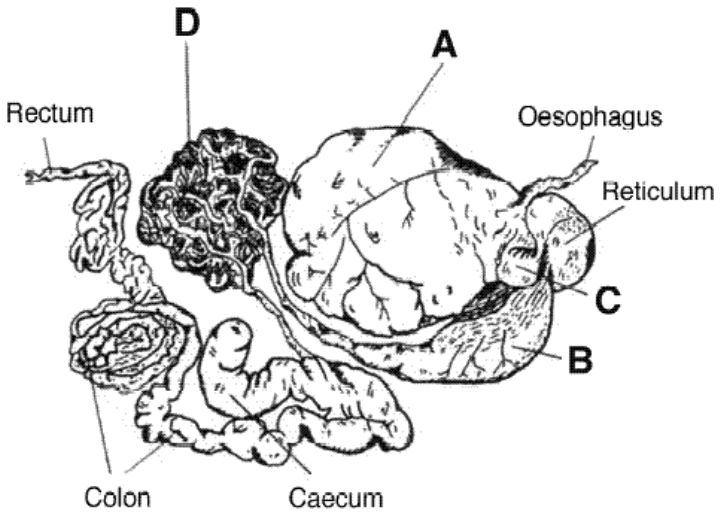


8. What happens to the wool production when the stocking rate is increased? _____
   _____
   _____
9. What happens to prime lamb production when stocking rates are increased? _____
   _____
   _____
10. What happens to milk production when the stocking rate is increased? _____
    _____
    _____
11. When is the highest growth rate of ryegrass and white clover happening? _____
    _____

Question One

Cattle can survive on a diet of plant material such as leafy pasture, and crushed barley because they have the type of digestive system shown to the right.



(a) The parts of the digestive system labelled A and B in the diagram above allow cattle to gain energy and nutrients from plant material.

Name parts A and B then describe how plant material is broken down in these parts.

Part	Name	How plant material is broken down
A	_____	_____
B	_____	_____

(b) The mouth and the parts of the digestive system labelled C and D in the diagram are also important in the digestion process.

Name parts C and D and, along with the mouth, describe their function in the digestion of plant material.

Part	**Name**	**Function in digestion**
C		
D		
	Mouth	

(c) Cattle will gain weight when fed leafy pasture and crushed barley but will lose weight when fed stalky pasture and straw.

Give three reasons why cattle fed leafy pasture and crushed barley gain liveweight.

QUESTION TWO: LIVESTOCK BODY SYSTEMS

Farmers need a knowledge of livestock body systems to keep their stock healthy and get good results from their feeding and breeding practices.

(a) The digestive systems of ruminant and non-ruminant animals have some important physical differences.
For each part of the digestive system named in the table below, describe a physical difference between ruminant and non-ruminant animals.

Parts of digestive system	How each part of the ruminant digestive system is physically different from the non-ruminant animal
Mouth	
Stomach	
Caecum	

QUESTION THREE: FEEDING LIVESTOCK ON THE FARM

A Meat New Zealand article states that:

> 'It is always difficult to maintain animal production over summer as pasture quality declines due to plants going to seed.'

(a) Complete the table below to describe how pasture quality declines over the spring/summer period.
Use the terms in the word list to describe the level of plant constituents listed in the table.

Word list: low medium high

Plant constituent	Leafy spring pasture	Flowering pasture	Seeding pasture
Protein			
Fibre			
Carbohydrate			

The Meat New Zealand article also suggests that 'leafy feed crops such as kale should be fed in summer to help maintain production'.

(b) Explain why kale will maintain a dairy cow's production but a feed such as seeding pasture will not. _____
_____
_____

The article also warns farmers that stock should be introduced to kale over a 7–10 day period to allow time for the 'bugs' in the animals' digestive systems to adjust to the new feed.

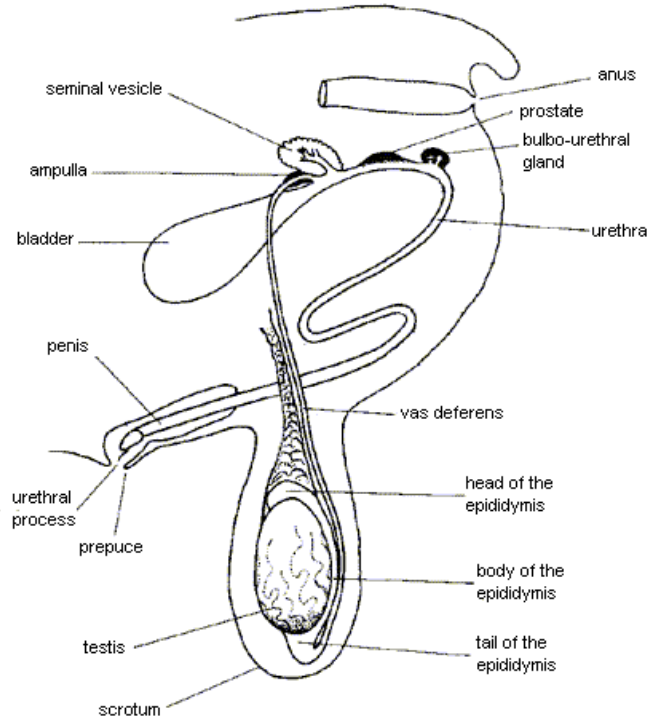
(c) Name the type of 'bugs' in the ruminant digestive system and state where they are found and what their function is.
(i) Type of bugs: _____
(ii) Where the bugs are found: _____
(iii) Function of bugs: _____
_____

Reproductive systems

For this we will be looking at the reproductive systems of cattle and sheep in particular. You need to be able to identify the external genitals along with the internal organs.
When looking at the external genitals you should be able to recognise: Penis (sheath), testicles, anus, vaginal and urethral opening, udder.
Task: label the following

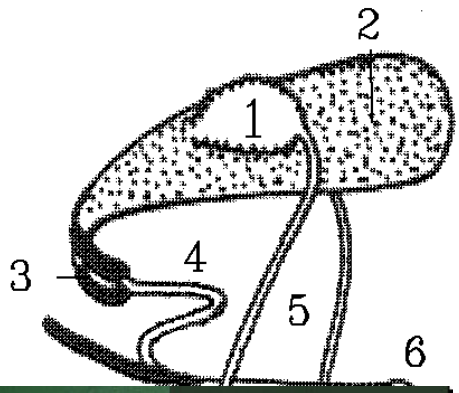
- Scrotum - Muscular sac housing the testes. Acts as a thermoregulator.
- Testes - Primary sex organ. Sperm production occurs within the seminiferous vesicles. Production of testosterone occurs in the Leydig cells.
- Epididymis - Carries the sperm from the testicle to the vas deferens. Sperm continue to develop (mature) in the epididymis and are stored there.
- Vas Deferens - Muscular tube carrying sperm from epididymis to the urethra during ejaculation. Spermatic Cord - Each testes is suspended in the scrotum by the spermatic cord. Has role in thermoregulation.
- Seminal Vesicles - Adds fluid and nutrients to the semen.
- Prostate Gland - Produces an alkali secretion to raise the pH of the ejaculate to about 6.0. Acts as a buffer. Produces characteristic odour.
- Bulbourethral Glands - Secrete thick mucous to assist in lubrication at mating.
- Urethra - the joint excretory canal for urine and semen.
- Penis - Function is to deposit semen in the female reproductive tract.
- Sheath (prepuce) - Fold of skin that surrounds the free end of the penis.

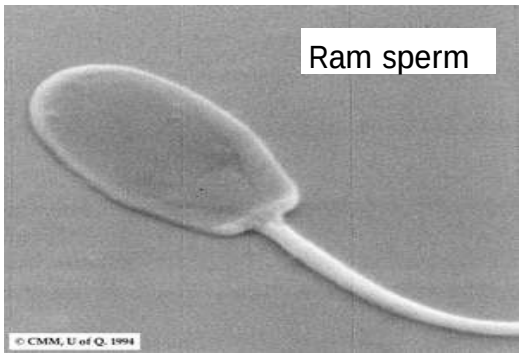
male

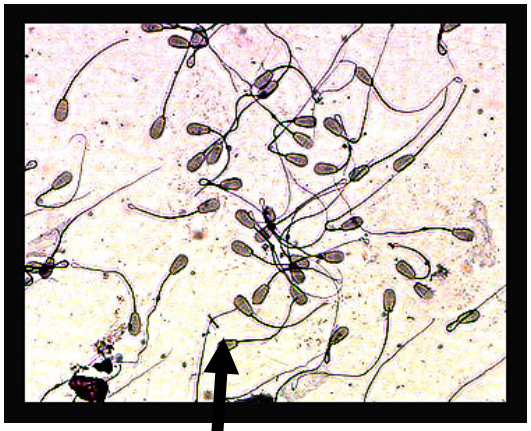


RIGHT: Side view of reproductive system in a bull showing the:

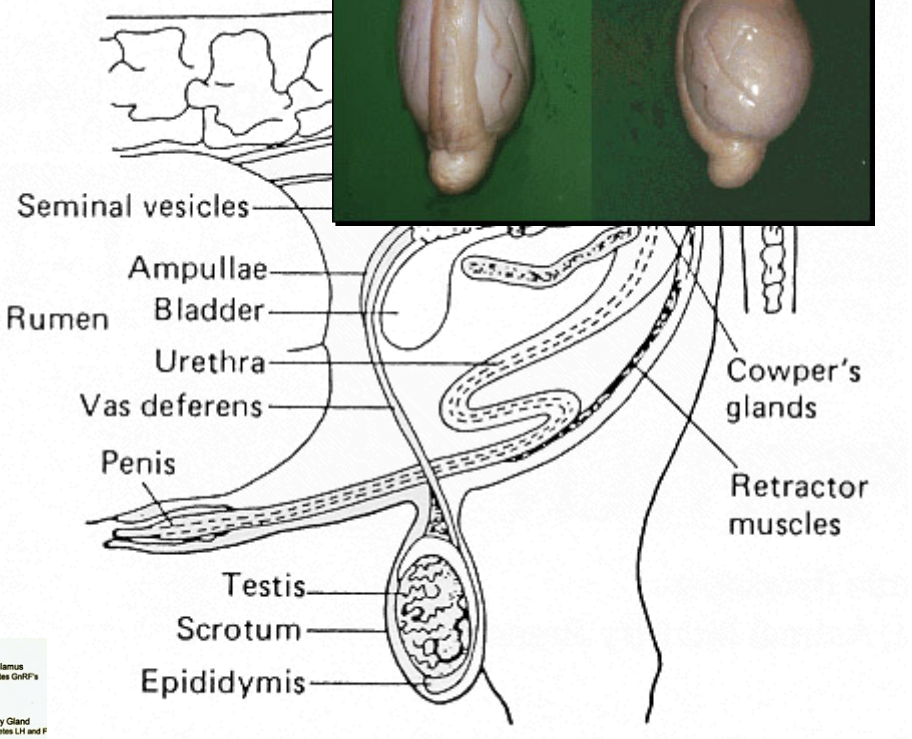
- seminal vesicles (1),
- the bladder (2),
- the cavernosus muscles (3),
- the urethra in an "S" shape sigmoid flexure (4),
- a pair of vas deferens from the testes (5),
- the penis (6),
- the epididymis (7),
- and the testis (8).



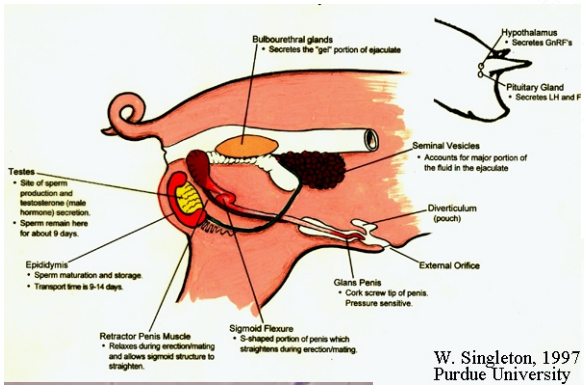




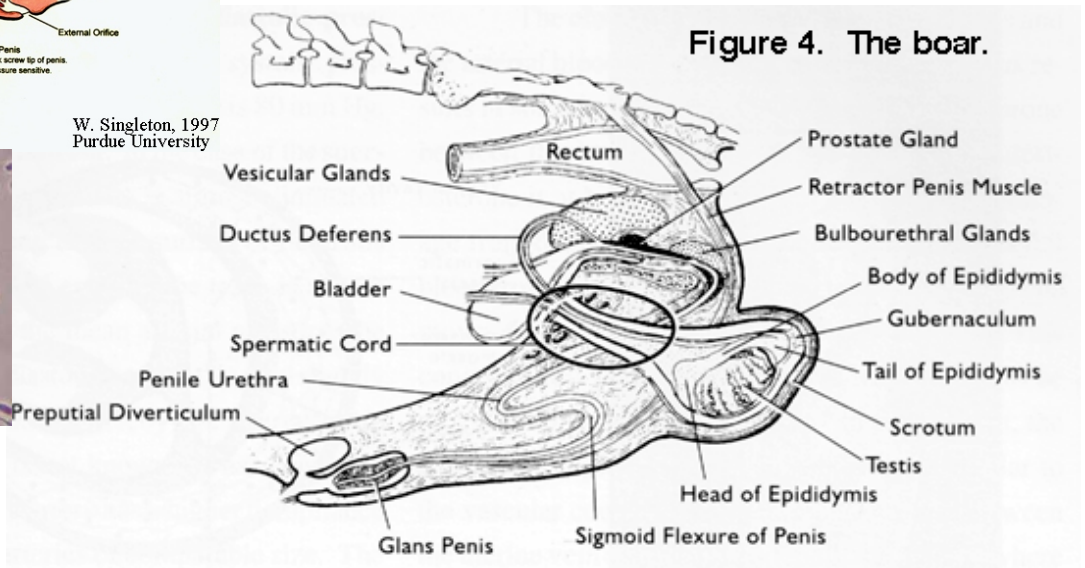
Bull sperm



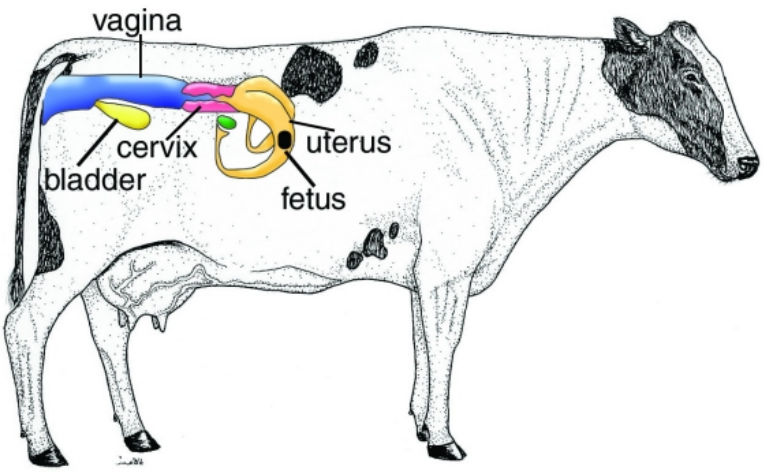
The reproductive tract of the bull



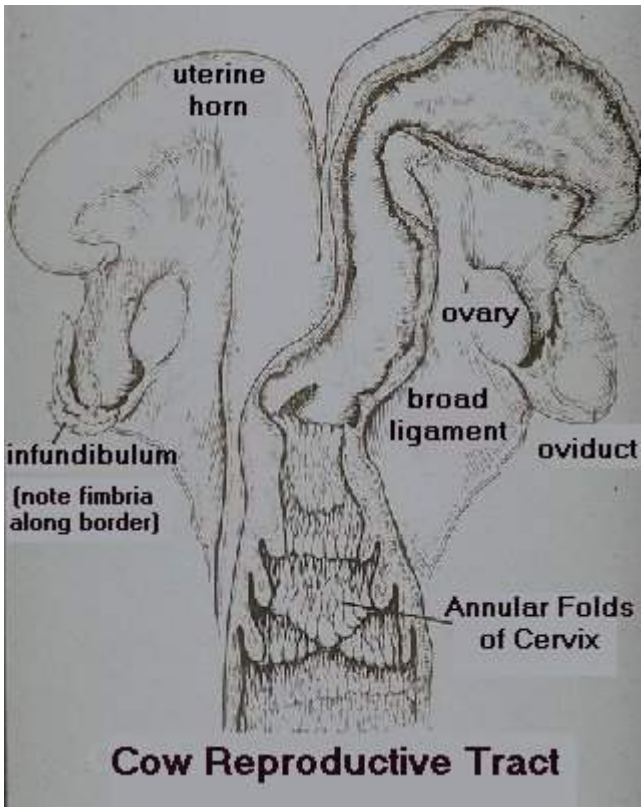
W. Singleton, 1997
Purdue University



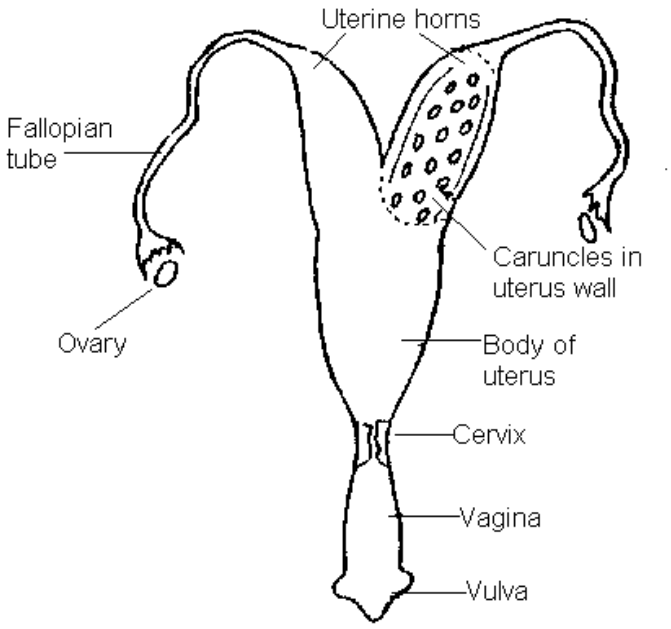
female



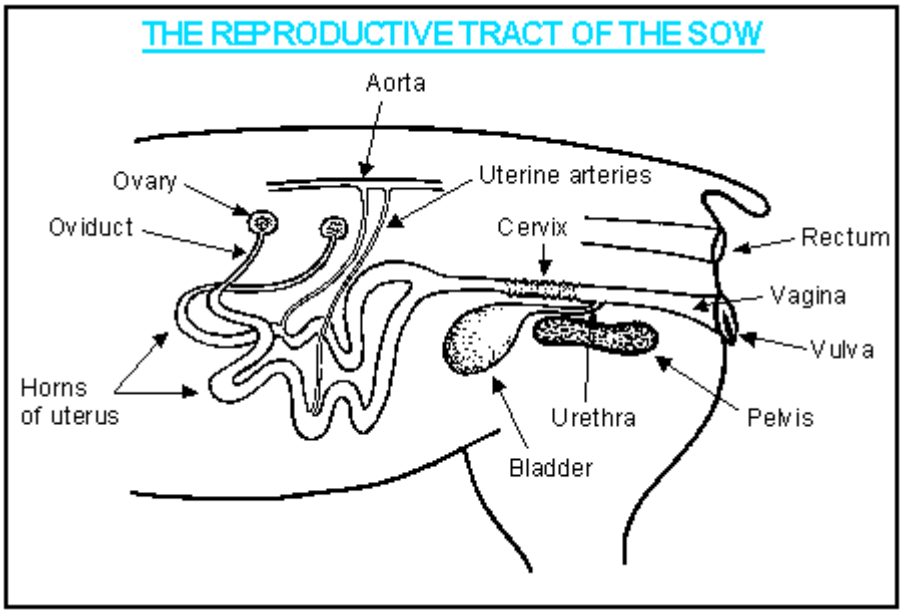
- Vagina :Also called the birth canal, the part of the female reproductive system which connects the cervix to the outside of the animal.
- Cervix :The part of the female reproductive system which connects the uterus and the vagina.
- Uterus :The organ in female mammals in which the foetus develops

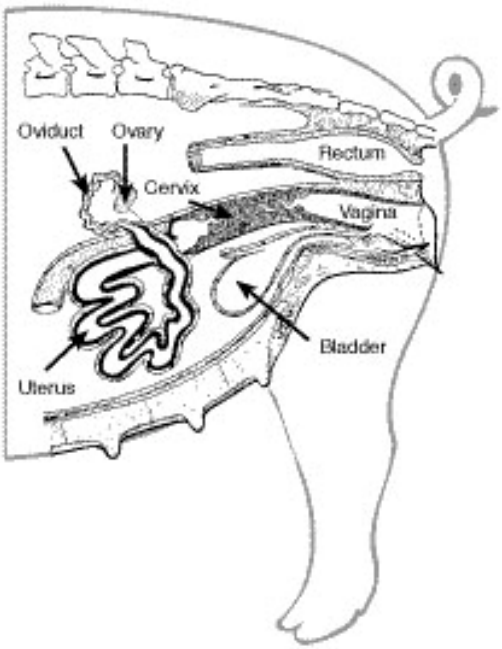


Ewe Reproductive Tract



- Ovaries - the ovaries have two principle functions: 1) production of eggs (ova); and 2) secretion of female hormones (estrogen and progesterone).
- Oviduct (fallopian tubes) - the oviduct "catches" the egg when it is released. The oviduct is the site of fertilization and early embryonic development.
- Uterus - the uterus is small muscular organ that provides protection and nourishment to the growing embryo. The uterus consists of two parts: body and two uterine horns. The inner lining of the uterus is made up of many button-like projections known as caruncles, which is where the placenta attaches.
- Cervix - the cervix separates the uterus from the vagina. During pregnancy, it seals and protects the embryo and fetus from the external environment.
- Vagina - the vagina connects the cervix to the vulva.
- Vulva - the vulva is the external opening of the female genital tract.





problems

Read pg118-121 dynamic agriculture and answer the following questions:

1. What are the main functions of the ovary? _____
2. Where are the fallopian tubes? And what is their function? _____
3. What is another name for the fallopian tubes? _____
4. Describe the uterus: _____
5. What is a cervix? _____
6. What does it do when the animal is pregnant? _____
7. Where is the vagina found? _____
8. What is the vulva and how does it help keep the vagina clean? _____
9. When you look at the vulva, how can you tell if an animal is on heat? _____
10. What are the functions of the testes? _____
11. What are the functions of the scrotum? _____
12. Where are the sperm stored? _____
13. Describe the path that the sperm travel along. Don't forget to mention the fluids that are added along the way: _____
14. What are the functions of the penis? _____

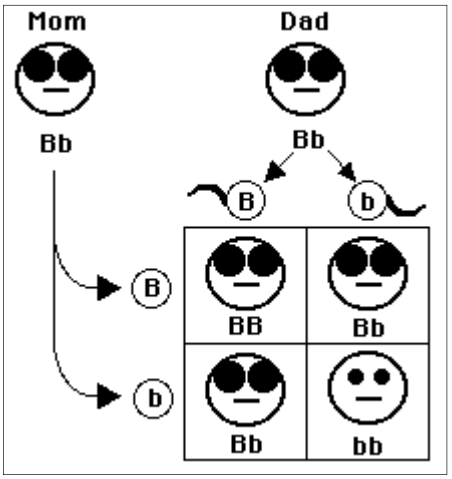
Genetics

Because farm animals reproduce sexually, they produce offspring that are a genetic mixture of their parents.
When choosing a sire to breed with our females (e.g. bull choice for a dairy herd) we consider a number of factors that are important to improving the genetics of our herd. With a genetic improvement we hope to increase our financial gain.
Mendel was a monk that discovered that we can predict the possible offspring characteristics for certain genes.

Definitions:

Genes: units of inheritance, control traits
Allele: different forms of the same gene. We use letters to represent alleles (e.g. E, e)
Chromosome: occur in pairs in the cell nucleus, made of DNA, carry the genetic information (hereditary material) as genes
Trait: inherited characteristic that can be measured (e.g. coat colour, eye colour)
Recessive: inherited feature, only expressed when both alleles are present (usually written as 2 lower case letters e.g. ii)
Dominant: inherited feature, expressed as long as at least one allele is present (can be either TT or Tt)
Variation: differences between individuals of the same species
Genotype: genetic make up, the genes e.g. Cc, CC, cc
Phenotype: what the animal looks like, physical appearance e.g. curly wool, horned
Heterozygous: different alleles e.g. Hh, Rr, Aa
Homozygous: same alleles, also called pure-bred e.g. RR, tt, SS, kk, mm
Homozygous dominant: the dominant alleles e.g. RR, TT, HH
Homozygous recessive: the recessive alleles e.g. rr, tt, hh
Incomplete dominance: when the dominant gene is not completely able to hide the recessive gene (allele) e.g. RR is red, rr is white, Rr is pink: incomplete dominance.

The words genes and alleles are used interchangeably.



Punnett Squares:

We use punnet squares to predict what the possible offspring may look like. At this level we only do simple monohybrid crosses, in other words we only look at one set of genes and the possible outcome from crosses to do with that gene. In the real world genetics are a lot more complicated and there are always exceptions to “rules”.
For simplicity we assume there are only 3 genotypes possible (e.g. TT, Tt, tt), and 2-3 phenotypes possible (dominant characteristic, recessive characteristic, and possibly incomplete dominance characteristics).

Problems:

A gene is responsible for normal or silky feathers in fowls (chickens). N (normal) is dominant, n (silky) is recessive.
A pure bred normal feathered rooster is mated to a silky feathered hen.
What is the genotype of the rooster? NN
What is the genotype of the hen? nn
What possible offspring could they have? All will be Nn, and have the phenotype of normal feathers.

	N	N
n	Nn	Nn
n	Nn	Nn

Question one:

Hone and Gill have purchased a small property, including some beef cows and a bull. They do not have an agricultural background but are keen to get advice from experts. They want to run a beef-breeding and beef-raising unit, using the existing cattle to start with. Through breeding they want to have high liveweight gain, polled (no horns) cattle.

Last year the bull, which is polled (no horns) was mated to 3 cows:

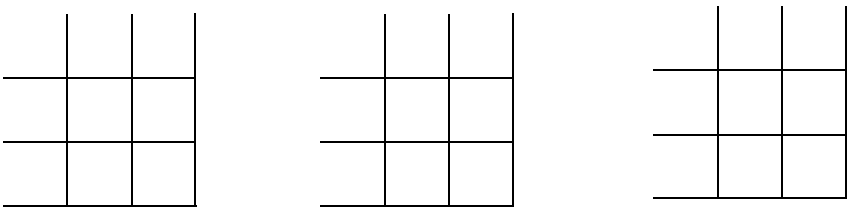
Cow A: which is horned, produced a polled calf
Cow b: which is horned, produced a horned calf
Cow C: which is polled, produced a horned calf

The allele for the polled (no horns) characteristic (P) is dominant over the allele for the horned characteristic (p)

What are the possible genotypes for the animals? _____, _____, _____

What are the genotypes of the cows and bull? Using a punnett square may help you to figure it out

Cow A: _____
Cow B: _____
Cow C: _____
Bull: _____



It would be desirable to cull all 3 cows. Explain why it would be desirable to cull cow C as well as cows A & B.

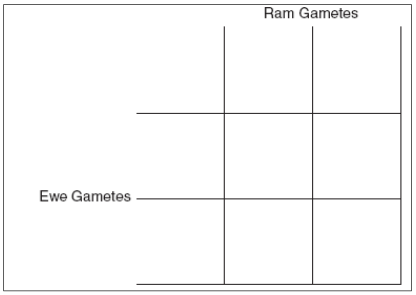
_____
_____
_____
_____

Question two:

Footrot resistance is due to a dominant allele (form of gene) (F) that shows dominance over the allele for no resistance to footrot (f).

A ram with footrot resistance is mated with a ewe with no resistance to footrot. <u>One of the two lambs born has footrot resistance, the other is not resistant to footrot.</u>

Complete the Punnett Square to the right to show the gametes produced by the ram and the ewe, and the genotypes of the lambs



Genotype of ram is: _____
Genotype of ewe is: _____

breeding systems

Some of the common methods used on farms for breeding include:

- Random breeding (not very common today)
- Selective breeding
- <u>Pure breeding</u>
- <u>In breeding</u>
- <u>Line breeding</u>
- <u>Cross breeding</u>
- Artificial insemination
- Embryo transfer.

Task: find out a definition for each of these breeding systems. Pick one from the underlined ones and do a more detailed definition on it, include advantages and disadvantages.
Due: _____

Heritability measures how strongly a characteristic is passed onto the next generation. It is expressed on a scale from 0-100 and can be used to measure how strongly a phenotype is influenced by the genotype and what progress can be achieved in breeding programmes.

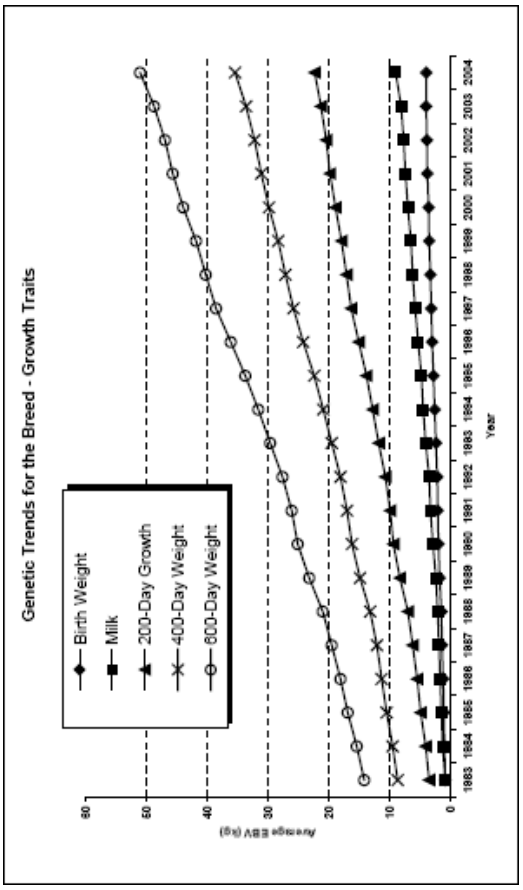
Characteristics controlled by only one or two genes is easier to control than those controlled by several genes.

Heritability of different characteristics

Characteristic	Heritability %	Characteristic	Heritability %
Sheep production		Dairy cattle	
Fleece weight	35-45	Milk production	25-30
Fibre diameter	20-45	Butterfat %	50
Staple length	35	Persistence of lactation	30
Beef cattle		Pigs	
Efficiency of weight gain	40	Litter size	10-24
Weaning weight	35	Litter weight	30
Pos-weaning weight gains	35	Post-weaning weight gain	14-58

Breeding Values, and stock improvement:

- Remember the young receive their genes from both of their parents.
- Some traits are more heritable than others.
- In New Zealand the terms: "Estimated Breeding Value" (EBV) or Breeding Value (BV) are used.
- Basically this is how stock improvement works:-
  Your cow has an estimated breeding value of say "1". She is mated to a bull with an EBV of say "9"
  The resulting calf will have a breeding value of "5" (Half the total of the parents breeding value)
- If, say, the cow has non identical twin daughters. Both daughters will have the same breeding value. However their traits may be different.
- By keeping the animals with the traits you desire in your herd, and culling out animals that are not up to your standards. By continually using superior sires with the traits you want for your replacements. The genetic merit of your herd/flock will increase. So will the market value of your animals.
- The graph to the right shows what can happen over time with good breeding



Artificial insemination:

Advantages of AI over natural breeding

- Allows the choice of using the best possible bulls of proven quality in improving the genetic make-up of the cattle population. Farmers have access to genes from bulls of a quality which they may not individually afford. Frozen semen can be transported globally.
- Disease control. Many potentially devastating diseases are spread by sexual contact. Because of the extremely tight controls exerted over both the health of donor bulls and the technical procedures themselves, these risks are vastly reduced.
- Cost effectiveness. The cost of an AI straw is around $10, this is as nothing compared with the costs of a Holstein bull (possibly $10,000 to buy). A bull is expensive to rear, is relatively unproductive, vulnerable to disease or accident and may even prove to be infertile.
- Flexibility. For a variety of reasons, a farmer may not wish all calves to be sired by a single bull with the same characteristics. It may well be impracticable to keep sufficient bulls to cover all possible requirements.
- Safety. Although there are differences between breeds, any bull can be aggressive and is potentially dangerous. This was a major stimulus to the initial setting up of AI services.
- semen can be collected from bulls over a period of years and stored. Can be used after the animal has died (or retired) as it can be stored for several years.
- samples of stored semen can be used to inseminate high quality cows and the performance of the progeny can be measured. In this way, the quality of semen from individual bulls is assessed before it is made available on a wide scale.
- the semen from quality bulls is used for large scale AI. Bulls of lesser quality are culled. A bull can sire offspring over a period long exceeding its natural life. Sometimes, when a bull has donated sufficient semen, it is culled to avoid maintenance costs.
- A bull can inseminate millions of cows via AI, but only hundreds if done the old fashioned way.

Read pg 133-135 Dynamic Agriculture

Flow chart illustrating progeny testing programme

1-2 year old bull provides semen

↓

About 500 cows inseminated

↓

9 months gestation

↓

Calves have own offspring at 2½ years old; begin lactation

↓

1 year of lactation

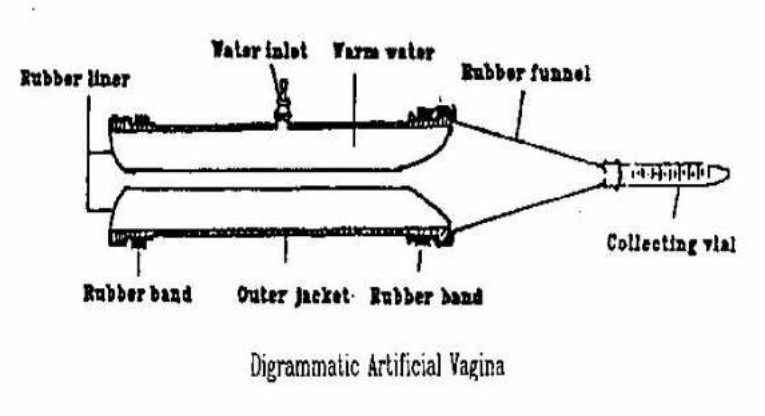
↓

Performance result of calves

↓

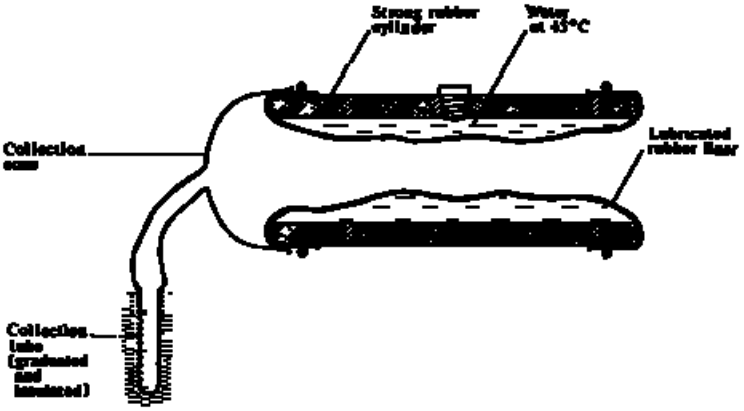
Bull possibly in use for AI

collecting semen



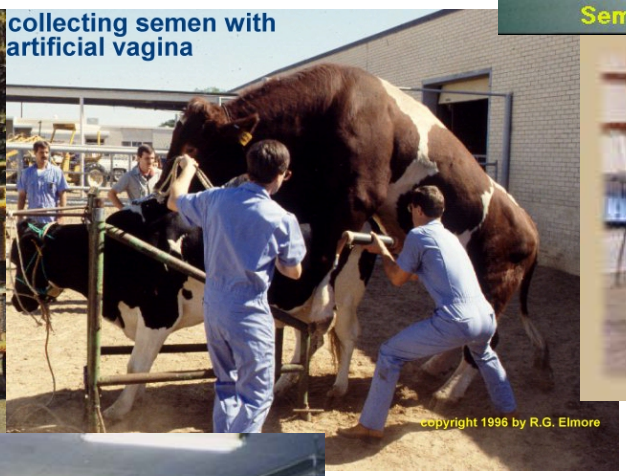
Digrammatic Artificial Vagina

Semen is usually collected from a bull as it mounts a suitably restrained live 'teaser' animal (such as another bull, or a cow). Bulls can also be trained to mount a mechanical dummy. The teasing process may involve inducing the bull to participate in one or more false mounts, (allowing him to mount but not ejaculate) sometimes with different teaser animals, before finally being allowed to ejaculate. Such procedures enhance both quantity and sperm count of the ejaculate. The operator holds the artificial vagina close to the teaser, parallel to the anticipated path of the penis. When mounting occurs, the operator directs the penis into the artificial vagina then ejaculation will take place. Semen is usually collected from a bull approximately four times a week



The bull is induced to ejaculate into an artificial vagina. This contains water at about 45°C held between a stout external rubber casing and an inner lubricated rubber sleeve. The object is to simulate the feel of a cow's vagina. The semen is collected in an insulated tube. After collection, the semen is checked for contaminants such as blood, pus or faeces. It is also examined microscopically for concentration and normality of spermatozoa.

Semen Collection Devices



Bull sample of semen on left, dog on right

The following images depict routine semen collection from a bull.

False mounting to arouse bull

An erect penis indicates arousal

Collector ready with AV

Collector diverting penis to the AV

Semen Evaluation

Semen should be evaluated grossly (looking at the sample in a container) for abnormal appearance. The presence of small "clots" or blood can indicate such conditions as seminal vesiculitis.

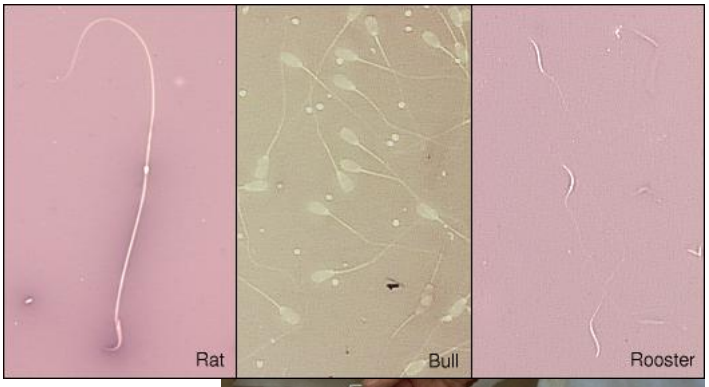
Parameter	Normal Values
Ejaculate volume	5 ml (range 1-15 ml)
Sperm concentration	1200 million/ml (range 300-2500 million/ml)
Total sperm per ejaculate	Typically 4-5 billion
Progressive motility	Greater than 30%
Morphology	Greater than 70% normal

Dilution and storage of semen

A sample of semen is taken and checked under the microscope. The technicians are checking for viable, healthy looking, strong swimming sperm. If everything is fine then the semen is diluted.

A large number of assays have been developed and advocated for assessing semen quality. Inevitably, at least three core parameters are evaluated:

- Sperm concentration and total sperm in the ejaculate. Total sperm is determined by multiplying concentration (sperm per ml) by ejaculate volume (ml).
- Sperm motility is usually assumed to be the percentage of sperm that are progressively motile. A progressively motile sperm swims briskly forward in a relatively straight line, as opposed to moving in circles. In some cases (e.g. with human sperm), total motility, or the percentage of sperm that are wiggling at all, is also recorded. In evaluating motility with most species, sperm are classified as non-motile, progressively motile or non-progressively motile. (A progressively motile sperm swims forward in an essentially straight line, whereas a non-progressively motile sperm swims, but with an abnormal path, such as in tight circles)
- Sperm morphology. The best samples of semen inevitably contain some sperm that have abnormal structure, such as bent tails or misshapen heads. To obtain a standard measure of sperm morphology, the percentage of sperm with normal shape and size is determined. It can also be useful to classify the abnormal sperm as to type of defect



Sperm is diluted because it means that more females can be inseminated with each ejaculation. With bulls each ejaculate contains approximately 100 million sperm. Only 20 million are needed for insemination.

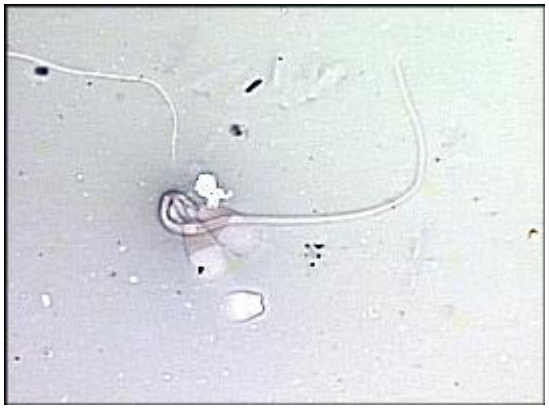
Semen is diluted in an 'extender'. This provides an appropriate concentration of spermatozoa, allowing more inseminations from each sample. A dilution of around 50 times is usual. The extender also nourishes and protects the spermatozoa during storage and distribution. Typically, the extender contains:

- milk or egg yolk to protect against cold shock (the initial cooling below body temperature);
- glycerol as a cryoprotectant (to protect from damage due to the formation of ice crystals during freezing);
- a buffer (usually citrate) to prevent pH changes due to, for example, lactic acid produced during sperm metabolism;
- glucose (and/or other sugars) to provide an energy source for the spermatozoa, as well as the correct overall water potential for their survival;
- antibiotics, to kill pathogens.

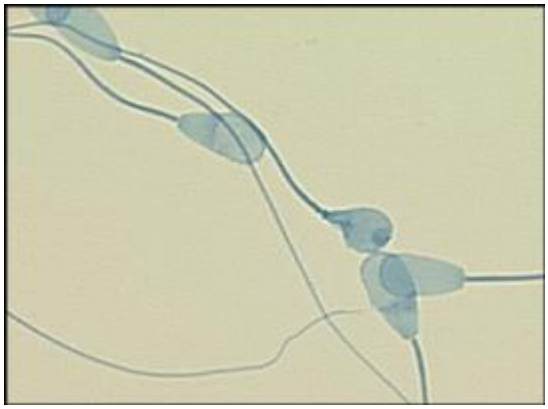
Semen is packed into the plastic straws and stored in liquid nitrogen at -196° C. Each straw contains around 20 million spermatozoa. There is slow deterioration of the effectiveness of semen with time.

For use, the straws are thawed in warm water for a few seconds before insemination to reactivate the spermatozoa

Examples of Morphological Abnormalities in sperm

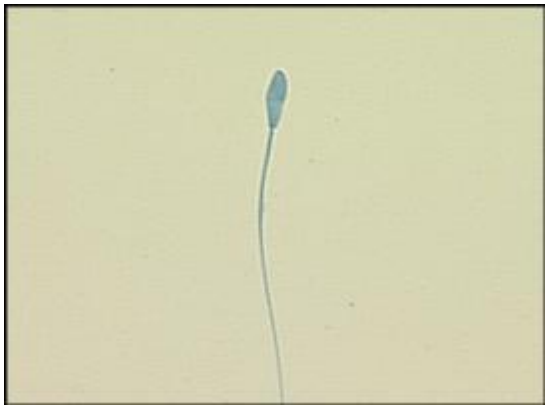


Double headed sperm (bull; eosin-nigrosin stain)

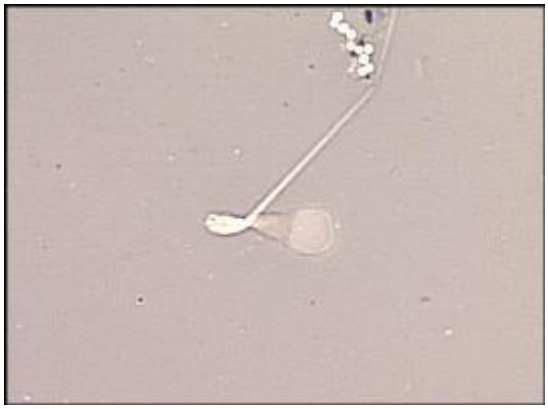


Misshapen head along with 4 normal sperm (bull; toluidine blue stain)

Elongaged head (bull; eosin-nigrosin stain)

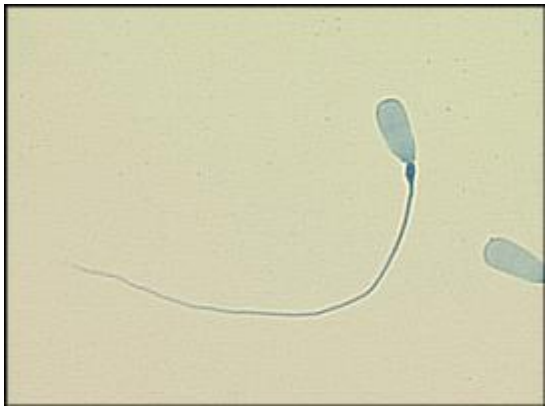


Elongated head (bull; toluidine blue stain)

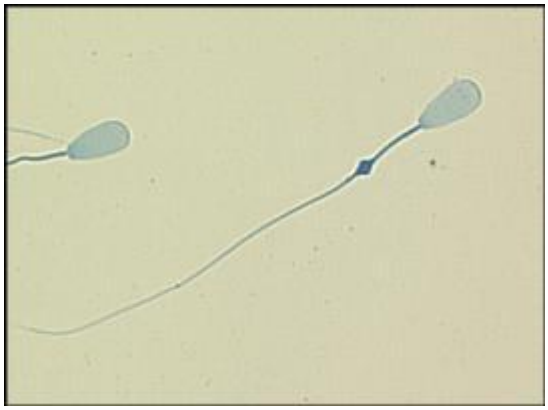


Pyriform (pear-shaped) head and bent, abnormal midpiece (bull; eosin-nigrosin stain)

Misshapen head and proximal droplet (bull; toluidine blue stain)



Proximal droplet (bull; toluidine blue stain)

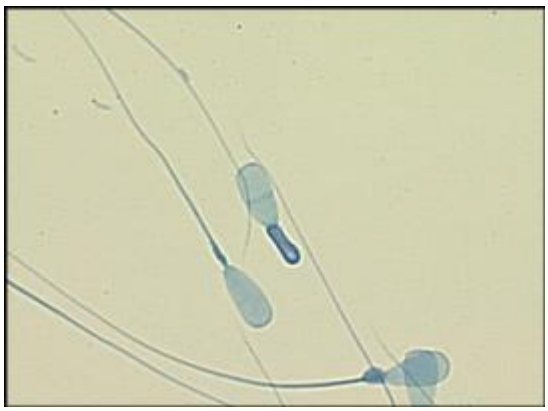


Distal droplet (bull; toluidine blue stain)

Detached head (bull; eosin-nigrosin stain)

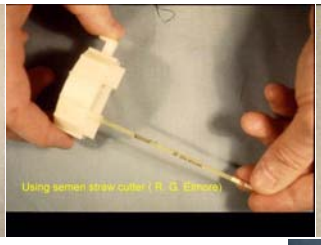
Bent tail or midpiece (bull; eosin-nigrosin stain)

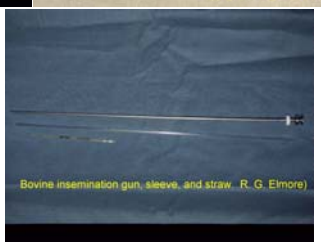
Coiled tail (bull; eosin-nigrosin stain)



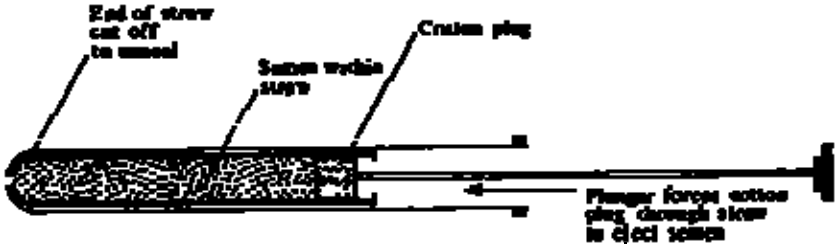
Coiled midpiece/tail in one sperm and proximal droplet in another (bull; eosin-nigrosin stain)

The straws are prepared on site when it is time to artificially inseminate the females.

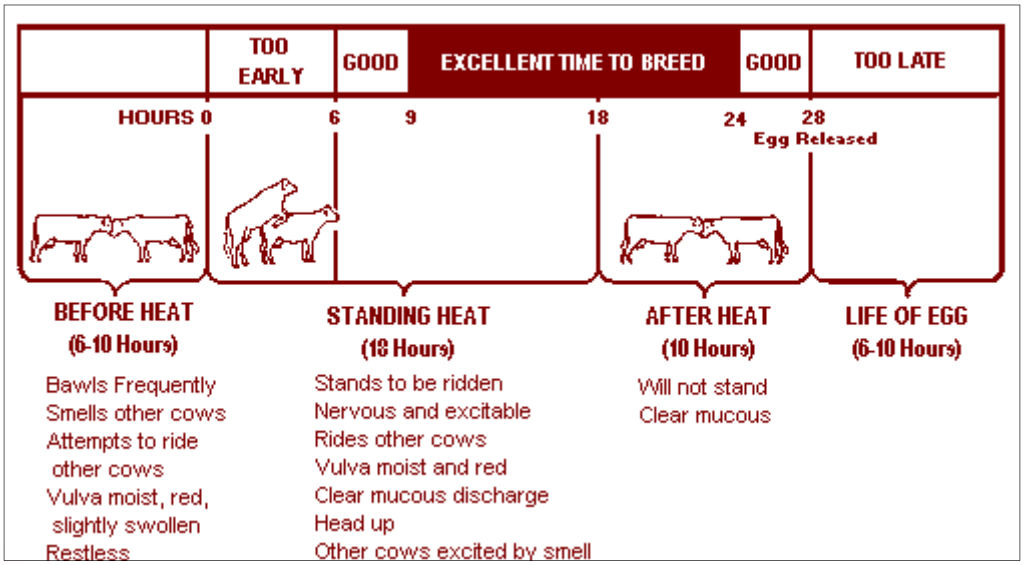


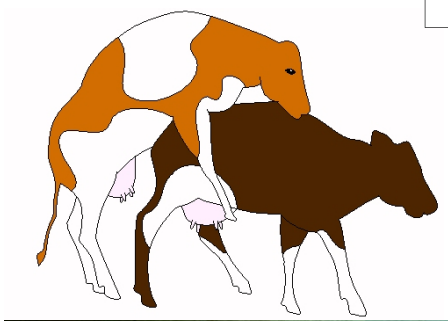


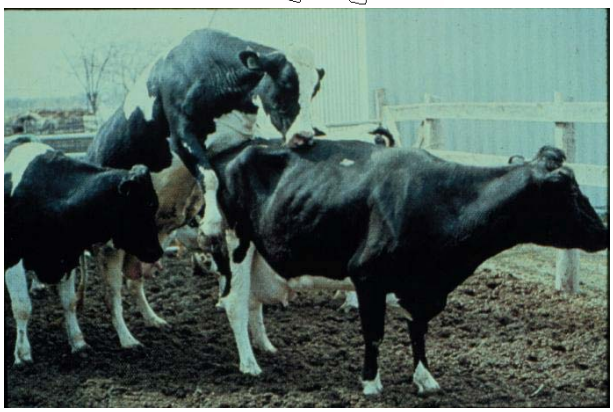
The pistolet is filled with a straw. The pistolet works like a syringe. It has an open end and a plunger at the other that is pushed when the pistolet is in place, pushing out the semen.

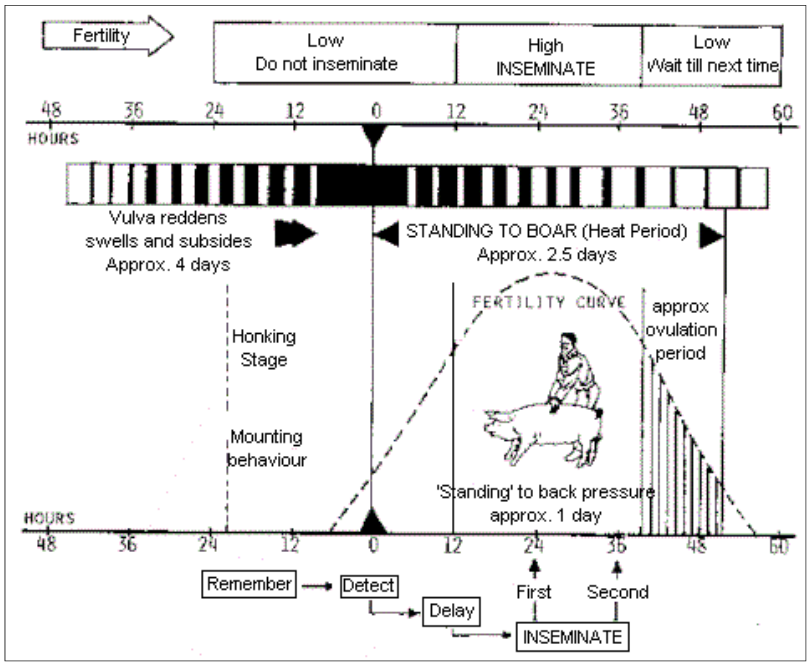


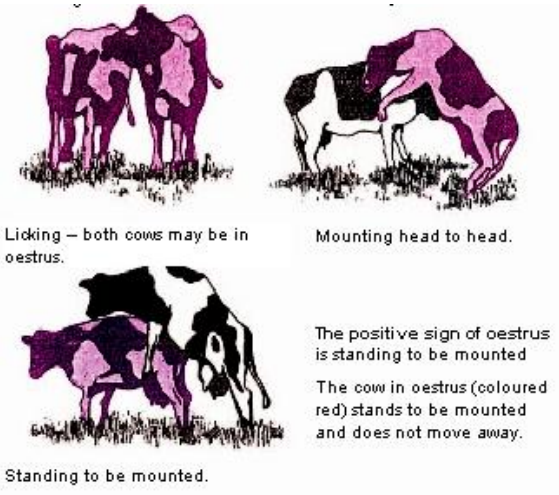
Knowing when to carry out artificial insemination is important. If it is done too soon the female won't get pregnant. If it is left too late, she won't get pregnant.











Licking – both cows may be in oestrus.

Mounting head to head.

The positive sign of oestrus is standing to be mounted

The cow in oestrus (coloured red) stands to be mounted and does not move away.

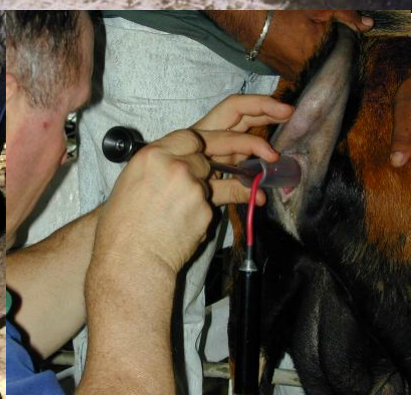
Standing to be mounted.

With cows, **bulling** is the term given to cows in heat. The cows will mount the animal in heat, and a cow coming into heat will sometimes try and mount another cow.
The signs of oestrus in the ewe are much less pronounced than in the cow and can usually not be detected unless a ram (or teaser ram) is present. When mature ewes are in heat, they will seek out the ram and stand still for him to mount them. Sometimes they wag their tails vigorously. They may nuzzle the ram around the belly or scrotum and even try to mount the ram. Young ewes rarely exhibit these behaviours. There is evidence to suggest that rams and ewes prefer to mate with their own breed, but when there is no alternative ewes will mate with almost any breed of ram.

When it is decided that the animal is in oestrus (heat), then the artificial insemination is carried out.

In the case of cattle:

The left arm (if the person is right handed) is placed into the rectum of the cow. It helps to guide the placement of the pistolet. The left hand "holds onto" the vagina. The right hand pushes the pistolet into the vagina. It can take some wiggling to get it into the correct place: the cervix. When the pistolet is at the opening to the uterus (cervix) the plunger is pressed and the semen released.



In the case of sheep:

In some cases the animal is placed into a cradle. There are four methods of artificially inseminating a ewe:

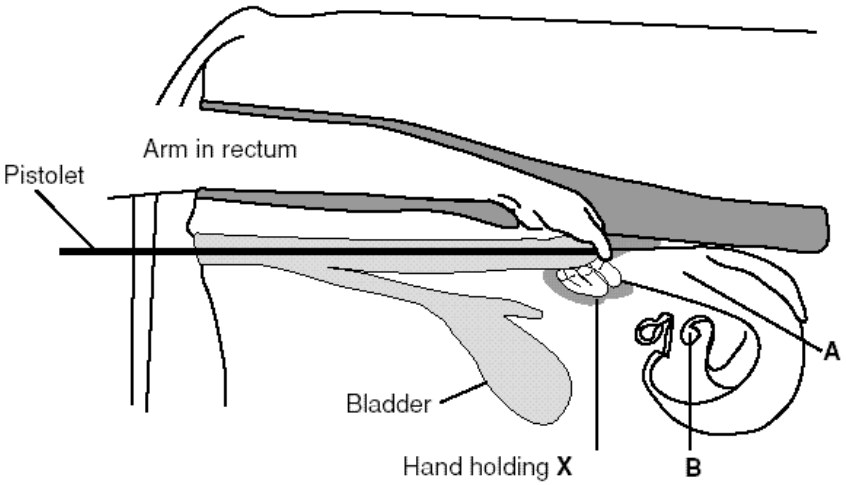
1) vaginal: using a pistolet type system, but no hand is placed into the rectum
2) cervical: The cervix is located, via a speculum fitted with a light source, and the semen is deposited into the first fold of the cervix
3) trans-cervical: grasping the cervix and retracting it into the vagina with a pair of forceps to allow an inseminating instrument to be introduced into the cervical canal
4) Intrauterine: deposits semen directly into the uterine horns

Label the parts on the diagram:

A: _____

B: _____

X: _____



revision

What is the reason behind artificially inseminating animals?

The cost of higher estimated breeding value (EBV) animals is prohibitive for most farmers. The easy way to increase the genetic potential of a herd/flock is to cross the females that are on the property with males that have a higher EBV. The cheapest way is to use the sperm of a higher EBV male, rather than try to buy one.

When you use males of a higher EBV the offspring will have a higher EBV than the mothers, but not as high as the fathers.

Artificial insemination is common in dairy herds. For those producing pure-bred animals (often for showing), they often choose particular bulls to cross with particular cows. Some non-showing farmers will go to the same commitment.

Often farmers will choose “bull-of-the-day”. This means they are choosing an unproven bull, but the bulls will have good genetics. All of the daughters need to have detailed records kept so that the information can be given back to livestock improvement so they can make accurate predictions about the breeding value of the bull.

Negatives include: can miss some animals that are on heat as they have a silent heat. Expensive in terms of labour and time. Person carrying out the insemination needs to be trained (costs to hire them or to be trained)

natural breeding

Natural breeding is more common on sheep farms, smaller units (hobby farms) and beef units.

It is becoming more common to use artificial insemination with many farmers, but the cost of inseminating only a couple of animals, or many thousands of animals can be cost prohibitive.

For some farmers they are not trying to improve the genetics in their animals and so any male with suitable characteristics is OK. E.g. good size, good growth, breed characteristics are preferred.

A farmer has a small herd of 30 Hereford cattle of undetermined breeding. She wants to get more characteristics like those of Aberdeen Angus, smaller calves for easy birthing, marbled meat, smaller bulls to cross over younger stock. How can she go about this?

- One possibility is to use AI from an Angus bull.
- A second possibility is to purchase 1 bull of a “lower” genetic pool to keep the cost down. Use this bull for 2 years, then cull him or on-sell him to another farmer.
- A third possibility is to hire a bull to use on her farm. This means that the cost of keeping him for the rest of the year is not her problem.
- The fourth possibility is to buy a better bull, use him on her own farm and then hire him out to other farmers.

All of these options have positive and negatives associated with them. Which one would you choose and why?

Natural breeding is often related to random breeding. This is because the males in a group are usually able to mate with whom ever they want to.
The advantages of random breeding include:

- A large genetic pool
- Natural pecking orders are established and only the best males mate with the females
- Great variation can occur

The negatives of random breeding include:

- Undesirable traits can occur more often
- Unpredictable traits can occur
- Possible inbreeding if the males are not changed and mate with their daughters.

The ratio of males to females
Beef Bulls to cows numbers vary from 1:25 to 1:50
Dairy cows that have finished being through an AI cycle is 1:100
For sheep the ratios vary from 1:30 for young rams to 1:100 for older more experienced rams.

Common terminology includes the following words, find definitions for each of them (some will have been said during classes and others will have been mentioned in your booklets):

Mating: _____
_____
_____
Breeding: _____
_____
_____
Tupping: _____
_____
_____
Putting the bull out _____
_____
_____
AI: _____
_____
_____
AB: _____
_____
_____
Inducing: _____
_____
Synchronising: _____
Oestrus: _____
Bulling: _____
On heat: _____
Flehmen: _____
Anoestrus: _____
Teaser ram: _____
Cryptorchid: _____
Wether: _____
Steer: _____
Heifer: _____
Teaser ram: _____

Collect a tx bk: read pg 180-185:
Copy and complete the following questions into your book:
 # 15, 17, 20, 22, 24, 25, 26

Typical Year:
A typical year usually begins on a farm with calving or lambing. The following are examples of what happens on a various farms in NZ. There are variations depending on where you are farming and the type of farming that is happening.

Typical year on a Merino Farm in the South Island		**North Island**	**South Island**
january	Ram sales		
february	Ram sales	2nd shear	
march		2nd shear Rams out	2nd shear
april	Testing 2th ewes/rams	Rams still out	2nd shear Rams out
may	Rams out		Rams still out
june	Market forcast		
july			
august	Ewe shearing	lambing	
september	Hogget shearing Lambing	lambing	lambing
october	Lambing		lambing
november	Lamb marking Wether shearing		
december		Shearing (full wool)	Shearing (full wool)

Typical year on a seasonal dairy farm in the north island		**North Island**	**South Island**
january	Farm maintenance	milking	milking
february	Farm maintenance	milking	milking
march	Farm maintenance	milking	milking
april	Begin drying off cows if conditions are not good	milking	Drying off
may	Drying off completed	Drying off	Winter maintenance
june	Wintering of stock	Winter maintenance	Winter maintenance
july	Wintering of stock Prepare calf pens Calving begins late July	Prepare calf pens Calving begins	Prepare calf pens
august	calving	calving	Calving begins
september	Calving finished	Calving finished early September, induced animals done early sept	calving
october	AI begins	AI	Calving finished early oct, induced animals done early Oct
november	AI continues	AI	AI
december	Bull put out to catch last cows not AI	Bulls out to catch last of cow not pregnant to AI	AI, bulls put out around Xmas to catch last of cows not pregnant to AI

With both types of farms (seasonal dairy and sheep) you can see that there are minor variations and differences in timing between the north and south island.
This is because there is a difference between the climates of the 2 islands. Spring comes to the North Island earlier than the south. This means that lambing and calving can begin earlier as there are warm temperatures and plenty of grass for the mothers to eat.

selection and recording

The selection process depends on the characteristics that the farmer is hoping to breed into their animals.

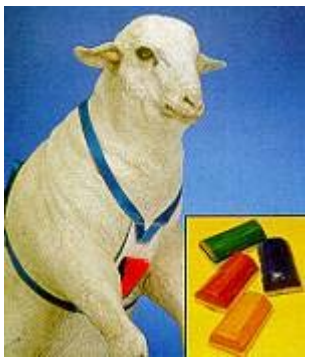
With dairy cows and AI, there are 2 main possibilities:

- Bull of the Day: this is an unproven bull. It doesn't have an up to date record of breeding values. The daughters of this bull have yet to have their milk production stats recorded. The up side to "bull of the day" is that they get the sperm cheaper. The downside is that they have no idea on how "good" the bulls genes are. They may get the semen from a soon to be top bull, or they may have had a "dud" bull that didn't perform as expected.
- Selected Bulls: these are proven bulls. They have a number of daughters and there are years of results related to their breeding values. When a farmer chooses a specific bull, they are selecting them on the basis of some specific characteristics that will improve their herd. This is more expensive, but you know what you are getting.

With both methods, accurate records need to be kept. Some of the records include:

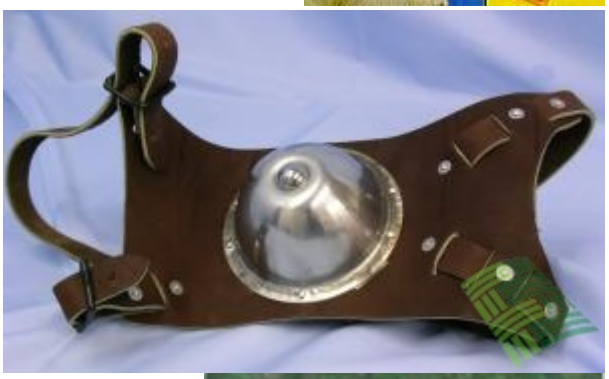
- Day of insemination (cow number and straw number)
- Day of birth (useful for working out gestation period)
- Ease of calving (big calves tend to be more difficult to birth)
- Sex of birth (useful for working out percentage of heifer calves)
- Volume of milk produced
- Percentage of butter fat and protein.
- Some farmers may also record birth weight and any medical problems that have resulted

When choosing a bull or ram to put into your paddocks, consideration needs to be given to the conformity of the male animal. Does it have the genes and characteristics you are looking for?



Keeping records is again vitally important. There needs to be a way of identifying which male has mated with which female. This is done using mating harnesses.

Mating harnesses are attached to the male, when they mount the female they leave a "stripe" on the females back. Each male has a different colour in their harness. The farmer then needs to record the date and the colour if they want to track individual animals. If they are interested in the percentage of animals mated to a particular male, they may only add up the "stripes" they see.



Records need to be kept.

With sheep the records include:

- Number of live lambs born
- Number of lambs weaned
- Sex of lambs
- Disease resistance status of animals (if known)
- Fleece weights
- Carcass weights
- With sheep it depends on the type of farming being done: wool, meat, both.

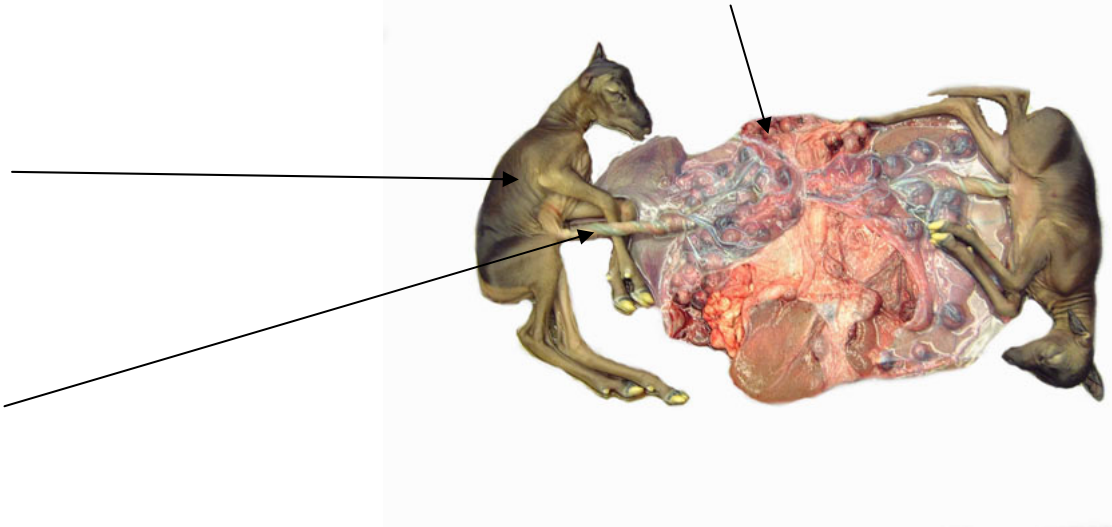
Animals on a farm need to be identified. There are several ways of doing this.
The most common way is to use ear-tags. The downside is that they can be pulled out. There are several different types of ear-tags. E.g. plastic, metal, electronic

Some farmers are moving to freeze branding. This works particularly well with dairy cattle as the number is on the rear end where the farmer is standing putting the cups on. This makes it a lot easier when it comes time to do herd testing. It doesn't "fall off" and is considered to be permanent.

Good identification methods are necessary for farmers to keep good records. Without good records it is impossible to see where the animals have come from, it also means that it is impossible to see what needs to be done to get where the farmer wants.

pregnancy

STAGES OF DEVELOPMENT OF FOETUS:
Depending on the length of gestation, most animals go through similar stages of foetus development.
Collect a textbook: read chapter nine (pg 155)
Look at the following diagrams, label them according to what the teacher says.



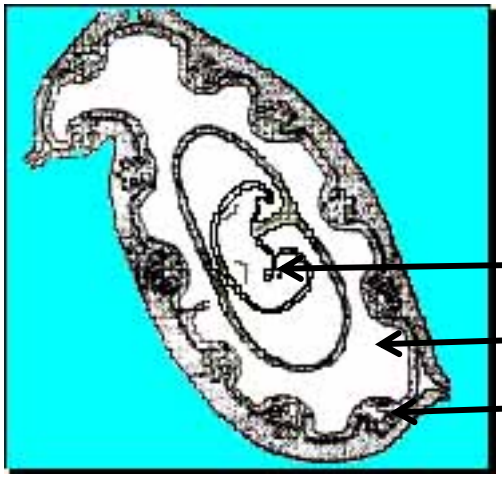
The diagrams below: label according to the teachers instructions and read the following.

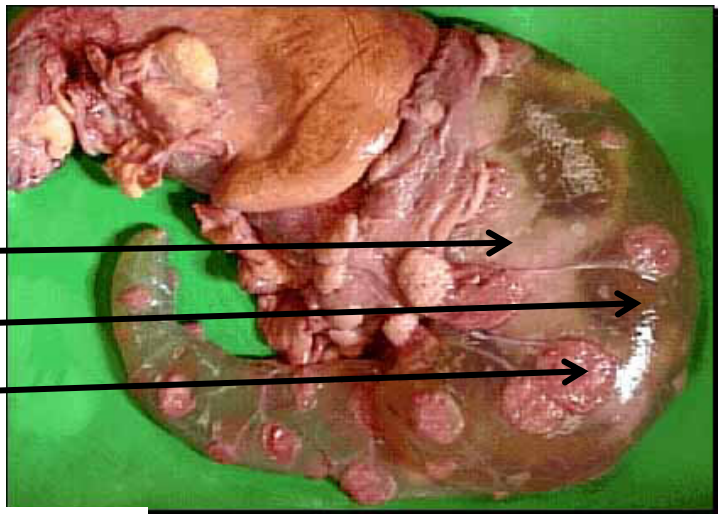
The outer membrane of the developing placenta is called the chorionic layer.

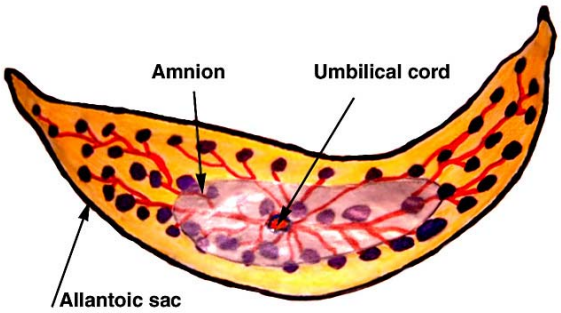
The amnion layer surrounds the foetus and is continuous with the integument of the foetus.

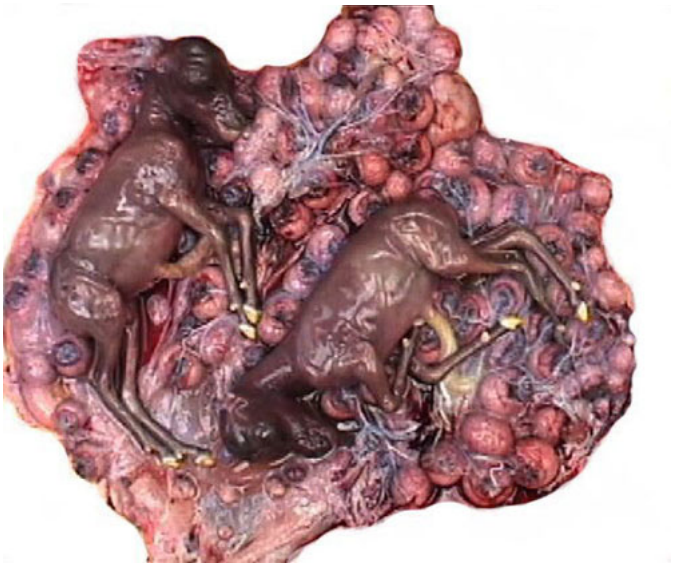
The allantoic layer developed as a sac off the end of the foetal bladder which passed through the umbilical cord and ballooned between the amnion and the chorion. These sacs expand and come in contact to form several double layered membranes.

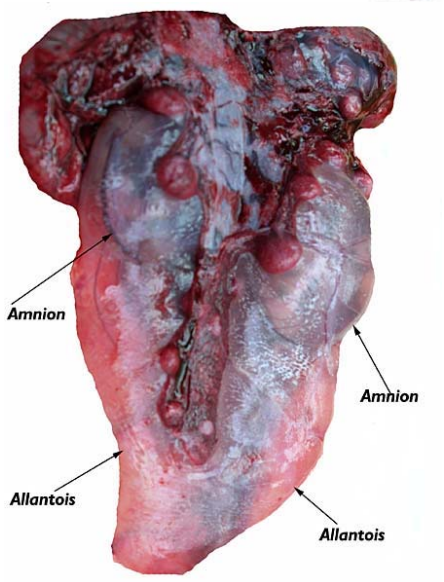
A portion of the horn of the uterus has been removed to reveal the placenta and part of the foetus. This placenta consists of an amniotic sac housing the foetus within an allantoic sac which accumulates wastes. It has a cotyledonary form of attachment. Cotyledons are seen on the surface of the chorioallantoic membrane; they attach to the maternal caruncles to provide for gas and nutrient exchange.

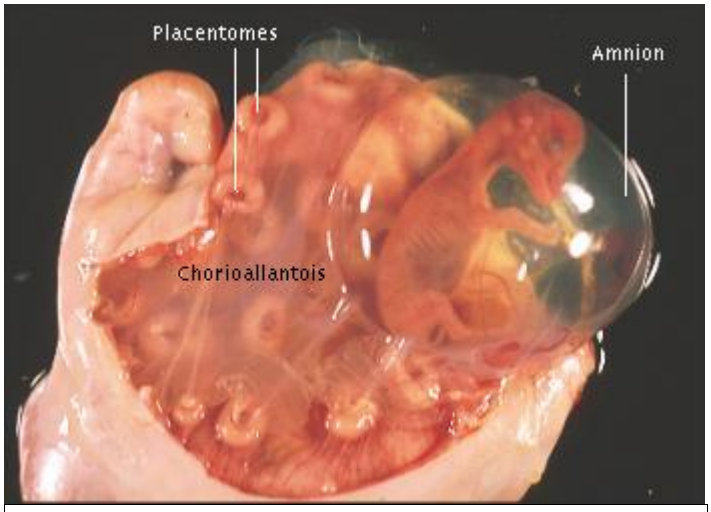




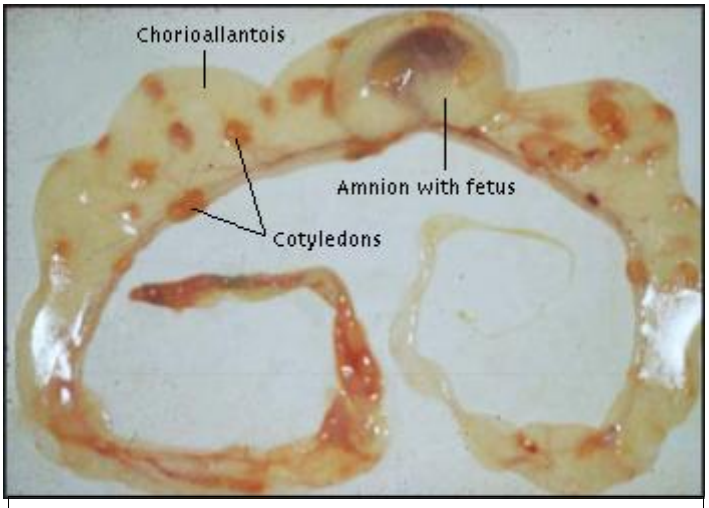








The image above shows an incised uterus from a pregnant sheep, roughly 50 days of gestation. The numerous button-shaped structures are placentomes, and the surfaces in view are actually cotyledons - the fetal side of the placentome. The slightly milky-looking membrane covering and between placentomes is the chorioallantois. The fetus is clearly visible inside the



The image above shows a bovine conceptus dissected away from the uterus. The size of the chorioallantois relative to the amnion and fetus is evident. The cotyledons are readily observed; caruncles have been left behind with the uterus. Cattle almost always have a single fetus, and, although the fetus is located in one horn or the other, the large chorioallantosis fills both uterine horns, and placentomes are present throughout the uterus.

Ruminants have a *cotyledonary placenta*. Instead of having a single large area of contact between maternal and foetal vascular systems, these animals have numerous smaller placentae. The terminology used to describe ruminant placentation is:

- **Cotyledon**: the foetal side of the placenta
- **Caruncle**: the maternal side of the placenta
- **Placentome**: a cotyledon and caruncle together

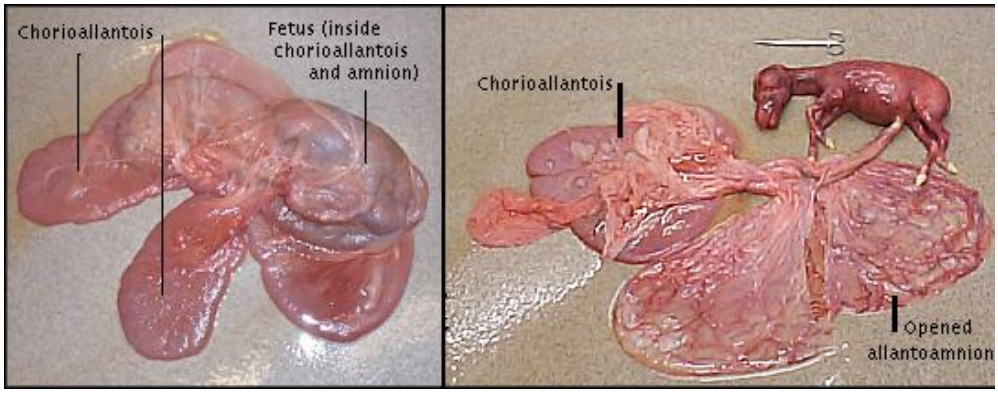
Caruncles are oval or round thickenings in the uterine mucosa resulting from proliferation of subepithelial connective tissue. As shown in the image below, caruncles are readily visible in the non-pregnant uterus. Further, they are the only site in the uterus to form attachments with foetal membranes. Patches of chorioallantoic membrane become cotyledons by developing villi that extend into crypts in the caruncular epithelium.

Throughout gestation, the mammalian embryo is a parasite that survives "at the pleasure" of its mother. Early in gestation, the embryo is small and has correspondingly small requirements for nutrients and for waste disposal systems - it subsists by taking up endometrial secretions and dumping its metabolic wastes into the lumen of the uterus. This situation changes rapidly.

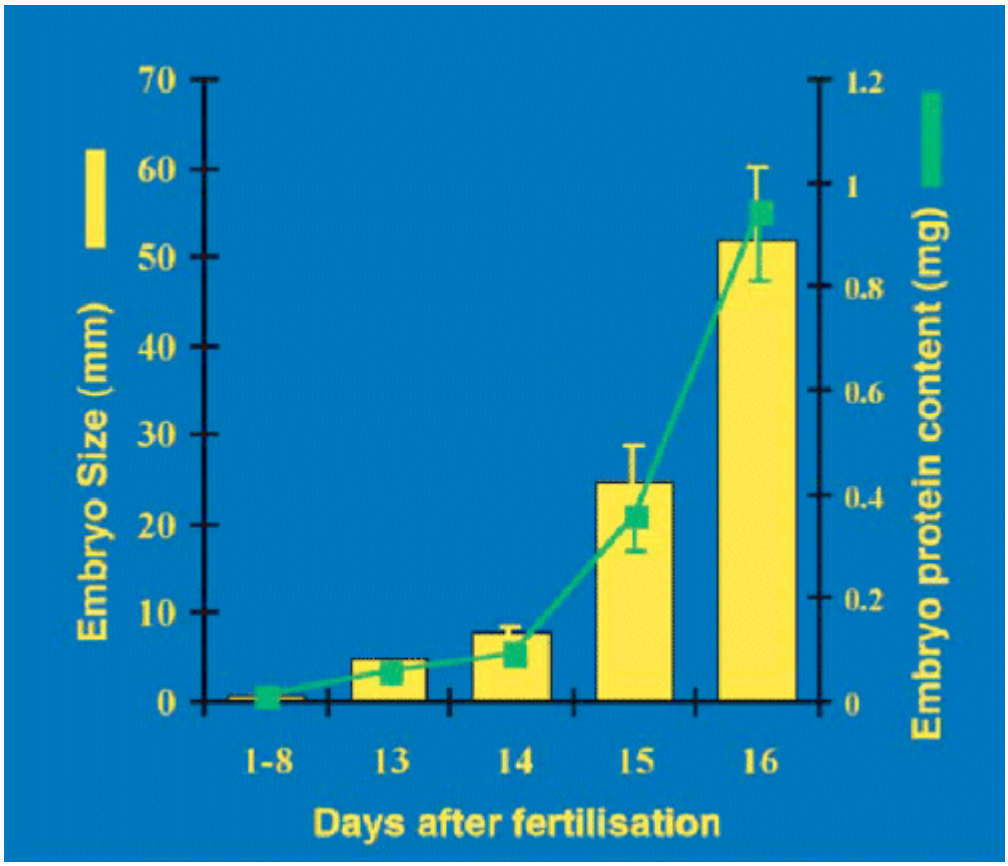
As the embryo grows and develops a vascular system, it must establish a much more efficient means of obtaining nutrients and eliminating waste products, and does so by establishing an efficient interface between its vascular system and that of its mother. That interface is the placenta.

In addition to its primary goal of facilitating transport between mother and foetus, the placenta is also a major endocrine organ. In almost all mammals the placenta synthesizes and secretes steroid hormones - progestins and estrogens. The placenta also produces a number of protein hormones. Depending on the species, it is the source of chorionic gonadotropins, relaxin, and placental lactogens. Placental hormones have profound effects on both foetal and maternal physiology.

Despite the fact that all placentae carry out the same basic processes of transport and hormone secretion, there are important differences in structure and function among families of mammals. The placentae of humans, cattle, horses and dogs are all very different from one another at both gross and histologic levels. They also differ in certain functions that are clinically important - for example, in the ability to transport maternal immunoglobulins to the fetus.

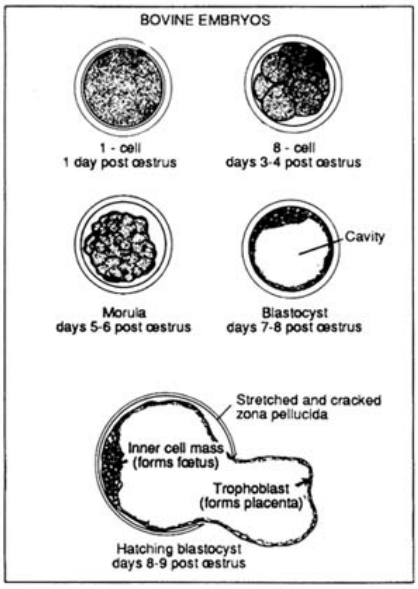


The image to the left is of an equine conceptus at approximately 9 months of gestation, dissected away from the uterus. On the left is shown the unopened chorioallantoic surface which serves as the placenta. In the image on the right, both the chorioallantois and allantoamnion have been opened to expose the foetus. Note the rich vascularity of the allantoamnion, which is typical of equine pregnancies. Note that there are no cotyledons (buttons) on the placenta.

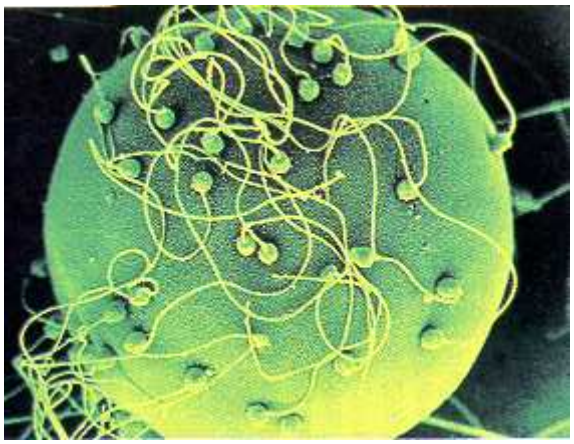


What does this graph show us about the development of a cattle foetus? _____

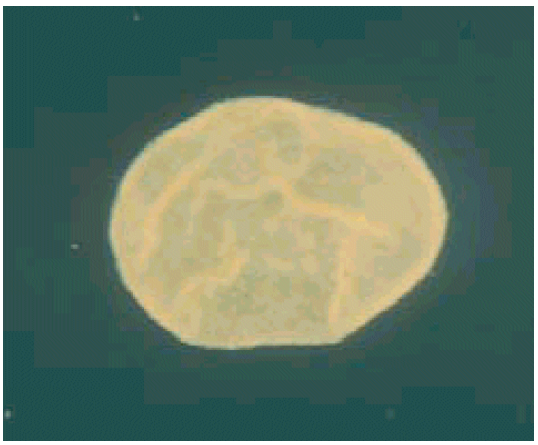
Early development of an animal foetus (in this case cattle) is similar to what happens in humans at first.
Over the next few pages there are several different lots of images showing embryo development in cattle.



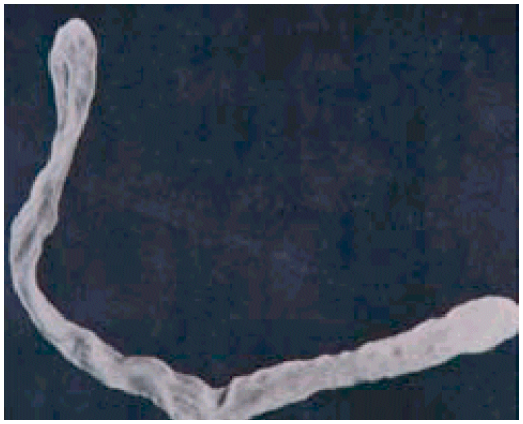
Fertilisation occurs in the fallopian tubes.



At day 2 the embryo is at the 2-cell stage, is enclosed in the zona pellucida and is approximately 170µm in diameter

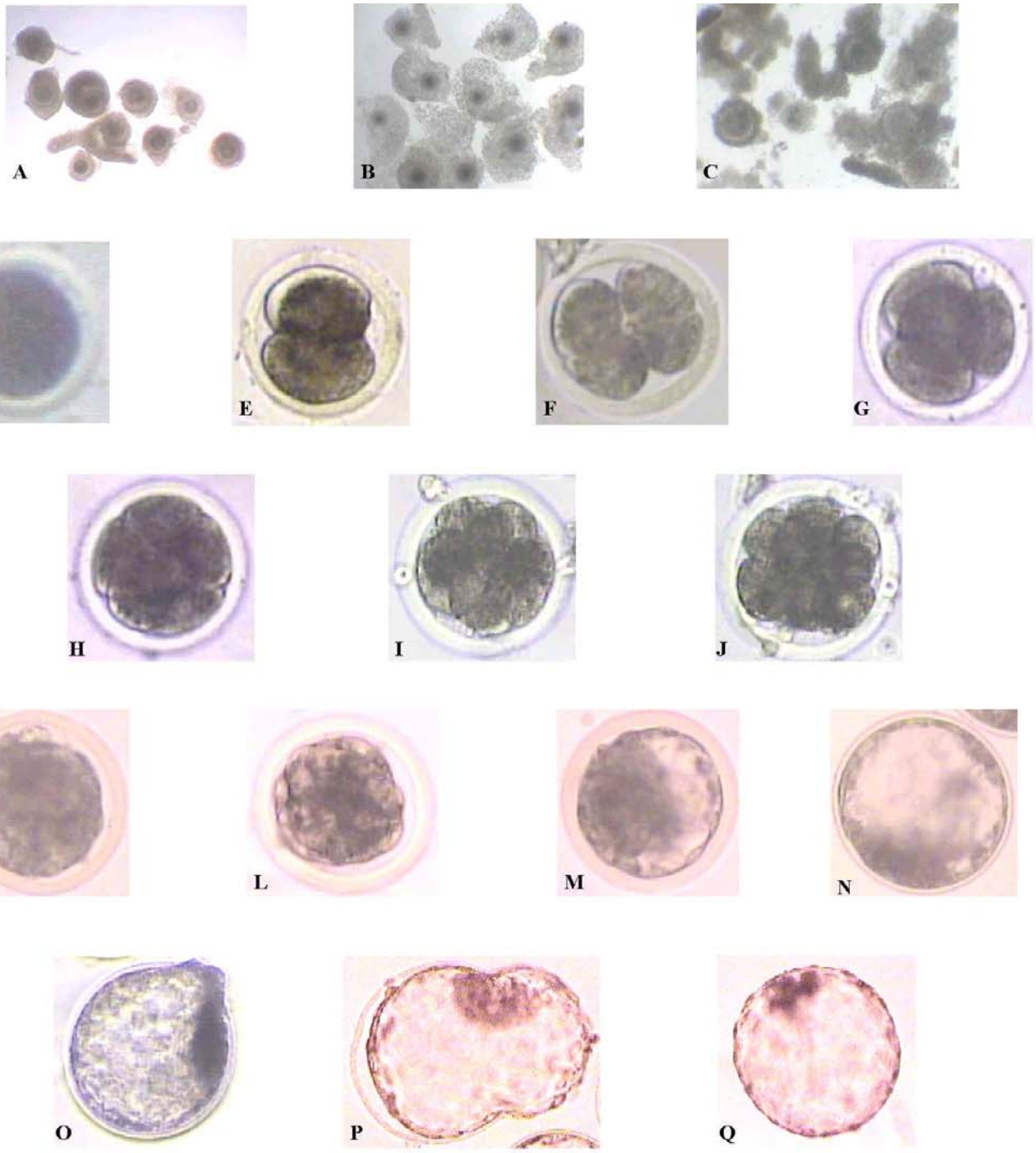


At day 13 the embryo has hatched from the zona pellucida and is approximately 5 mm in length



At day 16 the embryo has elongated and is now approximately 50 mm in length

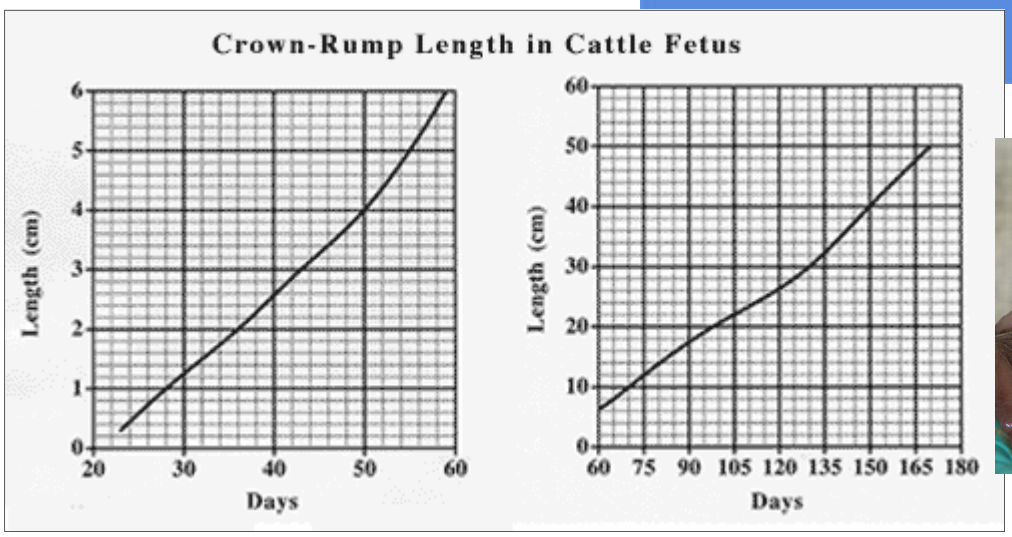
Embryo development in cattle.



A. Immature oocytes (d -1)
B. Matured oocytes (d -0)
C. Fertilized oocytes (d 0)
D. 1-cell embryo (d 0-1)
E. 2-cell embryo (d 1)
F. Cleaving 2-cell embryo (d 1-2)
G. 4-cell (d 2)
H. 8-cell embryo (d 2-3)
I. 8-16 cell embryo (d 3)
J. >16 cell embryo (d 3-4)
K. Compact morula (d 4-6)
L. Compact morula-early blastocyst (d 5-7)
M. Blastocyst (d 6-8)
N. Expanded blastocyst (d 7-9)
O. Hatching blastocyst (d 8-9)
P. Hatching blastocyst (d 8-9)
Q. Hatched blastocyst (d 8-9)

You can calculate the approximate age of a foetus by measuring the crown-rump length.
Measure the foetus to the right and using the tables below work out the approximate age. Assume that the foetus is life sized.

Approx length: _____
Approx age: _____



To estimate the age of an aborted bovine (cow) foetus use the following sizes as a guide:

- 2 months mouse
- 3 months rat
- 4 months small cat
- 5 months large cat
- 6 months beagle dog

Ultrasound scan of a bovine foetus:


25 Day Pregnancy


30 Day Pregnancy


35 Day Pregnancy


43 Day Pregnancy


50 Day Pregnancy


100 Day Pregnancy

Gestation periods:

Cattle: usual length of oestrus is 14 to 15 hours, cycle is 21 days long, gestation is 282 days (365 days in a year)

Goats: oestrus cycle in does occurs at 15 - 24 day intervals but only during their breeding season. The on heat stage can range from 8 hours to 60 hours. Gestation is 150 days

Ewes have a 17 day cycle. The gestation is 149 days. To calculate the estimated lambing date, count forward 5 months. 24-36 hours on heat

What are the typical "family" sizes of farm animals?

Generally one (1):

A horse (mare) has one foal.
A cow (cow) has one calf.
A pony (mare) has one foal.
A donkey (mare) has one foal.

Sometimes two (2):

A sheep (ewe) has one or two lambs.
A goat (doe) has one or two (sometimes three) kids.

A whole litter:

A pig (sow) can have 7 to 14 piglets in a litter.
A rabbit (doe) can have 7 to 10 bunnies in a litter.

From a clutch of eggs:

A chicken (hen) can hatch from 15 to 18 baby chicks from the eggs she incubates.
A turkey (hen) can hatch 12 to 15 poults from the eggs she incubates.
A geese (goose) can hatch 12 to 15 goslings from the eggs she incubates.
A duck (hen) can hatch 12 to 15 ducklings from the eggs she incubates.

Horse	11 months
Cow	9 months
Sheep	5 months
Pig	4 months
Dog	63 days
Goat	5 months
Donkey	12 months
Rabbit	1 month
Chicken	21 days
Turkey	26 days
Duck	30 days
Goose	30 days

Approximate gestation periods for "common" animals found on a farm

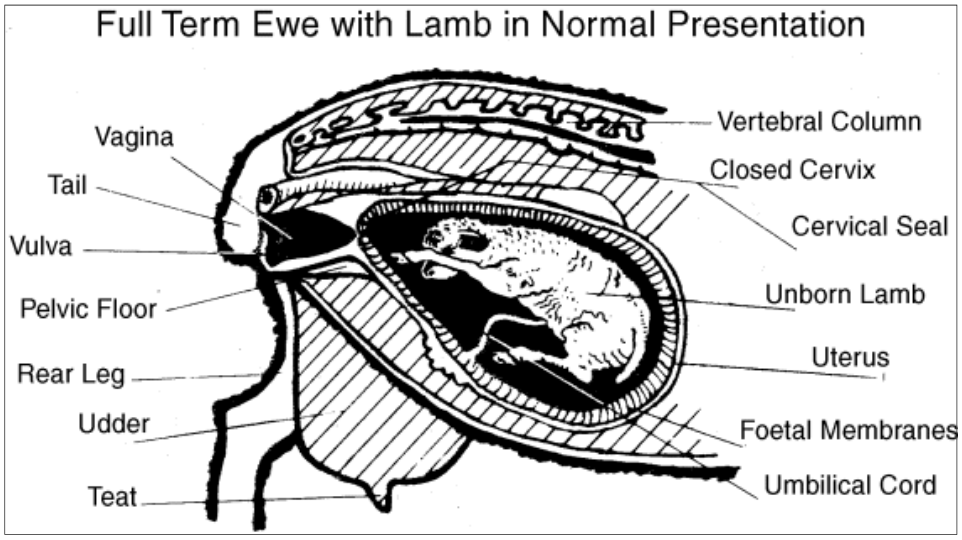
How do we know an animal is pregnant?

For cattle, the easiest way is to do a rectal palpitation and feel for the foetus. Cows can be manually pregnancy tested anytime from six weeks after bull removal. Doing pregnancy testing at this stage, instead of waiting until fifteen weeks or so, will allow early identification of late calvers and empties. There may be a low level of foetal loss after this stage but, on the whole, those diagnosed as pregnant should remain so and produce a calf come spring! Decisions to keep or cull late calvers, who may benefit from being re-checked at a later date, can also be made. With late calvers the decision to induce may also be an option.

With sheep farming one of the major limitations to progress has been the inability to know how many lambs each ewe is carrying in the advance of lambing. The use of ultrasound is becoming more common. The skilled operator will be able to tell by about 30 days after mating whether or not the ewe is pregnant.

Ultrasound can also be used with cattle.

The following diagrams are to do with birth of lambs.



Physiology of Parturition (Lambing)

The mechanism by which any mammal gives birth is stimulated by changes to the dams hormone balance and the bulk of the uterine contents (the fetus and the placental fluids). These stimuli cause the uterus to contract, pushing the fetus into the dilating cervix and expel it.

Lambing

In a normal lambing, there are three distinct stages:

1. Dilation of the cervix

As the uterine contractions start, a thick creamy white mucous, the remains of the cervical seal, is passed from the vulva. This is often missed. Continued contractions of the uterus push the first waterbag into the cervix, stimulating its dilation. Eventually the cervix will be about the same diameter as the neck of the uterus.
At this time the ewe is uneasy, getting up and down, switching her tail and bleating frequently. There may be some straining. This stage can take 3 - 4 hours.

2. Expulsion of the lamb

As the uterine contractions become stronger and more frequent, the lamb and waterbags are pushed into the dilated cervix. The first waterbag bursts, releasing a watery fluid through the vulva. As the ewe continues to strain, the second waterbag is pushed through the vulva and ruptures, to release a thicker fluid.
The rupturing of these bags has established a smooth, well-lubricated passage through the vagina. The hooves and nose of the lamb can often be seen in the second waterbag before it bursts.
The ewe continues to strain, gradually expelling the lamb, forefeet first, followed by the head. There may be considerable effort to pass the head and shoulders of the lamb through her pelvis. Once this happened, final delivery is rapid.
The birth of a single lamb should take an hour or less from the rupture of the first waterbag. A ewe, lambing for the first time, or with a multiple birth could take longer.

3. Expulsion of the afterbirth

The placenta serves no further function once the lamb has been born, and is passed 2 to 3 hours after delivery has finished. Nothing will be passed until after the first lamb has been born. In multiple births, there will be separate afterbirths for each lamb.

Signs of Abnormal Deliveries

Most ewes will lamb unaided and about 95% of lambs are born in the normal presentation, forefeet first. A normal delivery usually takes 5 hours from the start of cervical dilation to the delivery of the lamb, 4 hours for the dilation of the cervix and 1 hour for the actual delivery. The first 4 hours often go unnoticed.
If the ewe:
continues to strain, but there is no sign of the waterbags, or
continues to strain an hour after the rupture of the waterbags but there is no sign of a lamb, or
if the lamb appears to be wedged in the birth canal, or
if there is an abnormal presentation, a leg back, head back etc., assistance may be needed. Any delay in assistance could mean the difference between a live and dead lamb.|

Making the Internal Examination

Cleanliness is important to prevent infection of the uterus. Wash the area round the ewe's vulva with soap and a mild disinfectant to remove any manure and other debris. Scrub hands and arms with soap and a mild disinfectant, and lubricate with soap or an obstetrical cream. The hand is carefully slid into the vagina to feel the lamb and assess the situation. Obviously a person with a small hand is best suited for this task.
In many cases the lamb will be presented normally, you will feel two forelegs with the head between them.
In others there will be a malpresentation:

- one or both forelegs back, or
- head back, or
- hindlegs instead of fore legs, or
- one or both hindlegs back, or
- a breach presentation, only the tail and rump felt.

Resolutions

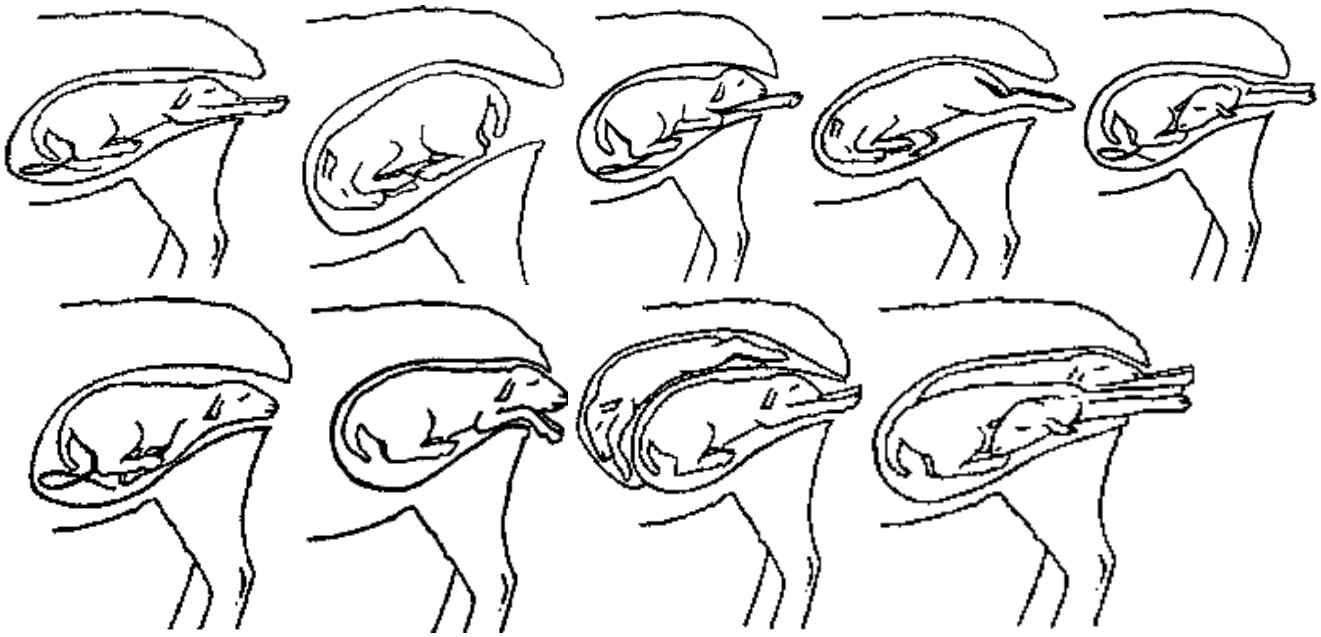
Normal Presentation

Place the noose of a lambing cord over each leg above the fetlock joint and apply a firm steady pull synchronized with the ewe's straining. Lubricate the vagina around the lamb with obstetrical jelly to smooth the passage of the lamb. This is especially important if the waterbags have been ruptured for some time and the vagina has lost this natural lubrication.
Abnormal presentations must be corrected before attempting to pull the lamb. Do not attempt to convert a hind leg presentation to the normal delivery. Pull the lamb out hind legs first, straight back until the lamb's hind legs and pelvis are out of the vulva, then change the pull to downwards towards the ground behind the ewe. Pulling down before the lamb's pelvis is out will wedge the lamb in the pelvic canal of the ewe. Other malpresentations are possible.
Remember that multiple births are common. Two lambs may be presented with legs intertwined. Always ensure that the legs and head are part of the same lamb before attempting to pull it.
Occasionally, deformed lambs will be produced with enlarged heads, stiff joints or skeletal deformities. To successfully lamb, a ewe in these situations may require help from an experienced shepherd or veterinarian.
As ewes often have multiple births, the same sequence of the rupture of the waterbag and expulsion of the lamb will be repeated for the delivery of each lamb. After an assisted lambing always check the ewe internally that there is not another lamb to be delivered.

Aftercare

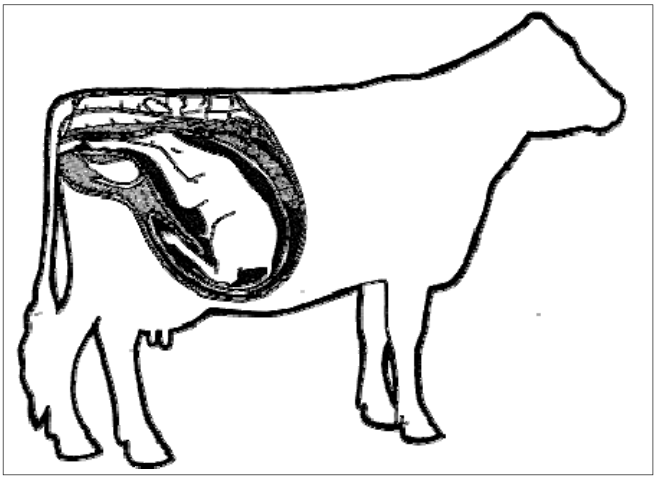
In all cases, whether the delivery was natural or assisted, check that the lamb is breathing; its nostrils are clear of mucous and are not covered by any

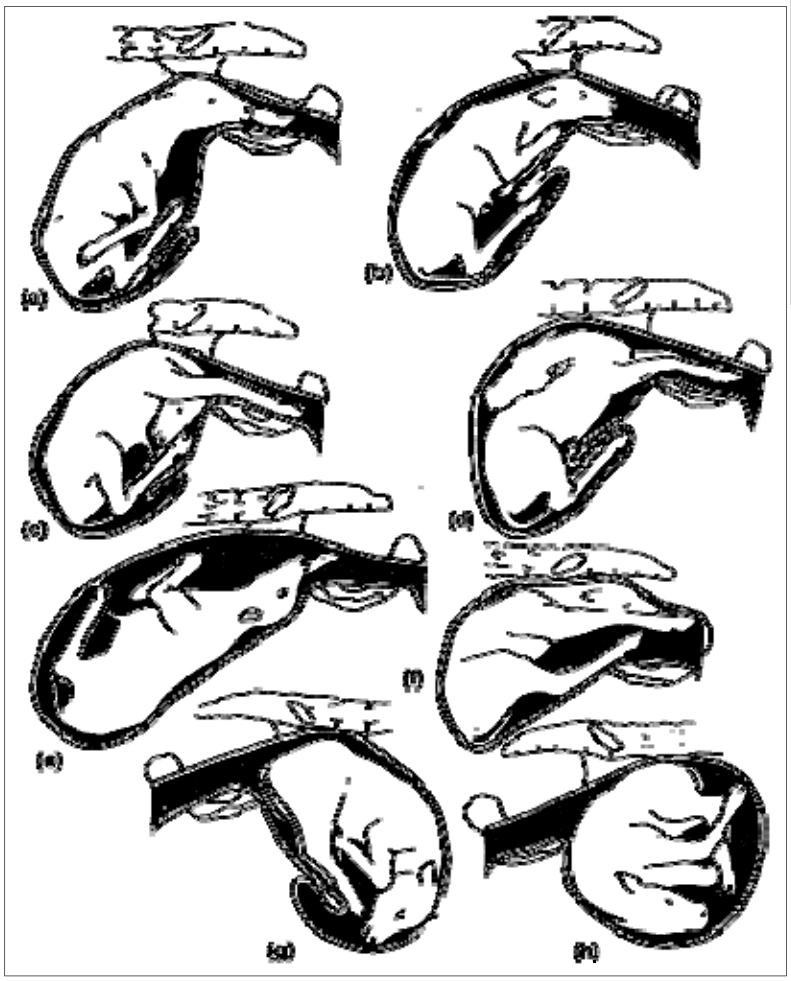
uterine membrane. At this time the lamb's navel should be disinfected to prevent infection.
The ewe usually starts to lick the lamb; this is a natural process and should be allowed to continue. Some ewes will eat the afterbirth, but this should be prevented as it can lead to digestive disturbance.
A healthy lamb struggles to its feet soon after birth and starts to nurse its dam. Lambs, weak from a protracted delivery should be helped to nurse, or given up to 250 ml of colostrum by stomach tube. This first nursing is critical as the colostrum contains antibodies to give the lamb immediate protection against infectious agents common to the flock. All lambs should nurse or be tube fed colostrum within 6 - 8 hours of birth. In the first 24 hours of life, each lamb should receive about one litre of colostrum. After 36 hours the lamb is unable to absorb any more antibody from the colostrum.
After any assisted delivery the ewe should be given an antibiotic injection and have an antibiotic oblet put into the uterus.



The following diagrams are to do with the birth of calves:

Normal presentation of a calf ready for birth: to the right hand side.
The diagrams below are abnormal presentations:



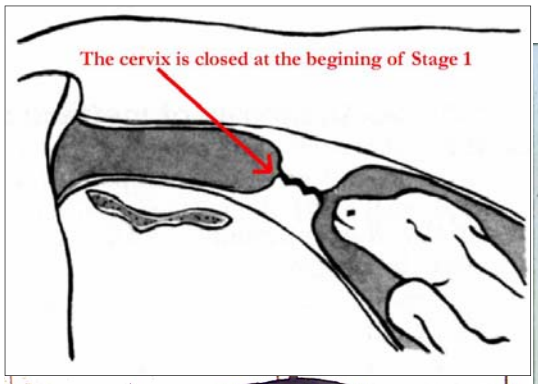


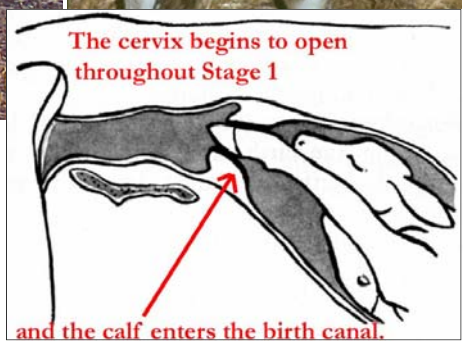
Normal Calving

Calving is a continuous event but for explanation it is divided into 3 stages.

Stage 1:

This stage, lasting 2-6 hours (can be a couple of hours longer in heifers), begins with initial labour and ends when the cervix is fully dilated and the calf has entered the birth canal. The end of stage 1 is marked by the observation of the water sac. The cow may show signs of discomfort by kicking at her belly, and becoming restless due to contractions. She may separate herself from the rest of the cows and urinate frequently. These signs are especially evident in heifers.





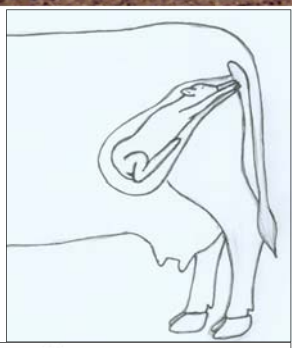
Stage 2:

In this stage, that lasts 1-2 hours for cows and 2-4 hours for heifers, the cervix is fully dilated, the cow may lie down, contractions will increase and abdominal pushing is obvious. This stage ends with delivery of the calf

The calf must enter the birth canal in a certain position in order to have a normal delivery.

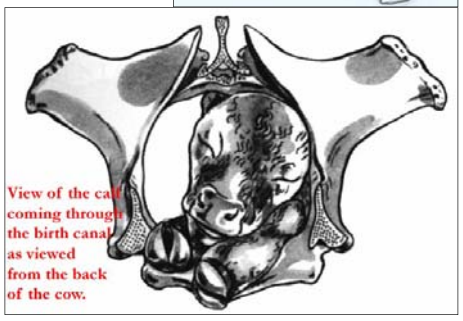
The terms presentation, position, and posture are used to describe how the calf is positioned in the birth canal. It is important that everyone on your operation dealing with calving have a basic understanding of these terms in order to communicate with each other and with your veterinarian in cases of difficult labour (dystocia).

Presentation refers to whether the calf is coming forward (anterior) with both front legs and head extended into the birth canal, backwards (posterior) with both hind legs extended into the birth canal (soles of the hooves up and toes pointed down), or transverse with either all four legs in the birth canal or the back of the calf entering the birth canal. Both forward and backward presentations are considered normal with forward being the most common. Keep in mind that a backward presented calf is a high risk calving because the umbilical cord is pinched off before the calf's head is delivered. A transverse presentation is never normal.



Position refers to how the calf is positioned in relation to the cow. If the calf's back is up towards the cows back (spine) it is considered right-side up (dorsal). This is the only position that is considered normal. If the calf's back is down on the bottom of the pelvis it is upside down (ventral). The calf may also be on either of it's sides; right-side down or left-side down

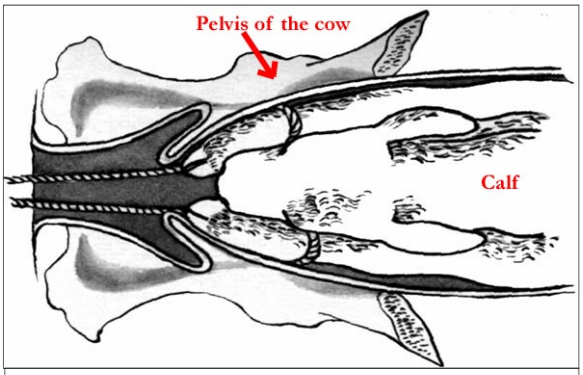
Posture refers to where the calf's limbs and head are in relation to it's body. The limbs and head should be extended into the birth canal. If the head or one or both of the limbs is retained the calf is considered malpositioned and needs to be adjusted prior to delivery



The most common delivery is when the calf is in a frontward presentation, a right-side up position, and with both front limbs and head extended into the birth canal.

You will observe that the cow will have strong abdominal presses while delivering the head and chest of the calf, after which she will usually take a short break (5-10 minutes or less). During this time the umbilical cord is being pinched off and you should notice the calf begin to breathe on it's own. After the short break, the hind limbs should be delivered uneventfully.

The water sac that is surrounding the calf's head should break during delivery of the head. If it does not break the calf could suffocate

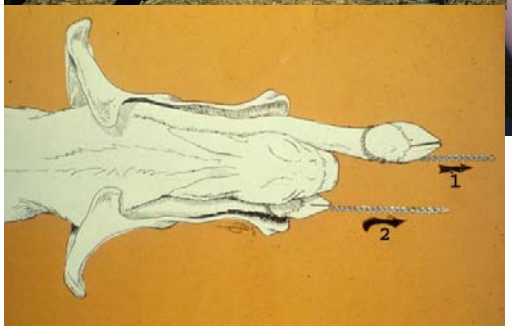


The picture above is looking down onto the calf as if you are above the cow

Stage 3:

After the birth of the calf, the placenta should be delivered within 6 hours

If there are problems you may have to assist.



Determining if the Cow/Heifer Needs Your Help:

Four decisions dramatically affect the outcome of delivery.
They are:

1 *Frequency of observation*. Recommended frequency of observation is every 1-2 hours. The ability to perform this is based on staffing at your dairy. Once a cow/heifer in stage 2 of labour the frequency of observation should increase to every 30 minutes. It is important to see if the dam is making progress in that time or not.

2 Knowing when to intervene. To make decisions about when to intervene it is important to know the normal range of time it takes for each stage of labour. All personnel should know the guidelines for intervention and understand why those guidelines are in place.

The guidelines below are based on the stage of labour.

Stage 1 - Usually lasts 2-6 hours. If you do not notice any progression to stage 2 after 4 hours the cow/heifer should be examined to determine if there is a problem. Low blood calcium (milk fever), uterine torsion, or a calf in breech presentation can prevent the cow from going into Stage 2 of labour.

Stage 2 - Intervention is needed if any of the following occur:

- If the water sac has been visible for 2 hours and you have not seen any progression (the cow is not trying).
- If the cow has been trying for over 30 minutes and making no progress.
- If the cow has quit trying for more than a 15-20 minute period of time after a period of progress. Rest periods normally should not last longer that 5-10 minutes.
- If the cow or calf is showing signs of stress or fatigue -- like a swollen tongue in the calf, yellow staining (meconium) of the foetus, or severe bleeding from the rectum of the cow.
- If you suspect that the calf is in an abnormal presentation, position, or posture.

Stage 3 - If the foetal membranes have not been passed within 12 hours after calving, intervention may be necessary. If they are retained, treatment may be indicated. In no instance should the membranes be manually removed. This may be detrimental to the cow's future reproductive performance.

It may be beneficial to cut the membranes close to the vulva in order to decrease the opportunity for contaminants (dirt, bacteria) to obtain entrance into the reproductive tract of the cow.

Be sure to consult with your veterinarian about proper treatment of retained foetal membranes in your dairy cows.

It is important to realize that early intervention provides the greatest benefit for calf survivability and future reproductive performance of the cow.

3 Determine if the calf can be delivered by forced extraction (pulling).Once you have decided to intervene you should palpate the calf and the birth canal: 1) to determine if the calf is alive or not and 2) to see if it can be delivered through the birth canal of the cow.

- If the birth canal is abnormal it is time to call for professional help.
- If the cervix is not fully dilated the cow should be given more time for dilation or checked for other signs of milk fever.

- If the calf's head is too large to fit through the birth canal forced extraction should not be performed.
- Studies have shown that calves delivered by c-section after forced extraction has failed have a decreased chance of survival compared to calves delivered by c-section alone. Therefore the decision to perform a c-section should be made a early as possible and the decision to pull the calf should be based on a realistic assessment of the likelihood of success.
- If the decision is made to pull the calf, you should know when to keep pulling and when to quit.
- Be sure to always correct any malpositions prior to forced extraction.
- For a forwards (anterior) presented calf, the head and shoulders must be able to pass the pelvic canal or the calf cannot be delivered. The shoulders of the calf are through the pelvis of the cow when the knees (carpi) of the calf are at the vulva. If you cannot get both knees to the vulva, the calf cannot be pulled without damage to the calf or cow.
- For a backwards (posterior) calf, if the hocks are one hand width beyond (outside) the vulva, the hips should be through the birth canal and you should be able to deliver the calf.

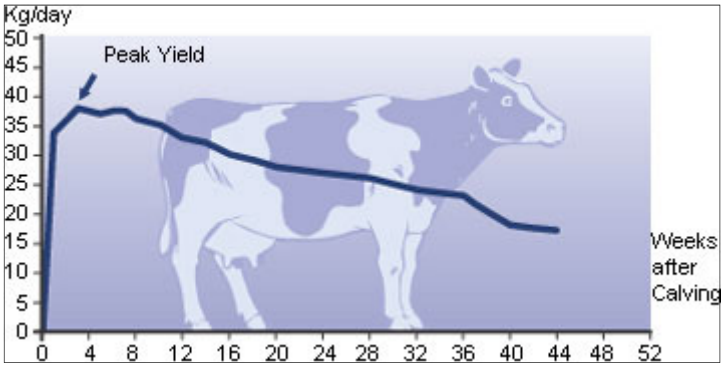
4 When to call for professional assistance. Professional assistance may not always mean a veterinarian, it may just be someone with more experience then yourself. Call for assistance if:

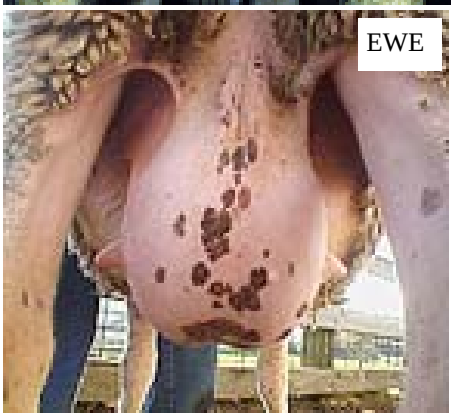
- You cannot assess the problem.
- You know what you are dealing with but you do not know how to correct it.
- You have been trying to correct the problem for 30 minutes and have not made any progress

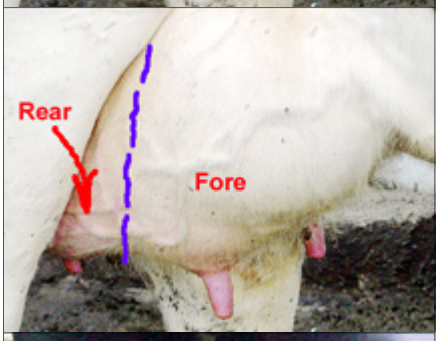
Lactation

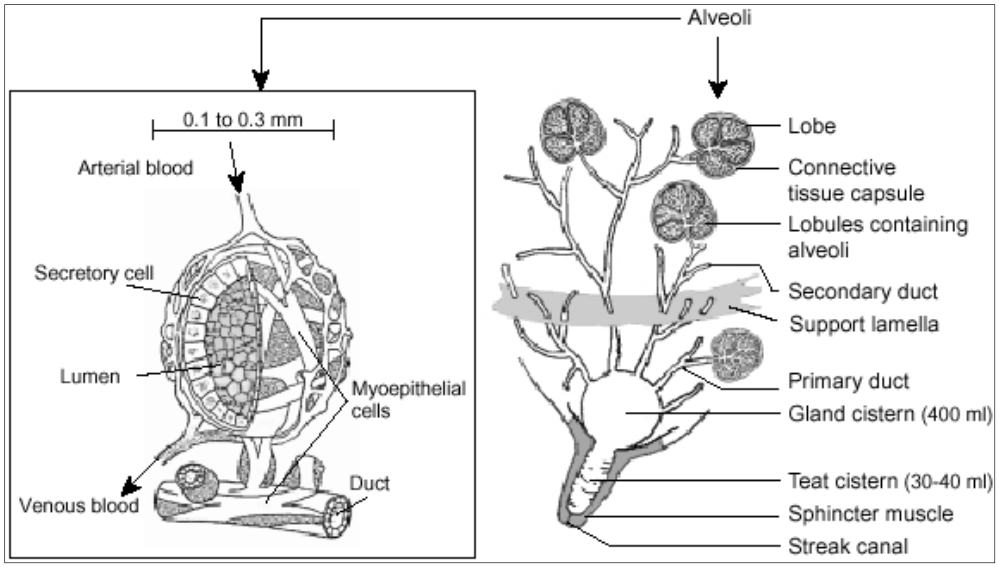
Lactation is the production of milk by an animal that has just given birth.

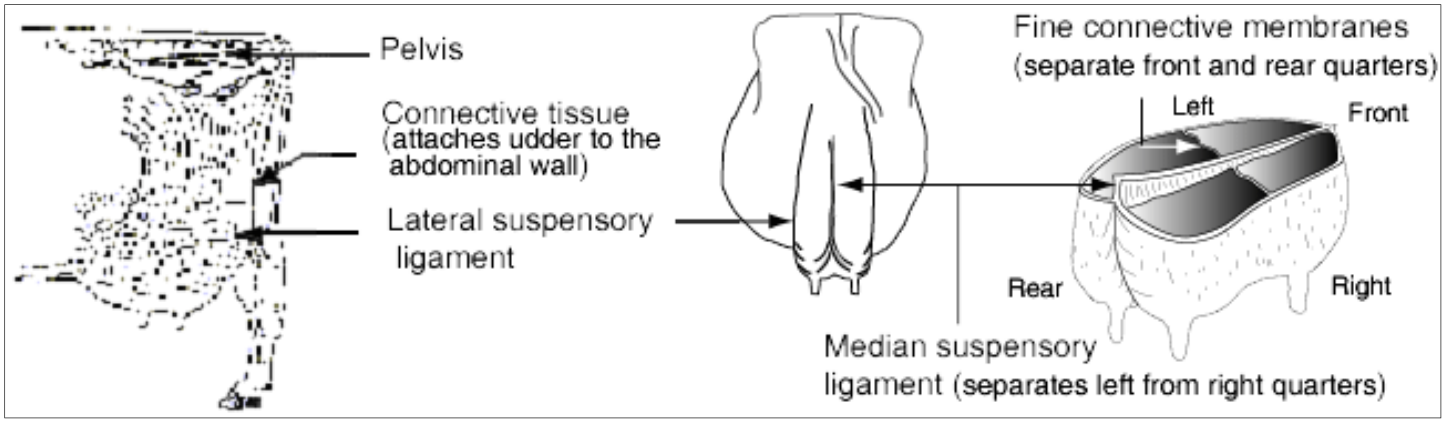
For most animals the milk they produce is for their offspring. With dairy cows the milk they produce is also for humans to use. There are several ways that we can use cow milk: fresh milk, milk powder, yoghurt, cheese, cream, butter etc.











The udder of a cow is an organ designed to produce and offer a newborn calf easy access to its mother's milk. It is suspended outside the wall of the rear abdomen and thus it is not restrained, supported, or protected by any skeletal structures.

The udder of a cow is made up of four mammary glands or "quarters." Each quarter is a functioning entity of its own which operates independently and delivers the milk through its own teat. Generally, the rear quarters are slightly more developed and produce more milk (60%) than the front quarters (40%). The major components of the udder are listed here with a short explanation of their importance and function.

Support system. A set of ligaments and connective tissue maintain the udder close to the body wall. Strong ligaments are desirable because they help to prevent the occurrence of pendulous udder, minimize the risk of injuries, and avoid difficulties when using milking equipment.

Secretory and duct system. The udder is known as an exocrine gland because milk is synthesized in specialized cells grouped in alveoli, and then is excreted outside the body through a duct system that functions like the tributaries of a river.

Blood supply and capillary structures. Milk production demands a lot of nutrients that are brought to the udder by the blood. To produce 1 kg of milk, 400 to 500 kg of blood must pass through the udder. In addition, the blood carries hormones that control udder development, milk synthesis, and the regeneration of the secretory cells between lactations (during the dry period).

Lymph system. Lymph is a clear fluid that comes from tissues highly irrigated by blood. The lymph helps to balance the fluid flowing in and out of the udder and helps to combat infections. Sometimes the increased blood flow at the onset of lactation leads to an accumulation of fluid in the udder until the lymph system is able to remove the extra fluid. This condition, referred to as udder edema, is more prevalent in first-calf heifers and older cows with pendulous udders.

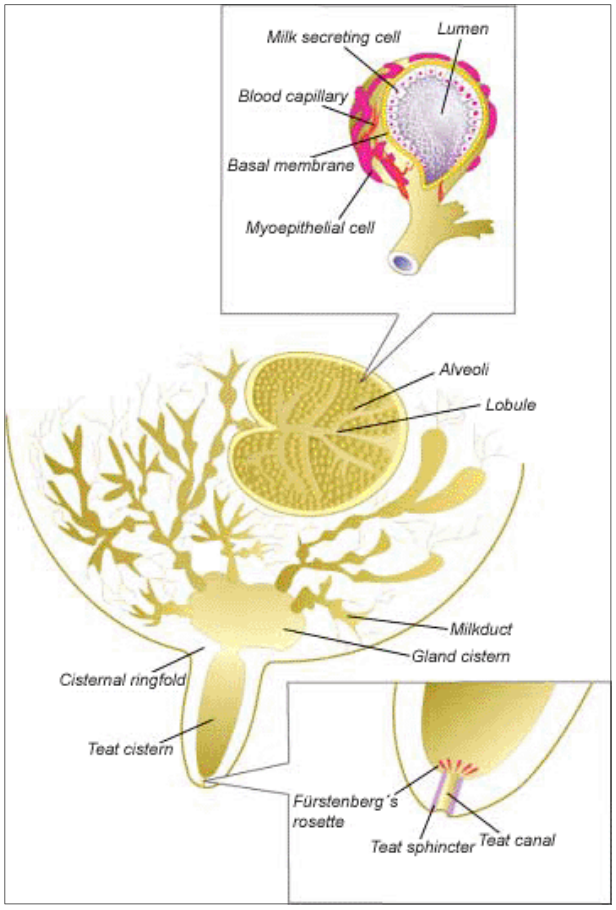
Innervation of the udder. Nerve receptors on the surface of the udder are sensitive to touch and temperature. During the preparation of the udder for milking, these nerves are triggered and initiate the "milk let down" reflex that allows the release of milk. Hormones and the nervous system are also involved in the regulation of blood flow to the udder. For example, when a cow is startled or feels physical pain, the concerted action of adrenaline and the nervous system decreases blood flow to the udder, inhibits the "milk let down" reflex and lowers milk production

Duct and milk secretory systems

The alveolus is a functional unit of production in which a single layer of milk secretory cells are grouped in a sphere with a hollow center (Figure 2). Capillary blood vessels and myoepithelial cells (muscle-like cells) surround the alveolus, and the secreted milk is found in the internal cavity (lumen). The functions of the alveolus are:

- To remove nutrients from the blood
- To transform these nutrients into milk
- To discharge the milk into the lumen

The milk leaves the lumen through a collecting duct. A lobule is a group of 10 to 100 alveoli drained by a common duct. Lobules are themselves organized into a larger units called lobes. The lobes discharge the milk into larger collection ducts that lead to the gland cistern, which lies directly above the teat of the gland.



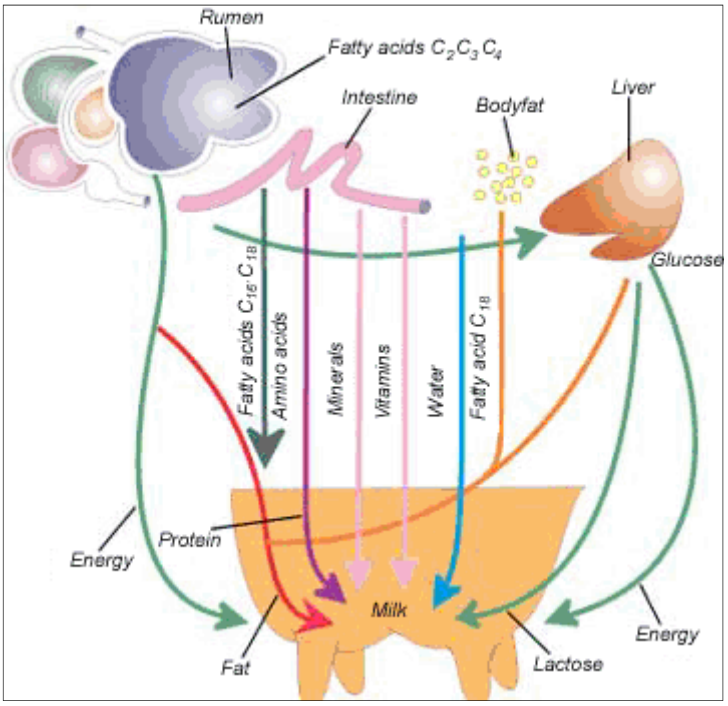
The udder is thus composed of billions of alveoli where milk is secreted. The ducts form channels of drainage in which milk accumulates between milking. However, it is only when the myoepithelial cells that line the alveoli and the smaller ducts contract in response to the hormone ***oxytocin*** (milk let-down reflex) that milk flows into the galactophores and the gland cistern.

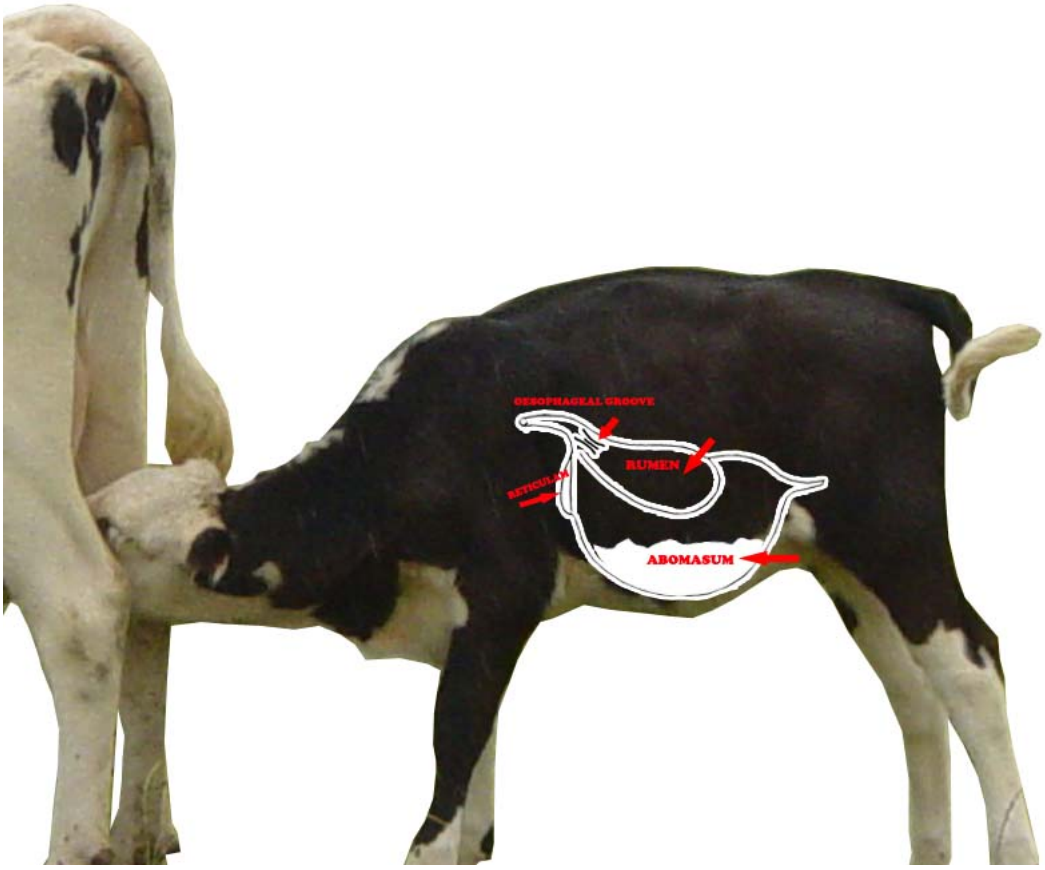
The teat forms a passageway through which the milk can be withdraw from the gland. It has a smooth skin covering and a rich blood and nerve supply. The teat tip closes with a smooth muscle ring or sphincter called the "streak canal." At its upper end, the teat is separated from the gland cistern by only a series of delicate folds of sensitive cells particularly vulnerable to damage. These folds of tissue are also found at the other extremity of the teat directly above the streak canal (rosette of Furstenburg). The teat is thus designed as a effective barrier to invading bacteria. Preservation of the normal teat structure is essential to the maintenance of the natural defence mechanism against mastitis-causing bacteria. Differences in teat structures, particularly the diameter and the length, are related to susceptibility to infection.

The diagram to the right shows the chemicals that are used by the animals to make up their milk. Every species of animal has a slightly different mix to their milk.

Hygiene is very important in the dairy shed. Correct use of equipment reduces the chances of infection, especially Mastitis.
Mastitis is a common infection found in dairy cows (and also in other lactating animals)

When calves are only on a milk diet, they don't ferment the milk. The milk by-passes the rumen, reticulum and omasum via the oesophageal groove and goes directly into the abomasum





health practices

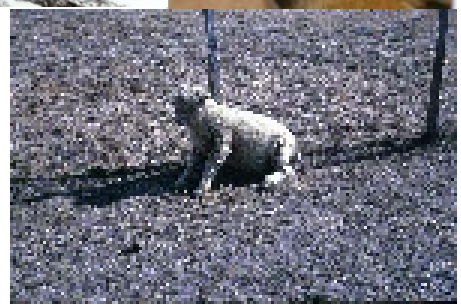
Disease can be defined as any impairment of the structure or function of any body, organ or tissue. There is an area before "true" sickness where there is a loss of production, and thus a loss in finances.

Types of diseases can be classified according to the following:

- Traumatic: physical damage to the animal, usually an injury.
- Toxic: poisons e.g. lead, copper, ragwort
- Deficiency: lacking an essential element e.g. calcium, magnesium
- Metabolic: disturbances to the bodies chemistry e.g. milk fever
- Functional: where an organ fails to function due to some abnormality, e.g. sterility due to a blockage of the fallopian tube or vas deferens
- Allergic: e.g. hay fever
- Parasitic: bacteria, viruses and lungworms are all parasites (as is a foetus) as they live off the animal but usually don't kill it.
- Infectious: due to infectious micro-organisms (bacteria, fungi, viruses and protozoa). Infection can be caused by: inhalation (pneumonia), wound infection (tetanus), contact (ringworm), swallowing (salmonellosis) or by penetration of the skin (leptospirosis)

Ill health in animals can be attributed to:

- Nutritional deficiencies
- Parasites
- Injuries
- Stress
- Poisoning
- Hunger/starvation
- Etc



Any infectious disease has 3 components:

1. The disease causing organism/s
2. The environment
3. The animal itself

There are always infectious diseases around animals, this doesn't mean that they will always get sick or even catch a particular disease in their lifetime.

Some common diseases/illnesses and their causes in animals are:

- Ringworm: caused by a fungus.
- Footrot: _____
- Pneumonia: _____
- Bloat: caused by spring pasture high in clover
- Johnes' disease: _____
- Facial eczema: caused by a fungus
- Retained placenta: _____
- Prolapse of the uterus or vagina: _____
- Brucellosis: _____
- Milk fever: _____
- Grass staggers (hypomagnesaemia): _____
- Leptospirosis: _____
- Mastitis: _____
- External parasites: e.g. maggots, lice, fleas
- Internal parasites: e.g. tape worms, liver fluke
- Poisioning: lead, urea, cyanide, tutu, ryegrass staggers

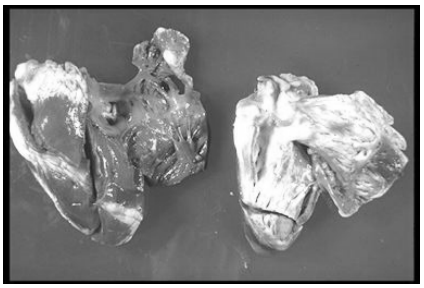
The infectious micro-organism/s:

Read chapter 11, pg 189->

1. What are the main types of diseases?

2. write definitions for each type of disease:

3. write notes about the primary and secondary causes of disease.



The ability of the micro-organism to cause illness/disease/sickness in animals depends upon the following:

The power of the organism to produce a disease, how dangerous it is. How virulent it is. Some diseases are so dangerous that they will always kill an animal if it is not treated in time. E.g. Rabies. But the diseases can't harm the host if they have immunity e.g. have been vaccinated against a specific strain of the disease.

The numbers of the organism present. For diseases to be a problem to the host they usually need to be in sufficient numbers. But you need to remember that the organism can reproduce and end up with sufficient numbers to cause illness. E.g. food poisoning, usually only a small amount is needed, the rest are produced in the host, thus gaining them the numbers that they need. Infected sore: usually only the immediate area is infected and is soon under the control of the hosts immune system.

Route of infection: most organisms have a preferred route of entry into the host. E.g. standing on some pneumonia viruses is not going to be a problem, but inhaling them could be.

Resistance of host: the more resistant the host, the harder it is for the micro-organism to become established in the host, no establishment, no illness.

Bacteria cause infections by 2 means:

Cell destruction: release enzymes that destroy the cell membrane

Toxin production: exotoxins (toxins that are released outside the bacterial cell wall) are produced by bacteria and secreted into the surrounding tissues. There are many different types of toxins: neurotoxins (nerve

poisons) e.g. tetanus; haemolysins (cause red blood cells to split) e.g. leptospirosis and leucotoxins (kill white blood cells) e.g. staphylococcal mastitis.

The environment:

Pasture: heavily fertilised and rapidly growing spring pasture can be deficient in some nutrients e.g. magnesium, this lack of nutrients can cause nutrient deficiency diseases in some animals e.g. grass staggers. In Nelson and Marlborough there is also a known deficiency problem with selenium, a lack of Se causes white muscle disease. Pasture with a high percentage of clover (high nitrogen and protein plant) are at greater risk of bloat.

Housing: this is particularly a problem with animals such as pigs, chickens and calves if they are housed inside a building. Adequate ventilation is vital as is cleanliness. Lack of ventilation leads to the easy spread of air-born diseases, especially if there is also a high humidity content in the air.

Temperature and humidity: the weather can be a factor in the spread of diseases. One disease which is closely linked to temperature and humidity is facial eczema. There is a reliable form of forecasting for facial eczema.

Other animals: especially when in close proximity can help spread diseases around. The best example of this is worms: when too many animals are placed onto the same paddock (pasture) they place a greater worm burden on the pasture and more animals are likely to ingest them and become infected. Another example is viral pneumonia, this is easily passed from one animal to another when they are in close proximity and breathing the “same air”.

The animal:

Some animals are more resistant to diseases than others. When this is recognised, the farmer should consider breeding these animals in their flock or herd. This is considered to be individual resistance.

Some diseases can’t cross from one species to another e.g. canine distemper can’t go from dogs to cattle. BUT some diseases do cross the species barrier e.g. leptospirosis can be passed from cattle to humans.

Animals can develop immunity to some diseases, especially if the micro-organism is less likely to mutate and form into a new version of the disease. The body’s defences will cause it to reject invasion from foreign particles e.g. bacteria, viruses.

Specific Diseases:

RINGWORM:

Caused by a fungal infection of the skin. Cross infection of species is common, take care when treating as it will go from animals to humans.

The ringworm fungi initially makes its attack on the outer dead layer of skin. The “ring” pattern is caused by the dead fungi in the centre and the growing fungi around the edges.

Prevention: rarely a large problem except where calves are housed indoors. Disinfection of the calf pens on a regular basis (virkon). Separation of sick animals from healthy ones. A good diet to keep the animals healthy and more resistant.

Treatment: use of a fungicide from the vet (or doctor if a human has been infected)

FOOT ROT:

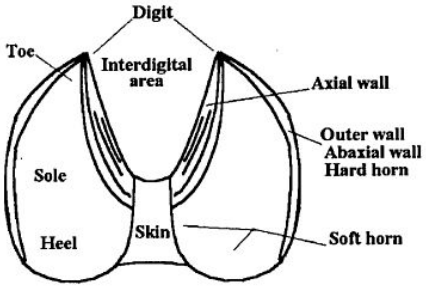
This is very common in both sheep, goats and cattle. In a minor case it can cause lameness. In major cases the animal can be incapable of walking.

It is a specific disease of the feet of sheep, goats, cattle, deer and other ruminants. It is

characterised by a progressive rotting of the layers in the hoof. The horn part of the hoof can become separated from the soft tissues of the foot.

The earliest sign of footrot is swelling and moisture of the skin of the interdigital cleft. A break occurs at the skin horn junction and from here the infection spreads under the horn tissue so that the hoof is only attached at the coronet.

When the lameness is severe, the animal may carry the leg, and if more than one foot is affected it may walk on its knees. Usually both claws are affected.



There is a characteristic foul-smelling discharge, small amounts usually. The detached horn can be lifted up and pared off in large pieces.

Loss of condition soon follows, and often the condition is complicated by the addition of blow-fly strike.

Foot rot is an important disease in NZ and Australia (especially the sheep industry).

Treatment: control of the organism (a bacteria) by killing it using disinfectant (footbaths). If every foot of every sheep is cleared of the foot rot, then foot rot can be eradicated from a farm. Infected feet should be pared back to expose non-infected tissue and allow penetration of the disinfectant. Walk all the sheep through the foot bath. If possible, separate infected sheep from non-infected and place on "clean" paddocks. A week later repeat the foot bath treatment. If an infected sheep is now not infected, it can be moved to the non-infected mob. After another week the sheep are passed through the foot bath again. If some of the infected sheep are still showing signs they could be culled (depending on the programme and numbers on the farm). This continues for 6 weeks. By now all infected animals should be well, or culled. If new cases appear the cycle begins again from the beginning. *Infections are caused by infected animals, not infected paddocks.*

With cattle foot rot it is more common in dairy cows. It is similar to that of sheep in that it is a bacterial infection.

It only invades the skin of the foot after it has been softened by wet grass, dung etc. the symptoms are similar to that in sheep.

Treatment: with cattle, the use of antibiotics is more common. The bacteria can be found in the digestive tract of cattle, which means eradicating it from a farm is not possible.

PNEUMONIA

Pneumonia is an inflammation of the lungs usually caused by the harmful effects of invading micro-organisms. Other causes of pneumonia include: migrating lungworm, solids or liquids that have entered into the lungs (e.g. drench fluid).

Open-mouthed panting puts lambs at increased risk of contracting pneumonia

Pneumonia can result in death within a day or two. More common is chronic pneumonia, this is where the animals get sick but don't die. Up to 70% of sheep can be affected, but it is only a small part of their lungs that get damaged.

Prevention: keep animals well fed (more resistant to infections), make sure there is adequate ventilation if the animals are housed indoors, avoid overcrowding or prolonged holding in pens, decrease the affects of dust by using a sprinkler on yards and pens, avoid stressing the animals (overheating, starvation, chilling etc)

BLOAT

Frothy bloat is a common and important condition. It is a major killing condition in cattle, especially dairy cattle. The condition can be seen in sheep.

Two factors are usually involved: (1) the feed and (2) the animal.

Usually the feed is of the succulent variety. Lucerne is dangerous and also red clover and white clover. The clovers causing bloat usually have less tough and fibrous leaves. There is a heritable predisposition towards bloating, but in dangerous conditions all the animals are at risk.

Cows susceptible to bloat produce less saliva than the unsusceptible ones. This is thought to have something to do with how the feed stuff froths up in the ruminant.

Bloat is caused by a build-up of persistent foam in the rumen based on proteins from new pastures in particular clover. Detergent given on a regular basis aids the breakdown of this foam allowing rumen gases to escape.

Cows may 'Bloat' within 15 minutes of being put on an 'at risk' pasture. Initially animals are bloated on the left side, this distension then extends to the right, animals become distressed e.g. kicking at their belly, have difficulty breathing, lie down and die if the pressure is not released.

Treatment: Bloated cows should be drenched with one part concentrate (bloat oil) in two parts water at 80mls per cow. These animals may not be able to swallow properly and may aspirate bloat oil and grass into their lungs.

If animals need to be stabbed to release the pressure of gas, remember to stab them on the LEFT. One positive stab about 50mm long should allow gases to escape. Always made the stab on the left hand side. A hands breadth behind the last ribs and a similar distance below the vertebral points. If the wound becomes clogged with grass remove this to allow more gas to escape. Avoid multiple stab wounds!!

Stabbed animals are likely to develop peritonitis, and a suitable antibiotic should be prescribed soon after stabbing. Some animals with large stab wounds will need stitching

Death can occur very quickly (15-20 min) and is usually due to the animal choking on the froth (asphyxia).

Control: using pastures less likely to cause bloat will help, drenching animals or putting bloat oil into water troughs can help, the correct grazing system may also help. A good farmer will check their animals shortly after they have been put onto new pasture, for many this is done after the animals have returned to the paddocks after milking. A quick look around the animals can show up any problems before they become major.

FACIAL ECZEMA:

This is a disease of sheep, cattle and deer that occurs mainly in the northern part of the North Island between January and April. It is also seen around Nelson/Marlborough. It causes extensive losses among stock through lowered production and death.

It is caused by a fungial disease. The fungus grows in the dead pasture litter. The spores of the fungus contain a toxin which causes damage to the liver when eaten by stock.

With sheep the first signs are the skin lesion that accounts for its name. The ears become reddened, swollen and droopy, and the lips and eyelids swollen. Scabs form within 2-3 days. Other parts of the skin exposed to sunlight may be affected e.g. backline. All of these are signs of photosensitivity and affected animals seek out available shade.

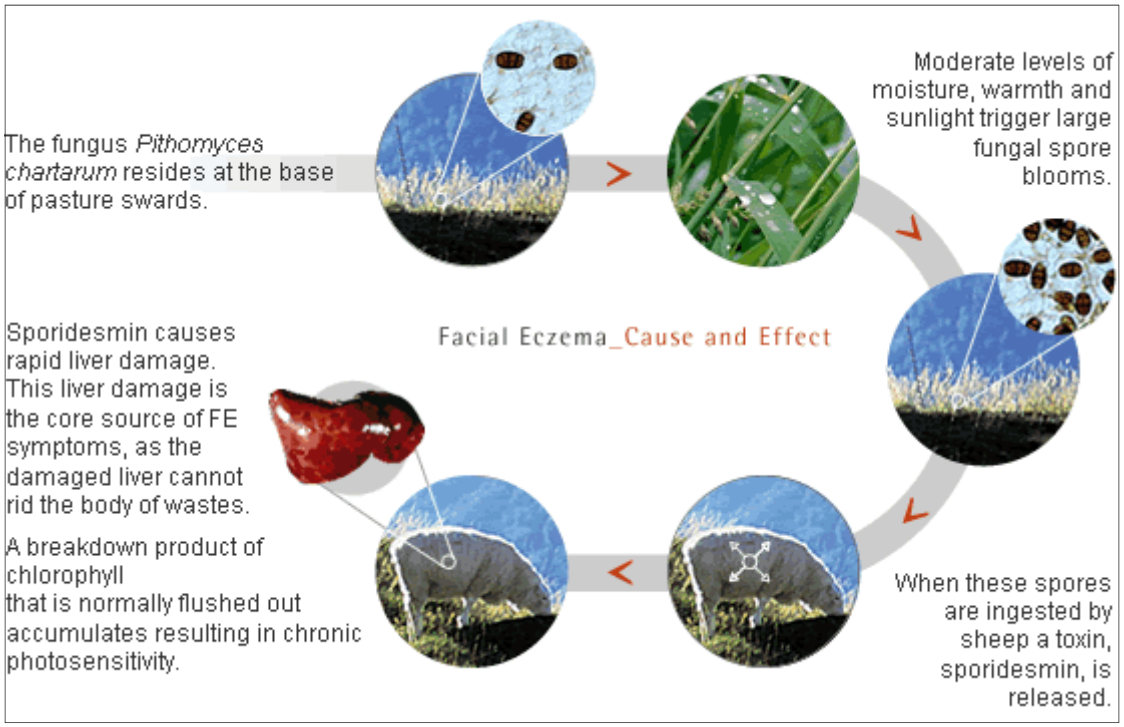
With dairy cattle, the skin lesions are seen on the udder and teats and down the inner side of the hind legs. Sometimes the skin of the face peels off over a large area. A drop in milk yield occurs within 1-4 days of exposure to the toxin, and is usually temporary, although sometimes

the cow will dry off completely.

Photosensitisation is an obvious sign of the disease. The damage to the liver is only seen when the animal is killed. The damage to the liver means it is no longer fully effective in removing waste materials e.g. bile pigments. When the waste products accumulate in the blood, the fat and skin tissue becomes jaundiced and show deep yellow discolouration. It is the pigment in bile (made from chlorophyll in plants that they eat) which makes the animal photosensitive.

The fungus grows best when humidity is high and the temperatures at soil level are above 12°C for a few days. It is possible to predict danger times using the weather and spore counts.

Treatment: provide adequate shade and a good diet. Affected sheep should be dressed to prevent fly strike. Affected milking cows should be dried off immediately (because it reduces the cows appetite, thus it eats less spores and accumulates less toxins), the udders should be checked for signs of mastitis and treated. With severe cases the only thing to do is cull the animal.



Prevention: spraying with fungicides, grazing management and dosing with zinc salts may also help.

PROLAPSE of the VAGINA or UTERUS

Vaginal prolapses (protrusion of the vagina) are most commonly observed during the last month of pregnancy or shortly after lambing. Many factors have been implicated in the cause of vaginal prolapse, such as hormonal/metabolic imbalances, overfat/ overthin body condition, bulky feeds, lack of

exercise, dystocia in previous pregnancies, increased abdominal pressure and fetal burden. Prolapses often recur in subsequent pregnancies. The exposed vagina of affected ewes should be washed with soapy disinfectant solution and forced back into the ewe. A bearing retainer or "spoon" can be inserted and secured in the ewe to prevent further prolapsing. In a ewe that has lambed, sutures are used to secure the prolapse. Affected ewes and their offspring should probably not be kept in the flock for breeding animals due to the possibly hereditary nature of the problem.

A uterine prolapse is when the womb is turned inside out and pushed through the birth canal by the abdominal strainings of the ewe. A bit like a sock being turned inside out. It occurs immediately after lambing and is a life-threatening situation. A prolapsed uterus must be manually forced back into the ewe. The uterus should be cleaned with a warm, soapy, disinfectant solution prior to replacement and should be replaced before the tissues become dry or chilled. Deep sutures are necessary to keep the uterus in place. Affected ewes should be removed from the flock. Older ewes are more commonly affected than younger ewes. A uterine prolapse can also occur in cattle.

Calling in a vet is usually the first thing farmers will do. Others will put the uterus (or vagina) back inside the animal and stitch them up, then call the vet to check everything.

With a prolapse of the uterus, the animal often dies of shock. If she lives, she will need to be culled at the end of the season. Once an animal has had a prolapse, it usually happens again.

LEPTOSPIROSIS

A common bacterial disease found in cattle in NZ. Is also found in other animals e.g. deer, goats. Can be spread to humans through the urine of infected cattle. This is a big problem for dairy farmers working in dairy sheds milking cows.

All dairy cows should be vaccinated against this disease on a yearly basis. The animals are not “permanently” immune to the disease, vaccinations have to be continued throughout the animals life.

In cows, the disease can cause abortions during the second half of pregnancy.

In humans the disease can cause continuing health problems. Symptoms of leptospirosis include high fever, severe headache, chills, muscle aches, and vomiting, and may include jaundice (yellow skin and eyes), red eyes, abdominal pain, diarrhoea, or a rash. If the disease is not treated, the patient could develop kidney damage, meningitis (inflammation of the membrane around the brain and spinal cord), liver failure, and respiratory distress. In rare cases death occurs. Symptoms usually begin about 10 days after infection. Leptospirosis is treated with antibiotics, such as doxycycline or penicillin, which should be given early in the course of the disease. Intravenous antibiotics may be required for persons with more severe symptoms. Persons with symptoms suggestive of leptospirosis should contact a health care provider.

Reference: OSH handout.

Reducing infection

To help reduce infection, farmers need to ensure that where possible all hazardous areas are able to be fenced off from animal access. This will help prevent injuries, poisoning etc.

When it comes to infections, the farmer needs to ensure that hygiene standards are high, this includes areas such as: dairy shed, calf pens, needles, etc.

The correct use of injections and drenches will also help reduce the rates of infection. Incorrect drenching can cause pneumonia in animals. Incorrect injections can cause infections.

All medications should be administered at the correct volumes and at the correct time. Some worms have become resistant to drenches due to farmers using them incorrectly. We are getting to the point on some farms where there is only one drench that will work, if the worms become immune to this then there is no drench that will help control them.

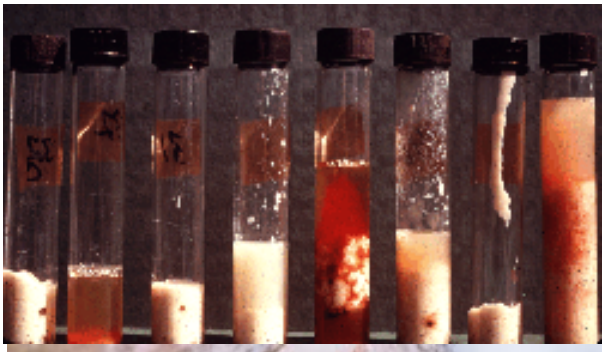
Prevention is better than curing. This means that the farmer should be using vaccinations when available and drenching the animals.

The provision of adequate nutrition at all times helps reduce the chances of infection. This is because the animal is more likely to have a healthy immune system and a greater ability to fight off any infections.

Correctly moving stock will help reduce the chances of injury and reduce the stress the animals are exposed to. If the animals have no injuries, there is no place for an infection to gain access. When animals are stressed their immune systems become impaired, this means they are more susceptible to diseases and less able to cope with the disease.

Overcrowding can also be a major cause of diseases spreading rapidly from animal to animal. The farmer needs to be alert for any signs of diseases or infections. When symptoms are seen, the animals need to be removed from the area, and the sick ones quarantined.

If worse comes to worse, the farmer needs to consider culling the animals. This is especially important when the animal has repeat episodes of a disease.



MASTITIS

Mastitis is a common disease in cattle. It is due to a bacterial infection in the udder. In a standard dairy herd (per 100) there will be:

- 1 cow with mastitis
- 15-40 with high somatic cell counts
- Approximately 10% of cows will have mastitis at least once during their lactation (milking season)

Animals can be identified using somatic cell counts when the herd is tested. This is known as subclinical mastitis (in other words can be seen visibly). When the milking plant is being cleaned, the filter sock should be checked for signs of mastitis. If lumps are visible, then the herd needs to be checked to find the cow/s that have mastitis. This can be done using a chemical test, or stripping the animals and checking for lumps.

If an animal is found to have mastitis, she should be treated with an appropriate antibiotic. This is usually injected directly into the teat canal after the animal has been milked. The milk from an infected animal should not be put into the vat, nor should the milk from an animal that has been treated with antibiotics. Antibiotics in milk will cause the dairy company to dump the milk, and the farmer will be fined for the losses. This is because the antibiotics stop the bacteria working to make cheese and

yoghurt etc.

The cups should be thoroughly cleaned before they are put onto another cow. This can be done by rinsing out the cups with cold water and then hot with a disinfectant, then again with clean hot water (no disinfectant). If the cups are not cleaned properly, the next cows could get an infection as well.

Teat spraying is a possibility to help reduce the chances of infection. The 2 most common teat sprays in NZ are: blue guard and iodine.

At the end of the milking season, all animals that have had mastitis should be treated with "dry cow therapy". If an animal has had a lot of mastitis during the season, culling should be a consideration. This is done when the animal is not going to be milked for months.

Basic hygiene can help reduce the infection rates in a herd.

Health practices

Drenching:

These are liquid medicines or chemicals which are given to kill internal parasites, usually worms. The liquid is deposited in the mouth via a drench gun that can be adjusted to allow different amounts to be dispensed.

There are many different types of internal parasites that can infect farm animals.

E.g. tapeworms in dogs, especially the hydatids tapeworm (*Echinococus granulosus*). Hydatids passes from sheep and humans into the dogs. The dogs pass the eggs back into the environment. This is why children should not kiss animals, and they should make sure that their hands are washed before putting their hands near their mouths. Farmers need to ensure that their dogs don't have access to offal from sheep. This is because cysts can form in the liver and lungs of sheep. In humans the hydatid cysts cause damage to lungs and liver through pressure. They can also invade the spleen, kidneys, heart and the central nervous system. NZ use to have very high numbers of hydatids cases. Due to an active control programme, the numbers have decreased. Originally all dogs were treated for hydatids (dog dosing), now it is only farm dogs that have to be treated and all raw offal has to be kept from dogs. This has meant making sure that home kills are in a specific area, and all offal is placed into an offal pit. If offal is to be given to DOGS then it must be cooked thoroughly (for at least 30 minutes).

E.g. liver fluke. The adult fluke is a hermaphrodite (all flukes can produce eggs). The lifecycle also involves a freshwater snail as an intermediate host. Adult flukes in the bile ducts lay eggs which pass out in the sheep's faeces. After a period of development each eggs hatches into a larva. The larva swims to find the snail. Here it finishes its development. When it reaches its fourth and final larval phase, the young fluke emerges from the snail and swims till it reaches vegetation. It then casts off its tail and cysts on stems or leaves, here it remains until it is eaten by a sheep. The young flukes migrate through the intestinal wall and into the liver. They live in the tissue feeding and growing for several weeks before entering the bile duct to produce eggs again. If the sheep has a big enough infestation, it can die due to blood loss internally. With a lesser infection, the animal can become anaemic or jaundiced and the

liver becomes cirrhotic. The animal is also more susceptible to black disease, this is because it likes similar conditions to the fluke. The use of grazing management can also help provide some control. But for liver fluke, the main method of control is the use of drenches. Make sure that they are used correctly to prevent the fluke from becoming resistant.

Internal parasites reduce productivity in animals. They live in the gut and feed off the nutrition that should be going to the animal. The animal has less food to live off and consequently the animal doesn't perform to its potential. Reduced wool growth in sheep is associated with internal parasite infections. The host animal can also suffer from anaemia (usually caused by blood sucking internal parasites), a loss of plasma proteins (usually caused by blood sucking versions), lack of nutrients (due to parasites "eating" the animals nutrients, lowered ability of the animal to absorb nutrients).

Over time, some sheep develop a strong resistance to infection with some species. Except for lambing ewes, adult resistant sheep carry a generally stable low worm burden and contaminate pastures less than do young sheep. Breeding from these resistant type animals can improve the genetics and thus the resistance of the flock. Breeding ewes often show an increase in faecal egg counts. There is good evidence that the rise results from a temporary relaxation of the immunological control of worm infection brought about by lactation and hence it may originate from worms already present in the ewe before parturition and from infections newly acquired in the lambing paddock.

Integrated control: the two major requirements of integrated control are firstly a drench and move of lambs in late November/early December (weaning) to pasture not grazed by ewes and lambs from the commencement of lambing until weaning and secondly a drench and move in late February/early March to pasture not grazed by lams since weaning. The pasture they are moved onto is considered to be "clean", i.e. free of worms, this means that they have no chance of re-infesting themselves, and the worms that have been "killed" are passed out through the faeces into the pasture.

With dairy cattle, the calves can be grazed ahead of the cows. This means that the calves have the best pasture with low worm burdens. This is done in association with the use of drenches. With beef cattle, the calves are urn on one area up to weaning, drench them, and then wean them onto "clean" pasture with a follow up drench 3-4 weeks later. Three months later they are drenched onto a new area of safe pasture, again followed by another drench a further 3-4 weeks later.

Drenching can also be used as a prevention/treatment for bloat.

Remember to take into consideration any with-holding periods for the culling of stock.

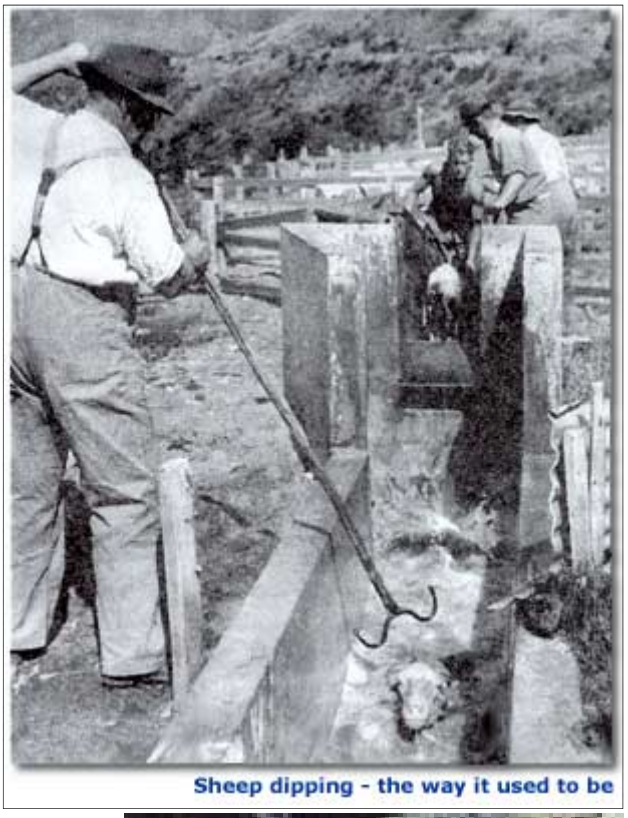
Reference: look at handout on how to drench cattle.

Dipping

Dipping is used to control external parasites. External parasites include: flies, lice, ticks, ked and mites. Some cause anaemia due to their bloodsucking habits.

Most biting parasites have protein-digesting enzymes in their saliva. This damages local capillary walls to allow more blood to flow.

Dipping can be in the form of a dipping bath, where the animal is forced into a “trough” and dunked. This has a number of problems in that the solution becomes contaminated. More modern varieties use a form of shower, this is not as effective with sheep with a lot of wool, the animals are showered from above and below (like in a dishwasher). The chemical kills the parasites directly. The easiest form is a pour on version. This uses a special wand to place the solution close to the skin (also known as jetting). It then goes into the blood stream, when the animals bite, they take in the chemicals and die.



Sheep dipping - the way it used to be

E.g. fly strike: blowflies cause losses wherever sheep are kept in large numbers. The basic life cycle of all flies: an adult female lays eggs which hatch releasing larvae (maggots). These feed, grow, and then undergo further development within a resistant outer pupae casing. The adult fly breaks out of the pupae case and it all begins again, with adults able to lay approximately 2000 eggs. Most blowflies need to have severely damaged skin/dead meat for them to lay their eggs into. The more evolved species don’t need much damage to the skin. These are the biggest problem when it comes to fly strike. But they do need warm moist conditions near the skin. This is often found near daggy wool. Newly hatched larvae have protein-digesting enzymes that enable them to destroy intact skin and the resultant inflammation creates moisture for their further development. Their aversion to light causes them to burrow under the skin, extending the damage away fro the original strike. In the case of fly strike, prevention is better than cure. Crutching animals to remove daggs will help, as will shearing to remove wool at the right time. Mulesing is often used on Merino animals; it involves the removal of skin around the perineal region. The control of internal parasites will help reduce the incidence of scouring, thus reducing the chances of daggs. The use of larvacidal treatments will help “kill” the maggots, using an antiseptic will help prevent further infections. Prevention in the form of dipping may also help.

E.g. lice: there are 2 main types of lice: biting and sucking. They lay eggs attached to hairs and once hatched, the nymphs go through 3 stages before becoming adults. Lice are more numerous in winter due to animals becoming more unthrifty (less able to resist infection) and the animals having a thicker winter coat which can protect the lice. Well fed animals in good condition suffer little from the effects of lice. Lice free stock has a better appearance and makes them more sellable at the markets. The use of a drench may help eradicate them if the farmer is able to constantly remove them. This is because the lice are unable to survive away from their hosts for long periods of time. The cost of this eradication is prohibitive as the lice don’t seem to cause any major problems in healthy well fed animals.

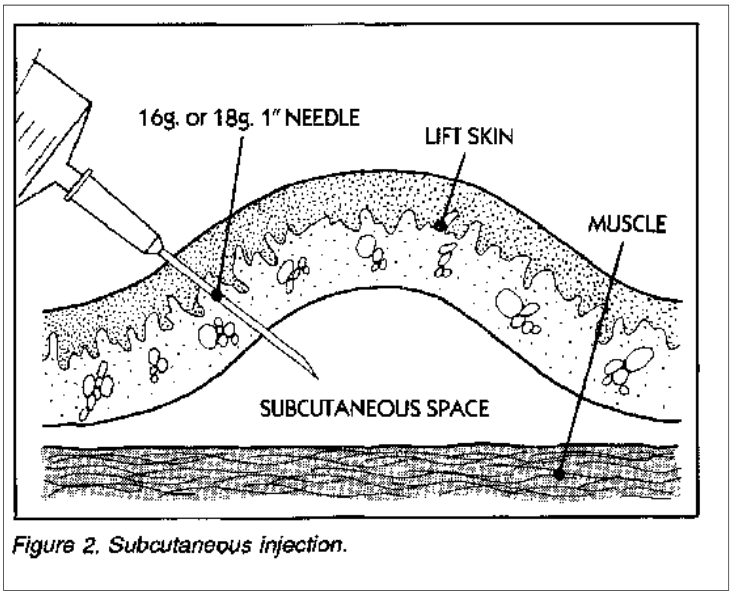
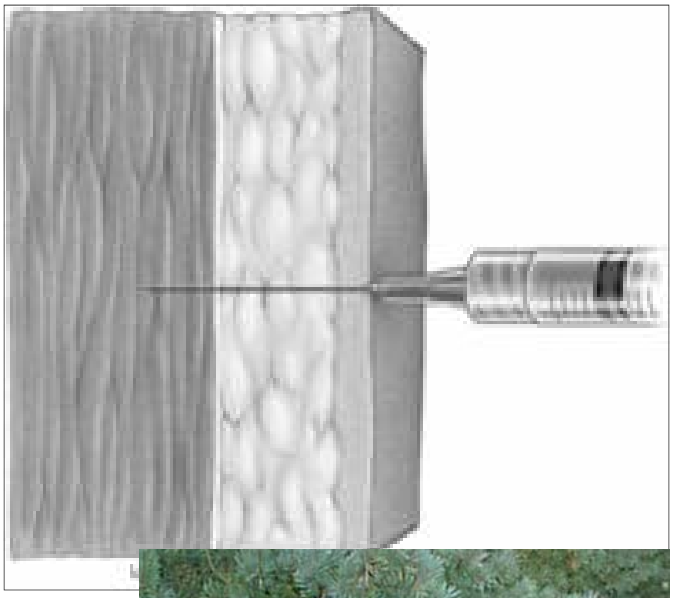


Figure 2. Subcutaneous injection.



Vaccination

Vaccination is used to provide protection from certain diseases, it does this by providing either antibodies directly or by providing the animal with a dead (or weakened) version of the disease so it can produce antibodies. The use of vaccines is becoming more common for many diseases.

Some vaccines are made from the powerful toxins produced by such bacteria as the clostridia (the cause of diseases such as blackleg, pulpy kidney and tetanus)

The following points should be considered before any vaccination programme is undertaken:

1. The possible loss from a disease outbreak
2. The likelihood of a disease outbreak
3. The means of curtailing an out break should it occur
4. The cost of the vaccination.

To make decision on vaccine usage a thorough understanding of the disease and an awareness of current stock values is required. This means that vaccination programmes are not fixed and have to be adapted for each farm or district.

E.g. tetanus antitoxin is given to horses to give them passive immunity against tetanus. The immunity develops quickly but is short-lived and they need to be given booster shots, particularly after the horse has suffered a wound.

E.g. pulpy kidney; blackleg, malignant oedema and blood poisoning: caused by a variety of clostridial diseases. The best prevention is the use of vaccines. This is because they usually cause death.

Reference: see sheet on vaccination

Vaccinations need to be given carefully. The are usually given subcutaneously (under the skin) and in the neck region. This is to reduce the chances of infection into “good” cuts of meat. The neck is an expendable cut of meat.

Intramuscular (into the muscle) injections are not common as they can cause infections deep in the muscle. There is also less space in the muscle for the injection fluid when compared to subcutaneous injections.

Hygiene is very important when vaccinating animals and the needles need to be sharp and clean.

Other diseases to consider:

Milk fever: this is caused by the loss of calcium from the animal. Happens early in milk production especially in dairy cattle. It is an inability to mobilise and use enough calcium from food or body reserves to supply the sudden demand due to milk production. In other words the cow is unable to eat enough food to supply the Ca it needs for milk production.

Milk fever is usually seen 3 days either side of calving. The signs include tremors, hypothermia, constipation, depression, recumbencey (lying down), bloat etc.

Milk fever is treated using a solution of calcium borogluconate. The solution is usually administered subcutaneously (or if very severe, by a vet intravenously (into a vein)). The animal often tries to get up during treatment (sitting on the animals neck can prevent this), that is how quick it can be.

Milk fever can be prevented using calcium supplements just before birth. Keeping good records of which animals have been affected will also help to prevent future episodes as animals tend to be at greater risk if they have suffered from milk fever before.

Grass staggers is another metabolic disease. It is caused by a lack of Mg in the animals diet. The signs of grass staggers include: hyperirritability, muscular incoordination, convulsions and death.

The treatment is similar to that of milk fever: a subcutaneous injection of magnesium solution.

The prevention of grass staggers is usually done through the use of drenches, bullets, water treatment or pasture dressing (causemag). The best forms of prevention include those where the animals gets its dose of Mg directly (drenching or bullet) rather than randomly (having to eat or drink it); this is because the random versions have varying amounts ingested by each animal, some may not get enough.

Tuberculosis:

Bovine tuberculosis (Tb) arrived in New Zealand with the cattle of the first European settlers. It was a serious problem by the 1940s, reducing productivity and putting many people's lives at risk, and today it remains the most important disease for both cattle and deer farming in New Zealand. It is a wasting disease in both cattle and deer, leading to weight loss and death. In cattle, milk production may decline. Bovine Tb is similar to human Tb and can move from livestock to humans with potentially fatal consequences. Owing largely to the pasteurisation of milk and the compulsory Tb control programme for cattle, bovine Tb is now a minor cause (1% to 5%) of Tb in humans in New Zealand. The current issue is how it affects our livestock industries and exports.

The trading threat

International animal health standards have risen since the 1960s and are now a major factor governing and threatening access to our overseas markets. The dairy industry is one of New Zealand's most valuable livestock industries. In 1990, the European Union proposed to introduce regulations (but didn't do so at the time) requiring milk and milk products to be free of all pathogens, including Tb. This indicates the direction some importing countries are heading and the obvious risks to our trade. It is imperative that New Zealand clears Tb infection from its remaining infected dairy herds. The perceived safety of meat products is also a matter of international concern, especially since the emergence of "mad cow" disease (BSE). Effective control of Tb is critical to protect our trade in dairy, beef and venison products.

If the Tb eradication programme was to stop, then the potential cost to New Zealand, if major markets were lost, has been estimated at $5 billion over ten years. The levels of Tb in our cattle and deer currently prevent any exports of live animals to Australia and North America, and limit live export trade to other countries.

Eradication of bovine Tb

In most countries eradication of Tb from cattle herds is straightforward. All cattle are tested and those that are "test-positive" are either re-tested or slaughtered. Normally this rapidly reduces the level of Tb and can eliminate it entirely. The vast majority of our trading partners and competitors (Australia, North America, most Western European and South-East Asian countries) are classified as free from Tb. New Zealand has had a compulsory, national Tb eradication campaign operating in cattle herds since 1970, and in deer herds since 1990. However, 0.5% of the national cattle herds and 1.4% of deer herds are still infected with Tb.

So why does New Zealand still have a significant Tb problem, despite a long-running national eradication campaign?

Pests as Tb reservoirs and vectors (possums)

In the late 1960s, veterinarians in the Westport area were puzzled by chronic infection in cattle herds that could not be cleared by standard test and slaughter methods. Researchers linked the problem to high levels of Tb infection in the possum populations adjacent to these herds. Bovine Tb had "jumped" to a new host. Since then, possums with Tb have been identified in widely separated areas of New Zealand, co-existing with tuberculous cattle. While several wild animal species can be infected with Tb, research suggests that possums, and perhaps ferrets, are likely to be the only self-sustaining reservoirs of Tb. Feral red and fallow deer have also been identified as important vectors of Tb.

In the 1960s and 1970s, infected possum populations were mostly confined to high rainfall areas of the West Coast, and the lower and central North Island. Since then, infected possum populations have continued to spread and now occur in the areas shown on Figure 1. Scientists now regard possums as the most important vector of Tb, for most infected herds in New Zealand, over the last 25 years.

In total, Tb-infected possum populations now occupy about 38% or 10 million hectares of New Zealand. By 2002, approximately half of this area (4.6 million hectares) was under sustained Tb vector control.

Figure 1

Areas occupied by Tb-infected possums (in dark grey) (2002) Source: AHB

How much control for Tb?

"No control" for bovine Tb purposes is not an option, given the trade, social and political risks. "How much" control is the issue.

The initial control operations that focused on Tb possums between 1974 and 1978 were very successful at first, and the number of infected cattle herds dropped rapidly. Unfortunately, as a consequence of this early success, funding, and therefore the number of control operations, was reduced over the next 11 years. Over those 11 years, the number of areas where wild animals had bovine Tb increased from eight to fifteen, and the number of infected herds rose to pre-control levels. Clearly, this "do little" option was not enough to contain, let alone reverse the Tb problem. Funding for Tb vector control rose in 1989 as other species, particularly ferrets, were identified as Tb vectors. Funding now exceeds $50 million a year. Currently, the National Bovine Tb Strategy has set higher objectives to reduce the number of infected herds, and prevent new Tb areas from establishing. Obviously this means a greater effort, particularly in the control and eradication of Tb vector populations.

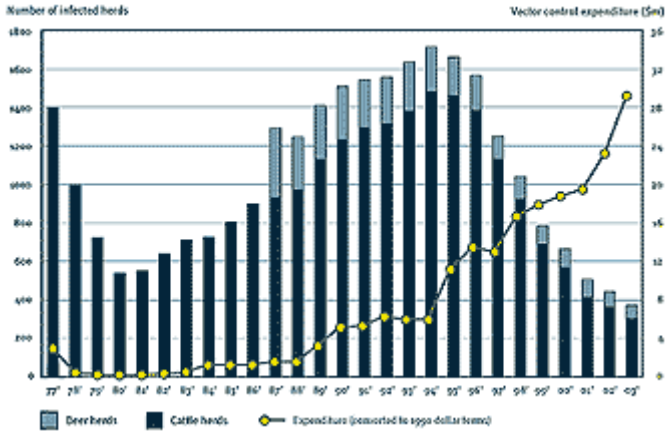
Movement control is the latest method to help prevent the spread of bovine TB. Animals from high risk areas must be tested before they can leave the property. If they test positive they will need to be culled. If they test negative then a certificate is issued to show that they are negative at the time of testing and can be moved. Animals from TB free properties can move to TB properties but not the other way.

The downward trends are now very encouraging, thanks to the high investment in vector control since 1994. However, the areas with Tb infection are continuing to spread. Figure 2 shows the

level of investment that has been required to control Tb vectors to achieve a decline in the number of infected herds.

Figure 2

Number of TB-infected cattle and deer herds and expenditure on Tb vector control

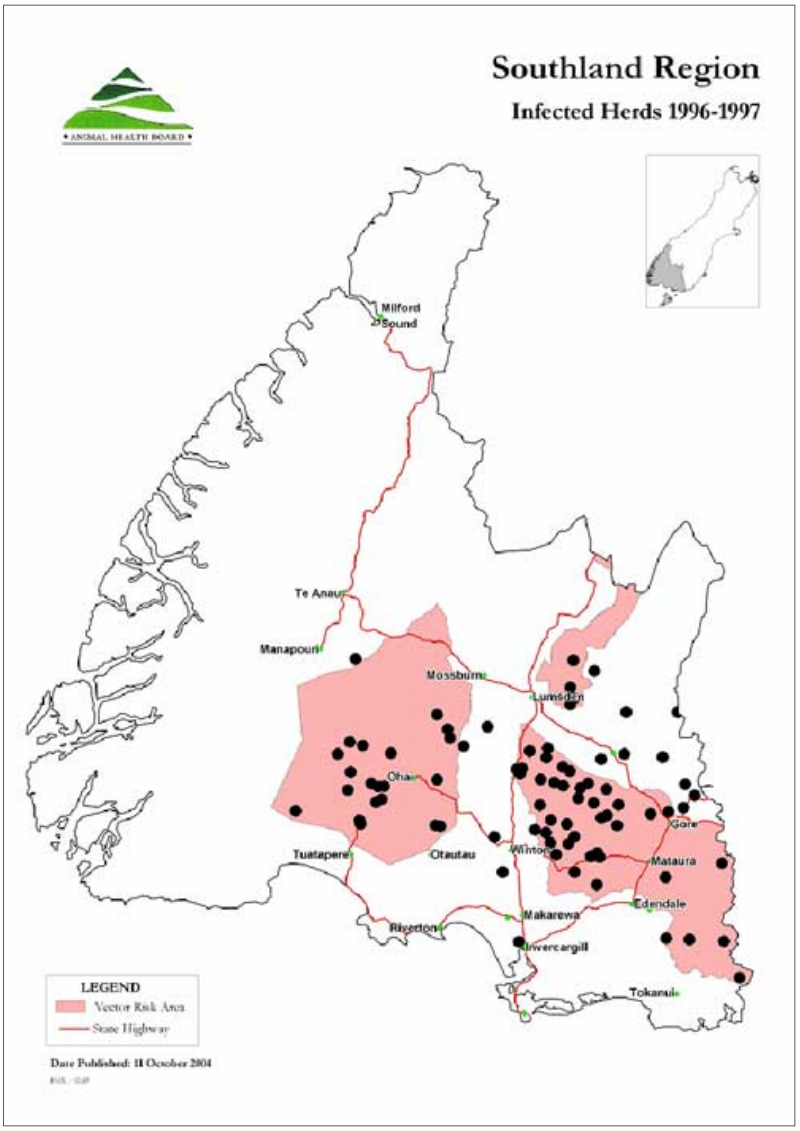


Management of bovine Tb

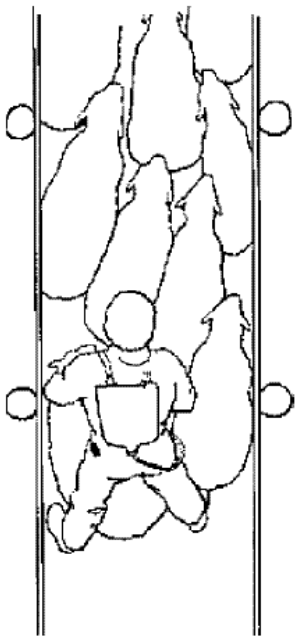
Current management of possum populations for Tb involves two distinct phases.

1. First, the population has to be heavily reduced over a large area, to cut down the likelihood of infected possums interacting with cattle or deer herds. Sometimes in this initial stage it is necessary to target other wild animal vectors, such as red deer and ferrets, as well. Large areas have to be treated, otherwise new possums moving in from the edges of the controlled area quickly increase the population again. Making these initial reductions often involves spreading 1080 baits by air, over large (>1000 hectares) or difficult areas of forest and scrub. Aerial operations provide rapid control over a large area, something that ground control rarely provides. Aerial operations are complemented with ground control of possums, often using a variety of techniques, on adjoining pasture and forest/pasture margins.
2. "maintenance phase", requires that the initial control is followed by regular re-treatment to hold the possums within a pre-determined density range. Low density levels are required to reduce the likelihood that possums continue to act as reservoirs or vectors for Tb. Maintenance operations are usually more frequent in the areas that were initially ground treated, such as farm-forest margins, as these are the areas where possums and cattle most commonly interact. Large bush and scrub blocks are re-treated by aerial 1080 operations at about four to six yearly intervals.

These control operations, coupled with herd testing, culling of "test-positive" animals, and controls on stock movement, usually achieve an immediate reduction in the level of Tb in herds close to infected possum populations. However, if the possum population and other vectors are not kept down through maintenance control, then Tb levels in the herds usually rise to the pre-control levels within five to eight years. On the other hand, if control operations are able to keep possum populations low enough for long enough, Tb can be completely eradicated from the population. This is the long term aim of AHB's operations, and has been achieved so far in six small areas.



The management practice of drenching lambs is shown to the right.



(a) Describe two actions taken by the farmer in the diagram that are important if every lamb is to receive a full dose.

Give a reason why, or how, each action you described is important.

(i) Action 1: _____
_____
_____
_____

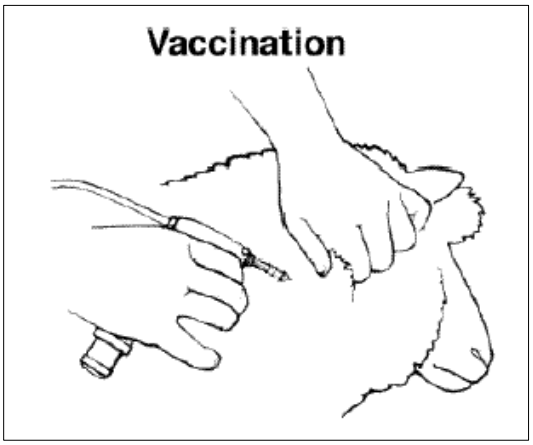
Reason for Action 1_____
_____
_____
_____

(ii) Action 2: _____
_____
_____
_____

Reason for Action 2_____
_____
_____

Another livestock management practice is the vaccination of stock as shown in the diagram below.

(b) Describe three actions taken by farmers so that the vaccination process is performed in a safe and hygienic manner.



1. _____
_____
_____
_____

2. _____
_____
_____
_____

3. _____
_____
_____
_____

(c) Explain why the injection is given in the area shown in the diagram. _____
_____
_____

Putting it all together: the following question will require your knowledge from this entire topic to help answer it.

A Southland farmer keen to take advantage of high dairy returns changed from sheep farming to dairy farming. A milking shed was built, paddocks sub-divided and cows were purchased from a retired North Island dairy farmer. A sharemilker was employed to milk and manage the herd.

After the first milking season, production figures per ha were 40% below the Southland average. The farmer was disappointed and aims to achieve the Southland average within four years.

(a) Explain THREE livestock management practices the farmer/sharemilker could use to help

achieve average production figures within four years.

(i) Management practice 1: _____

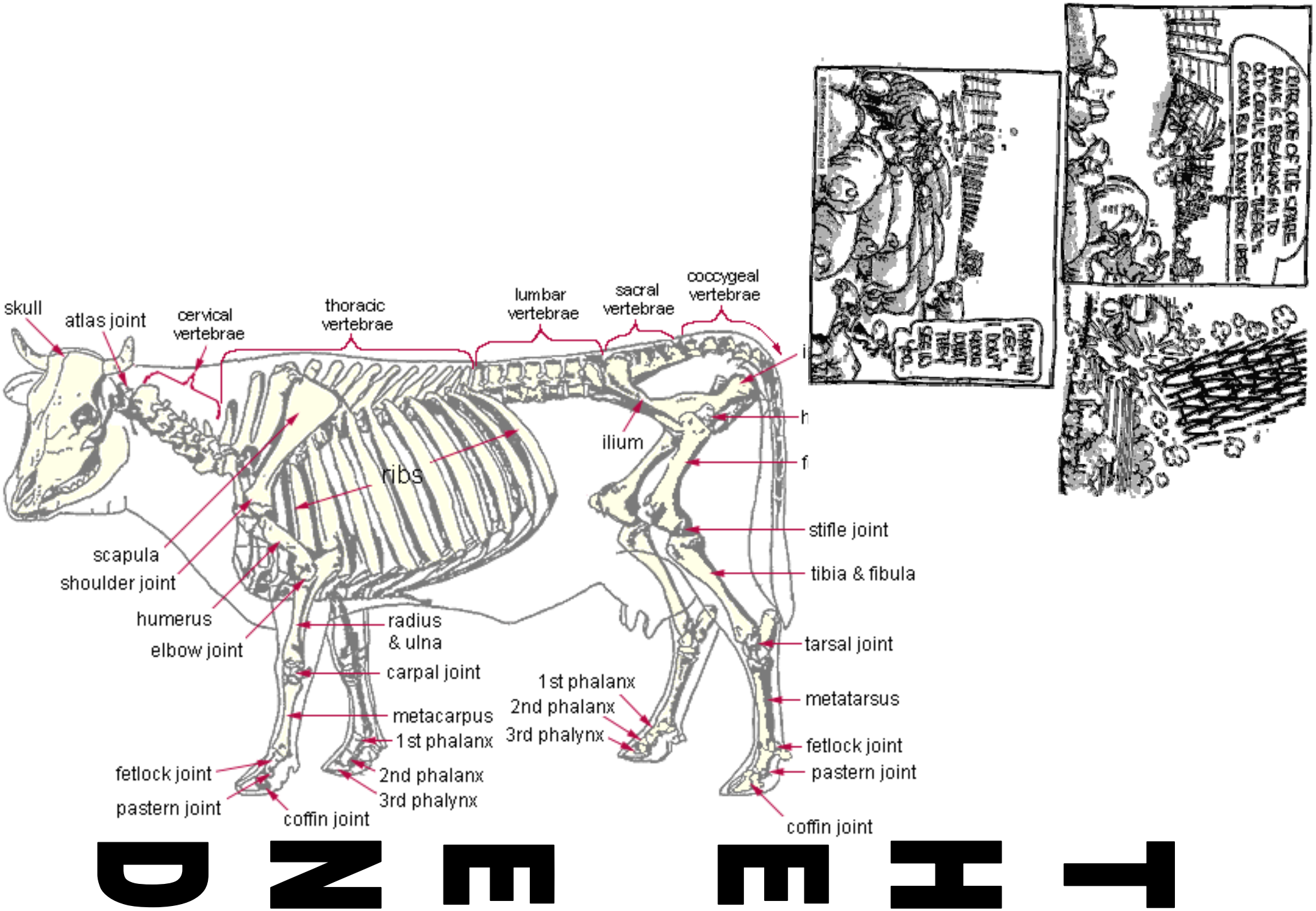
(ii) Management practice 2: _____

(iii) Management practice 3: _____

(b) Select the top priority management practice, and give reasons for selecting this management practice ahead of the other practices considered.

Top priority: _____

Reasons: _____


skull
atlas joint
cervical vertebrae
thoracic vertebrae
lumbar vertebrae
sacral vertebrae
coccygeal vertebrae
ilium
ribs
scapula
shoulder joint
humerus
elbow joint
radius & ulna
carpal joint
metacarpus
1st phalanx
2nd phalanx
3rd phalynx
fetlock joint
pastern joint
coffin joint
stifle joint
tibia & fibula
tarsal joint
metatarsus
fetlock joint
pastern joint
coffin joint
1st phalanx
2nd phalanx
3rd phalynx