Course Name	National Diploma: Animal Production NQF 5 (249 Credits) SAQA ID: 49011
Module Name	Module 6: Livestock Production Learner Guide
Unit Standards	116385, 116336
NQF Level	5
Credits	36

LEARNER GUIDE

Livestock Production

Part III Animal Breeding

TABLE OF CONTENTS

DEAR LEARNER

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

Unit standard ID:	Unit standard title:
116385	Integrate sustainable breeding and selection methods
116336	Understand juvenile animal rearing practices

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

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

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

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KEY TO ICONS

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

Alignment to NQF

ELEMENTS OF THE PROGRAMME

1. Name of programme	Livestock Production III
2. Purpose of the programme	Form part of the qualification to equip learners in Livestock Production
3. Duration of the programme	4 days of formal facilitation; 180 notional hours
4. NQF level	5
5. NQF credits	18
6. Specific outcomes	See Unit Standard Guide
7. Assessment criteria	See Unit Standard Guide
8. Critical cross-field outcomes	See Unit Standard Guide
9. Learning assumed to be in place	See Unit Standard Guide
10. Essential embedded knowledge	See Unit Standard Guide
11. Range statement	See Unit Standard Guide

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

Unit 1

Livestock Breeding

Unit Standard	
116385	**Integrate sustainable breeding and selection methods**
Specific Outcomes	
SO1: Integrate advanced breeding practices into a breeding management programme. SO2: Combine advanced selection methods into a breeding management programme. SO3: Incorporate the use of fertility and pregnancy diagnosis into a breeding management programme. SO4: Develop and manage a sustainable breeding management programme.	
Learning Outcomes	
By the end of this unit, you will demonstrate an understanding of: • The integration of advanced breeding into a breeding programme • Advanced selection methods • Fertility and pregnancy diagnosis • The contents of a sustainable breeding program	

Identifying	Collecting	Demonstrating
Working	Science	Contributing
Organise	Communicating	

1. ADVANCED BREEDING: GENETICS

1.1. INTRODUCTION

"The whole subject of inheritance is wonderful", wrote Charles Darwin in 1868. Darwin admitted, however, that the biology of his day provided no solution for what continued for many years to be called the "riddle of heredity".

While Darwin was writing this work, a monk and biologist Gregor Mendel was doing experiments with peas and he was beginning to unravel the riddle of heredity. His work became known around 1900 and the concept of the gene was developed. Today we still use the gene terminology and the genome (where the genes of a species are situated on which chromosomes or on the specific loci) of a lot of species are fully understand and described.

Mendel worked on what we call today the single gene inheritance. In other words, where the gene is inherited in a predictable statistical ratio and the expression of the characteristic controlled by the gene can be easily recognized.

Definitions

Locus: Where a specific gene is situated on a chromatid of a chromosome.

Loci: Plural of Locus

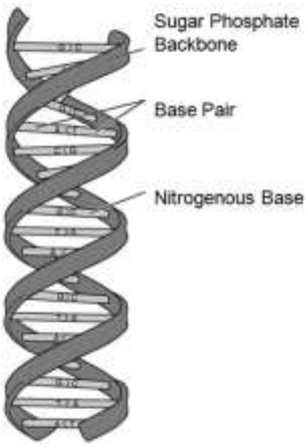
Genome: The genetic makeup of specie. That will give you the full picture where genes are situated on which chromosome and its location on the chromosome.

However, most of the genes responsible for production characteristics in farm animals are controlled by a lot of genes. The selection for such production traits is much more complicated. Scientists have developed many methods during the past years with which they can eliminate the concealing environmental aspects with complicated statistical calculations and are now able to come up with breeding values that can predict quite accurately how a breeding animal will breed. They also developed analytical skills with which they can determine the generic profile of any individual animal. In the future it seems that this DNA profiles will be used to predict an animal's breeding abilities.

Nature and Function of the Gene

Knowledge of the gene and some of its functions is necessary to obtain a good foundation in the principles of animal breeding. The gene is the smallest biological unit of inheritance and is carried, as was mentioned already, on the chromosome. Hundreds and possibly thousands of genes are carried on each chromosome.

The chemical composition of the gene has been studied indirectly by the chemical analysis of the chromosomes. It was found that chromosomes contain proteins and nucleic acids. Two kinds of nucleic acids occur in cells, namely DNA and RNA. DNA (de-oxyribonucleic acid) is the primary genetic material and the gene is a segment of a DNA molecule.

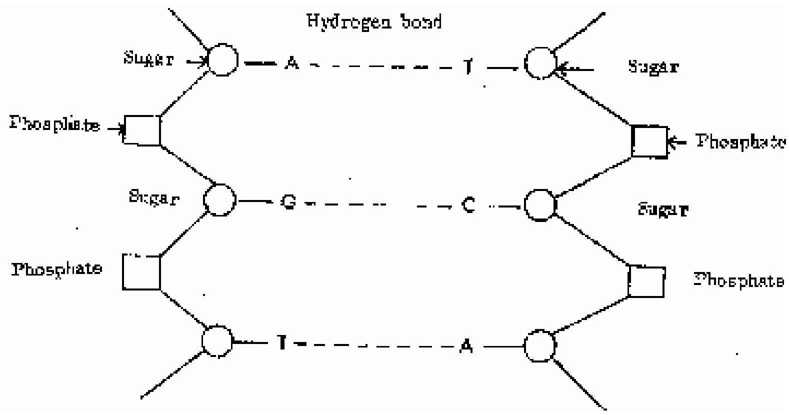


Electron microscope pictures show that the DNA molecule is longish and rather stiff, like a piece of cord. X-ray analysis shows that it is a double molecule or chain with one chain wrapped around the other in a helical structure. The two chains are connected at various points.

Our knowledge on the structure of the DNA molecule is mainly due to the work of two brilliant scientists, namely an American, Watson and an Englishman, Crick. While working at the University of Cambridge in 1953 they put forward a new idea for the structure of the DNA molecule. It is known as the Watson – Crick Model and up to now it is still the model that fit the fact most closely.

This model shows the DNA molecule as a double spiral consisting of similar molecules held together in a special way. One can think of it as a twisted ladder in which the two uprights consist of alternating phosphate and sugar groups, held together by strong chemical bonds. The rungs, which hold the uprights together, are attached to the sugar groups. These rungs may consist of any pair of wide range of different combinations of nitrogen bases, which is called purines and pyrimidines. Weak chemical forces, hydrogen bonds, between matching bases of the two chains hold the molecule together. In the figure the structure of DNA is presented according to the Watson – Crick Model.

If we imagine the strands of the spiral unwound and the whole structure flattened out, it would look somewhat like this.

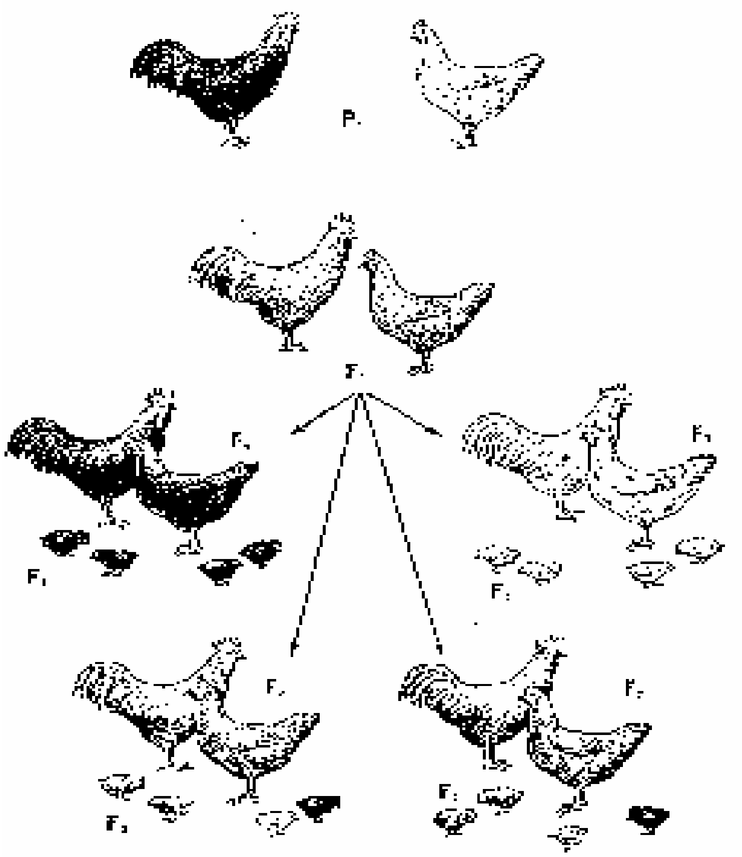


Where A, T, G and C etc. Are the nitrogen bases (purines and pyrimidine's).

Figure – Representation of the double helix set upon a flat surface.

The next figure illustrates the inheritance of a single gene responsible for the plumage colour of Andalusion fowls.

Crosses between black and white fowls produce only blue-grey offspring in the F1 generation. When the F1 offspring are mated with each other, the F2 generation they produce will have: 25% black, (which breed true); 50% blue-grey, (which breed like the F1 offspring), and 25% white (which breed true) coloured plumage.



1.2. THE PRINCIPALS OF GENETICS

All living creatures consist of millions and millions of cells. Every cell has a cell nucleus. In this cell nucleus very small strings, known as chromosomes, are found. These small chromosomes are found in pairs and therefore the genes are also found on both chromosomes.

Formation of Gametes

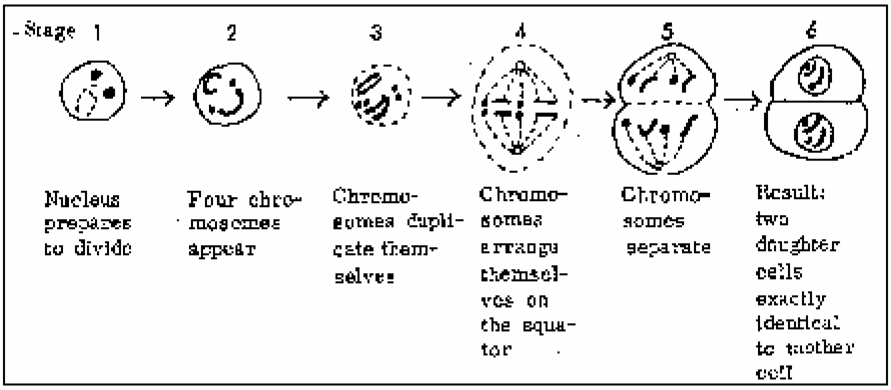
The ovum or gametes of the female animal has only one of the pairs of chromosomes that is found in a body cell. We said the cell is haploid. The body cell is diploid full set of chromosomes. The mature sperm cells of the male have also only halted the chromosomes and genes of the male's body cells. Therefore, the sperm cell is also haploid.

When the two gametes (sperm and ovum) combine during fertilization the result is a cell with a new combination of two sets of genes. Diploid and unique in combination of its genes and is called zygote.

The gametes are formed through a division called reduction division (Meiosis) because the chromosomes and genes are reduced to half (haploid) that of the body cells. When body cells divide, we call it mitoses. After mitosis the resulting cells have the same amount (diploid) of genes than that of the dividing cell.

Mitosis

We are now coming back to the fertilized egg cell. The cell divisions, which affected the growth of an animal, are called mitosis. It is visible under a strong microscope, shown schematically in the figure.



Stage 1-6 of the mitosis division – division of body cells

The most important feature of mitosis is that the chromosome number remains constant throughout successive cell divisions.

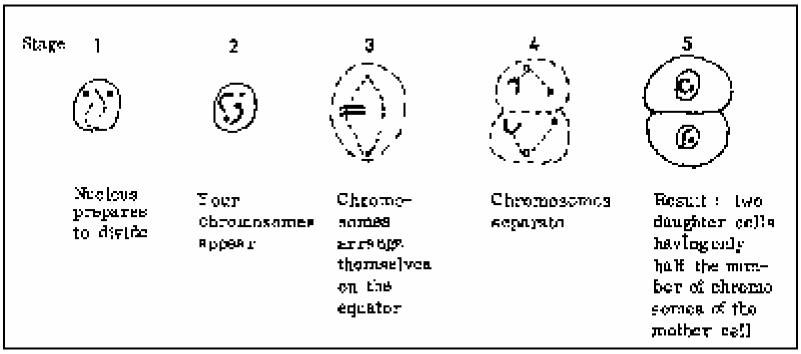
The result is an exact distribution of chromosomes to the new cells as they are formed. The new cell, formed by the chromosomes, is the same as that of the cell from which it has been derived. The ability for a single cell to give rise to all the different kinds of specialized body cells can be explained by the mechanism of differentiation.

Mitosis, then, is the normal duplication of body cells to form new daughter cells with the same chromosome number as the mother cell.

Meiosis

Fertilization occurs when the sperm and the egg unite to form a new individual. For species to maintain a constant chromosome number, it is therefore necessary that each egg and each sperm should contain only half the chromosome number. The process of cell division that results in the formation of sex cells (gametes) and the halving of the chromosome number are known as meiosis.

During meiosis the members of each pair of chromosomes line upside-by-side and separate in such a way that each daughter cell has one member of each chromosome pair. Each gamete will therefore contain exactly a half of the normal chromosome number. With fertilisation the normal chromosome number is restored. The process of meiosis is illustrated in the figure.



Stage 1-5: Meiosis forming of male and female gametes

Body cells

There are thousands of genes situated on the chromosomes in an individual's cell nucleus. The composition of the genes in everyone is unique.

During the process of fertilization, the two sets of chromosomes of the mother and father are joined, and a new individual with his own unique gene composition is conceived.

Note that each sperm/ovum produced by an animal does not carry the same gene component, because a different chromosome combination is possible in both the sperm and the ovum. This contributes to the variation in genotypes produced. Since new gene combinations occur continuously, new variations are also produced continuously.

1.3. QUALITATIVE INHERITANCE

Interpretations of Mendel's single gene inheritance (the experiments were done with peas. Therefore, the male gametes are pollen and female gametes are egg cells)

Interpretation

Assume that for a given pair of alternative characters, F1 individuals have received an appropriate genetic element from each parent. That will be the contribution of each gamete. Let X be the element representing the character that is expressed in the F1, and x be the element that is the basis of the character that is not expressed in the F1. The F1 individuals may then be designated Xx. Suppose that the pollen and egg cells, produced by these individuals, contain only one of the elements, X or x, and that these two kinds of elements are represented equally among gametes.

Definitions

F1 The first gross offspring of parents.

F2 Offspring of the possible crosses between F1 individuals.

As a result of fertilization when the male gamete (pollen) joins the female gamete (egg cell) the resultant combinations may be predicated as shown below:

	Pollen (male) X	x
Egg Cells (female) X	XX	Xx
x	Xx	xx

Summarizing, we expect to find F2 combinations of genetic elements in the proportion. 1 XX: 2 Xx: 1 xx

If in the F2 the relationship of element X to x is as it was in the F1, xx individuals can be expected to express the characteristic expressed in F1 individuals. This means that in the F2 one expects XX and Xx individuals to show the same characteristics and xx individuals to show the alternative. F2 individuals are then expected to occur in a proportion of three (1XX + 2Xx) to one (1xx) and that is what Mendel found in his experiments.

Terminology

The following basic concepts are important:

A **unit** of **heredity**, for example the element that controls the stem length in peas, is called a **gene**.

The members of a pair of such units, like L and I controlling the long-short stemmed alternative, are called alleles.

One (or very few) pair of genes with a large effect controls the Mendel inheritance of traits. We called these traits or characteristics qualitative or single gene traits. They have **a characteristic, easily recognizable**, that can be identified as either a dominant or a recessive characteristic, or each gene expresses a part of the characteristic's expression.

Dominance is where a gene's influence will show (it does not matter if one or both dominant genes are present) its will to be expressed in its offspring. **Recessive** genes can be obscured by the presence of the dominant gene.

The Gene Theory of Heredity

Single gene heredity was the first clear experiments in the early years of the development of the theory of inheritance. That was because the environment does not influence this kind of inheritance. Morgan, a well-known investigator of Mendel's theories, and his team put the facts together into a theory. This is known as the gene theory of heredity and can be summarized as follow:

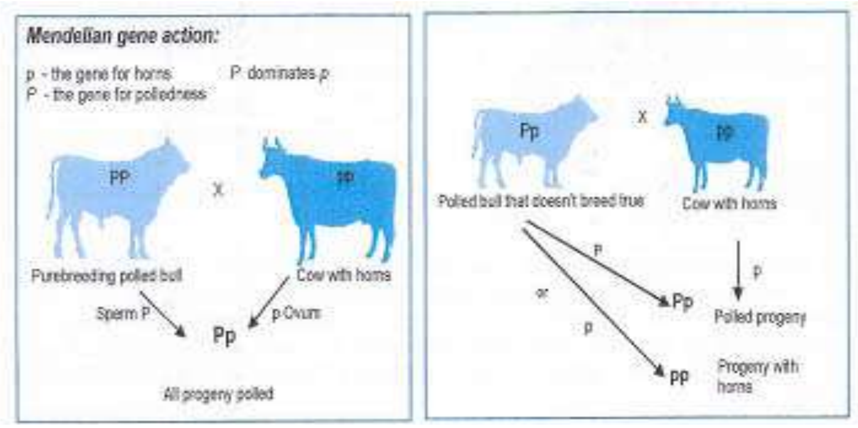
- Hereditary traits are determined by tiny particles called genes.
- These particles are transmitted from one generation to the next during the process of reproduction.
- The genes are strung in single files along the length of nuclear structures called chromosomes.
- Each gene has a definite position, or locus, on the chromosome in which it resides.
- The gene, at a given locus on a chromosome, may take one of several different (allelic) forms.

- Each gamete has a complete set of genes carried in a single set of chromosomes (monoploid/haploid).
- When two gametes unite, the resulting zygote received two complete sets of chromosomes carrying two complete sets of genes (diploid).
- When the zygote develops into an organism, each cell receives two complete sets of chromosomes carrying two complete sets of genes.
- The interaction of the two sets of genes contained in each cell determines the characters which show in the organism.
- When this new organism produces gametes, reduction division (meiosis) causes the paired chromosomes to separate, so that only one member of each pair goes to any one gamete.
- This separation of chromosomes provides the mechanism by which allelic genes are separated from one another.
- Since each gene always retains its own identity, allelic genes separate in pure form.
- Chance determines how gametes unite to produce the next generation. Therefore, it is chance that determines the recombination of the segregated genes.
- The recombination of genes by chance results in various ratios (Mendel), such as the 3: 1 ratio.
- The gene theory explains the way in which genes are carried over from one generation to the next; that is the mechanism of this process. What the gene really is that its bio-chemical composition and bio-chemical action first became clear by virtue of research done after 1950 and with which people are still busy.

P = Gene for cattle without horns

p = Gene for horns

P is dominant over p



Definitions

Monozygotic = both the gametes have the same genes.

Heterozygote = Half of the gametes have the dominant gene while the other half has the recessive gene.

1.4. QUANTITATIVE INHERITANCE

Quantitative inheritance is very common in nature; it is common among plants and animals. Most production traits of farm animals such as growth rate, milk production, and hair and wool production is inherited in this way. Many genes control quantitative traits, each with a small effect, while the environment plays a more important role in the expression of this trait. To fully understand what is meant by certain expressions let us explain a few terms.

Genotype

The genotype of a cow, ram or chicken can be described as that specific individual's genetic make-up, in other word, the unique genetic composition of that individual. No two individuals, except for clones and identical twins, have the same genotype. At present the genotype cannot be identified because it is inside the very small cell nucleus. Part of its expression in the individual is also obscured by the environmental influence on the development of the individual.

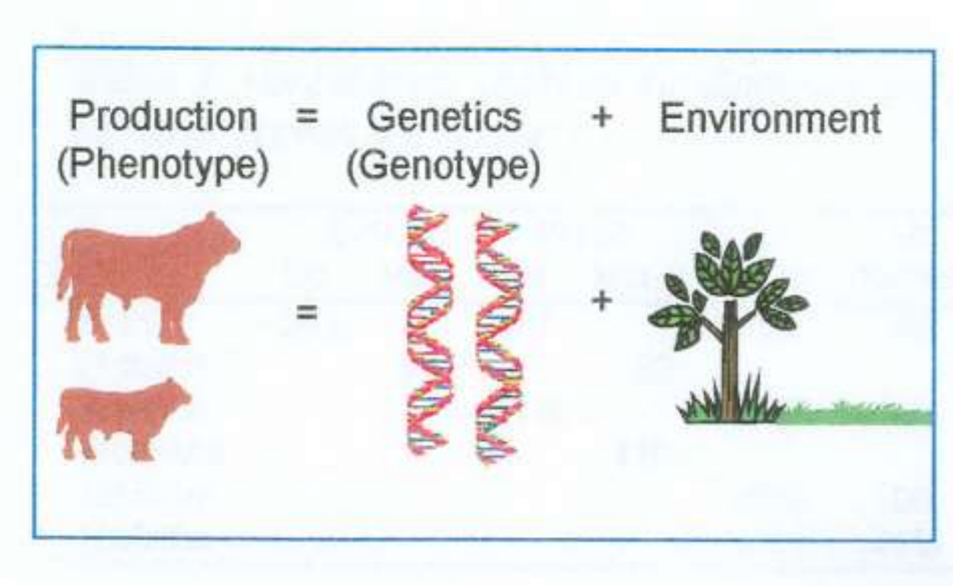
The phenotype

The phenotype, on the other hand, is how the individual expresses itself. In other words, how the individual will look like or what it's mass, colour or built will be.

The phenotype is a measurable expression of all environmental and genetic contributions put together in the individual, plus the interaction that the environment changes has on the gene combination of the genotype.

In short: Phenotype = Genotype + Environment + Interaction of the environment and the genotype.

The Meaning of Quantitative Inheritance for the Farmer



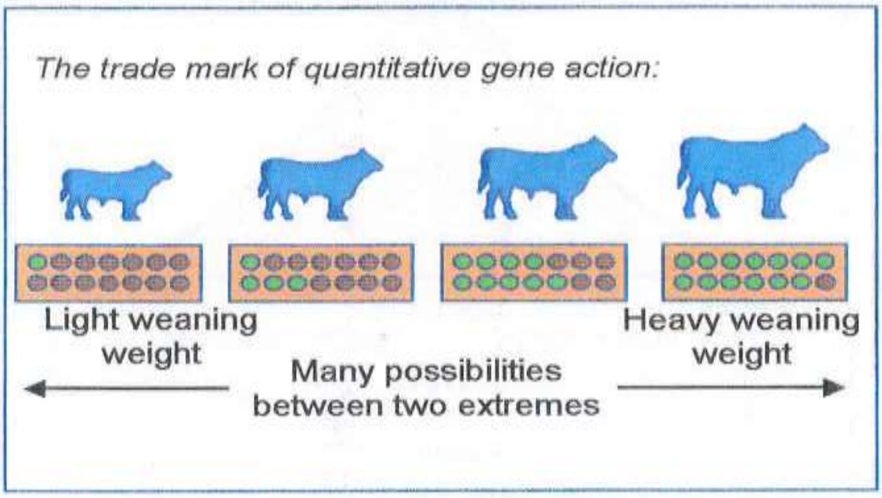
The phenotype (P) of an animal refers to the measurement of the animal, e.g. weaning weight (or any other performance record). The genotype (G) is the total genetic composition of the animal for a specific trait ant the environment (E) refers to all environmental effects that have an influence on the measurement.

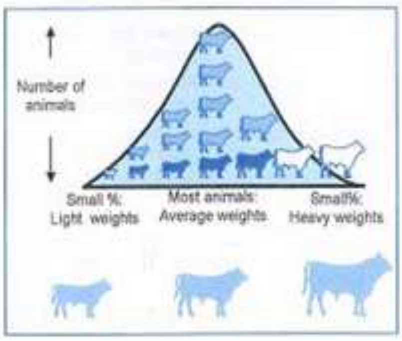
Because most of the production traits inherit in a quantitative way, it is very important that the breeder of the farm animals has a basic understanding of how quantitative traits can be selected.

Heritability

Heritability is an indication of the number of genes, that determine a certain production trait, is transferred to the progeny. In genetics the term **positive genes** are used for the genes that supports and **contributes to** the development of the trait while the term **neutral genes are used** for the genes that does not support or contribute.

Body Size of a Sheep or Cattle

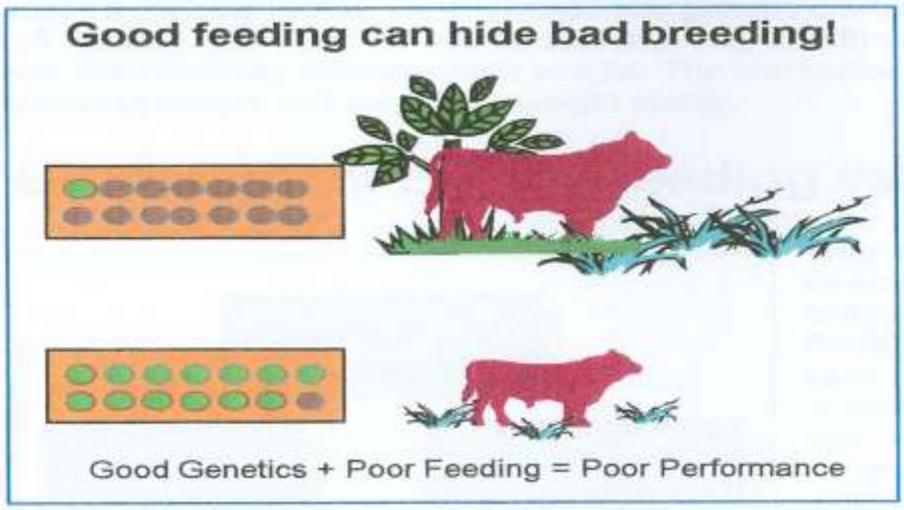




A small sheep and a large sheep will have the same number of genes that are responsible for the size of the sheep. It the two sheep are kept in the same environment; the large sheep will have more positive genes for body size and the small sheep more neutral genes.

The environment also plays a very important role and may be responsible for 70% of the size of the sheep and the genes only for 30%. Then we say the heritability of body size is 30%. That means that 30% of the body size was inherited from the parent's genes. One important aspect to remember is that although the heritability of a trait is 30%, it means that 30% of the factors determining the body size were inherited from the parents. Each parent contributes only a half of the genes responsible for body size.

If both parents contribute, say 10 positive genes for body size, the body size of the offspring will be bigger than when one parent contributes 5 positive genes and the other parent 10 positive genes, and the environment is kept the same.



If an animal with a high genetic potential is not fed, it will be impossible for him to reach his genetic potential. A genetically inferior animal, on the other hand, which is well fed, will perform much better than his genetic potential IN THE SAME ENVIRONMENT, however, the animal with the superior genetics will perform better. Genetic improvement is permanent and is transmitted to the progeny, which is not the case with environmentally induced good performance.

How does a Farmer use Quantitative Inheritance to Improve his Flock?

Repeatability

As seen in qualitative traits, some bulls will breed purely for certain characteristics. In other words, he is homozygous for that aspect. He will repeatedly transfer a trait to his progeny.

However, in quantitative traits, such as body size and milk production, that will not be so clear-cut.

After careful selection and by means of line and inbreeding for a specific trait, the "positive" genes that enhance that trait, will accumulate in the progeny. We will say the progeny become more Homozygotic for a production trait. That animal will transfer his super gene combination to his entire offspring.

We call that the animal's high repeatability for a specific trait.

Selection of Animals to Improve Performance

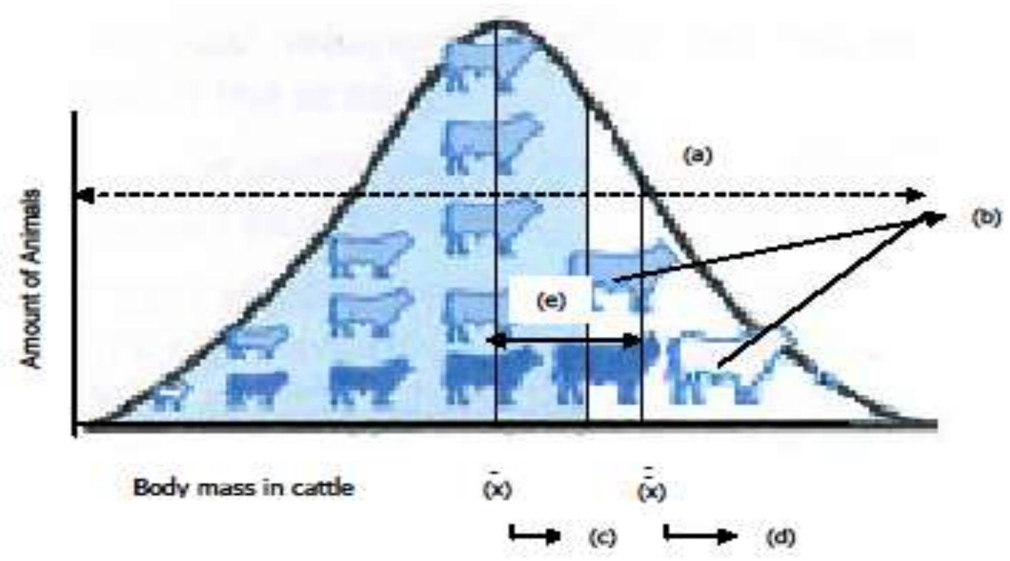
The Normal Curve

The so-called normal curve and selection: the normal curve is a graph that gives the variation for a certain trait among farm animals

In a flock of merino sheep there will be sheep that produces only one kilogram of wool per year and there will be sheep that produces 6 kg of wool per year. Then there will be a lot of sheep producing wool between 1 and 6 kg wool per year. The variation of wool production will therefore be between 1 and 6 kg of wool per year.

If you plot all the sheep's production on a graph, then you will find that most of the sheep will produce round about 3.5 kg (the average wool production of the flock) of wool per year.

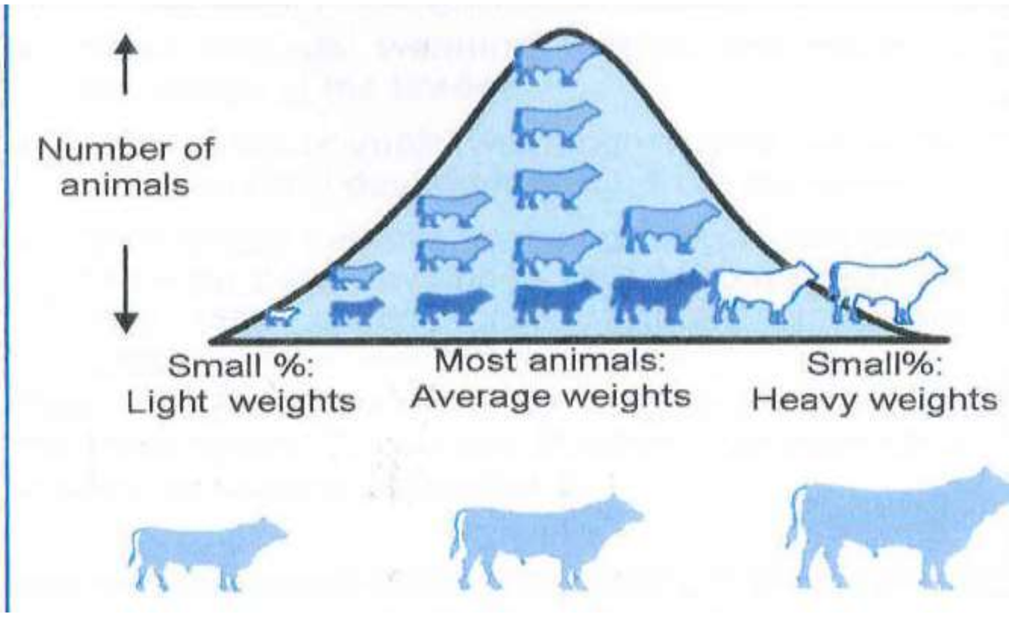
The curve will look like a clock and is called the normal curve.



a) Represents the variation in body size of the cattle
b) Represents the selected group of animals
c) Represents the average of the population
d) Represents the average of the selected group
e) Give you the selection differential

You can use this curve to select the animals that are superior, and you can work out the selection differential. That is the amount (difference) the average of the wool production or body mass will be higher in the selected group, than the average production of the sheep or cattle in the unselected population. Another example: Body size in cattle.

See cattle example:



The Importance of a Good Reproduction Rate in Farm Animals

To improve your flock, it is important to cull a few female and male animals every year.

The average reproductive lifetime of female animals is between five and seven years. If keeping in mind that an animal rarely reproduces in its first year, you will replace breeding stock at a rate of about 20% per year.

Part 3: Unit 1:

Group Formative Exercise 3B: *A farmer has a herd of 2 000 sheep.*

2. BREEDING

2.1. INTRODUCTION

We have looked at the importance of a high fertility rate to be able to select successfully. To be able to breed successfully, also needs a plan. To understand the plan better, let us have a look at the different breeding systems.

The success or failure of any system depends on:

- The frequency of the desirable genes that can be accumulated in the breeding flock.
- The breeder's ability or good fortune in mating the correct animals.
- Any system of animal breeding may be classified under one of two headings, namely inbreeding and out breeding. Inbreeding includes line breeding and family breeding; out breeding includes specie crosses, upgrading, crossbreeding and out crossing. Inbreeding is the mating of related animals; out breeding is the mating of unrelated animals.

2.2. INBREEDING

Inbreeding involves the mating of animals related to each other. More specifically, the mating of animals that is more closely related to each other than the average relationship in the flock, and even closer than any two animals drawn from the flock at random. The most intensive form of breeding is the repeatedly mating of a full brother with a full sister, sire with daughter or son with dam.

The genetic effect of breeding is that it makes more pairs of genes in the population homozygous.

In general, the effect of any system of inbreeding is an increasing of homozygosity and decreasing of heterozygosis. If harmful recessive genes are present in the stock, inbreeding will convert them (homozygous), thus enabling us to eliminate them at a faster rate. It is usually impossible, even by the most rigid selection, to rid an inbred line of all detrimental recessive genes.

Inbreeding Depression

Experience has shown that inbreeding is usually associated with an overall decline in vigour and performance. Some examples of inbreeding depression are given in **Table A.**

Table A Inbreeding depression per 10% increase in inbreeding coefficient.

Character	**Inbreeding depression per 10% increase of F**	
	Units	**% Of non-inbred mean**
Cattle		
Milk yield	136 litres	3.2
Pigs		
Litter size	0.38 young	4.6
Mass at 154 days	1.64 kg	2.7
Sheep		
Fleece mass	0.30 kg	5.5
Length of wool	0.12 cm	1.3
Body mass at 1 year	1.33 kg	3.7
Poultry		
Egg production	9.26 eggs	6.2
Hatchability	4.36%	6.4
Body mass	0.02kg	0.08

From the results of these and many other studies we can generalize that inbreeding tends to reduce fitness. Thus, characters that forms an important component of fitness, such as the number of young born, or lactation in mammals show a reduction after inbreeding. In saying that a certain character shows inbreeding depression, we refer to the average change of the mean value in several inbred lines. These separate lines are commonly found to differ to a greater or lesser extent in the change they show.

Inbreeding is the most powerful instrument at the disposal of the breeder to build up uniform or similar families or bloodlines. Inbreeding is therefore the only way in which pure-breeding groups can be obtained. However, breeders must realise that purity resulting from inbreeding is attributable to the system of mating related animals, while selection merely gives direction to this process.

In practise "pure breeding" usually means inbreeding with a specific breed and crossbreeding with other breeds thus being excluded.

The most important reasons for the application of inbreeding in a flock are the following:

- It is necessary when the relationship with a specific good ancestor must be maintained at a high level.
- It helps to reveal undesirable recessive characters and eliminate it from the flock.
- It results in uniform and separate families, so that the selection between family groups can be applied effectively.
- It increases pre-potency.
- Sometimes it is necessary because of financial considerations, particularly when another good sire must succeed a specific ram in use, which is of excellent quality and has been purchased at great expense.

The danger of intensive inbreeding is that the accumulation of undesirable homozygous genes takes place at such a rate that it is impossible to remove all the animals showing weaknesses as a result, from the flock. Some of these undesirable genes will therefore be fixed in the whole flock.

Definition

Prepotency = Power superior to that of the other parent in transmitting inheritable characters to the offspring.

The phenomenon of degeneration resulting from inbreeding may easily make its appearance in a flock without being identified as such. This problem probably arises when farmers breed their own rams by using a few purchased stud rams on a nucleus flock. A nucleus flock is usually small, which means that the successive sets of rams bred from it will therefore practically be regarded as half-brothers. Lambs of successive years will therefore be cousins, and this causes an increase in inbreeding of approximately six per cent in the flock. Dams can also be regarded as a poor quality. The danger of artificial insemination can also bring about severe inbreeding. The degeneration caused by inbreeding is often greater than the estimate inbreeding improvement resulting from the higher selection intensity. An unqualified recommendation can therefore not be made for the application of artificial insemination with a small stock, particularly not in cases where the flock consists of less than 2 000 breeding ewes.

2.3. LINE BREEDING

Line breeding is a form of inbreeding and a system in which the relationship of an individual, or individuals, is kept as close as possible to some outstanding ancestor. The ancestor is usually a male rather than a female, because a male produces many more offspring than a female, and this allows a greater opportunity to prove his merit by means of a progeny test. The genetic effect of line breeding is the same as that of inbreeding. Thus, homozygosis is increased, but in action, line breeding increases the profitability that the line-bred offspring will possess the same genes as the ancestor to which line breeding are directed.

Line breeding is also possible when the outstanding individual is already dead or not available for breeding purposes. In such a case one more of the ancestor's sons or descendants may be used to keep the relationship high.

2.4. OUT BREEDING

This is the breeding of animals not related to each other. The forms of out breeding to be discussed here are:

Species crossing

This is the widest form of out breeding and involves the crossing of different animal species, for instance, the donkey with the horse. This type of cross is of little practical use in the same stock industry.

Upgrading

Upgrading is the continual use – generation after generation – of male animals of a specific breed in a flock of another breed, e.g. the successive use of Merino rams on a hybrid flock, for the purpose of gradually building-up a Merino Flock. Upgrading is the most economical way to build up an ordinary stock to the level of stud animals, or purebred animals. The rate at which purebred male animals will change the genetic construction of a flock is represented in the table below:

Rate of blood change with upgrading

Generations	Percentage replaced	Percentage original blood
1	50	50
2	75	25
3	87.5	12.5
4	93.75	6.25
5	96.87	3.12
6	98.44	1.56
7	99.22	0.78

A relatively larger improvement takes place in the first few generations.

In South Africa many karakul flocks were built up by the continual use of karakul rams in a flock of the Blackhead Persian breed.

Cross Breeding

The term is used for the crossing of purebred animals of different breeds. (Merino crossed with Dorset Horn, etc.). Such a cross usually results in a larger animal, greater vigour and a better breeding capacity. The amount of improvement in these characters however differs for different crosses. On the other hand, crossbreeding destroys the character of pure-breeding or homozygosis and crossbred animals (the products of crossbreeding) will, although they may be excellent individuals, not breed pure.

The advantages and use of cross breeding are as follow:

- The application of hybrid vigour or Heterosis. It is applied in the production of meat, milk and sometimes wool. It is generally known that the best utilization of the Heterosis effect can be obtained in a system where the mother herself is a hybrid animal.
- The development of a new breed or breeds.
- With the development of the new breed, the two breeds chosen as parents are crossed. Sometimes another breed is also introduced in the crossing. The new breed is then developed by strict selection according to the aims of the new breed.

Out Crossing

This is the crossing of animals within a pure breed of animals, but which do not have a common ancestor or ancestors for many generations. Breeders often make use of this method to introduce new blood into a stud or flock and thus to minimize inbreeding. The principal here is to find an animal better than the animals in the farmer's own flock or stud.

Heterosis or Hybrid Vigour

The phenomenon of heterosis vigour is generally known. A classic example is that of a mule, which is harder than any of its parents. The chief character of hybrids, in which they differ from pure bred animals, is that they are more heterozygous in their genetic constitution and for this reason hybrid vigour is ascribed to increased heterozygosis.

Definition:

Mule = Cross between a donkey and a horse.

2.5. BREEDING SEASON

Some farm animals have very specific breeding seasons. In the previous level we have discussed that very well. To refresh your memory:

The British sheep-breeds have a very well-defined breeding season and so have the Angora goat in South Africa. The angora goats' breeding season starts in the fall late February, March and reaches its peak around April, May and decline towards the end of July.

Other breeds like the Dorper and the Indian Bikaneri have a very long breeding season and show no real anoestrus period. All the Merino and Merino crosses exhibit a long breeding season.

There are however farm animals that have a very specific breeding season as day-light length of the lack thereof play a big role. By contributing the daylight, one also has control on such animal's production cycle. Laying the hens of most poultry can be controlled in that way.

BREEDING SYSTEMS AND MODERN TECHNOLOGY

There are a lot of breeding systems that can be used in farm animals. The best breeding system to improve production is not always achieved without modern technology.

The number of calves and the weight of weaner calves sold determine the income in a cattle production system. If the main production goal is to produce one new-born animal per cow per year then the income goal is to sell these calves and non-productive cows at the best price.

The number of calves weaned as well as their weaning weights are the results of all the work done during the rest of the production cycle. It is now time to convert this result into money which is the driver for sustainable and profitable cattle farming operations.

The profit generated is calculated through a very simple equation:

Profit = Income (kg produced x price) - Expenses

A cow unit is used as an example to explain the basic calculation of the possible profit that can be obtained:

1. Ten cows produce eight calves per year (80% calving success rate).

2. Four of the calves are bull calves and are sold at weaning when they weigh 220kg. The price obtained is R20/kg.

3. One of the heifer calves weighing 200 kg is also sold at weaning at R18/kg.

4. The three heifer calves are kept as replacement for the cows.

5. One two-year old heifer that didn't grow well or didn't fall pregnant is also culled and sold.

6. The two cows that didn't produce a calf during this year are also sold. They weigh 450kg and the price obtained is R15/kg.

7. The cost of supplementary feeding was R600 per cow for the year and the cost of medicine, dip and vaccine was R50 per cow.

The profitability calculation is simplified as an example for training purposes but contains all the principles the livestock handler, whose primary role is to prevent production losses, must understand.

Basic Profitability Calculation for a 10 Cow Production Unit

Income	Quantity	Weight	R per kg	R per animal	Income	% of Income
Bull calves	4	220	R20	R4 400	R17 600	44%
Heifers 1	1	200	R18	R3 600	R3 600	9%
Heifers 2	1	300	R17	R5 100	R5 100	13%
Cows	2	450	R15	R6 750	R13 500	34%
Total Income	**8**				**R39 800**	**100%**
			Less			
Expenses	**Quantity**	**Unit**	**Unit Cost**		**Expense**	**% of expense**
Supplementary Feed	10	Cows	R 600		R6 000	42%
Animal Health	21	Herd	R75		R1 556	11%
Transport	12	Month	R125		R1 500	10%
Other expenses	12	Month	R450		R5 400	37%
Total Expenses					**R14 456**	**100%**
					Profit	**GP%**
Profit					R25 344	64%
Average Monthly Income					**R2 112**	

	Loss	% of Profit			
Loss of Calf	R4 400	17%			
Loss of Cow	R6 750	27%			

Profit = Income – Expenses

60% of income comes from sale	40% of incomes from the sale of cull animals (non-productive heifers and cows).
The loss of one calf (R 4 400) not successfully weaned and sold will decrease the probability of this production unit by nearly 20%.	The loss of one cow (R 6750) must be deducted from the possible profit, resulting in a 25% reduction in profit.

Source: Afrivet – Livestock Handler Training Manual Module 12 Pregnancy diagnosis and weaning of calves

Beef cattle farmers have a very extensive breeding system going. They test the progeny of the bulls (they want to use in their breeding plan) in a well-structured way. They use production traits such as daily growth rate, weaning mass and a lot of meaningful production aspects in a national progeny-testing scheme.

BREEDING OF CATTLE

Critical Control Points Breeding Season		Production Goals Breeding Season
1	Management of bulls	Enough quality bulls to get cows and heifers pregnant during a limited breeding season.
2	Management of cows	60% of the cows must conceive during the first 21 days of the breeding season.
3	Management of first-calf cows	60% of the first-calf cows must conceive during the first 21 days of their second breeding season.
4	Management of heifers	85% of the heifers must conceive during the first 21 days of their first breeding season.
5	Effective vaccination of calves	Calves must be protected against clostridial disease through vaccination, which will ensure that no calves are lost owing to black quarter.
6	Optimal growth of calves before weaning	Calves must maintain an average daily gain of 0.8 to 1 kg per day during the fast-growing period.

Source: Afrivet – Livestock Handler Training Manual Module 10 Managing the breeding of cows and growth of suckling calves

BREEDING SHEEP

Pre-Lambing Management

The nutritional needs of the ewes increase rapidly in the last six weeks before lambing. This is because of the fast growth of the unborn lamb/s inside the womb and therefore the limited space available for the large stomach (rumen) to be filled with food.

Grouping of ewes	Ewes should have already been scanned for pregnancy as from 42 days after the end of the breeding period. This examination is used to divide ewes into groups according to the number of lambs that they carry (single / twins / triplets). Nutritional management cannot be effective without this information
Supplementation	Supplement where necessary to obtain an average body condition score (BCS) of 3 at the start if lambing. Supplement bypass protein, high-quality roughage or pastures for optimal foetal growth and udder development. Too little nutrition will cause undersized lambs (less than 4.5 kg) and increase lamb deaths. Do not change the food ration r availability in the last three weeks before lambing.
Vaccination	Multi-clostridial vaccination four to eight weeks prior to lambing to provide passive immunity to lambs and protect ewes during the lambing process.
Deworm	Do worm egg counts to determine roundworm and liver fluke infestations. Treat if needed four to eight weeks before lambing to reduce contamination of the grazing.
Crutching of shearing	Crutch or shear four to eight weeks before lambing as shorter wool will prevent soiling during lambing and blowfly strikes. No shearing form three weeks before the start of lambing.
Select and prepare lambing area	Selection based on the size of the camps, the availability of shelter and the quality of available pasture.

Pre-Lambing Checklist

☐	Ewes grouped according to pregnancy status.
☐	Conditional score four to eight weeks before the start of lambing.
☐	Supplementation provided according to needs and body condition score.
☐	Ewes vaccinated with a multi-clostridial vaccine.
☐	Worm egg counts done to establish the need for deworming.
☐	Deworming done, if needed.
☐	Shearing or crutching done in the case of woollen sheep.
☐	Lambing camps selected and prepared.

Lamb Management

Be ready for the first births from 142 days after the start of the previous breeding season. The only way to manage this critical period effectively is to limit the breeding season so that ewes lamb down within a restricted period of four to six weeks.

Most lamb deaths occur within the first 24 hours after birth and lamb deaths are the major cause of production losses in sheep farming.

Management of pregnant ewes close to lambing	Put ewes about to lamb in lambing camps or pens. As the lambing season progresses, try to separate ewes with lambs from pregnant ewes that still need to lamb.
Close observation during lambing	Watch ewes closely. When ewes go into labour, allow 30 minutes to one hour for normal delivery. Help if more than an hour has passes without delivery, if there is an abnormal presentation, or the water bag has burst, and no lamb appears. Wash the external genitalia of the ewe thoroughly before entering the ewe. Hands and arms must then be washed with a disinfectant soap and then lubricated with a water-based

	lubricating gel. If you cannot readily get into the uterus and feel the Lamb, stop and call your veterinarian. Umbilical cords should be disinfected with a solution of iodine to prevent navel ill.
Colostrum intake	The lamb is born without an immunity against diseases. The only immunity it will receive to protect it during the first two to three months of life will be obtained from the colostrum (first milk). If the lamb has not nursed within six hours after birth or if it is weak, use a feeding bottle or stomach tube and feed it 50ml of colostrum.
Daily observation	Do not cause unnecessary stress to ewes busy lambing or just after lambing. Observe animals in daylight and avoid disturbing them during the late afternoon, night and early morning.

Lambing Checklist

☐	Be ready and equipped to assist ewes that struggle to lamb.
☐	Check that lambs drink colostrum within three to six hours after birth.
☐	Be ready and equipped to supply lambs that didn't suckle within the first three to six hours with colostrum.
☐	Disinfect naval at birth if the lamb is born in a contaminated area.
☐	Ensure the specific daily observation of lambs and ewes for the first signs of disease.

Being able to identify ewes very close to lambing, giving assistance with difficult births, providing colostrum with a stomach tube to lambs and resuscitating weak lambs are trained skills that the livestock handler must be taught by an experienced farmer or the flock veterinarian.

Equipment / remedies needed:

- Disinfectant for treatment of navel
- Disinfectant soap

- Lubricating gel
- Stomach tube
- Bottle with teats
- Glucose solution

This is a basic list of the equipment needed that can be expanded upon according to the different production circumstances and the intensity of the production unit.

Lactation Management

The most important factor in the growth of lambs is the level of milk production by the ewes. Milk production is stimulated by the availability of good grazing and the supplementation of bypass protein to the ewe.

Group ewes	Group in multiple and single-lamb groups to be supplemented according to need.
Dock tails	Dock lambs at less than two weeks of age, if possible.
Castrate male lambs	Castration may be done at this point. Lambs should be castrated before they are one month of age.
Remove ewes	Remove ewes that lost their lambs to save on the amount of supplementary feed needed by the lambing flock.
Monitor milk production	Observe and examine, if needed, the udders of all lactating ewes for any defects (mastitis) and milk production. Enough water should be readily available as a lactating ewe may consume up to 9 litre of water a day. Keep ewes on high-level nutrition during lactation for maximum milk production.
Monitor parasites	Ewes — Do faecal egg counts two weeks after the end of the lambing period.

	Lambs — First treatment for roundworm and tapeworm 30 days after the lambing season.
Vaccinate	Lambs — First vaccination against pulpy kidney should be done from two months of age when the protection provided by the colostrum is declining. Ewes — Annual vaccination of non-pregnant ewes against bluetongue.

Lactation Checklist

☐	Dock tails using the correct method. Dock tails using the correct method.
☐	Castrate male lambs.
☐	Specifically observe the udders of ewes for milk production.
☐	Deworm lambs.
☐	Deworm ewes, if needed.
☐	Vaccinate lambs against pulpy kidney.
☐	Vaccinate ewes against bluetongue.
☐	Feed supplement for ewes.

Weaning Management

Because of the short lactation period of sheep, it is essential to maintain the optimal growth of lambs up to and after weaning. To ensure this, creep feeding has become a standard management tool in sheep farming.

Lamb management	Lambs' rations should not be changed for two weeks before or after weaning. Creep feed, with a 16% to 18% crude protein content, can be provided to lambs. Creep feeding has a dual effect: increased weaning weights and lamb survival.

	Post-weaning survival rates are largely dependent on the growth rate in the pie-weaning period, as well as the final weaning weight. The faster growing and heavier weaners will have better survival rates.
Vaccination	Lambs must be given a booster vaccination against pulpy kidney at weaning. This vaccination can be in the form of a broad-spectrum vaccine that includes other clostridial diseases and vaccination against pneumonia.
Parasite Management	Depending on when lambing takes place, internal parasite infestations must be monitored, especially during the wet season. Follow-up treatments against roundworms and tapeworms are usually needed before and at weaning.
Evaluate ewes at weaning	If ewes are on a high level of supplementation, this can be reduced 14 days prior to weaning in order to reduce milk flow. Udder examination at the time of weaning is informative to identify ewes that did not lamb, ewes that have lost their lambs and ewes that have lambs with them at weaning. Use this data and the examination of the ewe's teeth to identify ewes for culling.

Livestock Handler Weaning Checklist

☐	Provide creep feeding to lambs.
☐	Booster vaccination of lambs against pulpy kidney.
☐	Monitor internal parasite infestations in lambs.
☐	Treat lambs against internal parasites, as needed.
☐	Evaluate ewes at weaning to determine cull animals. Evaluate ewes at weaning to determine cull animals.

Source: Afrivet – Livestock Handler Training Manual Module 10 Managing the breeding of cows and growth of suckling calves

Ewe's Reproduction Cycle

Stadium	Phase	Days	Condition Point: Objective	Energy MJ ME / head / day	Guidelines
1	Paar	0	3.5	8 – 9.5	Ooie moet in stygende kondisie wees. Moenie ooie onder 3 kondisiepunt paar nie.
2	Vroeg tot Mid-Dragtig	1 - 90	3	9 - 11	Behou kondisie.
3	Laatdragtig	90 - 150	3.5	Enkeling: 10 - 14,5 Tweeling: 11 - 18	Maak seker ooie kry genoeg kwaliteit voeding vir fetus- en uierontwikkeling.
4	Lam	150	3.5	Enkeling: 18 – 21 Tweeling: 23 - 27	Maksimum toesig met minimum inmenging - lam in klein groepies.
5	Laktasie	150 - 240	3		Ekstra voeding vir melkproduksie veral tweelinge - kruipvoeding (monitor kruipinname).
6	Speen	240	2		Speenlammers minimum 45% van volwasse massa.
7	Na Speen	240	2		Goeie kwaliteit voer vir lammers - beste benutters van voer.
8	Voor Paar	265	2 - >3.5		Prikkelvoeding sodat ooie verbeter in kondisie.

Reproduction Tables

DATUM GEPAAR DATE MATED		VERWAGTE DATUM VAN GEBOORTE / EXPECTED DATE OF BIRTH									
		OOI / EWE		MERRIE / MARE		KOEI / COW		SOG / SOW		TEEF / BITCH	
Januarie	1	Mei	30	Desember	6	Oktober	7	April	25	Maart	3
January	8	June	6	December	13	October	14	May	2	March	10
Januarie	15	Junie	13	Desember	20	Oktober	21	Mei	9	Maart	17
January	22	June	20	December	27	October	28	May	16	March	24
Januarie	29	Junie	27	Januarie	3	November	4	Mei	23	Maart	31
February	1	June	30	January	6	November	7	May	26	April	3
Februarie	8	Julie	7	Januarie	13	November	14	Junie	2	April	10
February	15	July	14	January	20	November	21	June	9	April	17
Februarie	22	Julie	21	Januarie	27	November	28	Junie	16	April	24
February	28	July	27	February	2	December	3	June	22	April	30
Maart	1	Julie	28	Februarie	3	Desember	5	Junie	23	Mei	1
March	8	August	4	February	10	December	12	June	30	May	8
Maart	15	Augustus	11	Februarie	17	Desember	19	Julie	7	Mei	15
March	22	August	18	February	24	December	26	July	14	May	22
Maart	29	Augustus	25	Maart	3	Januarie	2	Julie	21	Mei	29
April	1	August	28	March	6	January	5	July	24	June	1
April	8	September	4	Maart	13	Januarie	12	Julie	31	Junie	8
April	15	September	11	March	20	January	19	August	7	June	15
April	22	September	18	Maart	27	Januarie	26	Augustus	14	Junie	22
April	29	September	25	April	3	February	2	August	21	June	29
Mei	1	September	27	April	5	Februarie	4	Augustus	23	Julie	1
May	8	October	4	April	12	February	11	August	30	July	8
Mei	15	Oktober	12	April	20	Februarie	19	September	7	Julie	16
May	22	October	18	April	26	February	25	September	13	July	22
Mei	29	Oktober	2	Mei	3	Maart	4	September	20	Julie	31
June	1	October	28	May	6	March	7	September	23	August	1
Junie	8	November	4	Mei	13	Maart	14	September	30	Augustus	8
June	15	November	11	May	20	March	21	October	7	August	15
Junie	22	November	18	Mei	27	Maart	28	Oktober	14	Augustus	22
June	29	November	25	June	3	April	4	October	21	August	29
Julie	1	November	27	Junie	5	April	6	Oktober	23	Augustus	31
July	8	December	4	June	12	April	13	October	30	September	7
Julie	15	Desember	11	Junie	19	April	20	November	6	September	14
July	22	December	18	June	26	April	27	November	13	September	21
Julie	29	Desember	25	Julie	3	Mei	4	November	20	September	28
August	1	December	28	July	6	May	7	November	23	October	1
Augustus	8	Januarie	4	Julie	13	Mei	14	November	30	Oktober	8
August	15	January	11	July	20	May	21	December	7	October	15
Augustus	22	Januarie	18	Julie	27	Mei	28	Desember	14	Oktober	22
August	29	January	25	August	3	June	4	December	21	October	29
September	1	Januarie	28	Augustus	6	Junie	7	Desember	24	November	1
September	8	February	4	August	13	June	14	December	31	November	8
September	15	Februarie	11	Augustus	15	Junie	21	Januarie	7	November	15
September	22	February	18	August	27	June	28	January	14	November	22
September	29	Februarie	25	September	3	Julie	5	Januarie	21	November	29
October	1	February	27	September	5	July	7	January	23	December	1
Oktober	8	Maart	6	September	12	Julie	14	Januarie	30	Desember	8
October	15	March	13	September	19	July	21	February	6	December	15
Oktober	22	Maart	20	September	26	Julie	28	Februarie	13	Desember	22
October	29	March	27	October	3	August	4	February	20	December	29
November	1	Maart	30	Oktober	6	Augustus	7	Februarie	23	Januarie	2
November	8	April	6	October	13	August	14	March	2	January	9
November	15	April	13	Oktober	20	Augustus	21	Maart	9	Januarie	16
November	22	April	20	October	27	August	28	March	16	January	23
November	29	April	27	November	3	September	4	Maart	23	Januarie	30
December	1	April	29	November	5	September	6	March	25	February	1
Desember	8	Mei	6	November	12	September	13	April	1	Februarie	8
December	15	May	13	November	19	September	20	April	8	February	15
Desember	22	Mei	20	November	26	September	27	April	15	Februarie	22
December	29	May	27	December	3	October	4	April	22	March	1

3. LIVESTOCK REPRODUCTION PROCESS

3.1. REPRODUCTION IN FEMALE ANIMAL

The reproductive tract of a cow is located beneath the rectum—the last segment of the large intestine. Most parts of the reproductive tract can be examined indirectly when an arm is extended into the rectum (rectal palpation):

- The cervix can be manipulated during artificial insemination.
- The follicles or corpus luteum (CL) may be identified on the ovaries.
- The presence of a growing embryo in the uterus can be detected.

The uterus, oviducts and ovaries are suspended in the body cavity by a broad ligament. The position of this ligament permits the uterus to accommodate a growing foetus.

Vagina

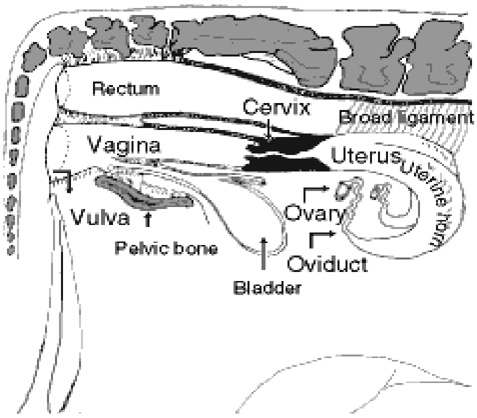
The vagina is a flattened tube, normally of about 30 cm long. It is the site of semen deposition during natural service. The vagina serves as a passageway for the instruments used for artificial insemination and for the emergence of the calf at the time of birth.

Cervix

The cervix is a strong muscle about 10 cm in length and 2.5 to 5 cm in diameter. It is pierced in its centre by a narrow canal. The canal is usually closed (and sealed during pregnancy) except during heats and at birth. The cervix is a very effective "control gate" that prevents any foreign material from invading the uterus and, in effect, isolates it from the outside world.

Uterus

The uterus is the part of the reproductive tract where the developing calf is carried. In a non-pregnant cow, the body of the uterus is less than five centimetres long and has left and right horns that curve like those of a ram. The uterus is a muscular organ capable of enormous expansion to accommodate a growing calf. By the end of a pregnancy, the uterus contains a calf of 35 to 40 kg, 20 to 30 kg of fluid, and five kg of placental tissue (afterbirth). After calving, it takes about 40 days for the uterus and other parts of the reproductive tract to regain their non-pregnant size (this process is called involution).

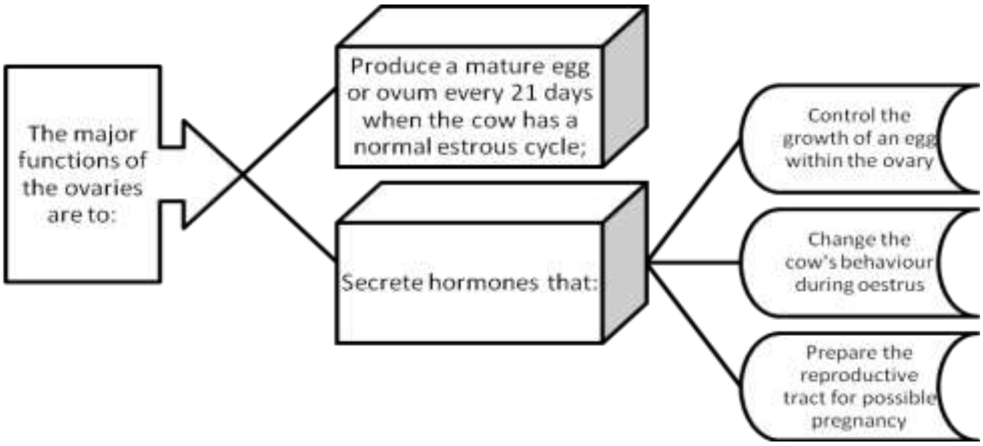


Oviducts

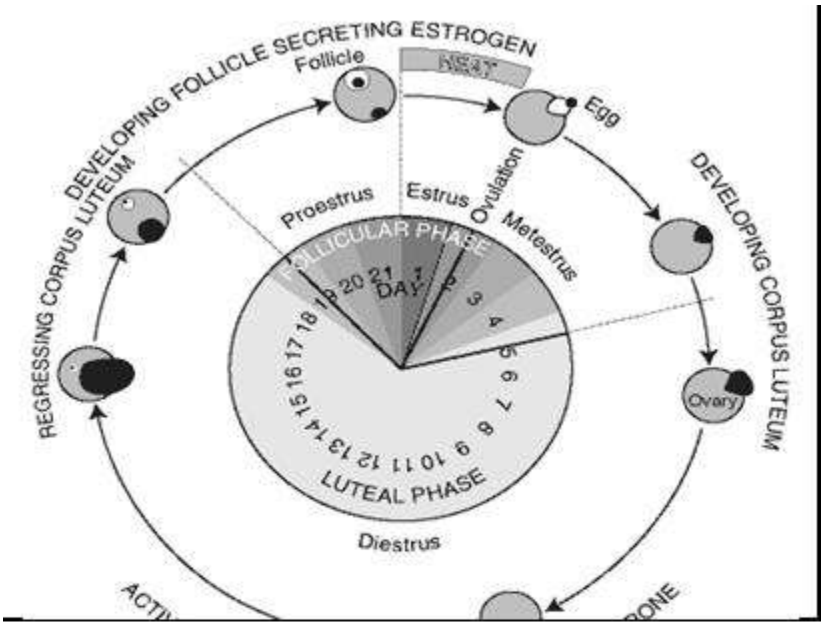
The oviducts are the two convoluted tubes that join each of the uterine horns to one of the cow's two ovaries; they are more than 20 cm in length and only 0.6 cm in diameter. The end of each oviduct opens into a funnel-shaped structure (infundibulum); this structure collects the egg that is ejected from the ovary during heat. Fertilization, or the union of the egg and a spermatozoon, occurs in the oviduct. The embryo stays in the oviduct for three or four days before moving into the uterus. This period of time is necessary for the uterus to prepare itself to receive a growing embryo.

Ovaries

In a non-pregnant cow, the ovaries are oval (shaped like an egg), about four to six cm in length and two to four cm in diameter.



One of two structures predominate at the surface of an ovary: either a follicle containing a maturing egg, or a corpus luteum (yellow body) which grows from what remains of a follicle after the egg has been expelled (ovulation).



Egg or Ovum

In contrast to all other cells in the body, each egg contains only one copy of the genetic information contained in the chromosomes. Eggs are found in the ovary before birth, but maturation of the eggs begins with sexual maturity at puberty (12 to 14 month of age) and the onset of heat cycles.

The Heat Cycle

The heat cycle is the interval (21 days average length) between two heats. A heat, or oestrus, lasts six to 30 hours and is the period of sexual receptivity (Day 1 of a cycle).

Follicular Phase

Toward the end of a heat cycle when an egg reaches maturity, it is enveloped in a series of coating cells and is surrounded by nutritive substances. The entire structure is called a follicle and it secretes estrogen, a hormone that changes the behaviour of the cow in heat. It is only during a heat that a cow allows herself to be mounted by a bull or other cows. During heat, the egg and the follicle reach the final stages of maturation.

At ovulation (12 hours after the end of signs of heat), the follicle "explodes," the egg is propelled into the oviduct and the remaining cells on the ovary begin to form a new structure called a corpus luteum. The corpus luteum secretes a hormone called progesterone that prevents the complete growth of follicles and is necessary to maintain pregnancy.

Corpus Luteal Phase

The complete development of a corpus luteum takes about three days (Days 2 to 5 of a cycle). Although some follicles start to grow on Day 1 of the cycle, the progesterone secreted by an active corpus luteum prevents them from maturing and they degenerate. On Days 16 to 18 of a cycle, if the uterus has not detected the presence of an embryo, it will send a hormonal signal (prostaglandins) that causes the corpus luteum to regress. This regression removes the inhibition of the final phases of follicular growth and allows a dominant follicle to complete its maturation. This leads to a new heat and the beginning of a new cycle.

3.2. OESTRUS

In the case of pregnancy, the uterus and the embryo send hormones that help maintain the corpus luteum throughout the entire pregnancy.

> The life cycle of an animal starts at conception.

> With cattle, the calf is born after a period of 283 days or approximately 9 months of pregnancy.

One of the most important factors affecting the management of breeding, is the length of this gestation period (the time the cow carries the calf from conception to birth). After calving, a cow should not be brought to the bull before at least 50 days have elapsed to allow the uterus time to undergo involution (a necessary period of rest and recuperation from possible injuries suffered at calving).

In herds where calving takes place in a restricted breeding season, a cow has a very limited period of time to fall pregnant. Adding 50 days to the 283 days of gestation and subtracting the total from 365 days, leaves the cow 32 days to conceive in time to calve the following year at approximately the same time of the year. On average a cow comes on heat every 21 days (heat lasts 6 to 18 hours), which means that she has at most 2 chances during these 32 days (often one chance only) to re-conceive.

Heifers are usually mated at either 15 or 27 months to calve down for the first time at 2 or 3 years respectively. As a rule of thumb, heifers should first be mated when they weigh at least 60% of mature mass. The age at which this target mass is reached will differ depending on level of nutrition (amount and type of feed available), breed, the age at which she cuts teeth and the time of year she was born.

First calf cows (*i.e.* heifers that have calved and are brought to the bull for the second time; by definition, a heifer becomes a cow at the birth of her first calf), have notoriously low conception rates, partly as a result of the fact that the inter-calving period between the first and second calf has been shown world-wide to be longer than subsequent inter-calving periods. Inadequate nutrition is probably a contributory cause of the extended first inter-calving period.

One of the strategies advised to overcome this difficulty is to breed heifers 4 to 6 weeks before the main herd. This practice compensates for the extended first inter-calving period and allows extra time between the first and second calf for the dam to build up body reserves as well as grow. It has been demonstrated that conception rates in first calves can be improved by breeding heifers ahead of the main herd, avoiding the imprudent loss of good genetic material where there is a policy to cull all skips (cows diagnosed non-pregnant at the time of pregnancy diagnosis).

Where first calves are run with the mature cows and/or if calves of first calves are not weaned before the main herd, the practice of mating heifers ahead of the mature cows does not achieve its aim of improving conception rates in first calves. If anything, failing to wean calves from heifers mated earlier, places additional stress on animals still in their growing phase. Another problem with breeding heifers ahead of the main breeding season is that the breeding season is timed to synchronise the available fodder production with the feed need of the mature cows. By breeding heifers earlier, their nutrient requirements are not matched to the fodder production of the farm unless supplemental feed for the heifers is provided. In practice it could be better to breed heifers with the main herd and at the same time ensure that there is adequate feed for all the animals on the farm. Where heifers are mated with the main breeding herd, more heifers must be retained annually to compensate for the additional loss of first calves that do not re-conceive.

Keeping heifers and first calves in separate herds allows younger, growing animals access to better quality feed and an equal opportunity to reach feed or lick troughs.

What are the Signs of Oestrus?

Definition

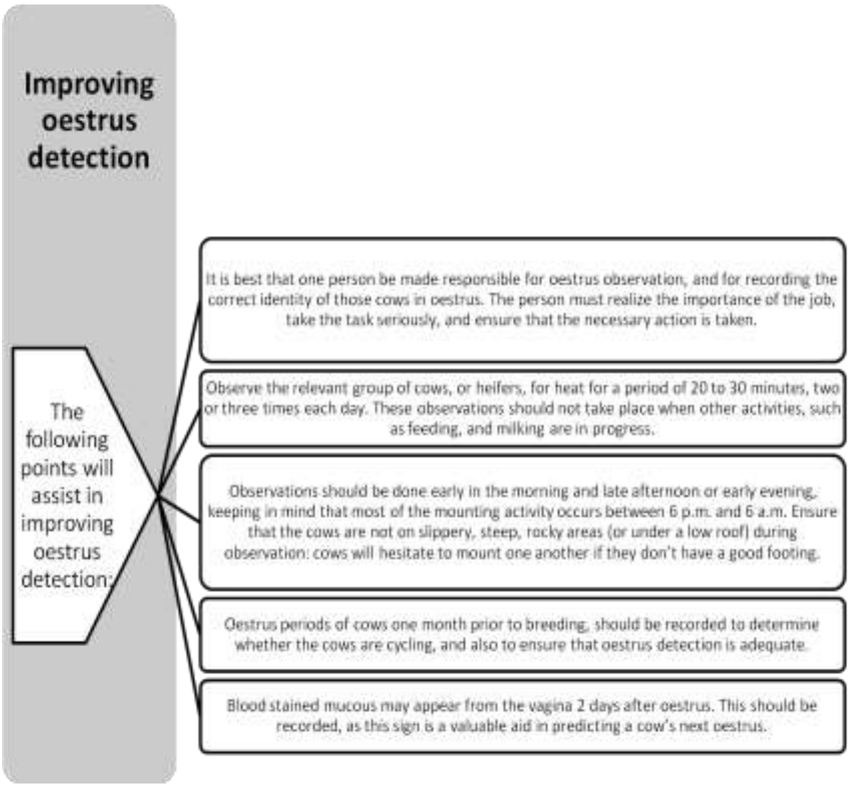
Oestrus is the physiological state during which a cow will stand to be mounted. The regular recurrence of mating behaviour (oestrus), together with changes in the reproductive hormones and genital organs, is referred to as the oestrus cycle.

> The oestrus cycle lasts from 18 to 24 days (average 21 days), and the cow shows signs of oestrus on average every 21 days.

Oestrus activity (ovarian activity with the production of oestrogen) normally recommences during the first three weeks after calving. The first observed oestrus (heat) occurs 3 to 6 weeks after calving, although there is a considerable variation between cows and herds. It is essential, however, to give the cow a voluntary waiting period (VWP) of 45 to 60 days after calving before rebreeding. This period is necessary for involution of the uterus, which may continue for up to 6 weeks after calving.

Definition

Involution is the shrinking of an organ (such as the uterus after pregnancy)



Oestrus Detection Aids

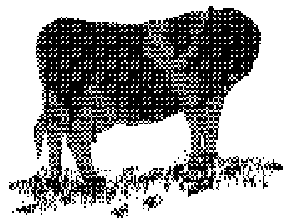
There is no real substitute for skilled observation, but heat detection aids can be useful. Listed below are some useful aids:

- The presence of a bull in the vicinity of the cows. This will stimulate oestrus behaviour in otherwise quiet cows. If the bull is placed in a pen sited in such a way that the cows can pass closely and regularly, those in oestrus will generally migrate towards the bull.
- Marker animals. Vasectomized bulls (bulls which have been surgically modified so that they are unable to fertilize cows but are still able and keen to mount them) or cystic cows can be used as heat detectors. If these animals are fitted with a "chin ball marker", they will mark the backs of those cows which they have mounted.
- Heat mount detectors. These are pressure pads in the form of sachets, containing coloured dye, which are glued in place on the tailhead. The pressure exerted by a mounting cow on this pad on the back of a cow in oestrus induces a colour change in the dye. False positives do occur, for example the banging or brushing of the detectors on obstacles such as cubicle rails. Their use is therefore best restricted to those cows which prove difficult to observe in oestrus.
- Tail "paint'. A well-placed strip of paint on the tailhead is a cheap and effective aid. This paint will be rubbed off or at least cracked when the painted cow is mounted by another. Again, false positives can be a problem, as in heat mount detectors. The technique demands good management, in the sense that cows should be checked at least once a day, otherwise heats might be missed.

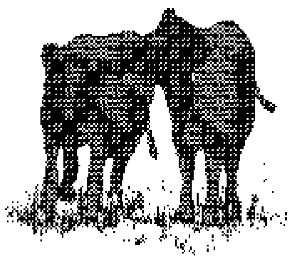
An alternative approach to oestrus detection, namely the control of oestrus by the use of hormone-type administrations, is also available. In this way oestrus synchronization can be obtained, and insemination done at a fixed time without visual confirmation of oestrus. This technique is commonly used by veterinary surgeons for the treatment of individual cows or groups not observed in oestrus by the required time. It must be stressed that, although oestrus control enables cows to be inseminated at the optimum time, it does not improve the chances of conception/pregnancy. These synchronization techniques, used on heifers under good management, have consistently given conception rates of 60 to 70%. Much poorer results have been obtained in lactating cows. Remember that synchronization is not generally used as a blanket treatment for all dairy cows. If this technique is used, then the farmer must ensure that factors which are likely to affect conception rates, *e.g.* nutrition and body condition are checked.

i) Sniffing of vulva or urine of other cows

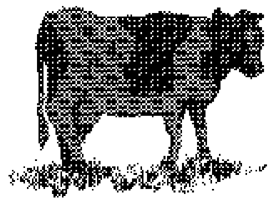
ii) Resting chin on other cow - both cows may be coming into oestrus



iii) Soliciting

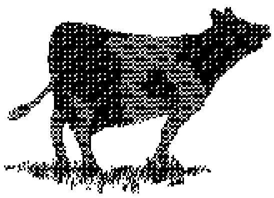


iv) Licking - both cows may be in oestrus



v) Scuffed tail head, dirty flanks and sweating

vi) Bunting



vii) Bellowing and restless

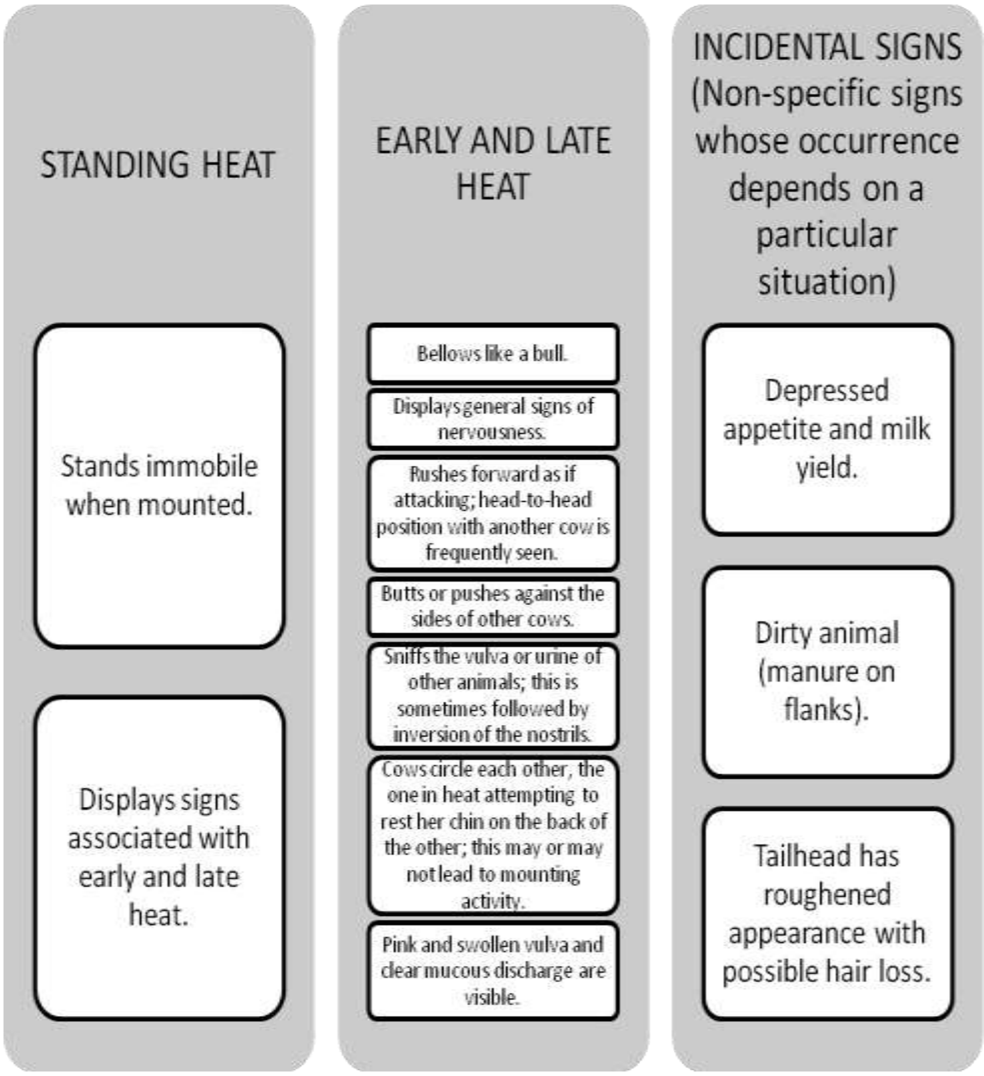
viii) Mounting head to head

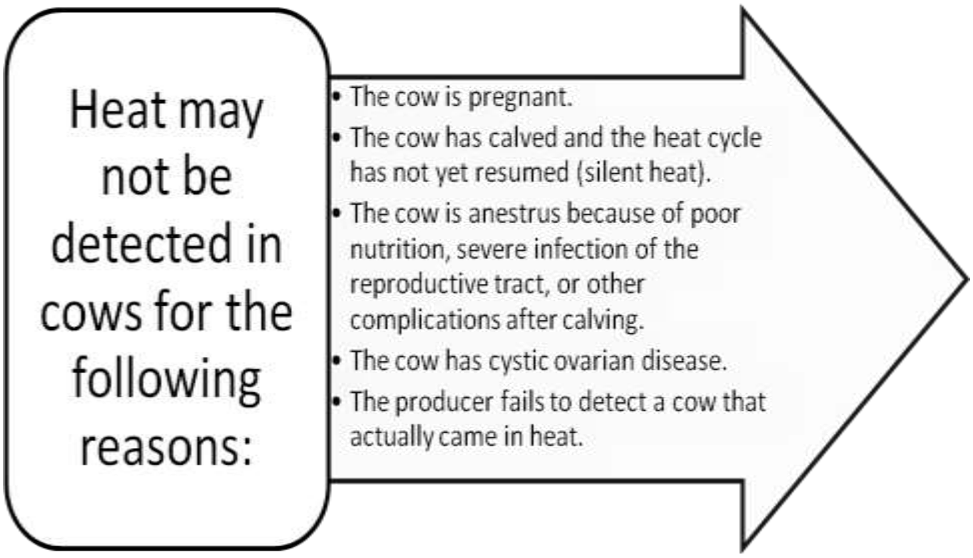
ix) Standing to be mounted

The positive sign of oestrus is standing to be mounted

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

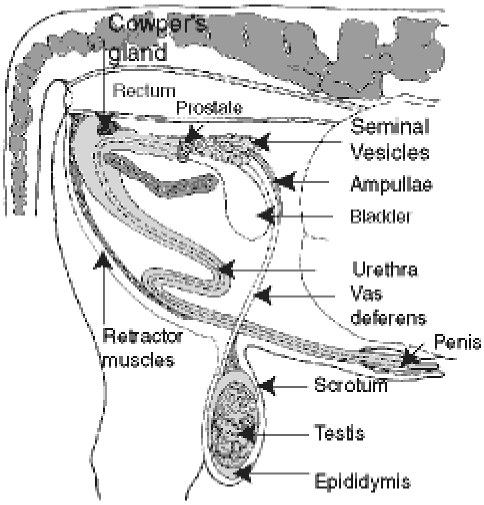
Illustrations by courtesy of the Agricultural Training Board, UK.


STANDING HEAT
Stands immobile when mounted.
Displays signs associated with early and late heat.
EARLY AND LATE HEAT
Bellows like a bull.
Displays general signs of nervousness.
Rushes forward as if attacking; head-to-head position with another cow is frequently seen.
Butts or pushes against the sides of other cows.
Sniffs the vulva or urine of other animals; this is sometimes followed by inversion of the nostrils.
Cows circle each other, the one in heat attempting to rest her chin on the back of the other; this may or may not lead to mounting activity.
Pink and swollen vulva and clear mucous discharge are visible.
INCIDENTAL SIGNS (Non-specific signs whose occurrence depends on a particular situation)
Depressed appetite and milk yield.
Dirty animal (manure on flanks).
Tailhead has roughened appearance with possible hair loss.


Heat may not be detected in cows for the following reasons:
• The cow is pregnant.
• The cow has calved and the heat cycle has not yet resumed (silent heat).
• The cow is anestrus because of poor nutrition, severe infection of the reproductive tract, or other complications after calving.
• The cow has cystic ovarian disease.
• The producer fails to detect a cow that actually came in heat.

3.3. LIBIDO OF BULL

The reproductive tract of the bull consists of the testicles, secondary sex organs, and three accessory sex glands. These organs work in concert for formation, maturation and transport of spermatozoa, which are eventually deposited in the female reproductive tract. The secondary sex organs are the epididymis, vas deferens and penis. The three accessory sex glands include the seminal vesicles, prostate and bulbourethral gland (Cowper's gland). This basic anatomy is illustrated in the figure.



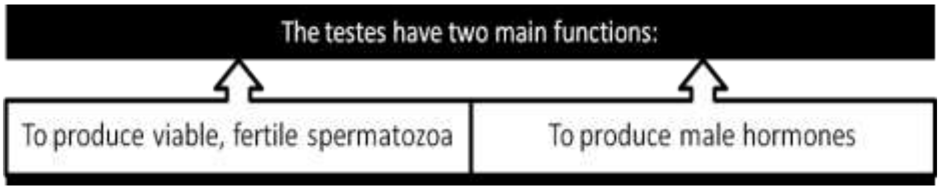
The testes of the bull produce the male sexual cells or spermatozoa which, like the egg, contain only one copy of the genetic information necessary to constitute an individual. Although the male sexual organs) begin to produce hormones before birth, the production of spermatozoa begins only at puberty (seven to 12 months of age).

Scrotum

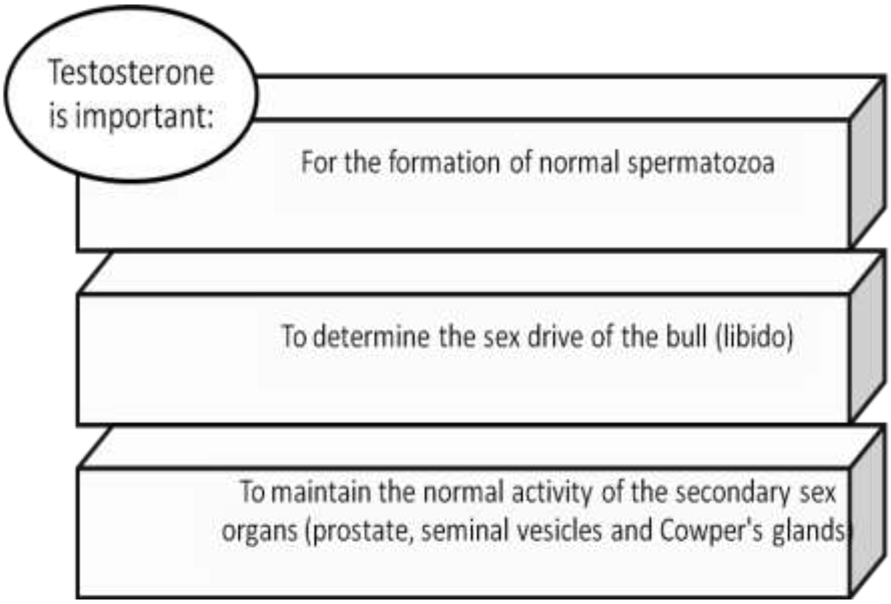
The scrotum is the sack located outside the abdominal cavity that contains the testes. By adjusting the distance between the testes and the body, the scrotum regulates the temperature of the testes. This is necessary because the formation of spermatozoa functions better at a temperature 2 to 4°C lower than normal body temperature.

Some bulls have only one testis in the scrotum. This descended testis will function properly, but the one that remains in the body cavity will not. This condition is inherited, and these bulls should not be used so the propagation of this defect will be avoided.

Testes



Each testis is enveloped in its own compartment and each is a complete, independent unit. The testes are primarily made of small tubules (seminiferous tubules) where the production of spermatozoa takes place. Some specialised cells (called leydig cells or interstitial cells) are dispersed throughout the tissues of the testes and produce testosterone, the predominant male hormone.



At the time of mating, before the sperm is ejaculated, the spermatozoa are mixed with secretions rich in nutritive substances from the secondary sex organs.

Formation of the Spermatozoa

It takes about 64 to 74 days for the formation of spermatozoa and 14 to 18 days for a sperm to travel through the epididymis (site of accumulation and final maturation of spermatozoa). Thus, symptoms of bull infertility may occur two and a half to three months after the process of sperm formation has been impaired. In general, sperm formation increases with the weight and diameter of the testes. Thus, larger and older bulls (that are likely to have larger testes) usually produce more sperm than smaller or younger bulls. The secretion of the accessory glands contributes, on average, up to 80% of the total volume of the ejaculated semen. A young bull coming into service produces as little as one or two ml of semen per ejaculation whereas a fully mature bull may produce 10 to 15 ml of semen per ejaculation. In general, when a bull serves a second, or even a third time in succession, the volume of ejaculate does not decrease, but the concentration of spermatozoa tends to decrease. Frequent ejaculations do not usually affect an adult bull's fertility, but a young bull should be used more carefully.

Signs of libido in bulls

As the cow reaches oestrus the bull becomes very excited and follows her closely, licking and smelling her external genitalia and often exhibiting flehmen. Recent work has shown that the bull uses the tongue to transfer fluid (probably urine) to a short incisive spur located on the dental pad. It is then transferred to the vomeronasal organ which is considered to be the site of pheromone identification. Pre-copulatory patterns include pawing the ground and snorting, chin resting on the cow's rump just before mounting and then copulation. Copulation is short (seconds) compared with horses and pigs (minutes).

Social ranking of bulls can influence their sexual activity, the most dominant animals mating the most.

The level of sexual behaviour displayed is determined by genetics, environmental factors, physiological factors, health and previous experience, e.g., bulls of dairy breeds are generally more sexually active than those of the beef breeds. New herd members attract greater sexual attention. Therefore, their introduction to a breeding group can be a useful means of stimulating sluggish bulls.

Testosterone and oestrogen enhance the libido of males and females respectively. Oestrus duration of cows is longer when there are many other cows in oestrus at the same time.

The bull detects the pro-oestrus cow about 2 days before oestrus and remains in her general vicinity.

During the oestrus period the cow increases her frequency of urination, so the bull can sample both the odours and the taste of her urine.

The period of sexual receptivity (mounting behaviour) ranges from 1 to 18 hours, with the average being about 4.4 hours.

Bulls that are used for AI or hand-breeding may have poor semen quality or poor reproductive behaviour, due to the lack of stimulatory effects that result from the prolonged courtship.

Bulls commonly masturbate, especially at times of inactivity.

Mounting causes an immobilisation reflex (rigid stance) in the oestrus females that are being mounted.

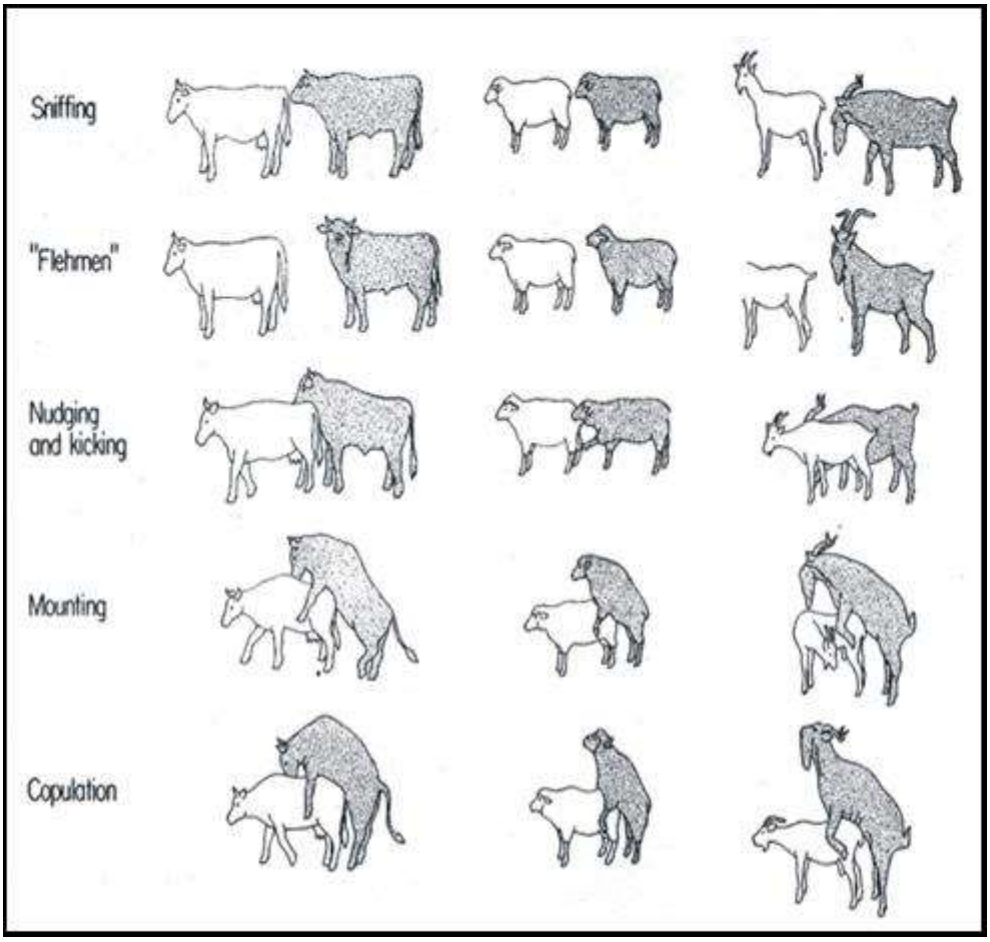
3.4. MATING BEHAVIOUR

When female animals are in standing heat male animals that are introduced to them will often exhibit phlement behaviour. This is the curling up of their top lips and sniffing at the female. Cows and goats show clear signs of oestrus. Signs to look for in cows, goats and pigs include:

- The animal became restless.
- The animals seem to lose its appetite.
- The animal bellows.
- She seeks male company.
- If kept among other females the other cows may mount the cow in oestrus.
- The vulva will appear red and swollen.
- When she nears standing heat, a thick slimy excretion will hang from the vulva. This is called the bull string.
- Sows will be more restless and noisier when in oestrus.
- You will have no difficulty to chase a sow on heat because she will stand still and make faint noises.
- The vulva of a sow will also appear red, slimy and swollen.

Animals like horses, cows and ewes will urinate frequently and if a male is nearby the male will sniff the urine on the ground and he will also sniff at the genitals of the female.

The mating behaviours of different animal species are shown in the diagram below.



3.5. PARTURITION

What is 'Parturition' and its Signs?

Definition

Parturition is the act or process of giving birth.

Pregnancy

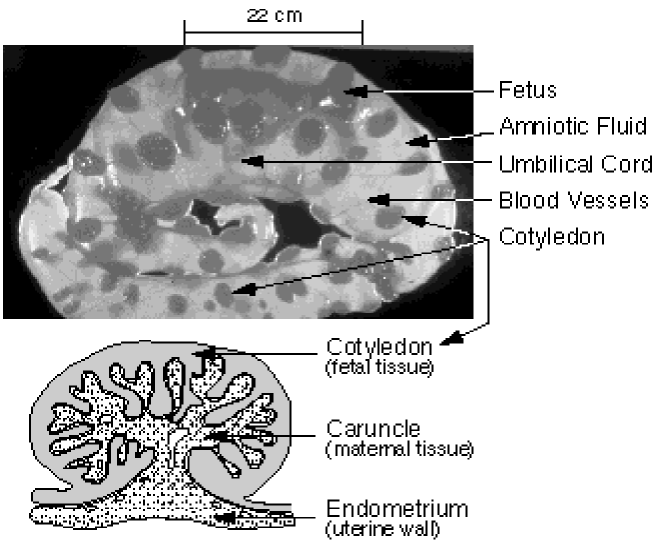
Fertilization

Fertilization is the union of an ovum and a spermatozoon to produce the first cell of an embryo.

Fertilization takes place in the oviduct. The embryo enters the uterus two to three days after fertilization but will not attach to the uterus wall (implantation) before about 28 days.

Implantation

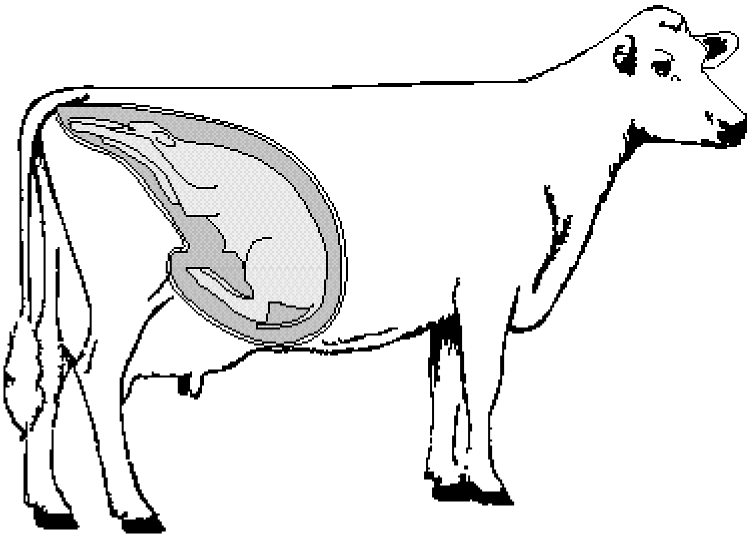
In part, implantation consists of the formation of about 80 to 100 structures where foetal tissue (cotyledon) and maternal tissue (caruncles) fold together. After calving, if the caruncles and the foetal tissue fail to separate, the placenta cannot be expelled, leading to retained placenta. The process of implantation also includes the formation of the umbilical cord that allows exchange of nutrients and waste products between the maternal and foetal tissues. Implantation is usually completed by Day 45 of pregnancy.



Foetus in placental membranes at about four months of age

Embryonic Death

Until implantation is complete, the risk of embryonic death is high. It is estimated that from 10 to 20% of all pregnancies end in embryonic death. If death of the embryo occurs within the first 17 or 18 days after fertilization, the cow will return to heat on a regular schedule and the producer may not know that the animal was pregnant. Later embryonic death will result in a delayed return to heat. In this case, the cow has an "apparent" heat cycle of 30 to 35 days. Thus, embryonic death may easily be mistaken for a cow's failure to conceive or come in heat.



Foetal position before calving

Pregnancy Check

Common methods to detect pregnancy include non-return of heat, rectal palpation and milk progesterone levels. Each method has its advantages and disadvantages.

Non-return to Heat

A cow not returning to heat 21 days after insemination may be presumed pregnant. However, a cow may not return to heat because of an ovarian cyst or failure to notice that the cow came in heat. Thus, when no other diagnostic tools are available, a cow is usually declared pregnant if no heat has been observed for at least 60 days (the time of about three normal cycles).

Rectal Palpation

A veterinarian may use rectal palpation 40-60 days after insemination to detect the fetus in the uterus, other structures associated with pregnancy, and the presence of a corpus luteum on the ovary.

Milk progesterone

During pregnancy, the heat cycle is interrupted because the corpus luteum persists and continues to secrete progesterone throughout the pregnancy. The persistence of progesterone in the milk 21 to 23 days after insemination may be used as a diagnostic tool for pregnancy.

4. ARTIFICIAL INSEMINATION

4.1. INTRODUCTION

Artificial insemination is a technique by which semen is introduced artificially into the body of the uterus at the time of heat in an attempt to cause pregnancy.

The major advantages of artificial insemination may be summarized as follows:

It provides the opportunity to choose sires that are proven to transmit desirable traits to the next generation.

It eliminates the cost and danger of maintaining a bull on the farm.

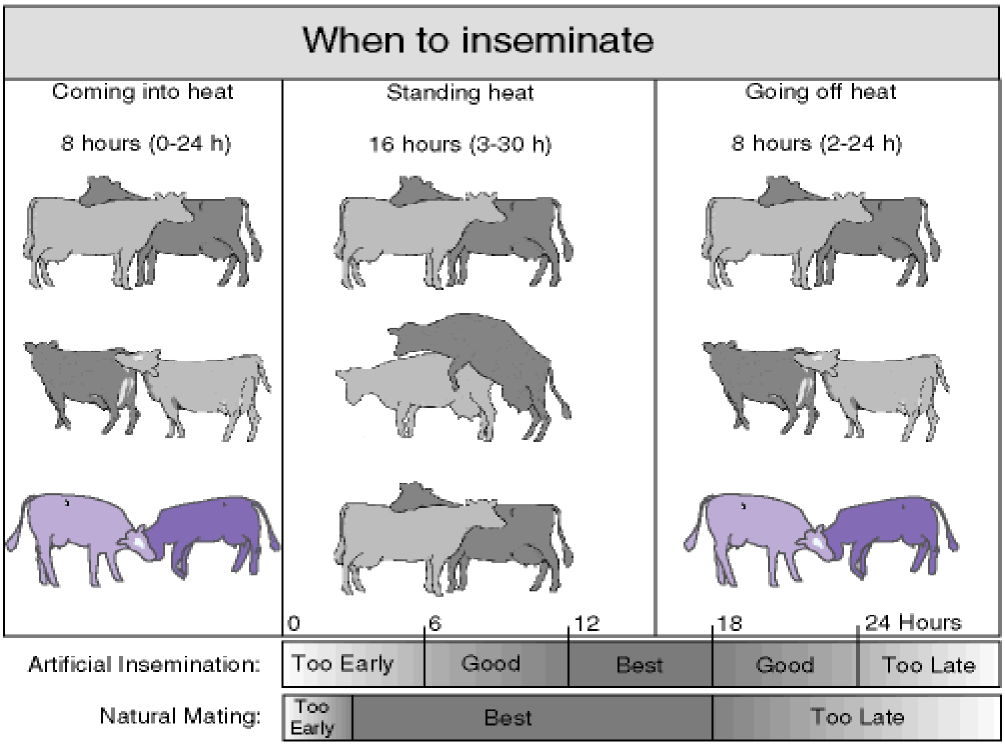
It minimises the risk of spreading sexually transmitted diseases and genetic defects (e.g., mule foot).

It has cumulative beneficial effects over the years.

Use of artificial insemination makes it necessary to develop a system to identify cows and record dates of heats and inseminations. Accurate recording is necessary to develop good reproductive management on the farm and it provides the data for breeding associations to keep accurate herd books.

Artificial insemination or natural service lead to a pregnancy only if the spermatozoa are "at the right place at the right time." The egg is released from the ovary about 10 to 14 hours after the end of heat and can only survive unfertilized for six to 12 hours. In contrast, the spermatozoa may live up to 24 hours in the reproductive tract of a cow. A common recommendation for the best timing of artificial insemination is the "morning-evening" rule: cows observed in heat in the morning are inseminated the same evening, and cows observed in heat in the afternoon are inseminated the next morning.

In the case of natural service, the cow and the bull may be allowed to mate starting a few hours after the cow accepts mounting until the cow refuses to be mounted.



The most limiting factor in artificial insemination programs is the proper detection of cows or heifers in oestrus. Oestrus, or "heat", is that period of time that occurs every 18-24 days in sexually mature, non-pregnant female cattle when they are receptive to mounting activity by bulls or other cows. In beef cattle operations where artificial insemination is the means of breeding the females, the herdsman must recognize and interpret a cow's heat signals. Proper timing of the artificial insemination is necessary to accomplish a high percentage of conceptions in the cows that are bred artificially.

Considerable amounts of research have been conducted on the various factors contributing to the efficiency with which cows are detected in heat. When all is considered, one of the key factors is the skill of the human performing the heat detection. With an AI program, people assume the same responsibility as the bull for accurately detecting heat and the proper timing of insemination. Thus, the dilemma for the inseminator is determining which cows are in a "standing heat" and when that heat occurs.

A cow is fertile only when an egg has been released (or ovulated) from the ovary. This occurs about 10-14 hours after the period called "standing heat" ends. Because sperm need time in the cow's reproductive tract before they are capable of fertilizing the egg, insemination should be made several hours before ovulation. This means that for the highest fertility, cows or heifers should be inseminated in the latter two-thirds of heat or within a few hours after having gone out of heat. This represents approximately 12-18 hours after the cow first comes in "standing heat."

What Instruments are used in AI?

Ai gun/syringe is manufactured for injecting the semen into the vagina of the animal

An AI tank used for storing semen

4.2. WHICH ANIMALS ARE READY FOR AI?

Maximum fertility to artificial insemination occurs when cows are bred near the end of "standing heat." Ovulation occurs about 12 hours after the end of standing heat. The 12-hour lead time allows the sperm cells to go through a process known as capacitation by the time the egg is released. Fertility decreases slightly when cows are bred a few hours on either side of this target and decreased markedly when breeding occurs more than 12 hours away from the end of "standing heat."

A guide that has proved to work well for timing AI is called the AM/PM rule. At the end of the morning heat detection period, animals detected the prior evening are bred; at the end of the evening heat detection period, those observed that morning are bred. In some situations, AI must be employed once-a-day wherein all animals detected in the prior 24 hours are bred. Some studies show little decrease in fertility when this approach is used.

Table - Using the AM/PM Rule		
Cows First Showing Oestrus	**Should be Bred**	**Too late for Good Results**
In the morning	That evening	Next day
In the evening	The next morning	After 3:00 p.m. next day

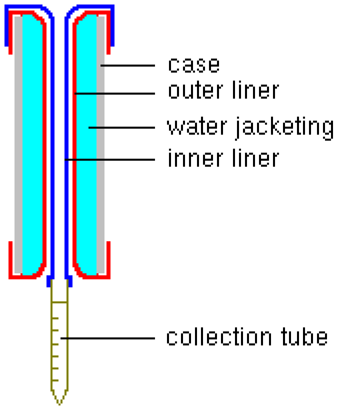
4.3. HOW TO COLLECT AND STORE SEMEN

Semen is most commonly collected from bulls in bull studs using an artificial vagina, as described below. Electro ejaculation is an alternative method used with bulls that cannot mount or are too fractious for easy handling (e.g. range bulls). Finally, semen can be collected by message of the seminal vesicles and ampulla per rectum.

There are three commonly used techniques for collecting semen: use of an artificial vagina, digital manipulation, and electro ejaculation. The technique used depends on the species being collected and the disposition of the individual male.

The Artificial Vagina

Artificial vaginas (AV's to the initiated) are used to collect semen from many species, most prominently cattle and horses, but also sheep, goats, rabbits and even cats.



Prerequisites to use of an AV are that the male be conscious, not significantly frightened of people, and more interested in ejaculating than in killing humans.

An AV uses thermal and mechanical stimulation to stimulate ejaculation. As shown in the image to the right, an AV is composed of a tube with an outer rubber lining that will hold water, into which is placed an inner liner that is lubricated just prior to use. The outer liner is filled and pressurized somewhat with water at 42-48 degrees Celsius. Shown below are AVs designed for use with bulls (bottom) and rabbits (top). The apparatus in the middle is a type of AV, usually called a director cone, which is used to collect semen from dogs.

To collect semen, the male is allowed to mount, and the penis is diverted into the AV where he ejaculates. *It is best to allow the male to thrust into the AV rather than trying to slide the AV onto the male's penis.* What the male mounts depends on his species and temperament.

Females can be used, but unless they are in oestrus, they rarely enjoy participating in the process, which can easily lead to injury of any and all of those involved. Another problem with using a female as a teaser is that if you miss with the AV, the female could be bred or possibly transmit venereal disease to the male. For collecting semen from bulls, a trained steer is usually used. In the case of stallions, a phantom ("dummy") is a popular choice for a mount.

Digital Manipulation

Many males can be induced to ejaculate by applying pressure and massage to the penis. After the male becomes aroused, a director cone of some type, attached to a collection tube, is slipped over the penis to facilitate harvesting the semen.

This technique is commonly used for collecting semen from pigs and dogs. An initial training period can be helpful and having a female in oestrus to arouse the male often is useful, particularly when the male is shy.

Another type of message used occasionally with bulls is to stroke the ampulla (terminal vas deferens), seminal vesicles and prostate gland through the wall of the rectum; in almost all cases, the bull must be restrained standing in a chute and sedated to allow relaxation and extrusion of the penis. In conjunction with a urethral catheter, one can obtain a sterile ejaculate using this technique.

Semen is collected routinely from chickens and turkeys using a form of digital manipulation.

Electro Ejaculation

Electro ejaculation involves applying a series of short, low-voltage pulses of current to the pelvic nerves which are involved in the ejaculatory response. It sounds like an extremely unpleasant experience but doesn't seem to cause much distress in bulls (although they do need to be securely restrained) and is conducted under anaesthesia in many species.

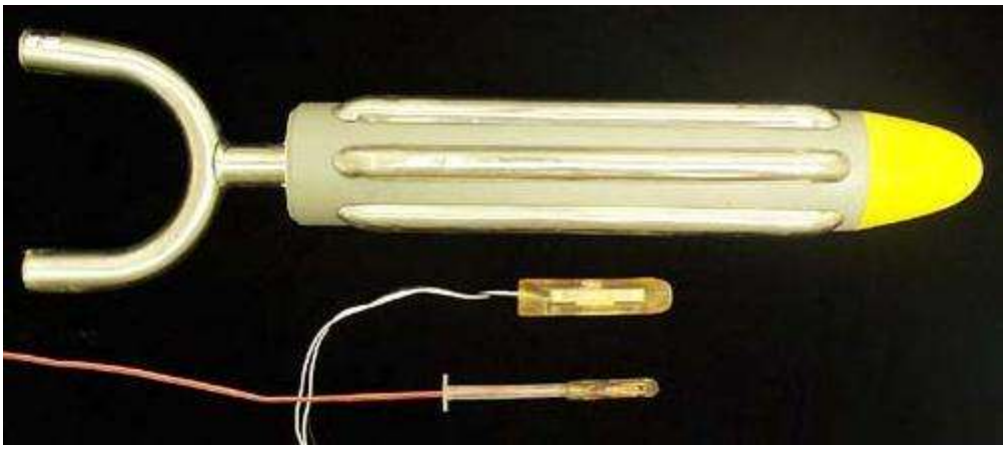
Electro ejaculation can be used with almost any mammal. With few exceptions, electro ejaculation is the only technique useful for collecting semen from wild animals, in which case the male is anesthetized prior to the procedure.

Another advantage of electro ejaculation is that it does not require a mount animal and can be applied in the field using a battery-powered unit. Finally, electro ejaculation can be used to obtain semen from animals that are physically incapable of mounting due to musculoskeletal disease or injury. It is used for collecting semen from quadriplegic or paraplegic men who desire a child but cannot ejaculate due to spinal cord injury.

With bulls, where there is abundant experience collecting semen by both artificial vagina and electro ejaculation, the samples collected using an electro ejaculator usually have a larger volume (due to excessive accessory gland secretion) and a lower number of sperms.

Three pieces of equipment are required for electro ejaculation. The electro ejaculator itself is a power supply with rheostats to control the amplitude of the delivered current and lots of circuitry to prevent accidental electrocution. Second, one needs a collection tube, usually attached to a latex rubber cone ("loving cup") in which to collect the semen. Finally, the pulses of current are applied through an electro ejaculator probe. The probe is inserted into the rectum such that the electrodes lie within the pelvic cavity.

Older probes had circular electrodes, which often caused undesirable muscle contractions; probes with parallel electrodes on one side minimise this problem. Three probes are shown below - the upper one is a commercial product for bulls and the lower probes were hand-made for use with small leopards (middle) and ferrets (bottom).



Successful electro ejaculation of an animal demands skill. It is not simply a matter of punching buttons and turning knobs but requires finesse in determining the proper timing and amplitude of pulses to apply to a given male.

Semen Collection via Artificial Vagina

Semen collection from bulls using an AV requires three people: one to handle the teaser animal, one to control the bull and one to collect the semen. It is important that the collection area have non-slip flooring to avoid injuries and because ejaculation may be inhibited if the bull is nervous about his footing. Bulls are heavy and should have regular hoof care. Poor hoof condition can inhibit the bull from mounting or cause pain when dismounting.

A steer is most commonly used as a teaser and mount animal. Female teasers are not recommended because of the potential risk of intromission and spreading of venereal disease. The teaser should be a calm animal of the appropriate size for the bull being collected.

The back and rear quarters of the teaser are washed with a disinfectant every collection day. It is also common for the rear quarters to be clipped routinely. The bull's preputial hair should be clipped in preparation for using the AV. These sanitary precautions are intended to minimise microbial contamination of the semen being collected.

For collection, the teaser is positioned straight in front of the bull for mounting. Oftentimes, it helps to arouse the bull if the steer is led around the collection arena with the bull behind, then stopped abruptly, similar to the behaviour of a cow in oestrus.

The artificial vaginal (pictured above) uses thermal and mechanical stimulation to stimulate ejaculation. The liner of the AV is filled with water at 42-48 degrees Celsius, and the inner surface is lubricated with something like K-Y jelly. An insulating cone is placed over the end from which the collection tube protrudes to avoid subjecting the semen to temperature shock.

False mounting is an effective way to sexually stimulate the bull. Providing two false mounts with two minutes of active restraint and one additional false mount maximises sperm cell numbers. Final preparations are made to the AV between the second and third false mounts. Proper construction of the AV is important to avoid damaging the bull's penis and to avoid stressing sperm cells.

Successful semen collection with an AV depends on the bull being comfortable around people, and they need to be trained to use the AV. However, **bulls are big and dangerous, and personnel safety should be emphasized constantly.** Most bulls in artificial insemination centres have a nose ring installed as a valuable and humane means of physical control. *Bulls undergoing semen collection should be haltered and one should never tie a bull up by their nose ring* - if startled, then can rip it out which is not only quite traumatic but yields an animal that may be exceptionally difficult to control. During collection, the person handling the AV must remain aware of where their feet are relative to the bull. As the animal ejaculates, it is common for him to jump forward. To avoid foot injury, collectors should wear boots with steel toes.

In artificial insemination centres, bulls are typically collected 2 or 3 times per week, with 2 or 3 ejaculates per collection day. 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*

4.4. SEMEN EVALUATION

Semen Evaluation

Semen should be evaluated grossly 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

The quality of frozen semen when it arrives at your farm or ranch is determined by the bull and organisation that processed it. But once it arrives, it is up to you to take proper steps to ensure its viability.

Frozen bull semen can be stored indefinitely, if it is maintained constantly at very low temperatures. The critical temperature is approximately -80 degrees Celsius. Semen which is exposed to temperatures warmer than -80° C (even for a short time) and then returned to the storage tank may be damaged.

The extent of damage depends upon how long the semen is exposed to the elevated temperatures. Although it is easy to maintain frozen semen at a safe temperature, it is also easy to destroy it in a few moments of carelessness.

The semen storage tank is a large vacuum-sealed metal bottle with an extremely efficient insulation system. Because of the vacuum bottle construction, the temperature can remain at -195.5° C (liquid nitrogen temperature) as long as at least two inches of liquid nitrogen is present. Technical advances in design and construction have produced storage tanks with a liquid nitrogen holding time of six to nine months.

Although semen storage tanks are well constructed, they still are susceptible to damage from mishandling. Semen tanks should be kept in clean, dry, and well-ventilated areas. Avoid excessive movement of the tank. The inner chamber, which contains liquid nitrogen, is suspended from the outer shell by the neck tube. Any abnormal stress on the neck tube, caused by sudden jarring or an excessive swinging motion, can crack the tube. This results in vacuum loss from the outer chamber.

To increase holding time, keep the tank in a cool location away from direct sunlight. Avoiding drafts from furnaces and outside air also helps prevent excessive nitrogen evaporation. However, make sure there is sufficient ventilation in the room to prevent possible suffocation which can be caused by excessive nitrogen gas in the air you breathe.

Protect the tank from corrosion by keeping it elevated above concrete or wet floors. Use boards or pallets. Pick a location that is safe from children and vandals, but do not hide the tank; it must be placed where it can be seen daily and where it can be monitored routinely for nitrogen level.

Finally, always be watchful for a lid that is left off and for frost or sweat on the tank. Give particular attention to the neck and vacuum fitting. Frost indicates that the vacuum insulation has been lost, and liquid nitrogen has been or is evaporating rapidly. If you suspect this has happened, use a wooden yardstick to measure the amount of liquid in the tank. If the tank contains liquid nitrogen, the semen must be transferred to a good tank immediately. Should the tank be empty of liquid nitrogen it is doubtful that the semen is viable; it should be evaluated before it is used?

4.5. RETRIEVING SEMEN

In the typical farm semen tank, dangerous temperatures exist in the upper half of the neck tube.

Exposure to these temperatures can occur when trying to locate a specific unit of semen or when transferring semen from tank to tank. Thermal injury to sperm is permanent and cannot be corrected by returning semen to liquid nitrogen.

In order to minimise thermal damage:

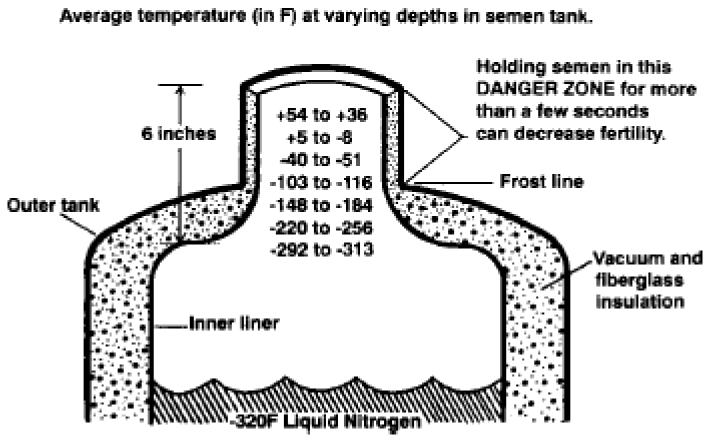
Identify which canister contains the desired semen. A semen inventory which keeps track of the location of each bull prevents unnecessary searching.

Remove the canister from its storage position to the middle of the tank. Raise the canister just high enough in the neck region to grasp the desired cane of semen. Keep the canister tops no higher than the frost line, or keep the tops of the canes no higher than two to three inches from the tank's top.

Grasp the desired cane, and immediately lower the canister to the tank floor. Keep the cane as low in the tank as possible while removing the unit of semen. Use tweezers to remove the straw. If the straw is located in the upper goblet, bend back the top tab of the cane to a 45 degree angle. This will keep the straw from bending or breaking. The straw should be removed within 10 seconds from the time the canister is raised into position.

Immediately after the unit of semen is immersed in water, return the cane to the canister by raising the canister up over the cane. Return the canister to its storage position.

Any time it takes more than 8 to 10 seconds to locate a particular cane, the canister should be lowered back into the tank to cool completely. Never return a unit of semen to the tank once it has been removed from the cane.



Cross-section diagram of liquid nitrogen tank used to store semen

Thawing Procedures

The correct thawing recommendation for semen in straws is not the same for all AI organisations. However, almost all organisations now recommend warm water thawing of straws for 10 to 60 seconds. For optimum results, follow the specific recommendations of the semen processor. Breeders may use semen from various AI organisations, but practice only one thawing procedure. The National Association of Animal Breeders has recommended that, when in doubt, 90 degrees to 95 degrees for a minimum of 40 seconds should be used as a universal thawing recommendation.

A major concern with warm-water thaw is the danger of cold shock when the straw is mishandled after thawing. Cold shock is the permanent injury to sperm caused by a sudden decrease in semen temperature after thawing. It occurs when semen is thawed and then subjected to cold environmental temperatures before reaching the cow.

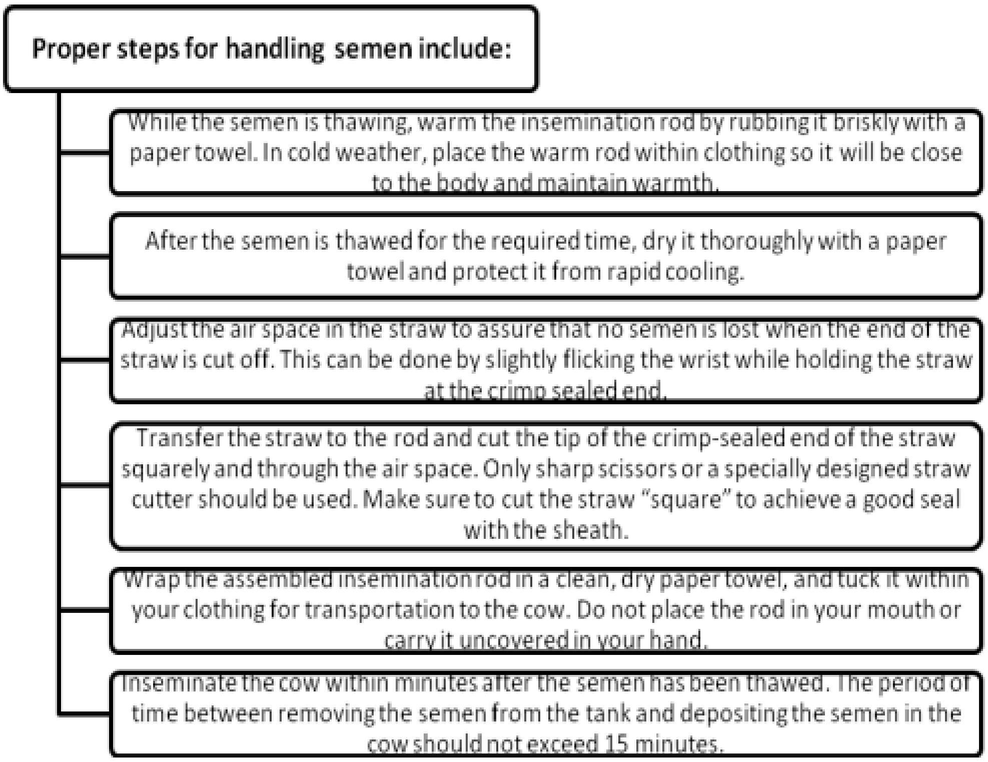
The severity of damage depends on rate and span of temperature drop. If precautions are taken to prevent cold shock, the advantage of warm thaw will be realized.

Here are some thawing tips:

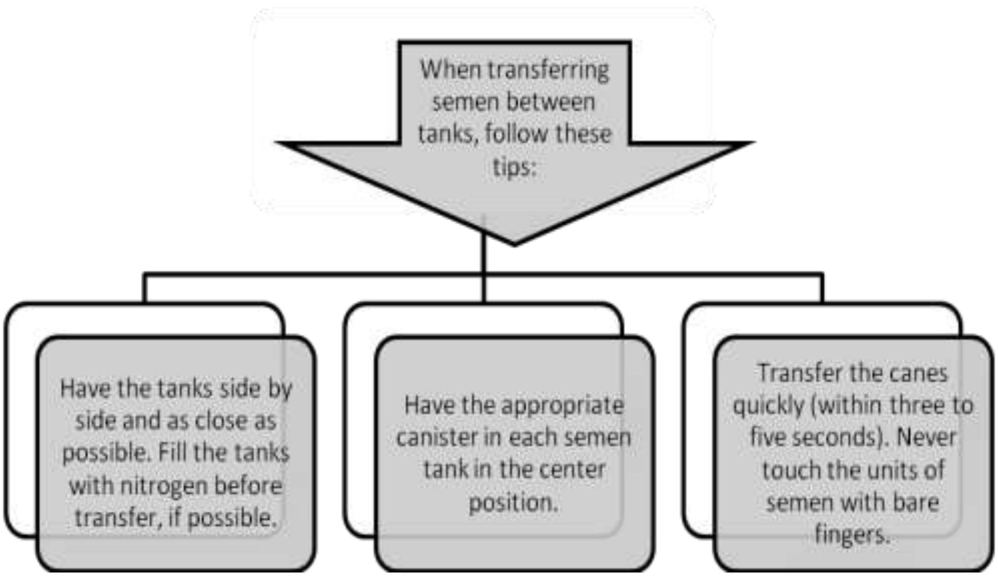
- Always keep insemination equipment clean, dry and warm.
- Use a thermometer; do not guess at the temperature. Check the thermometer for accuracy at least every six months with a reference thermometer.
- Use an insulated water bath designed for thawing semen or a one-pint wide-mouth thermos which is deep enough to immerse the entire straw. Recently, electronic thawing devices which maintain water temperature accurately between 35 - 36.7 degrees C have been developed. These are convenient to use when breeding many cows at one time.
- Never thaw more than one unit of semen at a time. You breed your cows individually, so you should thaw units of semen individually.
- Gently shake the straw as it is taken from the tank to remove any liquid nitrogen that may be retained in the cotton plug end of the straw. Time the thaw with a watch to avoid guessing. When possible or practical, use thawing recommendations of the AI organisation from which the semen was processed.

During Insemination

One of the most frequent chances for semen damage is during transport to the cow. After thawing, the semen temperature must be maintained as close to 35 degrees C as possible. Handling thawed semen and preparing the insemination rod should be done in a sheltered, heated area.



Semen Transfer



It is essential that frozen semen be handled and thawed carefully and properly in order to obtain anyone optimum results. It also is important to deal only with reputable, well-established AI organisations because their semen has been processed under standard, controlled conditions that are evaluated routinely.

4.6. ADMINISTERING SEMEN

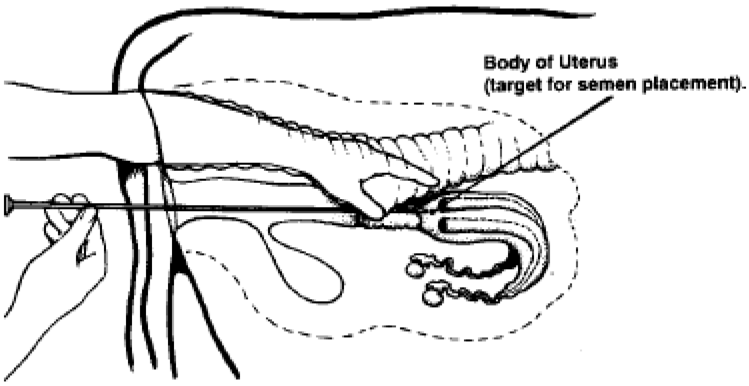
Although not part of the female genital tract, the rectum (terminal portion of the large intestine) is an important organ for you to become familiar with because your arm inside the cow will be working through this thin-walled tube. The rectum is 25.4 – 30.48cm long and very stretchable. That is important because it is through the rectum that you will manipulate the cervix.

The anus serves as a valve between the rectum and the outside. It is made up of a circular (purse string) muscle located directly under the skin. It surrounds the very end of the rectum. Again, the anus is stretchable, hence, your hand and arm can easily slip into the rectum. Circular muscle contractions move along the rectal wall toward the outside. When strong, these contractions may block your hand from moving forward and make it difficult to manipulate the genital organs through the rectal wall.

4.7. SEMEN PLACEMENT

The insemination process is quite straightforward. However, since relatively few sperm cells will be used, their placement is critical. The semen should be placed in the body of the uterus just in front of the cervix. You can recognize the proper site by the change in tissue consistency—from firm and hard in the cervix to soft and spongy in the uterus. To achieve the highest possible fertility rate, semen should be deposited at the very front end of the cervix. The internal (or front) end of the cervix is often called the anterior cervical os. To deposit semen at this location requires the use of a special device called Cassou pipette, or "AI gun." The rectovaginal insemination process is used. The inseminator places his hand in the rectum and manipulates the reproductive tract so that the gun passes through the vagina, then it is manipulated through the cervical rings, and then held at the internal opening of the cervix for semen deposition. In adequately restrained cattle this will take 30 seconds to 2 minutes. At first, however, passing an insemination syringe might not be easy because you might encounter natural obstructions on your way to the target.

Beware of obstacles. The front end of the vagina forms a circular blind pouch where it joins the backward projecting cervix. This blind pouch is usually from 1.27 – 2.54cm deep, surrounding the entire dome-shaped back end of the cervix. You'll meet other obstacles once you're inside the cervical canal. Firm, finger-like projections arranged in three to four circular rings extend into the canal. These cause the passageway to be crooked and contain blind pockets, or dead ends. The circular blind pouch of the vagina and the winding cervical canal with its dead ends are the two major stumbling blocks for anyone learning how to artificially inseminate.



Proper placement of insemination gun to deposit semen in the body of the uterus

Next to oestrus detection, semen placement error (by the technician) is most likely to affect fertility. Correct semen placement is very difficult to confirm in the field. It is impossible to check pipette placement. The pipette position changes too easily. Post-mortem tracts or examining culled cows inseminated with dye can be used to check semen placement after slaughter. Studies using dye deposition followed by slaughter have shown that up to 70 percent of the cows are inseminated incorrectly. The dye was placed in the vagina, posterior cervix, uterine horn, or bladder. The target for semen deposition is the anterior cervical os, a difficult site to find. Inexperienced inseminators often do not pass the pipette far enough, or they pass it too far into the uterine horns. Since the body of the uterus is only 1.27 – 1.91 cm in length, pipette passage 2.54cm into the uterus results in most of the semen entering only one horn, effectively reducing conception. Semen deposition is often made too rapidly, and semen takes the avenue of least resistance. If one horn is not as open as the other, it does not receive enough semen.

Take your time while breeding a cow and depositing the semen. It only takes a few extra seconds to make sure semen is deposited correctly. The plunger should be depressed over a 5-second period, allowing the semen to flow slowly and evenly, divided between horns. In non-pregnant cows, walls of the uterus are soft and spongy. Inseminating syringes should never go beyond the front end of the cervix, because it is too easy to poke into or through the uterine wall. This could cause infection and perhaps even fatal peritonitis.

Sanitary technique

Wash your hands. Inseminating cows is an invasion into the delicate uterine environment that is very conducive to growing bacteria. Bacteria on your hands could be transferred to your inseminating gun during the loading procedure. If carried into the uterus during insemination, these organisms could thrive and grow rapidly resulting in metritis and infertility.

Using Technicians

Professional technicians are more successful at insemination than inexperienced owners or managers. Inseminators should periodically attend AI courses in order to improve or correct techniques. Selection of a qualified inseminator is an important element in the success of the artificial insemination program. While the insemination process is simple to understand, it does require considerable manipulative skill. Semen-selling companies conduct three or four-day training programs, which will provide individuals with sufficient skill to begin inseminating. However, recently trained individuals generally experience lower conception rates until they have inseminated a number of animals. Regular practice at inseminating is required to maintain high conception rates. In many localities, AI studs have trained inseminators who provide insemination service for a reasonable fee. Cattle operations where artificial insemination is routinely used often have a well-trained individual who may be available as a technician. Before producers decide whether to hire a trained technician or to train a member of the farm team, they should weigh the considerable cost of a reduced conception rate during the learning process against the fees paid to a trained technician.

4.8. FOLLOW-UP POST AI

After the program, the cows are usually run with a "clean-up" bull to cover those cows that did not conceive to AI. At least 21 days should elapse after the AI program is concluded before clean-up bulls are used if sire parentage of the calves needs to be known.

If heifers or cows need to be transported to a pasture after A.I., embryonic loss due to transportation stress is least likely to occur before day 4 after breeding or after day 45.

Unfortunately, available research does not answer all questions about details such as length of haul or trailing versus trailering. Heat stress is known to impact embryo development and the embryo is most sensitive early in development. Use low stress handling techniques and avoid overcrowded trailers to minimise potential effects.

Preg-checking or pregnancy checking cows is done by a highly common and popular method in cattle called Rectal Palpation. Rectal palpation is the messiest, yet cheapest and often quickest form of preg-checking that can be easily learned by all those who raise cows. The following steps below will show you how to properly preg-check a cow or heifer.

1

Confine the cow. Put the female bovine to a squeeze chute or head-gate with gates on either side that prevents her from moving side-to-side.

2

Dress up. An OB (obstetrical) suit or coveralls are best for this job. However, if you have old clothes that you don't mind getting dirty, then those will work fine as well.

3

Glove up. Put on fingered shoulder-length gloves on the one arm (preferably your strongest arm) you will use to do rectal palpation with.

4

Lube up. Apply a handful of OB lubricant to your hand and rub it so that it gets above your hand as well as the inside.

5

Go in. Grab the tail with one hand (the one not gloved up), hold up above your head (see photo above) and with the gloved one, form a kind of closed-puppet mouth configuration with your hand (thumb tip connecting with all four tips of your fingers), and with the point of the top of your fingers forming a 45 to 60 degree angle, push into the anus of the cow.

You will have to push hard because the cow will be straining against you to push you out. Keep your wrist rigid and in-line with the rest of your arm, and keep your elbow flexed slightly so you have enough strength to push into the cow's rectum.

6

Expel unwanted faeces that are taking up too much room. If the rectum is full of faeces, then carefully scoop the loose faecal matter with your hand and retract your hand enough so that you can expel the faeces for the cow. Expel enough of the faeces that you have room enough to work, so you can reach and find the cervix.

7

Locate the cervix. It will be below your hand, as will the rest of the female bovine's reproductive tract. You should be able to feel a hard-cylindrical shape part of the way in. If you are up to your shoulder in the cow and still can't find the cervix, you're too far in. Move back until you can feel the cylindrical object below your fingers.

8

Move further into the cow. If you have short arms, you may either need a stool to stand on, or have to go in right up to your shoulder to feel for anything in the fallopian tubes or uterus of the cow.

9

Feel for the foetus and uterine tract. If you feel anything that feels like the uterus is distended, with a small oval ball of liquid floating inside it or something that feels like a foetus, then you have found that the cow is bred. If you don't feel anything of the sort, just a uterus, then she may be open (not bred.)

It takes a lot of practice to know what you're feeling for. Often, it's best to preg-check 2 to 5 months into the cow's gestation period, so that you know you are feeling for something larger than a golf-ball sized ovary. The sizes you should be feeling are according to how far along the cow are:

- 2 months - size of a mouse
- 3 months - size of a rat
- 4 months - size of a small cat
- 5 months - size of a large cat
- 6 months - size of a small dog
- 7 months - size of a Beagle

These sizes are good to go off of if you suspect the cow has aborted.

A vet or bovine practitioner who has had more experience and has preg-checked more cows will be more accurate than one who has done only a few cows. Thus saying, the more practice you get or the more chances you get to preg-check cows, the more accurate you'll become.

10

Pull out and release the cow. Once you've determined if the cow or heifer is pregnant and how far along, pull your arm out of the cow, and release her back into the herd, and repeat with another cow or heifer.

3A. <u>Group Formative Exercise:</u> *Refer to and complete handout 3 (Wool production)*

3C. <u>Individual Formative Exercise</u>: *Plan a breeding management program*

Unit 2

Livestock Birth and Rearing practice

Unit Standard	
116336	**Understand juvenile animal rearing practices**
Specific Outcomes	
SO1: Demonstrate full understanding of use and care or maintenance of all equipment used in the nursery. SO2: Demonstrate the ability to plan and integrate systems to effect juvenile animal rearing. SO3: Possess a detailed knowledge of the biology of the species including reproduction. SO4: Have complete knowledge of the feeding requirements of the juvenile animal species. SO5: Have full knowledge of and follow strict procedures for the rearing phases and be able to trouble shoot abnormalities. SO6: Know and apply correct hygiene procedures for the whole facility.	
Learning Outcomes	
By the end of this module you will understand: • The birth process of livestock • The rearing of livestock.	

Identifying	Communicating	Contributing
Working	Demonstrating	Science
Organise	Collecting	

1. BIRTH PROCESS

1.1. ABORTION

Abortion in dairy cattle is commonly defined as a loss of the foetus between the age of 42 days and approximately 260 days. Pregnancies lost before 42 days are usually referred to as early embryonic deaths, whereas a calf that is born dead between 260 days and full term is defined a stillbirth. A low rate of abortions is usually observed on farms and 3 to 5 abortions per 100 pregnancies per year is often considered "normal." However, the loss of any pregnancy can represent a significant loss of (potential) income to the producer and appropriate action should therefore be taken to prevent abortions and to investigate the cause of abortions that may occur.

Common Causes of Abortion

While infectious agents are perhaps the most frequently thought of cause of bovine abortion, there are other factors which may cause a proportion of pregnancies to terminate with an abortion.

Genetic abnormalities in the foetus that may result in abortion are not very frequently diagnosed, and these usually occur as an individual cow problem rather than as a herd outbreak. These abnormalities, which may not cause a change in the outward appearance of the foetus, may result in abortion because of the growing foetus inability to develop properly in the uterus. Genetic abnormalities may also cause obvious physical changes in the foetus, just as other infectious agents may (see below).

Heat stress can affect reproductive performance in a dairy herd, although it will generally cause conception problems rather than abortions. While there is some evidence to suggest that a very sudden increase in environmental temperature may result in abortions, there is little evidence to support heat stress as a common cause of abortions. Similarly, on rare occasions a cow that develops a very high fever due to an infection may abort her foetus.

Toxic agents may also cause abortions or early embryonic deaths. Cattle are susceptible to fertilizer nitrites and nitrates or the nitrates found in plants under certain conditions (e.g. drought-stress). If a cow is exposed to sufficiently high levels of nitrates/nitrites (~.55 % or greater nitrate in forage), abortions may occur, especially in late gestation.

Some experimental studies have shown that mycotoxins such as zearalenone in very high levels can cause abortions in cattle, although these levels are not normally found in "naturally contaminated" feedstuffs. Likewise, the only reports of abortions associated with aflatoxin appear to be situations where the health of the cow was also severely compromised by the toxin.

Ergot alkaloids are toxins produced by the Claviceps fungus, which grows in the seeds of various grasses and small grains such as fescue, bromegrass, wheat, oat and rye. These toxins have been associated with abortions in dairy cattle as well as other health problems.

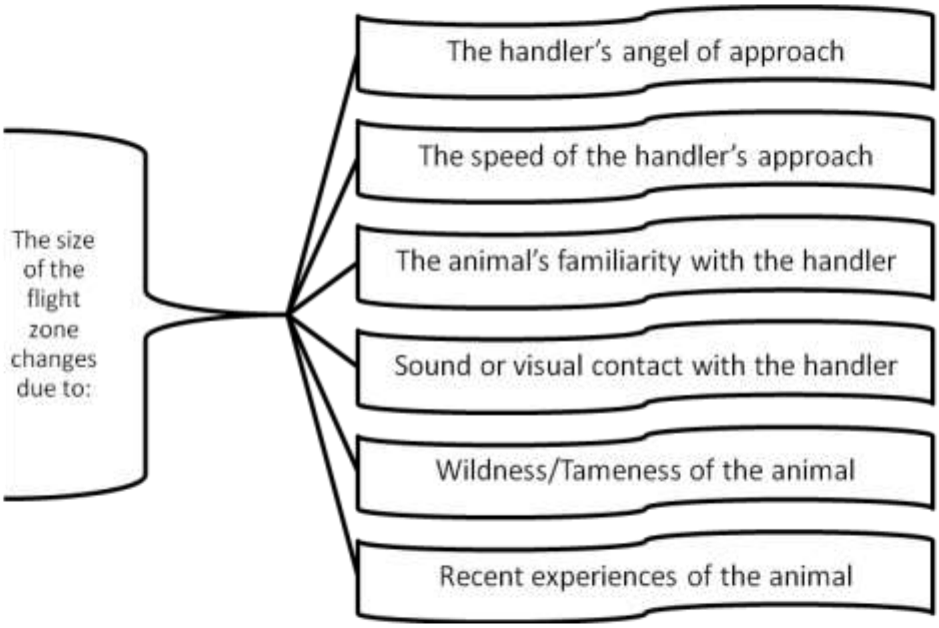
Although the cause of many abortions is never determined, infectious agents represent the most commonly diagnosed cause of abortions in many laboratories.

To understand how to enable dairy cattle to move or stop moving, we have to understand the following first:

The Flight Zone

This is the area or space surrounding the animal or group of animals. When a person enters this zone, the animal will move away until it feels safe. If the person retreats, the animal usually stops moving away.

Different animals have different flight zones. Tame animals have a much smaller flight zone than wild animals.



Abortion is the expulsion of a non-viable foetus before the normal term of pregnancy. Abortion of an implanted foetus occurs in 3 to 5% of pregnancies. The major causes of abortion are:

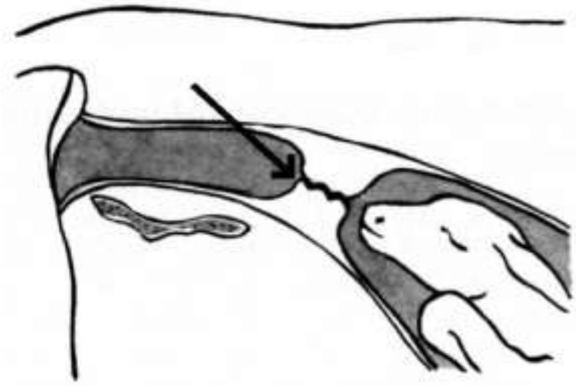
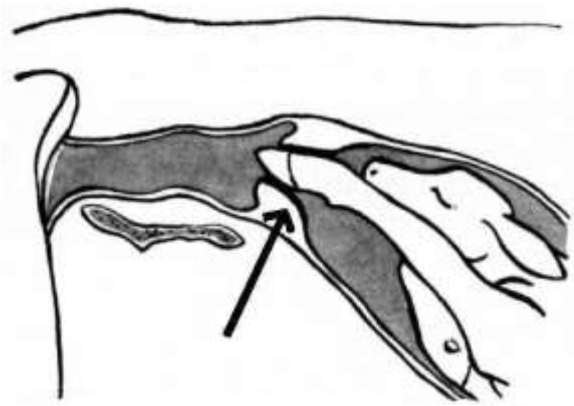
- Insemination of a pregnant cow
- Physical injuries (rough handling of pregnant cows)
- Ingestion of feed containing toxins, mouldy feed, or feed with high levels of estrogen
- Microbial infections (venereal diseases and other infections)

All cases of abortion should be viewed as potentially serious situations and rigorous efforts should be made to arrive at diagnoses. Bacterial (brucellosis, leptospirosis, listeriosis and vibriosis, etc.), viral (BVD, IBR), protozoal (trichomoniasis) or fungal infections cause abortion between the fourth and seventh months of pregnancy.

Calving, or parturition, is defined as the birth of a calf followed by the expulsion of the afterbirth (placenta). In the normal birth position, the foetus rests on its abdomen with its forefeet directed toward the uterine opening (the cervix) and its head resting between the forefeet (Figure 2). Abnormal presentation of the calf occurs once in about 20 calvings (5%).

1.2. NORMAL BIRTH

The Normal Birth Process of Dairy Cattle

Stage 1 – Dilation of the cervix	In general, this stage lasts from two to three hours in mature cows and four to six hours in heifers. During this stage, the cervix dilates because of the release of a hormone (oxytocin) and the pressure of the "water bag" against it. Thus, early breakage of the "water bag" may delay the normal dilation of the cervix.	 The cervix is closed at the beginning of stage 1 (A), but begins to dilate throughout this stage, allowing the fetus to enter the birth canal (B). 
Stage 2 – Delivery of the calf	The second stage is characterized by the progression of the calf through the birth canal and its expulsion. At this stage, the calf may still be enclosed in the second "water bag" (amniotic fluid). After the head has passed through the	

	birth canal, the rest of the body usually demands little extra effort to be expelled. This stage may last from two to 10 hours. A common mistake is to attempt to assist by pulling on the forelegs of the calf unnecessarily or too early.	 
Stage 3 – Expulsion of the placenta	During the third stage, the placenta or afterbirth is expelled from the uterus. After the delivery of the calf, uterine contractions continue for a period of time. These contractions help to break down the cotyledons by separating the placenta from the uterine caruncles. Normally, the afterbirth should be expelled within 12 hours of birth.	

1.3. NORMAL BIRTH PROCESS FOR SHEEP

<table>
<tr>
<td>The birth process, once the water breaks you should soon see the appearance of the front feet.</td>
<td>
This ewe has already given birth to her first lamb and is ready to give birth to another lamb.</td>
</tr>
<tr>
<td>The lamb's head should lay above and between the front legs in a normal presentation. The feet should also be pointing downward in a normal presentation. Feet that are pointing upward are generally from a breech birth. Lambs can be born in the breech position, but you will want to be sure to have the birth progress rapidly. As soon as a breech-positioned lamb is born, hold him up by his back legs and rub down his sides to help remove any fluid from his lungs.</td>
<td>
A closer inspection of the ewe shows that the feet are positioned correctly and are pointing downward.</td>
</tr>
</table>

The next step in the birth process is the appearance of the head. Most of the time a thin membrane will still cover the lamb. This membrane should break as the lamb is born. However, you may want to be nearby if the lamb needs assistance. If the birth is progressing, allow nature to take its course. Only assist if necessary.

Remember that a young ewe who is giving birth to her first lambs will take more time to complete the birth process than an older, more experienced ewe.

Shortly after the feet appear, the head should appear above and between the front legs.

As more of the lamb appears outside of the ewe, allow the ewe to continue pushing until the lamb is completely born. When the ewe stands up, the umbilical cord will break on its own. Do not cut the cord as this is likely to cause excessive bleeding. Allow the cord to tear on its own.

Allow the ewe to push the lamb out on her own. Also, be sure to let the umbilical cord tear on its own.

Once the lamb is born, check to make sure that it is breathing. Wipe the head and nose off well to make it easier for the lamb to breath. If the lamb is not breathing, try inserting a piece of straw a short way into a nostril to encourage the lamb to sneeze. You may also need to lift the lamb up by the rear legs and vigorously rub its sides.

In cold weather it is also a good idea to dry off the ears and tail as best as possible. This helps to prevent freezing. Allow the mother to lick the lamb to clean off the rest. She should be "talking" to her lamb now that he is born.	Use a towel to dry off the lamb's head and nose. This will help him to breathe easier.
If the mother is still lying down, move the lamb toward her head so that she can lick off the lamb. This is a bonding process for the mother and lamb to identify each other. They will need to be able to identify each other once they are turned out with a group of ewes and lambs. Do not move the mother and her new lamb into a lambing pen until she has given birth to all her lambs. An ewe that is forced to lamb inside the smaller sized lambing pen runs a higher risk of laying down on the first lamb that was born while she is giving birth to the second lamb. Lambs who are born outdoors on pasture don't have to be brought inside to a lambing pen. Use your best judgment based on how well the ewe is caring for her new-borns.	 Allow the ewe to lick her lamb. This helps clean off the lamb as well as helps the mother to identify her offspring.

A vigorous lamb will soon be trying to stand up. For weaker lambs, they may need a few minutes longer (sometimes up to an hour) before they are ready to stand up to nurse. You may want to give any weaker lambs a dose of a high energy/vitamin and mineral drench to provide extra energy until they are able to nurse on their own. Once the ewe has finished giving birth to all of her lambs, she can be moved into a smaller lambing pen for several days. This gives her additional time to bond with her lambs and allows you to keep a closer watch on the lambs to make sure they are getting enough milk to drink.	 A vigorous lamb will soon begin trying to stand
Your last tasks once mother and lambs are in the lambing pen are to check her teats to make sure they are open and to check that the mother has milk. Another task is to dip the lamb's navel in iodine to prevent any navel infections.	 Check the ewe's teats to make sure they are open and to make sure the ewe has milk

	 Dip the lamb's navel in iodine to prevent a navel infection.

Source: Sheep Home Study Course, Penn State Extension, http://extension.psu.edu/courses/sheep/reproduction/the-process-of-lambing/the-birth-process

1.4 BIRTH PROBLEMS

Recognising Birth Problems

Experience and judgment are needed to decide when to assist a calving. After one or two hours of intense pushing, the forefeet of the calf should appear. If there are signs of distress, assistance should be provided. It is very important to wash and disinfect hands, arms, the cow's vulva and all equipment used during assistance. The position of the calf must be checked first and, if necessary, corrected before using traction. Traction should be applied as the cow pushes.

Intervention / Assistance

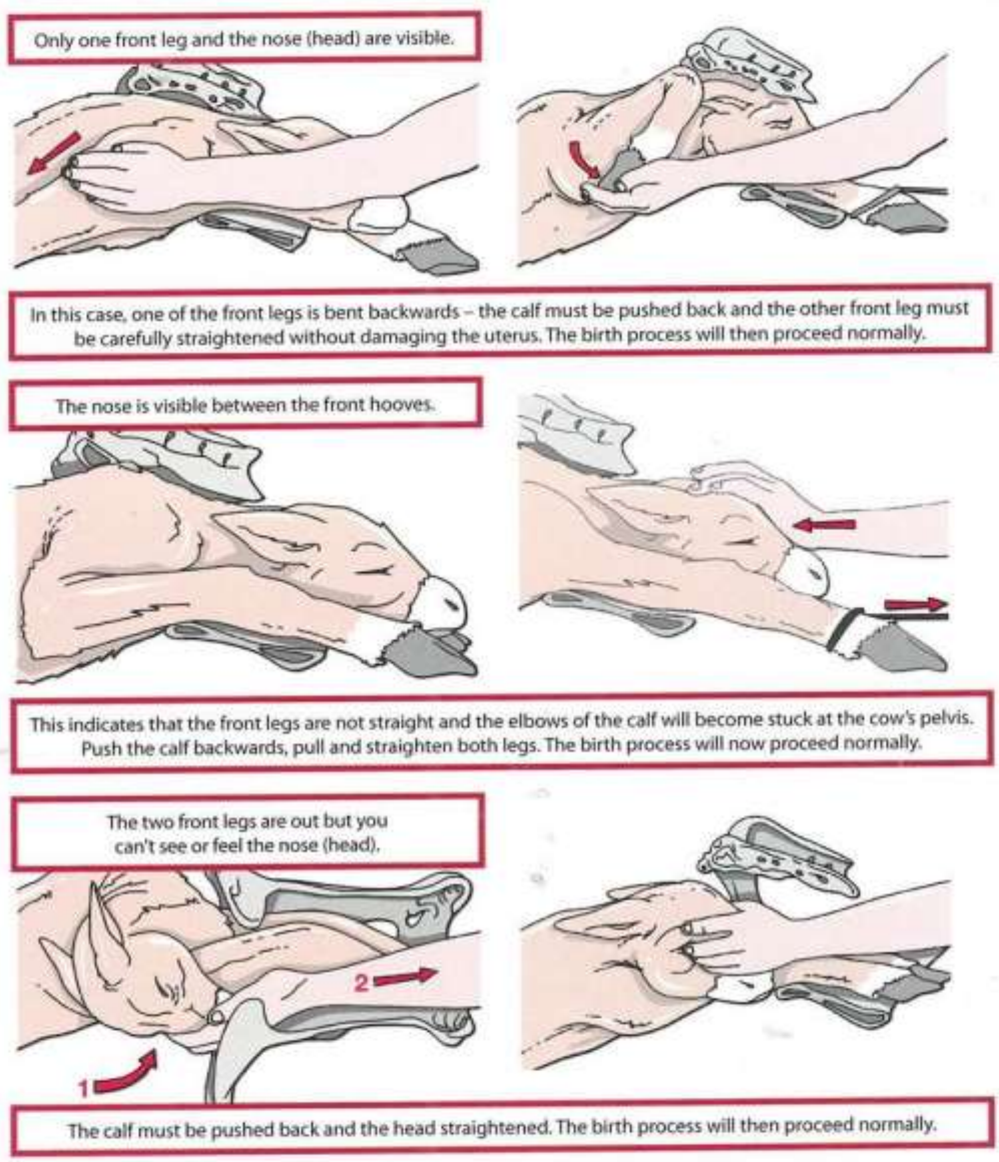
During stage 1 of the calving process:

If the cow gets contractions (uneasy, lies down and gets up again) for more than eight hours without observing the breaking of the water. Some abnormality is preventing stage 1 of the birth process to progress to stage 2.

During stage 2 of the calving process:

- If the water broke or the water sack is visible for two hours and the cow is not trying to push.
- If the cow/heifer has been trying for over 30 to 60 minutes and is making no progress.
- If the cow has stopped to push for more than 20 minutes after an initial period of progress. Breaks between pushing normally should not exceed five to 10 minutes.
- If the cow or calf are showing signs of excessive fatigue and stress — such as swollen tongue of the calf or severe bleeding from the vagina or rectum of the cow.
- If you observe an abnormal delivery. The basic rule is that if a trained livestock handler cannot assist to get the calf out in 30 minutes, call in the help of a veterinarian. Any further pulling or manipulation will just cause damage to the cow.

The first principle to remember is that if either the front legs or the head is bent backwards, the calf cannot come out. With the right training, the following three common problems (incorrect postures) can be observed and corrected easily when done soon after the water have broken, and the birth canal is still very wet and naturally lubricated.



After Calving

A process called uterine involution begins immediately after calving. The uterus shrinks in size considerably and layers of tissue must be renewed.

Although ovarian activity may lead to ovulation as early as 15 days after calving, this is usually not accompanied by heat (silent heat), and the first few cycles may be of short duration. However, more than 90% of cows should have been observed in heat at least once within 60 days of calving.

1.5. ABNORMAL BIRTHING BEHAVIOUR

Believe it or not, studying cattle behaviour absolutely pays off. Not only does it increase and help in the production you are hoping to attain, but it makes raising cattle a lot easier. When you understand their behaviour, you will also understand how they adapt to their surroundings. You will therefore learn how to manage them effectively as well.

You may now be asking yourself what causes cattle to produce poorly despite all that you have provided. It is stress. Stress affects cattle too, thereby producing poorly. It affects their immune system, and this will cost you more money. That is why learning about cattle behaviour is important because when you know how your cattle behave, you will know what stresses them.

There are five areas of cattle behaviour you ought to look into. First is the allopoietic behaviour. This is actually the starting point of cattle behaviour. It is most helpful if the animals are not confined. You can observe them when they are out in the field grazing pasture or simply resting. Because cattle are a herd, they function as a unit, you will be able to easily spot which among them might be sick or calving or displaying any abnormal behaviour.

Next is the herd behaviour. Cattle also form their own groups. Females group together as well as the males, and at times you get a mixed gender group. Having mixed genders often happen during mating season. Observing them in their groups will help you know how to group them without causing any unrest. You have to be considerate of all members of the cattle especially the bulls when they tend to be very aggressive.

Then there is the ingestive behaviour. This is probably the most important aspect for good production. When it comes to effectively feeding them, cattle behaviour during eating and drinking should be observed. First, you have to consider them as innately grazing animals. But if you want to add crop as part of their diet, that can be done too. Plan their diet ahead of time so that they will be able to adjust well. Just keep in mind to prioritise their health. Next, food must be easily accessible. And during feeding times when not out in the field, they should not be facing each other to avoid aggressive behaviours.

The last two areas of cattle behaviour are maternal and handling behaviour. You have to give special consideration to cows and calves during the following months after they're born.

Cows tend to be very protective. And if they're not able to give protection, this causes a lot of stress on both mother and calf. And as for handling the entire cattle, the key is to remain calm. Do not fight with them because there will be many procedures like branding or ear tagging. They have to know that they'll be able to interact with humans peacefully.

1.6. POST BIRTH

Post-calving complications

Retained placenta

Retained placenta occurs in about 5 to 10% of otherwise normal calvings. The frequency of retained placenta increases with premature or difficult calvings, and also in the case of bacterial infections. The placenta should NOT be removed manually because of possible injury to the uterus and risk of permanent sterility. Efforts should focus on trying to avoid infections and stimulate uterine contractions (treatment with estrogen is sometimes successful). Prevention of retained placenta should be an active part of reproductive management because it is often followed by other complications. Prevention includes proper sanitation during calving and proper nutrition during the dry period.

Metritis

Metritis is an inflammation of the uterus most often due to an invasion of microorganisms. Metritis can frequently be diagnosed by a purulent vaginal discharge. A difficult calving or retained placenta increase the risk of metritis. Unless metritis is severe, cows usually recover without any treatment in several weeks. In severe cases, the veterinarian may evacuate fluids from the uterus by rectal palpation followed by an infusion of the uterus with an antibiotic solution. When antibiotics are used, the milk has to be discarded, usually for a period of three or four days. An alternative treatment is to induce a heat using the hormone prostaglandin. During heat, uterine contractions help to clear the infection and minimise the need for antibiotics.

Pyometra

As in metritis, this problem involves an infection of the uterus. However, in the case of pyometra, the cervix is closed, preventing drainage of the infectious material from the uterus. The uterus fills up with pus and the cow does not come in heat. The damage caused by pyometra may lead to permanent sterility.

Calving guidelines

Good management practices are very effective at minimizing the stress at calving and calf mortality. Managing a dairy herd with an aim to minimise difficult calving is essential to a successful operation and requires the control of many factors:

Proper feeding: Proper feeding of heifers is important because they should not be inseminated until they have reached proper body weight. Cows should not be overfed during the last part of lactation or the dry period because over conditioning (obesity) increases the risk of difficult calving.

Use a maternity pen: A maternity pen should be reserved for about every eight cows in a herd. Thus a 40- to 50- cow herd should have six or seven individual maternity pens in which cows can move freely during calving. The pen should be dry, well ventilated and thoroughly cleaned after each calving.

Be patient but ready to call for veterinary assistance when trouble occurs: Look for the early signs of calving and observe the progression of the calving. Give the cow adequate time to prepare herself for delivery; after one to two hours of intense pushing, the forefeet of the calf should appear. If there are no signs of progress and the cow begins to show signs of distress, check the position of the calf. If you are unable to deter-mine the position of the calf or you are not sure of how to correct the problem, call for veterinary assistance immediately.

If the decision to assist the calving is made, use strict sanitary conditions: When examining a cow, use strict sanitary procedures to minimise the risk of infection.

Provide good care to the new-born calf: Clear the nostrils of mucus and make sure the calf is breathing. Tickling the inside of the nostril with a finger is usually sufficient to initiate breathing. If the lungs are obstructed by a large amount of mucus, the fluids may be cleared by holding the calf by the hind legs for a short period of time. Use a disinfectant to prevent infection of the umbilical region. Feed colostrum within a few hours after birth to help the calf gain immunity against infectious diseases.

2. NEW-BORN

2.1. INTRODUCTION

The Behaviour of New-born Calves

Suckling behaviour begins 2-5 hours after birth and the mother must be standing. The calf vigorously butts the mother's udder with its head while suckling. It has been noted that heifers which had a difficult birth took longer to stand than cows that had already had several new-born animals. Experienced cows usually stand within one minute of the birth of the calf. The mother licks the young to stimulate breathing, circulation, urination and defecation. The cow is a 'hider' species, so the young are hidden near the birth site straight after birth and the afterbirth is eaten, because it could attract predators.

Teat sucking by the calf is most intense soon after it stands up and it is common for suckling to occur first from a front teat. The distance maintained between the cow and calf increases steadily with time after calving but they keep in contact by vocalising. Within the first week of life the calf begins to follow the cow, but for periods of the day, groups of new-born animals will be found lying together for much of the day while the cows are grazing. It is in the period before new-born animals are themselves grazing that 'nurseries may form. There may be 'guard' cows left in charge and observations are reported from cows under extensive rangeland conditions. Fostering of new-born animals is possible if a group of new-born animals is placed with several nurse cows, but there is a large variation in the number of suckling's permitted by the cows.

A cow becomes restless 1–2 days before calving. If possible, she will leave the herd shortly before birth, finding a quiet place to calve. This is often not possible in most domestic contexts, so herd interference can occur at the birth, and bonding may be disrupted.

If new-born animals are removed from their mothers immediately after weaning, they can be pre-conditioned. This involves handling quietly, early castration and dehorning to accustom them to human handling, making them quieter to handle as they age. They will suffer less stress than cattle that have had less frequent human contact. This is in comparison with new-born animals that are left with their mothers and learn behaviours to avoid humans.

Vision, olfactory and vocal senses are involved in cow and calf identification. Cows will groom their new-born animals, 'labelling' them as their own. New-born animals usually stand 45 minutes after birth and are suckling 2–5 hours later; the mother aids suckling by positioning her body for easier access. Between birth and 7 months, the mean duration of suckling time for new-born animals was seen to be 34 minutes, with the suckling frequency being 4.5 times per day. Weaning studies in *Bos indicus* have shown that heifer new-born animals are weaned at 8 months of age, whereas bull new-born animals are weaned at 11 months.

Twins may receive less grooming than single new-born animals. Cows will lick the urogenital/rectal areas to stimulate urination and defecation. Hormones regulate maternal behaviour.

At calving, cows should be allowed to seek isolation in a sheltered place, which will allow a dry and soft surface to lie on. Dairy new-born animals should be licked by their mothers, but the duration must be controlled so that new-born animals are able to suck.

The heritability of maternal behaviour is low in cattle, so it is difficult for farmers to select for good mothering ability in bloodlines.

Contact between the cow and her calf for a period as brief as 5 minutes postpartum results in a strong specific maternal bond.

2.2 BEHAVIOUR OF NEW-BORN LAMBS

Maternal behaviour is key to ensuring survival of lambs, particularly when an ewe has two or more offspring. New-born lambs need milk and immunological protection shortly after birth, and early interactions between the mother and the young are critical in this respect. Bonding, and consequently survival, of twins can be considerably improved if the ewe remains at the birth site for a minimum of 6 hours, and this can be encouraged in part through feeding management. Two major factors contribute to the formation of this early bonding: postnatal vocal communication and sucking. The ewe makes a low-level bleating noise, standing so as to encourage the lamb to find the udder and start suckling.

Research shown that:

- Lambs that are quick to stand and suck after birth have better survival than lambs that are slow to get up and suck.

- Lamb behaviour are influenced by lamb genetics – breed, selection line within breed and sire of the lamb all affected early lamb behaviour. Lamb behaviour immediately after birth is heritable, suggesting that selection for lamb behavioural traits could improve lamb vigor at birth and increase lamb survival.

- Lamb rectal temperatures are correlated with lamb behaviour. Taking a lamb's temperature soon after birth could provide useful information on lamb vigor.

The ewe and lamb maintain a close spatial relationship over the first week of life. After this period lambs gather into peer play groups and up to 4 weeks of age, they go increasingly longer distance from their dam. Nurturing and recognition are the key components of early maternal care, and the ewe expresses these through immediate licking and grooming behaviour, which enables her to learn the smell of her offspring.

As well as recognizing their mothers' voice, lambs also visually recognize breeds and are attracted by the sight of the same breed in the absence of their mother. There are significant breed differences in grazing, activity and social interactions. Maternal influence plays an important role in shaping the behaviour of their offspring as they develop, although this is not evident immediately after birth, where breed differences are most evident regarding sucking and early vigor and play behaviour.

Social learning influences dietary habits, with lambs generally acquiring a preference for foods or grazing behaviour that they have learned about from their mothers or from young companions. They also prefer feeds that are nutritious and avoid those that are toxic, again following early positive or negative experiences.

The location of preferred foods will influence where sheep choose to forage. As they grow, lambs will imitate the mother's preferences for grazing location. It has been proposed that exposing social groups of sheep to underutilized habitat types early in life may increase their usage of these areas at later stages and therefore careful and strategic grazing management can offer the best opportunity to improve grazing distribution.

2.3. SIGNS OF ABNORMAL BEHAVIOUR IN NEW-BORN ANIMALS

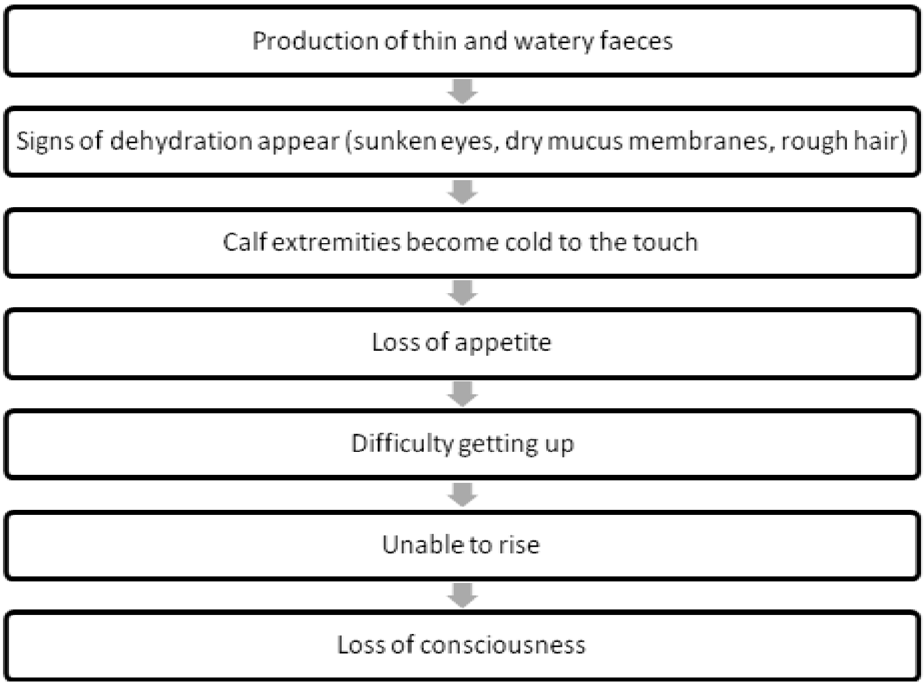
Septicaemia

When a new-born animal has septicaemia, it has disease-producing organisms or their toxins in its blood. Septicaemia in new-born animals is usually the result of a bacterial infection that occurs while the new-born animal is in the uterus or during, at, or immediately after birth. The route of infection can be the blood of a sick dam, an infected placenta, the new-born animal's umbilical stump, mouth, nose (inhalation), or wound. Septicaemia is the most severe medical problem that a new-born animal can develop because the blood-borne infection disseminates and damages many different organs. The bacteria that cause septicaemia in new-born animals, many of which are characterized as gram-negative bacteria like *E. coli* and *Salmonella*, are difficult and expensive to treat, and survival rate is low. Early signs of septicaemia may be subtle but affected new-born animals are usually depressed, weak, and reluctant to stand, and suckle poorly within 5 days of birth. Swollen joints, diarrhoea, pneumonia, meningitis, cloudy eyes, and/or a large, tender navel may develop. Fever is not a consistent finding in septicaemia new-born animals; many have normal or subnormal temperatures. Most septicaemia new-born animals have a history of inadequate colostrum intake.

Diarrhoea

Diarrhoea is the most common cause of death in young new-born animals and is almost entirely avoidable by good management. The highest risk period for diarrhoea is from birth until about 1 month of age. Clinical signs of diarrhoea begin with loose faeces and can progress to a semi-comatose state.

Clinical Signs of Diarrhoea



Bacteria, viruses, and/or parasites cause diarrhoea in new-born animals. Usually, the new-born animal is infected with more than one agent. Typically, the virus, bacteria, or parasite is identified from a faecal sample or from the intestines of a dead new-born animal. The agents can be isolated from healthy new-born animals and adult cows as well as new-born animals with diarrhoea. Some faecal bacterial isolates, E. coli, Clostridium perfringens, and Campylobacter, are normal intestinal flora. The veterinarian uses the findings from faecal or intestinal exams to determine the most likely cause of the diarrhoea problem and to revise vaccination, treatment, and disinfection protocols. Knowing the potential pathogen provides insight into the infection source as well as the relevant factors that may have triggered the outbreak. When Salmonella is isolated, antibiotic sensitivity patterns guide the treatment protocols. When viruses and parasites are isolated, use of antibiotics is not indicated.

The agents commonly incriminated in new-born animal diarrhoea outbreaks are listed below. The age of onset of diarrhoea can be used as a guide to the agents most likely to be involved. Unfortunately, the colour and consistency of the faeces are not reliable indicators of the cause of diarrhoea.

E. coli

- Most new-born animals are affected within the first 3 days of life.

- There are many types of *E. coli*: some are normal flora; different types cause septicaemia; others are invasive; enterotoxigenic *E. coli* (ETEC) is the most common cause of diarrhoea.
- Special tests are needed to identify the *E. coli* as ETEC.
- Dehydration is usually severe and may cause death before diarrhoea develops.
- The course of the disease is rapid: from weakness, diarrhoea, dehydration, to death can be less than 24 hours.
- Antibiotics rarely affect the outcome of this disease; fluid support is critical to survival.
- Vaccination of dry cows and good colostrum feeding can eliminate this problem.

Salmonella Species

- This is an important cause of diarrhoea, and infected new-born animals are at risk of developing septicaemia.
- This bacterium can also cause pneumonia.
- Effective antibiotics should be used to prevent bacteraemia.
- Infections usually occur in 5- to 14-day-old new-born animals.
- Blood and casts of intestines may be seen in the faeces.
- New-born animals are slow to respond to treatment and are often sick for 1 to 2 weeks.
- *Salmonella dublin* infection can make cattle carriers/shedders for life.
- This organism may be found in unpasteurized waste milk.
- People (especially children) handling new-born animals that are shedding Salmonella can contract Salmonellosis and become ill.

Clostridium Perfringens Type C

- There are several types of *C. perfringens*; type C can be a cause of diarrhoea.

- More typically, this causes sudden onset of weakness or death.
- Colic or nervous system signs may be seen before death.
- Post-mortem examination has characteristic haemorrhage in the intestines.

Campylobacter spp.

- This is frequently isolated but rarely the cause of new-born animal diarrhoea.

Rotavirus

- Rotavirus is found in faeces of many new-born animals between 1 and 30 days of age.
- There are more than one group and serotypes of rotavirus; the conventional vaccine covers the most important one. A newer product offers some additional strains.
- Not all new-born animals with rotavirus have diarrhoea.
- Diarrhoea usually develops between 3 and 7 days.
- Colostrum from vaccinated cows may protect new-born animals for up to 4 days.
- The infection may be short lived, but the intestinal lining has to recover from damage.

Coronavirus

- Like rotavirus, it is commonly found in new-born animals, not all of which have diarrhoea.
- Intestinal lining damage is more severe with Coronavirus than rotavirus; because of this, other pathogens can collaborate to produce a severe diarrhoea episode.
- Faecal shedding pattern and diarrhoea onset are similar to rotavirus.
- Colostrum from vaccinated dams will help prevent the disease in new-born animals up to 4 days of age.
- This has been implicated as a cause of winter dysentery in adult cattle.

Bovine Diarrhoea Virus (BVDV)

- This virus can cause diarrhoea in young new-born animals, but it is rarely the cause of young new-born animal diarrhoea.
- One of the strains is capable of producing a bleeder syndrome in new-born animals between 4 and 10 weeks of age if they are infected shortly after birth.
- The virus may also be a factor in pneumonias that develop after weaning.

Cryptosporidium Parvum

- This is an important parasite that is very prevalent on dairies and is capable of producing diarrhoea by itself or in combination with other agents.
- New-born animals usually are infected shortly after birth and develop diarrhoea about 5 or 7 days of age.
- Organisms can be found in a faecal smear.
- The organisms survive well in the environment.
- New-born animals that do not have good colostral immunity or that are stressed by cold or inadequate nutrition are particularly susceptible.
- Colostral immunity is not completely protective.
- A commercial vaccine is not readily available.
- Currently, there is no treatment that "kills" the organism in an infected new-born animal.
- Many infections are inapparent.
- Some preventative treatments can delay shedding of the oocyst in faeces.
- This small parasite can cause diarrhoea in humans.

Eimeria spp. (coccidiosis)

- Two species are considered important in cattle.

- New-born animals between 7 days and 4 to 6 months are considered to be at risk.
- Four products commonly used in new-born animals are amprolium (Corid®), decoquinate (Deccox®), Lasalocid (Bovatec®), and Monensin (Rumensin®).
- Products work at different stages of the life cycle and stop development or kill the organism.
- Once new-born animals develop diarrhoea, this is a very difficult disease to treat.
- Subclinical infections impair the new-born animal's resistance to other infections and decrease growth.

Giardia spp.

- Under unusual circumstances, these protozoa may cause diarrhoea in 2- to 4-week-old new-born animals; it is not a major pathogen.
- The organism can be found in the faeces of normal new-born animals.

Despite the fact that the agents differ, the resulting enteritis is remarkably consistent in terms of the presenting clinical picture. New-born animals with diarrhoea consistently have some degree of dehydration. Dehydration may be life threatening and can be assessed by observation of typical clinical signs.

Assessing Dehydration

Clinical Sign	Percent Dehydrated
Few clinical signs	<5%
Sunken eyes, skin tenting for 3-5 seconds	6-7%
Depression, skin tenting for 8-10 seconds, dry mucous membranes	8-10%
Recumbent, cool extremities, poor pulse	11-12%
Death	>12%

In most cases of fatal diarrhoea, the new-born animal dies of dehydration and loss of **electrolytes**, not from the infectious agents that triggered the diarrhoea. Blood glucose levels are low, and hypoglycaemic coma can develop in new-born animals that are in cold housing and have milk or milk replacer withheld for more than one feeding. Electrolyte abnormalities involving potassium, bicarbonate, and sodium are frequently found, but these resolve rapidly when fluids are given to correct the dehydration and new-born animals have access to water. For this reason, treatment of new-born animals with diarrhoea is primarily supportive. The most important aspects are early recognition and aggressive fluid therapy. Prompt treatment with oral fluids and electrolytes is necessary for successful treatment of diarrhoea.

Fluid Requirements for Treatment of Diarrhoea

New-born Animal Health	% Dehydrated	Daily Milk	Oral Fluids
Healthy new-born animal	0%	4.4 kg	0 kg per day
Mild diarrhoea	2%	4.4	1.1 kg per day
Mild diarrhoea	4%	4.4	2.2 kg per day
Depressed	6%	4.4	3.3 kg per day
Very ill	8%	4.4	4.4 kg per day
Recumbent	>10%	4.4	Need intravenous fluids
Should be fed separately from electrolytes.			

2.4. PNEUMONIA

Pneumonia is an inflammation of the lungs. Clinical signs of pneumonia include nasal discharge, dry cough, body temperature of >41°C, respiratory distress, and decreased appetite. New-born animals that develop pneumonia prior to weaning frequently share the same risk factors as those that develop diarrhoea: failure or incomplete transfer of immunity from colostrum, prolonged exposure to adult cattle, and/or the ventilation limitations of warm housing. Large diurnal temperature variations and transportation or grouping stress can contribute to the development of pneumonia. As with diarrhoea, frequently more than one agent is identified in an outbreak. Herds often experience outbreaks of pneumonia occurring in a number of new-born animals at the same time. Antibiotic therapy is necessary but frequently yields disappointing results. Because of the significant impact that pneumonia has on growth and future productivity of dairy new-born animals, early identification and treatment are important, but resolution of significant risk factors is imperative! New-born animals that develop chronic pneumonia seldom recover completely and should be culled. Early vaccination is not an effective means of prevention.

Agents are usually one or a combination of the following:

- Pasteurella haemolytica
- Pasteurella multocida
- Mycoplasma dispar
- Mycoplasma bovis
- Hemophilus somnus
- Actinomyces pyogenes
- BVDV
- BRSV
- IBR/PI3
- Salmonella Dublin

The first three agents listed are the most important in the young dairy new-born animal. Frequently pneumonia is first recognized right after weaning when new-born animals are grouped for the first time. In many herds, the first episode that occurs prior to weaning and as early as 2 weeks of age is missed. In large herds or groups of new-born animals, ear infections can be a sequel to respiratory disease and are frequently caused by the same agents.

2.5. RISK FACTORS

Even though the immune system of a new-born animal is functional at birth, it is less responsive than that of an adult cow and is naive and easily overwhelmed by the bacteria, viruses, or parasites in the environment. Prolonged exposure or an increased level of exposure occurs when susceptible dairy new born animals remain in the calving area, have continued contact with adult cattle, are in contact with affected new born animals, commingle with sick cows, or are housed in facilities that are under-bedded, warm, damp, humid, or poorly ventilated. Noxious gases, dusts, and mold in the air put new-born animals at significant risk for developing pneumonia. Cold housing can reduce the risk of infection, provided new-born animals can be dry and draft-free. New-born animal-to-new-born animal contact, crowding, or continuous use of facilities prolongs the survival rate and increases the numbers of pathogens in the environment of the new-born animal, even with cold housing.

Inadequate colostrum intake or absorption puts new-born animals at significant risk of infection from septicemia, enteritis (diarrhoea), or pneumonia. Dairy new-born animals should be hand fed 3 litres (Jerseys, Guernseys, Ayrshires) or 4 litres (Holsteins, Brown Swiss) of colostrum. The entire volume should be from the first milking of a single cow. Colostrum can be delivered in one or two feedings prior to the new-born animal reaching 12 hours of age. The entire volume can be delivered safely and effectively in a single feeding. New-born animals can suckle, be fed by oesophageal feeder, or receive colostrum by a combination of the two methods.

Colostrum should be collected from appropriately prepared cows within 6 hours of freshening. Collection and storage containers should be sanitized between sequential uses. For effective cooling, colostrum should be placed in 2- or 4-litre containers that can be clearly labelled with cow identification and date of collection. Fresh or refrigerated colostrum provides the best combination of antibodies (immunoglobulins), immune cells, other important immune factors (lactoferrin, lysozyme, and complement), vitamins, and minerals important to the immune system of the new-born animal. The availability of frozen colostrum allows the producer to discard colostrum from cows with mastitis, bloody milk, diarrhoea, or Johnes disease and supplement the colostrum from a first-new-born animal heifer, purchased animals, or incompletely transitioned cows. Refrigerated colostrum should be used within 1 week and frozen colostrum within 1 year of collection.

The use of mastitic- or antibiotic-containing waste milk has been related to high mortality rates. Many producers feed **milk replacer** to decrease the potential transmission of infectious disease. Colostrum absorption may be compromised in new-born animals born in extreme heat or cold, new-born animals that have difficult deliveries or abnormal gestational length, or those exhibiting respiratory difficulty. Other non-colostral factors that impair immunity of new-born animals are inadequate caloric intake; crude protein deficiency; selenium deficiency; low levels of vitamins A, C, or E; reduced stores of copper, manganese, zinc, or iron; and coccidiosis. Inadequate caloric intake puts new-born animals at risk for disease.

For dairy new-born animals, inappropriate volume, concentration, fat or protein content, mixing, or feeding temperature of milk or milk replacer can compromise the immunity of the new-born animal. Failure to provide fresh water and a palatable new-born animal starter that is supplemented with a coccidiostat and presented in a clean feeder will enhance their susceptibility to disease. Consistent feeding practices (timing, presentation, temperature, and quality of feeds) and personnel and management practices enhance the non-specific immunity of the new-born animal.

Make sure that there are adequate **feeding utensils** to be able to clean and disinfect between uses on sick new-born animals. A dedicated utensil for sick new-born animal use is ideal. This means that there are enough oesophageal feeders to dedicate one to each sick new-born animal for that feeding or that day. Contain risk by reducing new-born animal stress. Stress is imposed when new-born animals are asked to adapt to change. Feed changes - colostrum to whole milk to milk replacer, dilute milk replacer to concentrated milk replacer, milk withdrawal and reintroduction - create stress. Each time there is a housing change - maternity pen, warming area, new-born animal hutch, group pen, or transport to a different location - the new-born animal is more susceptible to disease. Depending on timing, amount, and type, vaccinations or medications can impose significant health risk to young new-born animals. Keep things simple for new-born animals.

Feed a single, large volume feeding of colostrum. At the second feeding, begin feeding the milk replacer or milk that will be the mainstay of the new-born animal's pre-weaning diet. Feed the liquid feed at a consistent time, temperature, and concentration throughout the pre-weaning period. Adjust in volume or number of feedings for cold temperatures or illness. Provide new-born animal starter within the first week of life.

Move the dairy new-born animal from its calving area and place it in its permanent pre-weaning home as soon as possible after birth. Avoid crowding and competition, particularly before, during, and immediately after weaning. Under most circumstances, dairy replacement heifers that receive adequate colostrum from vaccinated dams have little or no need to be vaccinated before weaning.

2.6. INFECTION SOURCE

Infection Source

Persistence of the agents that cause diarrhoea, pneumonia, and septicaemia in the environment is the major reason for outbreaks of new-born animal problems on the dairy. Usually the source of infection is faeces (diarrhoea and septicaemia)—from normal adult cows into shared housing and new-born animals that are non-immune shedders—or aerosol (respiratory disease pathogens). Occasionally, water, feeding utensils, rodents, birds, pets, or people can be the source of infection for new-born animals. Depending on the time of onset of disease, the most likely source of infection can be identified. Problems that occur within 5 days of birth usually have their source as the dam or the calving environment. After 7 days of age, problems develop from a source in the new-born animal environment. If the source of infection can be identified, it can be diluted or bypassed, using one of these strategies:

- Ventilation
- Bedding changes
- Sunlight
- Freezing
- Disinfectants
- Time between occupancy
- Space between occupants
- Change calving areas
- Change location of hutches or new-born animal housing
- Eliminate overcrowding

2.7. EARLY IDENTIFICATION OF SICK NEW-BORN ANIMALS

Successful treatment protocols for diarrhoea and pneumonia depend on early identification of sick new-born animals. These criteria can be used to trigger a treatment intervention:

- Early morning rectal temperature (taken at the same time every day for the first week of life or identified risk period) that exceeds 39.4°C for two successive mornings or is accompanied by slow, reduced, or no milk intake that feeding.
- Slow, reduced, or no milk/milk replacer intake.
- Watery and/or bloody diarrhoea.
- Cough, nasal discharge, or laboured breathing.
- Head tilt, umbilical or joint swelling.
- Weakness, inability or reluctance to rise.
- Lameness.

Supportive care is more valuable than antibiotics. Sick new-born animals must be able to stay clean and dry. Keep it in its own housing area but put fresh bedding down. Administration of warmed fluids is an effective way to raise body temperature. Make sure fresh water is available at least twice daily. Offer milk/milk replacer at the usual dilution and temperature, but reduce volume (to 1 litre, for example) and feed more frequently (4 times/day, if needed). What liquid feed isn’t consumed, administer by an oesophageal feeder that has been cleaned, disinfected, and rinsed between new-born animals.

Oral fluids are an effective way to correct dehydration provided that the new-born animal is strong enough to stand and has no abdominal distension. Non-steroidal anti-inflammatory drugs like aspirin, banamine, or ketoprofen can keep new-born animals eating. Supplementation with probiotics may help restore the intestinal environment, especially after antibiotic use. Use antibiotics when they are known to be effective for the problem that is identified. Antibiotic selection should be based on culture of the bacterial organism from the premises or during the outbreak. The veterinarian should advise you on route, dose, and duration of therapy. Responsible use of antibiotics is a must!

In conclusion, the five C's provide an effective formula for managing the young dairy new-born animal:

- Colostrum
- Cleanliness
- Comfort
- Calories
- Consistency

While the agents that cause disease are always there and can be extremely important in a disease outbreak, comfortable, clean calves with good colostrum management, consistent feeding and management practices, and plenty of calories in the diet can be disease free even if they become infected.

3D. <u>Group Formative Exercise</u>: *Refer to handout 4*

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