Reproduction & Breeding

Believe it or not, the reproductive cycle of a cow is central to the entire business of a dairy operation!

Cows must have a calf before they are able to produce milk. Heifers must have a calf before they can produce any milk during their lifetime and older cows must keep having calves at regular intervals to keep producing milk. The calves themselves are also important as they will eventually be needed to replace older cows in the milking herd and to bring better genetics into the herd for improvement.

There are 5 things needed for a successful breeding program:

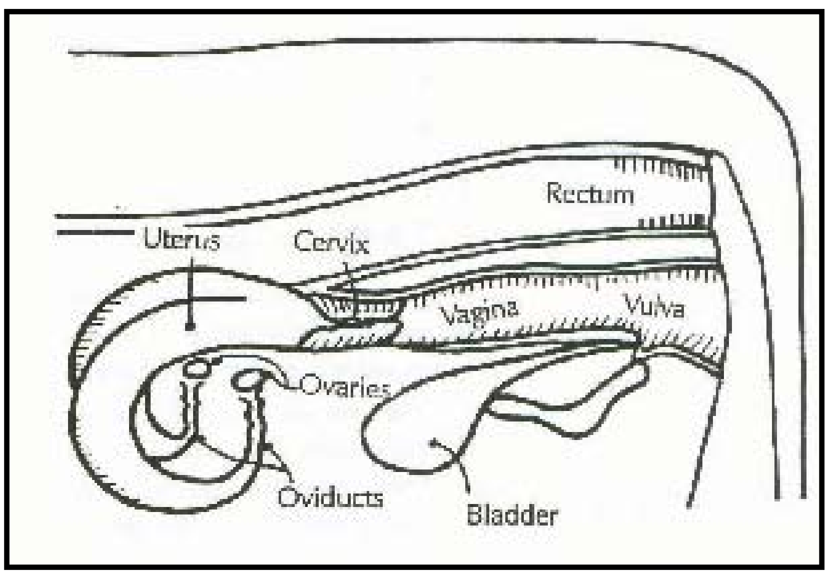
1. Goals
2. A good heat detection system
3. A good herd health program
4. A balanced nutrition program
5. Knowledge of breeds, traits and genetics

In order to understand the whole process, it is important to understand the reproductive body parts of a cow and how they work!

The Calf Factory: The Female Reproductive System

Cows are mammals; therefore, they produce eggs internally. These eggs may be fertilized and result in a baby calf that grows inside their bodies. Like other mammals, they produce milk to feed their babies once they are born. Cows have the same basic reproductive system as other animals, like pigs, horses, and even humans.

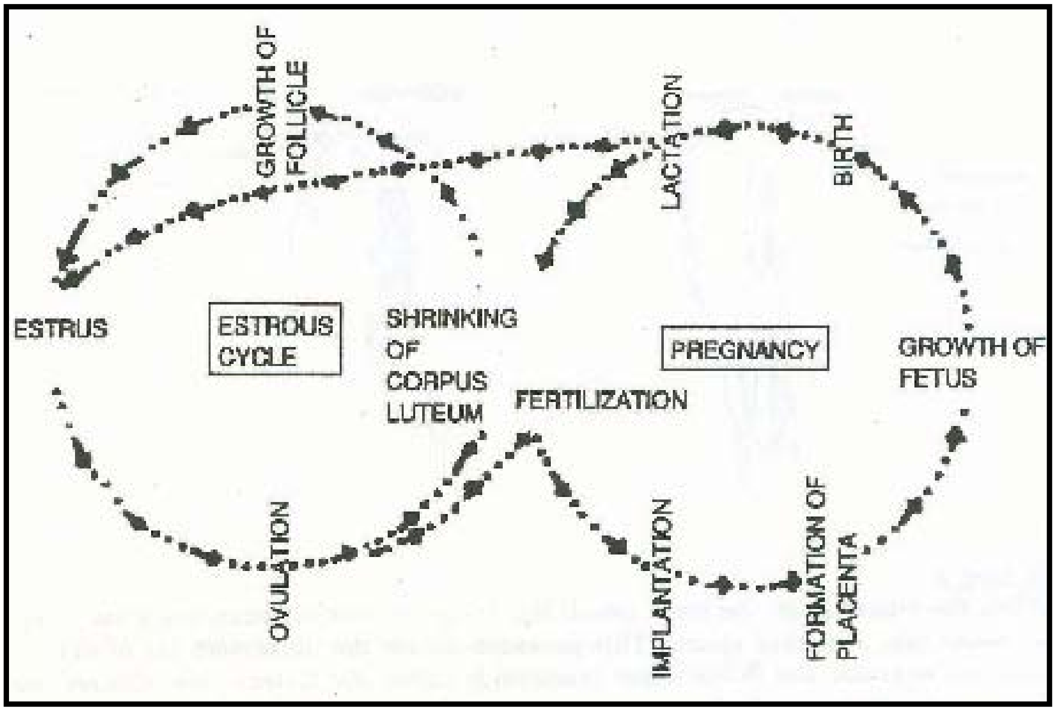
The main parts of the cow or heifer's reproductive tract are her ovaries, oviduct, uterus, cervix, vagina and vulva.



First are the **ovaries.** There are two of them, and they are round or bean shaped. **Ova** (or eggs) are produced inside the cow's ovaries. Inside the ova are chromosomes. These contain half of the genetic material for an animal. The other half of the genetic material comes from male's sperm. The **chromosomes** from both the ova and the sperm combine to form the genetic blueprint for the growth and development of a fetus.

During a cow's reproductive cycle, a fluid-filled **follicle**, containing one egg begins to grow on the ovary. During ovulation, this follicle bursts and the egg is released. The follicle that has released the egg turns into a hard raised structure, called the corpus luteum (C.L.). It may also be called the yellow-body because it is yellowy-white in colour. The released egg then travels into the **oviduct**, a thin tube.

Once the egg is in the oviduct, one of two cycles can occur, depending on whether or not the cow is bred.

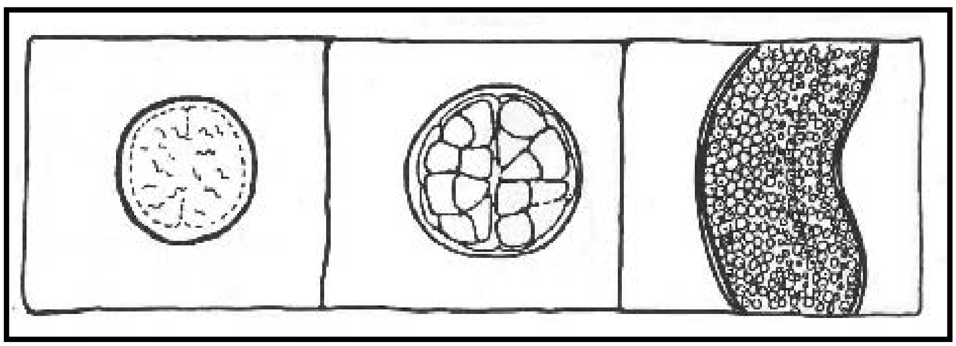


Cycle 1: No Fertilization

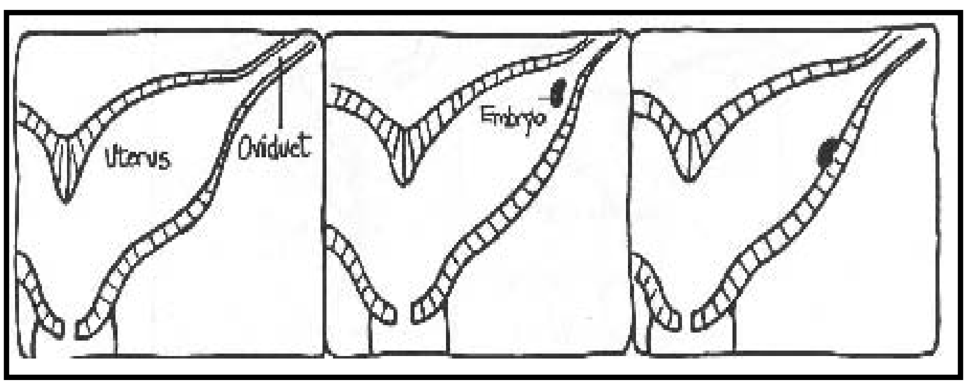
If the cow is not bred and there is no sperm for the ovum to meet up with, the C.L. shrinks. When this shrinking is complete, new follicles will begin to develop and the cycle starts again.

Cycle 2: Pregnancy

If breeding happened and the ovum meets up with a sperm cell from the male, fertilization occurs. The two cells, each containing one half of the genetic material combine to form an entire cell. This single cell is now ready to grow and develop into a calf. The cell continues to divide to create many more cells and is now called an embryo.

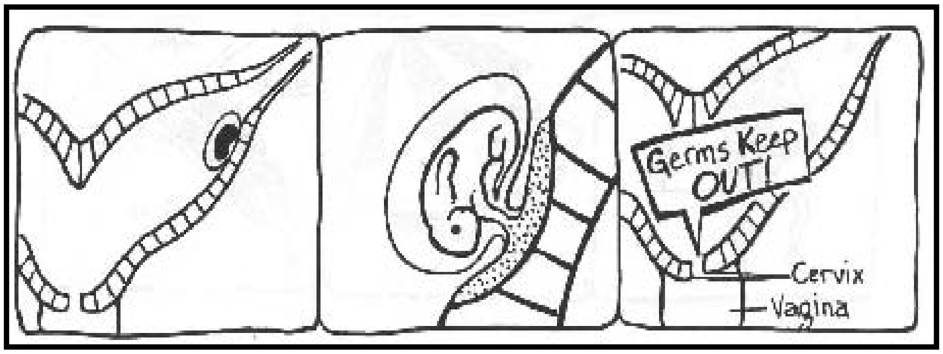


Newly fertilized egg divides to form an embryo



Movement of embryo into uterus

The **oviduct** opens into the **horn** of the **uterus**. Each uterine horn itself opens into the body of the uterus. The uterus is a big tube that is flexible and muscular and shaped like a "Y". By the time the embryo reaches the uterus, it is a cluster of cells. The embryo attaches to the inner lining of the uterus 7-10 days after its release from the ovaries. This attachment is called implantation. Once the embryo has implanted itself into the uterus, it is called a fetus. At this point, the C.L. sends hormones to signal to the cow's body that she is pregnant.



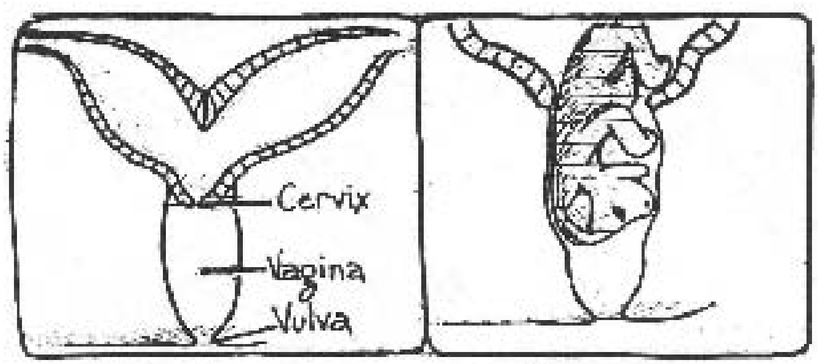
Implantation of embryo and growth of fetus

The lining of the uterus and the fetus form a fluid filled membrane for the fetus to grow in. This is called the **placenta**. The placenta allows nourishment to pass from the mother to the fetus and for waste material to pass from the fetus to the mother via the umbilical cord. It also absorbs shock and helps to keep some diseases away from the fetus. The fetus grows and causes the uterus to expand.

The outer entrance to the uterus is the **cervix**. During estrus, it relaxes to allow sperm cells to enter the uterus en route to the oviduct. It also relaxes during birth to allow the fetus to exit. The rest of the time, the cervix is closed and helps to help prevent infection from entering the uterus.

The **vagina** is the canal that leads from the cervix to the outside of the cow's body. The vulva is at the outer end of the vagina. The vulva is the outer part of the reproductive system that you can see from outside her body.

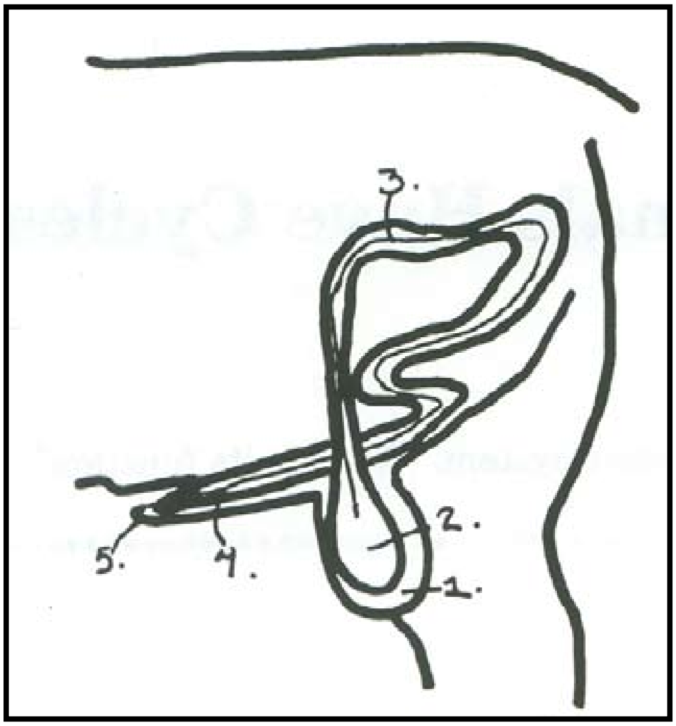
The cervix, vagina, and vulva are all very flexible. They need to be flexible so they can expand to several times their normal size to allow the fetus to be delivered during birth, as seen in the diagram below:



The Other Half: The Male Reproductive Organs

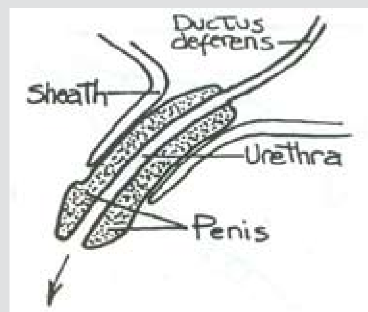
The male reproductive system contains half of the genetic material for an animal. Each male has two **testicles**. They produce millions of microscopic cells called **sperm**. The sperm are the cells containing genetic information.

The testicles are located inside the **scrotum**, which can be seen between the bull's hind legs. The testicles hang outside the body to keep them at a slightly cooler temperature since sperm do not survive as well at higher temperatures. During breeding, sperm travels through a thin tube called the **ductus deferens** and enters a larger tube called the **urethra**. Other fluids are added to the sperm en route. The urethra travels through the centre of the **penis**. The penis is usually hidden by a fold of skin called the **sheath** and is only visible when the animal is urinating or breeding.



The reproductive system of the bull:

1. Scrotum
2. Testicles (testes)
3. Ductus deferens
4. Penis
5. Sheath



Male Reproductive Failure

There are a number of reasons why a bull may be unsuccessful in providing viable semen:

1. **Too young** – young bulls only produce half as much sperm as older bulls, reducing the chance of fertilization.

2. **Stress** – low sperm count and low sex drive can result from poor nutrition, breeding too often or obesity.

3. **Infection** – infection can result in deformed sperm or low sperm counts. Since it takes sperm weeks or months to form, it could take awhile before the effects of a minor infection are even noticed. Rest and treatment are required for the male to breed again.

Digging Deeper - **Control of the Cycles**

Whether it is the estrous cycle, the sperm production cycle, or the pregnancy cycle, the whole reproductive system of cattle is controlled by hormones.

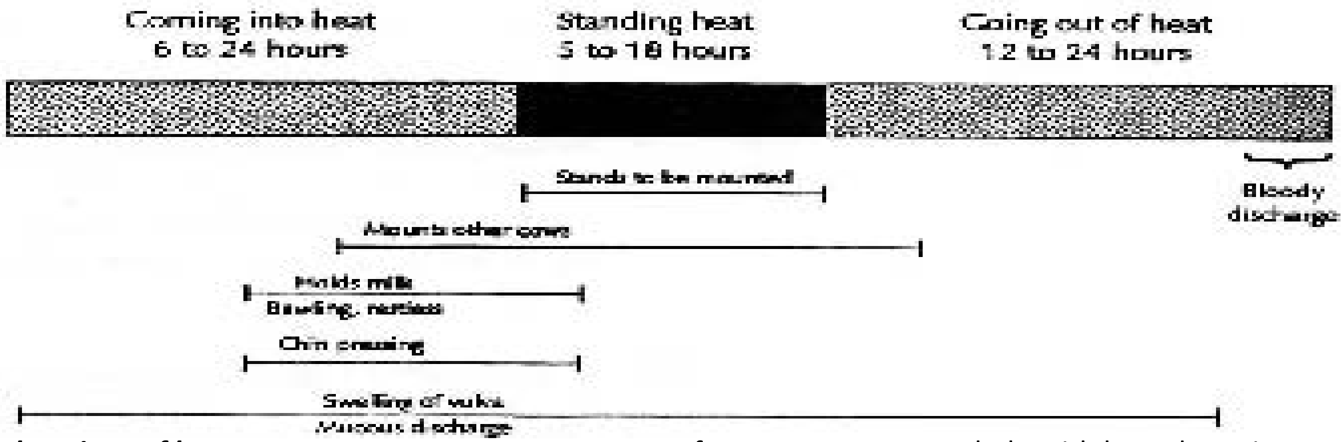
The chart below describes all of the hormones involved and their function:

Hormone	Source	Effect	Other Information
FSH (Follicle Stimulating Hormone)	Pituitary gland in the brain	• Stimulates follicle growth on the ovary of the female • Stimulates growth of sperm cells of the male	• FSH levels are high late in estrous cycle • Injection by veterinarians can induce ovulation
LH (Luteinizing Hormone)	Pituitary gland in the brain	• Activates ovulation (egg release from follicle) • Controls C.L. development • Stimulates secretion of progesterone in female and testosterone in male	• Used to treat ovarian cysts
Estrogen	Ovaries	• Produced by developing follicles • Stimulates signs of estrus (heat)	• Estrogen levels in blood are high during estrus
Progesterone	Ovaries	• Produced by the C.L. • Helps prepare for and maintain pregnancy	• Low levels in the blood during estrous but high during pregnancy
Prostaglandins	Uterus	• Causes the C.L. to shrink • Stimulates start of heat and birthing process	• Often injected to trigger birth or bring an animal into heat
Prolactin	Pituitary gland in the brain	• Stimulates milk production and secretion by mammary gland	• Levels in the blood are high during lactation
Testosterone	Testes (testicles)	• Responsible for development of secondary sex organs and sexual characteristics and behaviour	• Fairly constant after puberty

A Closer Look at the Estrus Cycle – The 21 Day Shift!

When the ovary releases an egg from a follicle, the cow shows signs of **"heat".** Heat signs indicate that a cow is ready to be bred.

The best sign of heat is when a cow remains standing to be mounted by another cow, a stage referred to as **standing heat**. A cow needs to be bred 12-24 hours after standing heat is observed.



Other signs of heat are:

- Bawling, restless behaviour
- Butting
- Swollen, reddened vulva
- Mucous discharge
- Withholding milk
- Increased urination
- Mounting other cows
- Chin pressing on other cows
- Sniffing, licking of the vulva, lip curling
- Pays little attention to feed

Heat detection is a very important part of herd management. Finding heats means that you know when cows are ready to be bred. This way they can get in calf quickly and that semen is not wasted on cows that are not really in heat.

Rule of Thumb: Farmers should spend at least twenty minutes three times each day watching their animals, and recording any signs of heat that they see.

If cows are only watched once per day, less than 60% of heats will be caught.

While a set of human eyes is the best detector, farmers can get extra help with heat detection because it is hard to be around to see every heat:

- **Heat mount detectors** – a patch filled with dye is applied to a cow's rump. If it changes colour, it proves that the cow was mounted and is in standing heat
- **Computer transmitters** – pressure triggered transmitters send a computer signal to a receiver when the cow is mounted. The receiver forwards the information to a computer indicating the cow's name or herd identification, number of mounts and the mount time/length
- **Heat detector animals** – heifers treated with hormones can detect heats in cows. A chin ball marker attached to the treated animal causes her to mark any cows she mounts
- **Pedometers** – these monitors record how much a cow walks and transmits the information to a computer. The computer calculates the cow's average physical activity. Cows are usually more active when they are in heat so the heat is detected when the cow has more movement than usual.

What if She Does Not Come into Heat?

Anestrus means 'no estrus' and is used to describe an animal that does not come into heat. There are different types of anestrus:

1. **Lactational anestrus** – is when an animal does not cycle when it is nursing its young. This is rare in dairy cows because they are usually milked by a machine and are not bonded to their young.
2. **Pregnancy** – cows/heifers do not cycle when they are pregnant.
3. **Anestrus due to infection or illness** – unhealthy animals often do not come into heat. For example, a uterine infection can prevent ovulation and therefore prevent estrus.
4. **Anestrus due to cystic ovaries** – this is very common in dairy cattle, especially early in their lactations. Cystic ovaries occur when the follicles grow but do not release the ova from inside them. While this usually leads to anestrus, it can also have the opposite effect – increased frequent estrus behaviour (also known as nymphomania).

While hormone therapy can provide treatment, the best way to deal with anestrus is to prevent it by:

- **Keeping animals healthy**
- **Knowing your animals' cycles** – when should or shouldn't they be cycling. Individual animals may behave in slightly different ways when they are in estrus (heat).
- **Keeping records of reproductive events** – You can find anestrus problems sooner if you know how long it has been since an animal has calved or last shown a heat
- **Close observation** – Watching for heats is important. Many high producing animals will not even be truly anestrus. They will be having estrous cycles but not displaying the signs of a heat. This is called a 'silent estrus' or 'silent heat' and often occurs when animals are in closed housing a lot. Detection by a veterinarian will help identify the cycle and allow the cow to be rebred more quickly.

Digging Deeper - **Managing Heat Cycles**

Reproductive Goals

A good breeding program should have several goals to ensure that the cows have the greatest opportunity for production over the course of their lifetimes. The table below shows a few main goals:

Measure of Performance	Goal	Too high, needs work
Interval from calving to first heat Number of days from the time a cow calves until she comes into heat again.	40 days	60+ days
Days to first service Number of days from calving to the first breeding	70 days	90+ days
Days open Days when the cow is not pregnant, measured from the time of calving until a successful breeding	85 days	110+ days
Calving interval Time between one calving and the next calving	12.5 months	13+ months
Services per conception Average number of times each cow needs to be bred before she becomes pregnant (The closer to 1.0 the better)	1.5 to 1.7 times	2.0+ times
First service conception rate The percentage of cows that become pregnant on the first breeding	60%	Less than 50%
Cows culled for reproductive reasons The percentage of cows that have to be culled because they cannot conceive	5%	10%+
Age at first breeding Aim to breed heifers so they will calve by 24 months of age	15 months	17+

To ensure the breeding goals are met, it is important to watch animals carefully for heats and to ensure that all animals in the herd are healthy. Individual farmers may have other factors that help them decide when to breed some or all of their animals. Other factors that can affect decisions about the timing of breeding are schedules for showing cows and calves so that the animals are born or ready to show at the right time, allowing smaller animals to grow a little longer before breeding, calving at the proper time to have more milk for incentive days, etc.

Breeding Heifers

While the goal is to breed heifers at 14 to 15 months of age so that they are calving out at 23 or 24 months of age, it is important that the animals are large enough to be bred at that time. The chart below shows minimum breeding sizes for different breeds of dairy cattle:

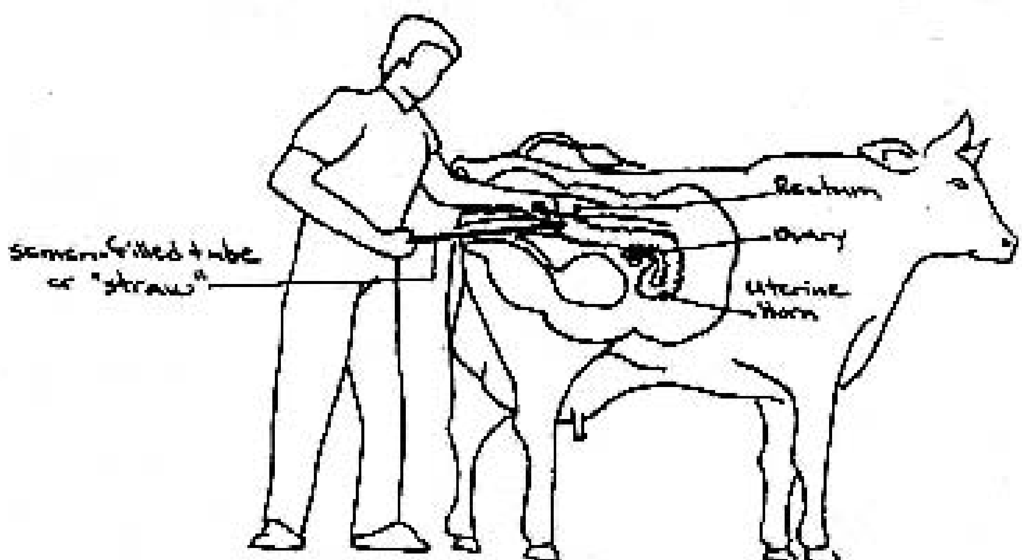
Breed	Weight	Height
Holsteins and Brown Swiss	366kg	130cm
Ayrshires and Guernseys	310kg	122cm
Jerseys	268kg	115cm

Managing Reproductive Cycles – It's Breeding Time!

There are two methods of breeding cows and heifers once they are in heat:

1. artificial insemination (AI)
2. the natural method of keeping a bull on the farm

While the natural method is self-explanatory, AI requires more technology. **AI** is a technique in which male semen is collected and later implanted in females. At an AI collection facility, the male mounts a dummy female and **ejaculates** into an artificial vagina. The semen is then collected and mixed with an antibacterial agent (i.e. penicillin). It is then frozen along with an **extender** that will help preserve the semen for a long period of time. The frozen semen remains submersed in liquid nitrogen until it is used on farms, at which point it must be warmed slowly. Once cooled, the semen must be inserted into the cow within a few minutes to optimize chances of semen survival and thus a successful breeding.



Artificial Insemination of a Cow

The chart below compares the two methods of breeding:

	Advantages (☑) and Disadvantages (☒)	
Factor	**Artificial Insemination**	**Natural**
Costs	☒ Each vial of semen ☒ Fee for insemination costs	☒ Buying the bull ☒ Feeding ☒ Medical bills
Choice	☑ Can select bulls from local AI units or anywhere in the world to match the needs of your herd	☒ Most farms just keep one bull
Conception Rates	☑ High with good heat detection system	☑ High with good heat detection system ☑ May be more likely to inseminate 'problem breeders'
Health	☑ Bulls are all tested for disease ☑ Little chance of spreading disease	☒ Can spread diseases from bull to cow ☒ Bull can injure a cow or himself during breeding
Risks	☑ Few	☒ Bulls are unpredictable and extremely dangerous
Genetics	☑ Can choose from the best, most modern genetic pool ☑ Good genes are proven because the bull has many daughters in other herds ☑ Sexed semen can be purchased to increase likelihood of female offspring	☒ Some bulls have genetic records but there is no choice of genetic selection when you only have one bull on the farm ☒ No proof that his genes are good

Artificial insemination clearly provides more opportunity to improve genetics in the herd. Many herds use AI primarily, and then use a 'clean up' bull to impregnate the cows that do not successfully get bred by artificial insemination.

Programmed AI Breedings using Prostaglandin

Timing is very important in AI breeding to get a high conception rate on the first service. Farmers can use **prostaglandin** to program breeding and bring cows into heat at a predictable time.

Prostaglandin is a natural hormone in the cow's estrus cycle. The uterus produces prostaglandin if the cow does not become pregnant during her cycle, so that she will come into heat again.

Manufactured prostaglandin mimics the natural hormone. When injected, a cow will come into heat right away. This alters her estrus cycle so that you can use AI to breed her at a suitable time. If a cow does not show a heat the first time, sometimes prostaglandin must be administered again 14 days later. It can be used on problem cows or as a regular part of your breeding program.

Knowing when a cow should be coming into heat helps with heat detection and increases the likelihood of a successful breeding. It can help to achieve reproductive goals like low calving intervals and reduce the number of days open.

Other Breeding Options

While artificial insemination and the barnyard bull are the most common methods of breeding cows, modern technology has led to the development of other methods of getting cows pregnant.

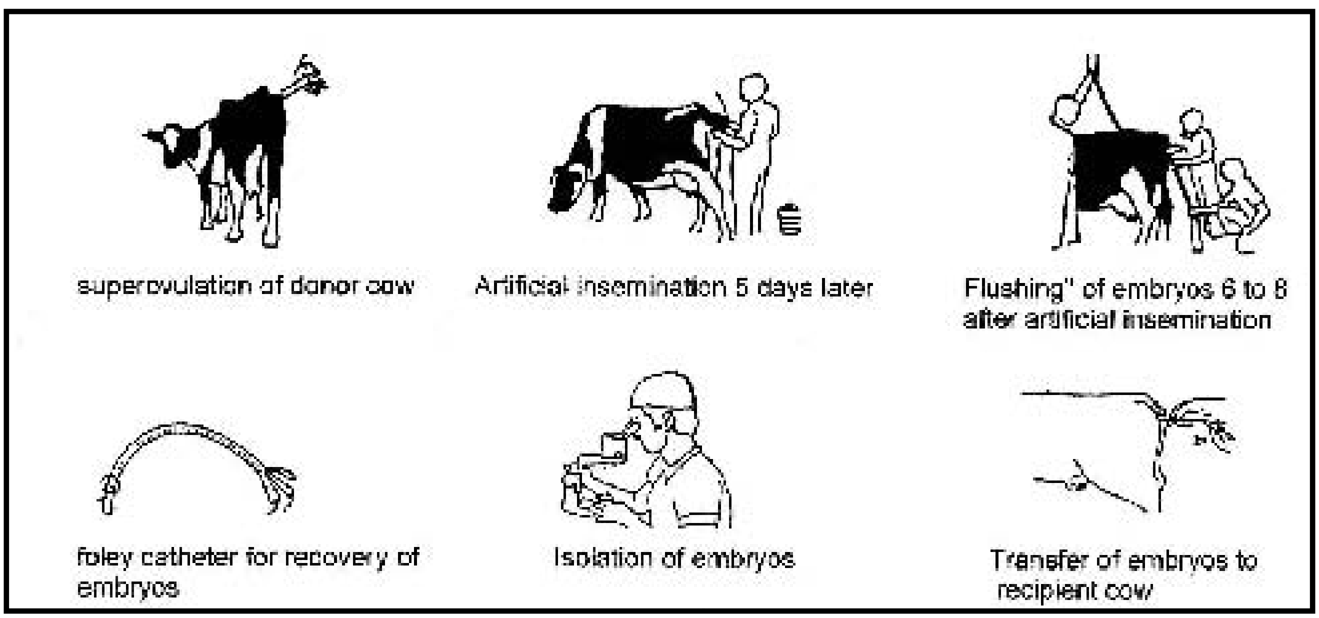
Multiple Ovulation and Embryo Transfer

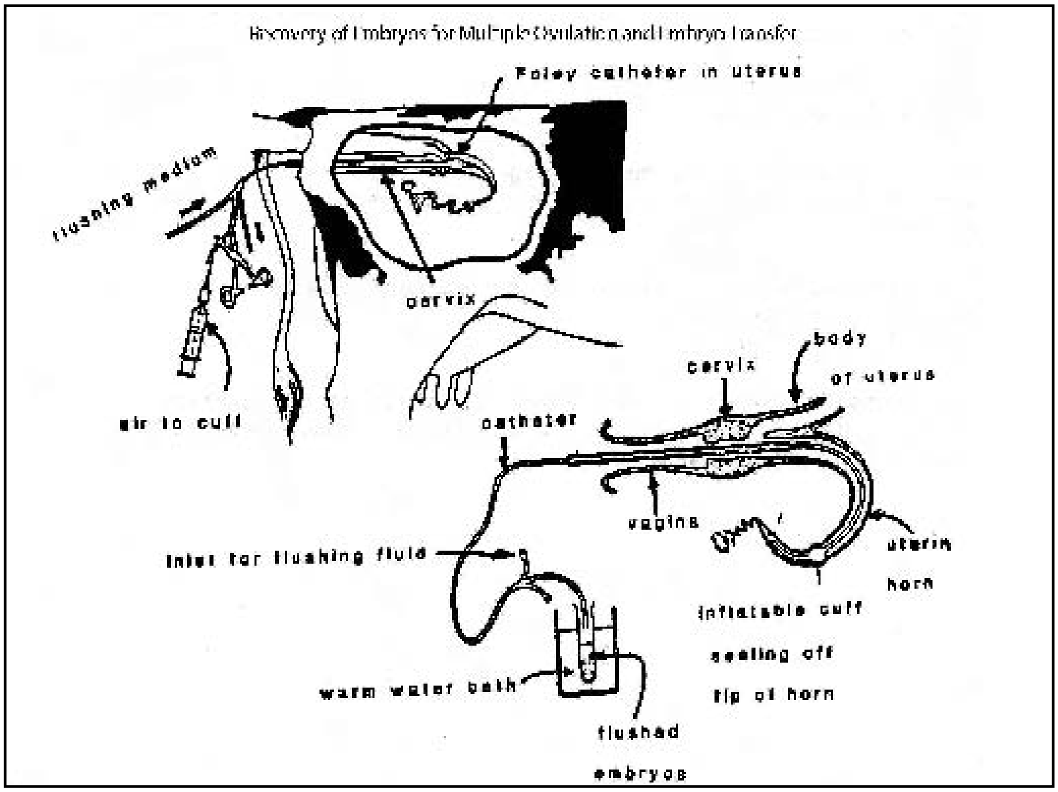
This reproductive method has been in use for many years. It is an expensive process, so farmers usually only use this method to harvest embryos from their best animals. Poorer animals or virgin heifers are often used as recipient animals.

The process requires several steps:

- The donor dam is injected with Follicle Stimulating Hormone (FSH) for a few days. This causes her to release more ova than usual. This process is called **superovulation.**
- The cow is bred (typically using artificial insemination) during her heat. Since superovulation results in more ova, more sperm can fertilize them, resulting in more than one embryo.
- The embryos are flushed out of the uterine horns using a catheter and are isolated using the help of a microscope.
- The eggs can be implanted fresh into animals that were at the same point in their cycle as the donor dam was or they can be frozen in liquid nitrogen for later use, just like semen is. If the embryos are intended to be sold to another country, they must be “washed for export” before freezing. This means that the embryos are rinsed in a trypsin solution that helps prevent the spread of disease.
- The donor dam can be rebred on her next heat.

The steps of embryo transfer in dairy cattle are indicated in the diagrams below, and on the next page:





In Vitro Fertilization (IVF)

In vitro means "out of the body" as opposed to other types of breeding that occur inside the cow's body "in vivo". In this type of breeding, an unfertilized egg is removed from a cow's ovary by a technician. Then the egg is fertilized with semen that is combined with it in a laboratory dish. Then the embryo is implanted in a recipient just like embryos are transferred after multiple ovulation and embryo transfer.

Eggs can be taken from live cows or recovered from the ovaries of a dead cow. When eggs are taken from dead/culled animals the process is called **genetic salvage**. Using very advanced technology, eggs can even be harvested from two or three month old calves. This decreases the time required from one generation to the next, and thus increases the rate of genetic improvement. It also makes it possible to save the eggs of a valuable animal that dies.

Cloning

In recent years, reproductive technology companies have begun cloning famous cattle. This process, using cells from the donor animal, is very expensive and due to costs, health, and moral concerns, it has not become a mainstream activity. Significant testing has been done, mostly in the United States to determine if the milk produced from cloned animals is safe for human consumption. Studies thus far indicate that it is safe and poses no risk to the animals or humans ingesting food from cloned animals.

For an illustration of how cloning is done, visit the website of the University of Tennessee's cloning project - http://animalscience.ag.utk.edu/utcloneproject/pdf/AJRIVCloningReviewFigures.pdf

Steps in Cloning:

1 - eggs are collected from donor cows (from an abbatoir or donor animals). 2 - eggs are cultured for 18-20 hrs. 3 - the maternal DNA is removed. 4 - the somatic cell is place next to the cell cytoplasm. 5 - the somatic cell and cell cytoplasm are electrofused. 6- the embryo is created from the somatic cell and cell cytoplasm from a resistant animal. 7 - activation (similar to the actions of the sperm). 8 - culture cloned embryos for 7 days. 9 - transfer of embryos into surrogate mother. 10 - pregnancy diagnosis using ultrasound. 11 - cloned offspring of somatic cell donor (term delivery 280 days).

Marking the Genome

DNA – deoxyribonucleic acid – is the basic building block of life. It contains all of the genetic material that is passed on from one generation to the next. Using DNA, scientists can determine the sex of an embryo. Efforts are also being made to find genetic markers for profitable traits in cows. One day, for instance, an embryo might be able to be tested for high milk and component production based on its DNA. Health traits could potentially be 'marked'. Genetic marking involves finding the specific location on the genes that has the genetic material to result in the expression of a certain trait. This is a very exciting and ever-growing field of scientific research.

Detecting Pregnancy

Once the cow is impregnated, regardless of method of breeding, it helps farmers to know if their cows are pregnant or not. There are a couple of methods of determining whether or not a cow is pregnant:

Palpation – a hand inserted in the rectum can feel the uterus and ovaries from above, and determine changes in the organs that are signs of pregnancy, such as the continued follicle development. A cow must be at least 35-40 days pregnant before palpation can be a reliable method of pregnancy detection.

Ultrasound – similar to palpation, a hand, holding the ultrasound wand, is inserted into the rectum of the animal. Sound waves from the ultrasound bounce off of the uterus and result in a picture forming on the ultrasound screen. A veterinarian can look at the fetus to determine the sex of the fetus. On farms, developing fetuses can be detected as early as about 25 days into pregnancy. When the fetus gets a little older (i.e. 60-90 days) then ultrasound can be used to determine the sex of the developing fetus.

Laboratory testing – progesterone levels can be measured in the milk and blood of animals to detect the estrus and pregnancy cycles. Low levels indicate a normal estrous cycle (no pregnancy) and high levels indicate pregnancy. This testing can be done earlier than the other tests. Other hormone levels can also be measured to determine pregnancy during the first three months of pregnancy.

Gestation

This is the period of time when a cow is pregnant. The gestation period of dairy cattle is 282 days on average. Cows usually continue milking throughout their gestation period until they have been milking for 305 days or a couple of months before they are expected to calve again.

Sometimes, there is a problem during pregnancy that stops the embryo or fetus from developing and prematurely ends gestation.

Abortion is when a dead fetus is passed out of the uterus before the normal birth is due.

Sometimes a fetus ceases development but is not passed through the uterus. Instead, it dries up and stays there as a mummified fetus until it is removed. A cow carrying a mummified fetus will usually show anestrus as her body will 'think' it is still pregnant.

Reproductive failure during the gestation period could have a variety of different causes:

- 'Normal' – up to 40% of embryos do not develop as a fetus. This could be because it is not developing properly or because twins are developing and the cow's body rejects the twins early inside the uterus.
- Infection – the embryo/fetus is susceptible to several diseases such as Bovine Viral Diarrhea (BVD), Infectious Bovine Rhinopneumonitis (IBR) and Leptospirosis. Diseases such as these could cause the fetus to stop developing and then be aborted.
- Stress – transportation, high temperatures, sickness of the pregnant female, or poor nutrition could all stress the fetus enough to cause abortion.

Once an animal aborts, it is helpful for a veterinarian to examine the fetus and placenta so that further abortions in the herd can be avoided (in case it is caused by a disease). Many diseases can be prevented by vaccinating animals so that they do not become infected in the first place.

Late Gestation Care

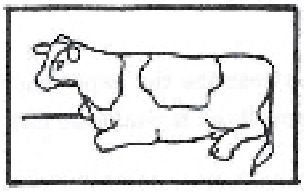
There are several things that can be done to help ensure a healthy calf is delivered and that calving related diseases in the cow are avoided as often as possible.

1. **Close observation** – know the animal's due date and its expected behaviour during birthing so that you know when it is time to call for help. Trying to assist the calving cow too early can cause harm, but arriving to help in time can increase the chances of survival of both the cow and calf.

2. **Clean birth area** – prior to calving, the cow should be put in a clean dry area that provides good footing. This helps to prevent infection in both the cow and calf.

3. **Gentle assistance** – help the cow calve, but only if she needs it.

4. **Selective breeding** – some sires produce offspring that are smaller and easier to deliver and can be used in breeding programs. Often, dystocia (difficult birth) is caused by a fetus that is too large to fit through the birth canal easily, so selecting for smaller calves may prevent many problems.



Calving

Calving refers to the birthing process, whereby the fetus makes its journey from the protected environment inside the uterus of its mother into the outside world. When a calf is born, it stops receiving oxygen and nutrients from its umbilical cord and starts to breathe and eat for itself.

Before Calving Starts

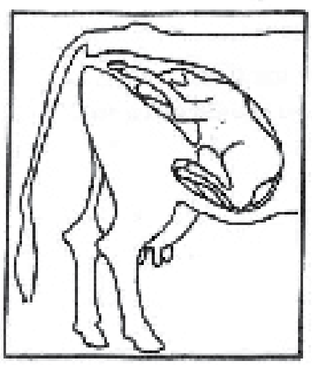
Just before a cow calves, she:

- stops eating
- becomes restless
- isolates herself from other animals
- lies down and gets up a lot
- raises her tail
- discharges a thick, clear mucus from her vulva
- tries to urinate often

The Calving Process

Calving involves three stages, **pre-calving, calving and post-calving.**

Stage 1 – Pre-calving (Labour)

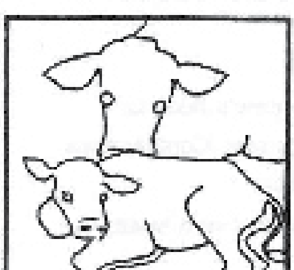


- Lasts 2- 6 hours
- Contractions begin. Contractions squeeze the muscles in the uterus to push the calf out.
- The calf changes position, turning so that it heads towards the birth canal.
- ‘Labour’ means work – the cow’s body is preparing to calve

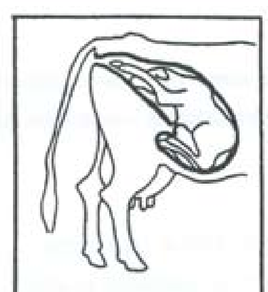
Stage 2 - Calving

- Calf enters the birth canal
- Contractions get stronger and closer together
- Cow strains to push out the calf
- The front feet and muzzle appear
- The rest of the calf appears and slides out easily
- Usually lasts two hours for cows and three hours for heifers

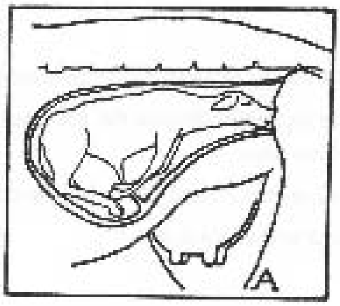
Stage 3 – Post-calving (Delivering the Placenta)

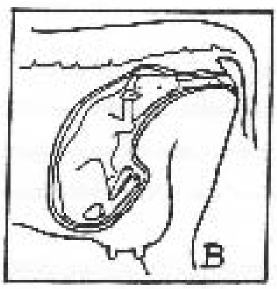


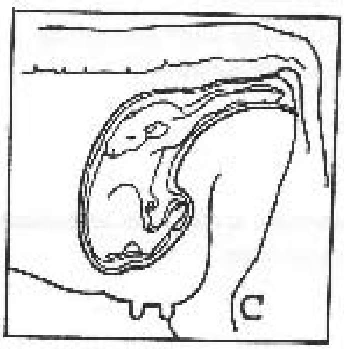
- The cow discharges the placenta, or afterbirth, within 12 hours of calving
- If the placenta is not expelled it could be due to a difficult calving or a poor diet. This is called a **retained placenta** and can cause infections or make it harder for her to get pregnant again. If a cow has a retained placenta, it is time to call the vet!

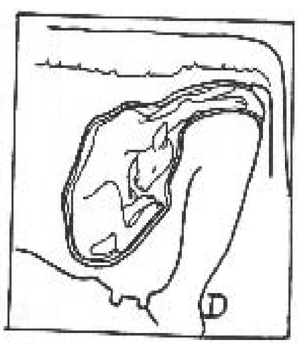


Normal Position









Problem Calvings

Dystocia (Difficult Birth)
This occurs when the fetus does not come through the birth canal easily. This could be because the fetus is too large for the birth canal or because the fetus is in an abnormal position. Dystocia can result in a sick cow and/or a fetus that is stillborn (dead at birth) or weak.

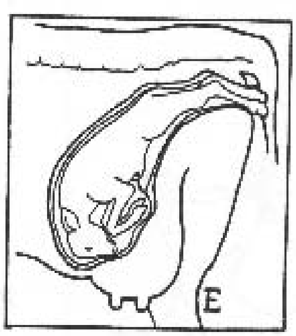
The normal position for the calf at calving is facing the birth canal, with the front feet entering the birth canal first, followed by the head, which rests on the front legs. However, calves may be situated in these other positions:

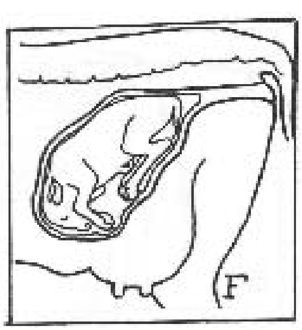
A. Head first with one or both legs bent backward
B. Head and one leg first, with the other leg crossed over her neck
C. Front feet first with the head twisted backwards
D. Front feet first with the head bent down between the front legs
E. Breech, backwards with the hind feet first
F. Breech, with the rear legs tucked under the calf's body
G. Breech, upside down, feet facing up
H. Hiplock – the calf is stuck at the hips

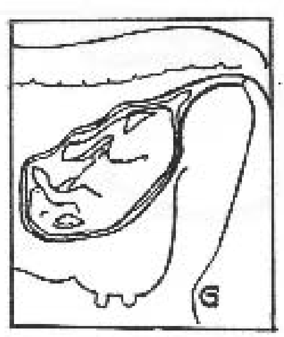
When you need to get help…

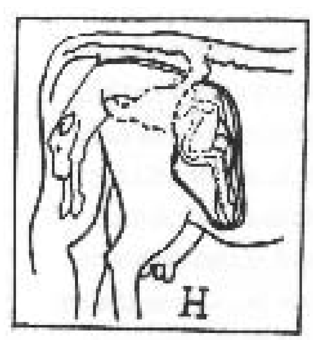
During Stage 2 Calving, you may need to give or get assistance if:

- It lasts longer than two or three hours,
- The placenta or water bag is showing for two hours,
- The cow keeps straining but you can't see any part of the calf,
- The cow is straining hard, but not making any progress in having the calf, and/or
- Part of the calf other than the front feet appear or can be felt at the start of Stage 2.









Checking for Problems

The two most important things to remember when palpating a cow are **sanitation** and **lubrication**. Clean the cow and yourself with warm soapy water and lubricate your arm with soap or mineral oil. Slide your hand into the cow's vagina to check on the progress of calving. If it is hard to get your hand in, stop. Do not force it because you may cause further complications or injury to the cow or calf.

When you feel the orientation of the calf, you can make the decision to either call the vet or try to move the calf yourself.

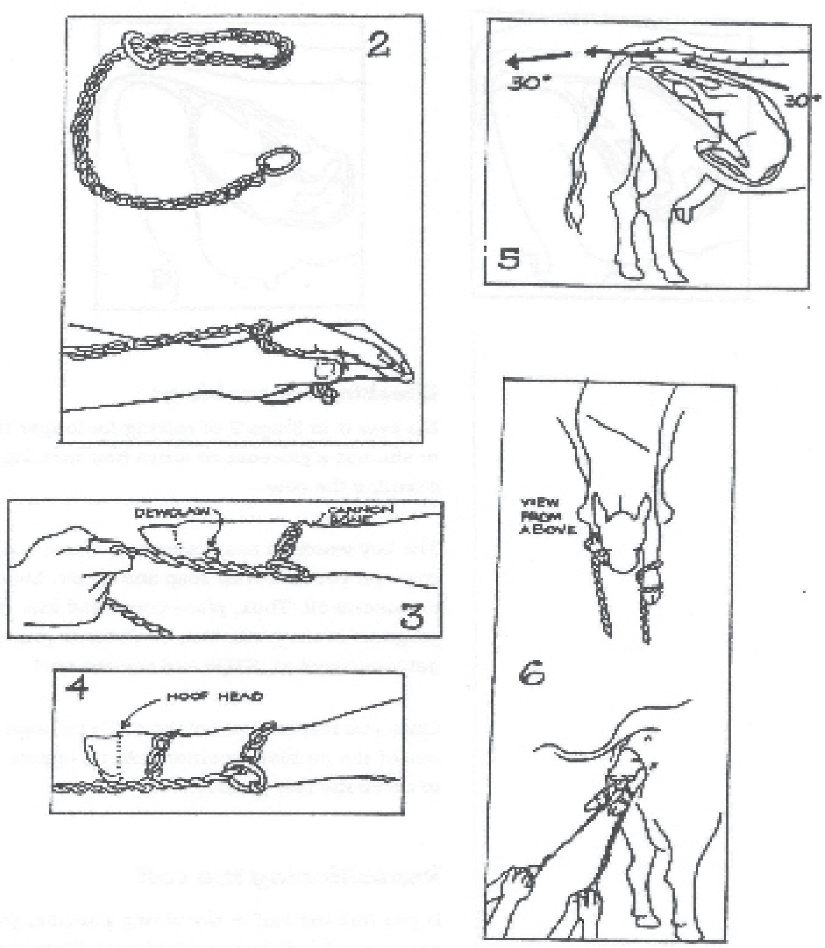
Repositioning the Calf

Calves can be delivered in the breech position with the back legs sticking out, but all other unusual calf orientations require repositioning the calf so that it can be delivered through the birth canal. There are some things to remember to make it easier to reposition a calf:

- Correct the head first, then the feet
- If you are moving the feet of the calf around, cup them in your hand so they do not tear the inside of the uterus.
- Reposition in between contractions so that you do not hurt the cow, the calf or yourself
- If you have tried for 15 to 20 minutes to reposition the calf without success, STOP and call the vet.

Calving Chains

The ideal way for a cow to calve is to do it naturally, on her own. However, often cows need help to get the calf out. You could use a calf puller or calving chains to give the cow a little help.

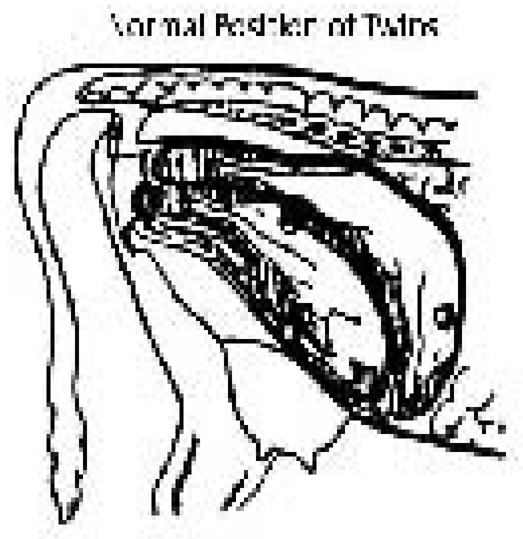


Steps to follow when using calving chains:

1. Disinfect the chain
2. Make a loop in the calving chain
3. Slip the loop over the calf's dewclaws
4. Make a half hitch in the chain between the dewclaws and the hoofhead
5. Pull up 30° and down 30° from the ground and the ceiling. This angle works naturally with the cow's body. Work with the cow and only pull when she is pushing.
6. Alternate pulling on each leg a few centimetres at a time. This keeps the calf's hips and shoulders at an angle so that the calf passes easily through the pelvis.

Double Trouble!

Twins may be exciting for people, but they are often a big disappointment on the dairy farm. Twins are often difficult for the cow to give birth to, increasing the chance of complications, and unless they are both the same sex, they are of little value to the farmer. When the twins are a heifer and a bull, hormones pass between their birthing sacs in the uterus and give them a combination of both male and female sex characteristics. Almost all of the time, this means that the female is a **freemartin** (an unbreedable female born as a twin with a male).



Newborn Calf Care

There are a few things that need to be done as soon as a calf is born.

It's Time to Take a Breath!

The first step is to make sure the calf is breathing. Clear any membranes off of its nose and inside its nostrils to help it breathe better. You may need to tickle its nose with straw to help it start to breathe, especially if its mother has not started to lick it off yet. Sometimes calves have problems breathing because they still have fluid in their lungs and throat. After all, they have been floating around in a liquid for 9 months! If the calf is having trouble breathing, you can lift it up by its hind legs so that its head is off the ground. Gently swing the calf from side to side. This helps to drain the mucus out of its lungs so that it can breathe.

If the calf still is not breathing, you can try rescue breathing for it. Put your mouth over the calf's nostrils and blow gently. Blowing too hard could burst a calf's lungs.

Navel Treatment

Dipping the calf's navel in an iodine solution will disinfect the umbilical cord area and help to prevent infections. It takes a few days for the umbilical cord area to dry up and heal over, so disinfection and a clean, dry place to lie down are very important for newborn calves.

Colostrum – The Super Drink!

Colostrum is the first milk that a cow gives after she calves. It contains a lot of anti-bodies that help the calf fight germs.

It is ideal to make sure the calf gets at least four litres of colostrum within 30 minutes after birth, and an additional two litres within 8 hours of birth. This amount varies with the size of the calf, as a smaller breed, like a Jersey, will only need three litres of colostrum initially. Timing is important because after about 24 hours, the calf cannot absorb the antibodies in colostrum anymore.

(More information on feeding colostrum is available in the Nutrition section of the 4-H Dairy Resource Guide.)

Identify the Calf

Once you have a healthy calf on the ground, it is important to make a record of its birth date and parents – kind of like a birth announcement for cows!

Maintaining accurate calving and parentage records is important to track where animals originate from when they are sold (what farm and where it is located in the world), on-farm management, national health programs, registrations and evaluations. If two calves were born on the same day and they got mixed up, hair samples with their DNA would have to be sent away to figure out which one was which. This is more costly and confusing for the farmer, so it is best to keep everything identified from the very beginning.

Tagging

Tags are an important part of the Canadian Quality Milk Program through Dairy Farmers of Canada. This program regulates milk production to ensure food safety.

Newborns of all dairy breeds in Canada must be tagged using the national ID system. This applies for both registered and non-registered animals. The national identification number corresponding to the tag is assigned to that animal and its farm of origin.

This system includes tags that can be read three ways:

1. **Radio Frequency ID** (RFID) – the front of the tag contains a microchip button with a small panel tag on the back. Information contained on the microchip can be retrieved by wand or portal at an abattoir or sales barn.
2. **Bar code**
3. **Visual Identification**

The tag that does not have the RFID microchip is called the security tag. It has the bar code and large front and back panels. Both sides of tags have the national ID number printed on them and the panel tags have a different within-herd management number for convenient use on a daily basis.

Steps to tagging:

1. **Ensure** you have the **right tags** corresponding to the animal's registration number and that all tags have the same number
2. **Depress** the spring clip on the tagger and insert the front part of one of the tags.
3. Put the matching rear panel on the applicator pin
4. **Rotate** the front bar-coded panel 90° from the left for the left ear and 90° to the right for the right ear for ease of visibility and to properly position the tag and tagger.
5. **Properly restrain** the animal, regardless of age and tag from the front of the animal, while facing the animal.

Male calves that are destined for slaughter may be tagged with a 'beef' tag approved by the CCIA (Canadian Cattlemen's Identification Agency). These tags are a single RFID yellow button tag.

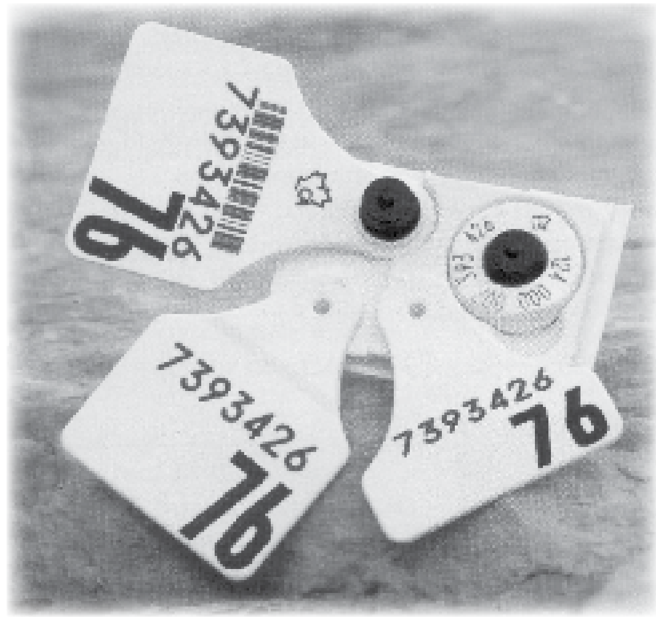
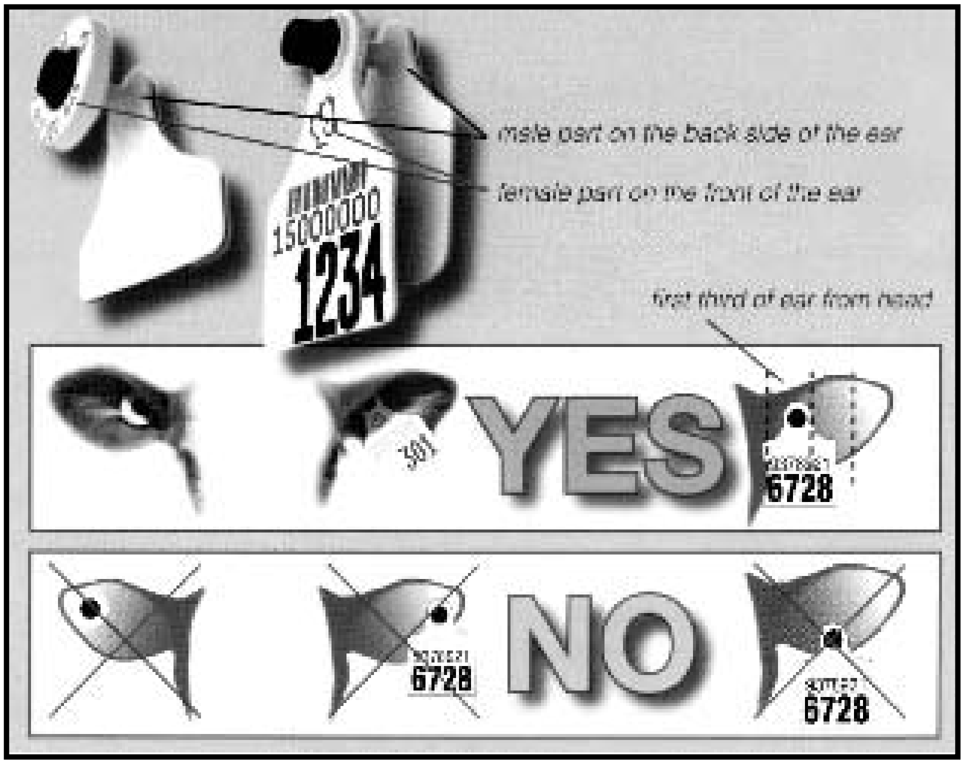


Image: 'One National Tagging System for Canada's Dairy Industry', NLID – National Livestock Identification for Dairy, Revised 2005

Animals that were born before this system came into place and were identified by sketches, photographs, or tattoos can be tagged using transition tags. These tags must be ordered so that individual registration numbers can be printed on them. Likewise, lost tags must be replaced and can be ordered with an individual animal's registration and herd management numbers printed on them.

Animals must be tagged to participate in cattle shows, be sold or slaughtered.

Calves must be tagged in the first third of the ear, closest the head so that the tag does not get caught or wiggle around easily. They should also be placed in the upper part of the ear, between the ribs of cartilage. Careful tagging will help prevent lost tags or tags being ripped out - see the diagram on the next page.



Source for tagging information and diagrams: 'One National Tagging System for Canada's Dairy Industry', NLID – National Livestock Identification for Dairy, Revised 2005

Other Identification

There are other ways that animals may be identified on-farm in addition to the national tagging system. Types of ID include:

- Tattooing
- Branding
- Sketches and photographs
- Other methods of ID that are not permanent (neck chains, tags, straps, transponders)

When registering an animal, you should check with your breed association to find out how calves should be identified.

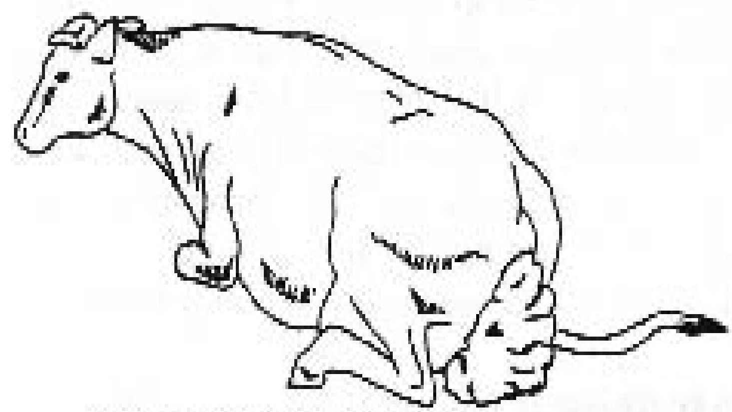
Tattooing and branding have become more important to all dairy breeds since November 2007. All animals that are exiting Canada to cross the border into the United States must be tattooed or branded with the letters 'CAN' to indicate their country of origin.

Cow Care after Calving

After calving, cows should be given access to fresh water, good forages and kept in a clean environment to help prevent infection. Sometimes, especially after a difficult calving, problems can occur and need to be treated.

Retained Placenta – if the placenta does not pass from the uterus in a normal amount of time (usually within 12 hours of calving) then she is said to have a retained placenta (RP). This is often caused by dystocia (difficult birth).

Metritis – this term refers to infection in the uterus. It usually delays the onset of the estrous cycle. This disease is often caused by dystocia.



A cow suffering from a prolapsed uterus

Prolapsed Uterus – after the calf comes out of the cow, a prolapsed uterus occurs when the uterus also passes through the birth canal and hangs from the vulva, inside out. It is usually caused by dystocia or low calcium levels in the cow's blood after she calves.

Nerve or Muscle Damage – dystocia or slipping injuries can cause nerve or muscle damage.

Milk Fever – This condition is caused by low calcium levels in the blood and muscle tissues. It results in weak muscles and the inability to rise and stand. This condition can occur in animals in early lactation, but onset is most common in the first few hours after calving. While this disorder can be treated by the administration of calcium by subcutaneous, oral, or intravenous means, proper dry cow rations are critical to avoiding this problem

Herd Health – Management throughout the Reproductive Cycle

Herd health programs have existed for over 40 years to help dairy farms meet their goals. Marketing milk is the number one goal of dairy production, and reproduction of dairy cows is central to this goal. A herd health visit is a regular examination by a veterinarian. The main goals of herd health programs are to:

- Prevent problems instead of treating them
- Organize and plan all health-related procedures and exams
- Keep records to use in management decisions

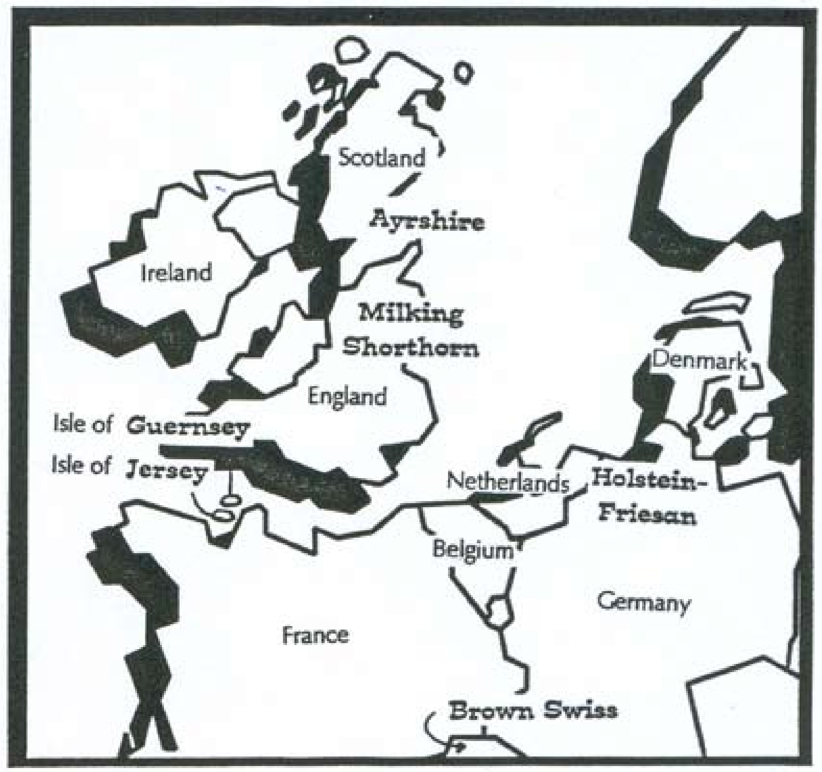
The number one goal of herd health visits on farms is reproduction. Veterinarians may also offer other advice on transition cows, nutrition, housing, vaccinations, and other aspects of farm management.

Typical animals that would be examined during a herd health visit are:

- pre-breeding cows at 15-45 days after calving
- cows bred three or more times
- cows with normal discharges from the vulva
- cows that have been in calf for one month or more – a pregnancy check examination
- cows showing no heats or irregular heats

Breeds of Dairy Cattle in Canada

There are seven main dairy breeds in Canada, each with its own historical, production and conformation traits that make it an important part of the dairy industry. These breeds include the Holstein, Ayrshire, Jersey, Brown Swiss, Milking Shorthorn, Guernsey, and Canadienne.



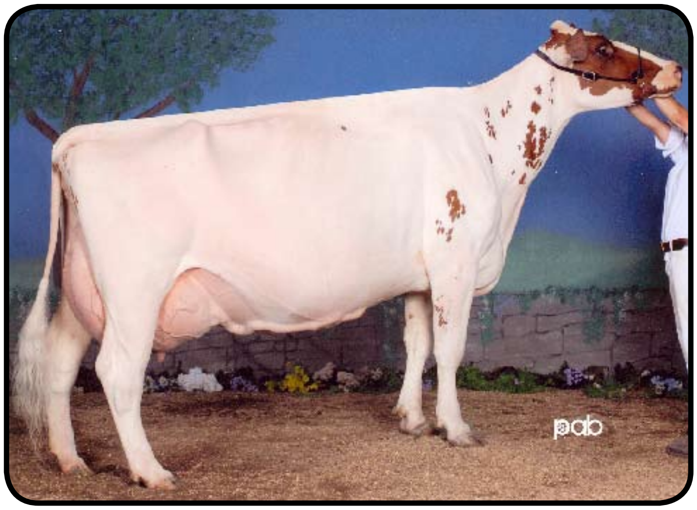
The only one of these breeds that was developed in Canada is the Canadienne. In fact, the Canadienne is the only breed that exists today that was developed in North America. The other dairy breeds all came from different parts of Western Europe and Great Britain.

In Canada, there are approximately 1,040,100 milking dairy cows. The Holstein is the most common breed in Canada, making up 95% of the dairy cattle population. Across Canada, the Ayrshire is the second most prevalent breed, followed by the Jersey.

In Ontario, there are approximately 372,000 dairy cows. Holsteins account for 92% of the dairy cattle population, followed by Jerseys, which make up 7% of the population. The Ayrshire, Brown Swiss, Guernsey, Milking Shorthorn and Canadienne each make up less than one percent of the Ontario cattle population.

Ayrshire

Descriptive Traits: Ayrshires can be recognized by their red and white markings. They are slightly smaller than Holsteins.



Origin: Ayrshires originated in the mountains of Ayr County, Scotland, an area of very moderate temperatures. While the red and white characteristics of the breed developed by 1800, the breed was not recognized as such until 1814. The first Ayrshires came to Canada in the early 1800s.

Distinguishing Characteristics: Ayrshires are known for their low somatic cell counts. The breed currently has the highest average BCA indexes of any of the dairy breeds – indicating rapid breed improvement. They also have very low birth mortality rates of 1.09%.

Breed Association: The Ayrshire Breeders' Association of Canada

Brown Swiss

Descriptive Traits: Brown Swiss are a solid dark brown to silver gray colour with black hooves and muzzles. Mature animals range from a pale whitish brown to a grayish brown colour. They are about the same size as Holsteins, with mature animals weighing an average of 625kg. They are rugged in nature.

Origin: Brown Swiss are the oldest of the dairy breeds, having descended from cattle in Switzerland from before historic records were available. There has been little introduction of outside blood, resulting in a pure breed with distinctive characteristics.

The first animals were brought to Canada from the United States in 1888. The original animals were brought as a dual purpose breed into the Eastern townships of Quebec, but North American animals were later developed into dairy animals.

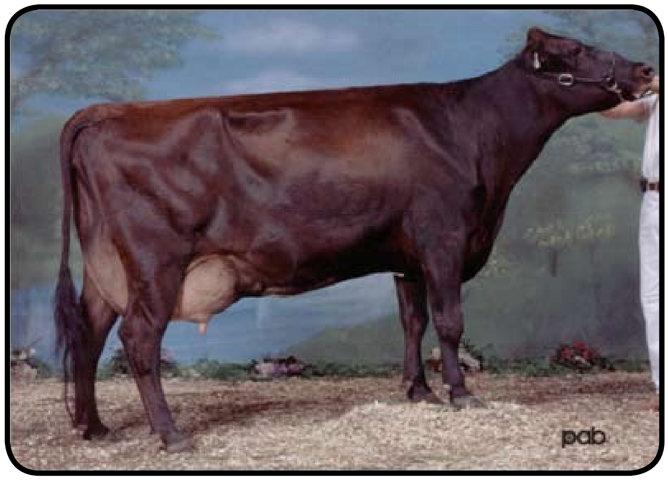
Distinguishing Characteristics: The Brown Swiss are well known for their ruggedness and exceptional feet and legs that are strong and sound. Given their origins in the mountains of Switzerland, they are very adaptable to different altitudes.

Breed Association: In addition to the dairy strain of this breed, there is a beef strain, called Braunvieh, developed in Canada. Because Brown Swiss and Braunvieh share the same genetic makeup, they are included in the same breed association, The Brown Swiss and Braunvieh Association of Canada. Five provincial associations also exist.

Canadienne

Descriptive Traits: Mature cows are usually a dark brown or black colour, but can be a light brown or reddish. They are lighter along their toplines, around their muzzles, and around their udders. The skin on their body usually has black pigment. Calves are born a light brown colour. Mature cows are about the same size as Jerseys, weighing 450 kg to 500 kg. Newborn calves weigh approximately 30 kg.

Origin: This breed is the only breed to have been developed in Canada, or any of North America. Its descendants came from France in 1608 to 1610. Since there were so many of them during the mid 1800s, the Canadian Parliament discouraged people from breeding them, so by 1880 there were very few in existence. In 1886 a herd book was established to help maintain the breed. In the 1970s Brown Swiss were introduced to the breed to improve milk quantity, but was stopped to prevent the breed from complete extinction. To help maintain the breed, the Ministry of Agriculture established a support program, called Project Embryo Plus. This program involves flushing 100% purebred females to 100% purebred males.



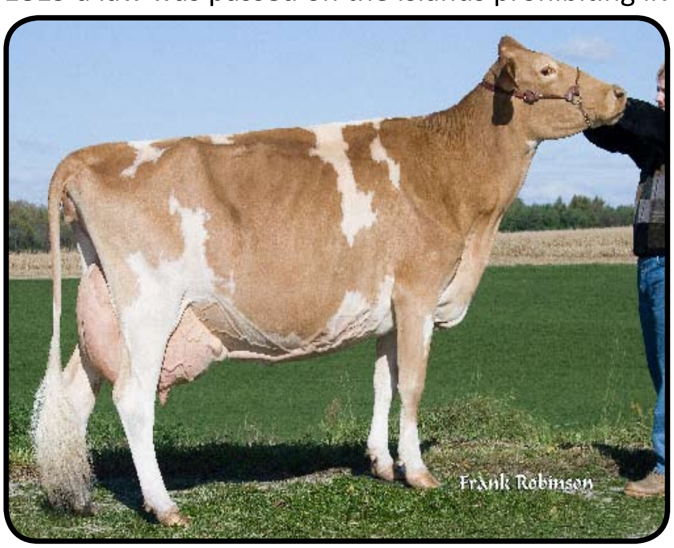
Distinguishing Characteristics: The unique history of this breed resulted in its being granted official heritage status by the Quebec government in 1999. It is known as a hardy animal that can thrive in low management, pasture grazing systems.

Breed Association: The French Canadian Cattle Breeders' Association, formed in 1895. Since this breed is considered to be a Rare Breed, information is also available from Rare Breeds of Canada.

Guernsey

Descriptive Traits: Guernseys are a golden fawn colour with white markings. The shade of fawn can range from very light brown to brownish red. They are medium sized cattle, about the same size as the more common Ayrshire, with mature animals weighing from 550 kg to 700 kg.

Origin: Guernsey cattle were developed on the Isle of Guernsey, in the English Channel off the coast of France. The breed was developed by monks who brought cattle with French bloodlines to the Island. In 1819 a law was passed on the Islands prohibiting live cattle from being imported to the Islands, resulting in a pure population of the breed on the Isle of Guernsey.

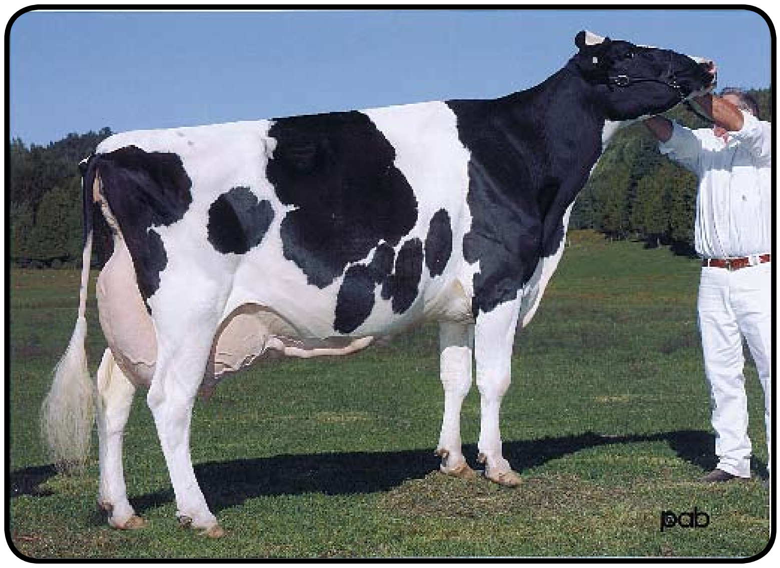


The first Guernseys arrived in Canada by accident when a ship heading for the New England states was forced to land in Nova Scotia. The residents were impressed by the animals, so in 1878, the first official importation of Guernseys to Canada was made by the Prime Minister, Sir John Abbott. The breed started in the Maritimes and traveled over land to other parts of the country.

Distinguishing Characteristics: Guernseys are most well known for the distinctive golden colour of their milk, which is caused by a very high content of Beta Carotene.

Breed Association: Canadian Guernsey Association

Holstein



Descriptive Traits: Holsteins are usually black and white, although some can be red and white, or carry red and white genes (called red carriers). Adult females weigh approximately 625 kg and are, on average, 58 inches tall at the shoulder. When they are born, calves weigh about 40 kg.

Origin: Holsteins were imported from Holland (now called the Netherlands) in the 1880s as Holstein-Friesians. Today, 95% of the dairy cattle in Canada are Holsteins, with provincial organizations throughout the country, as well as the national organization that maintains the breed's herd book, Holstein Canada.

Distinguishing Characteristics: Holsteins give the highest volume of milk, fat and protein of any of the dairy breeds.

Breed Association: Holstein Canada.

Jersey

Descriptive Traits: Jerseys range from light fawn to dark brown in colour, with or without white markings. They are also characterized by their dark hooves and muzzles. Jerseys are the smallest of the common dairy breeds, weighing 400kg to 500kg as mature animals.

Origin: Jersey cattle were developed on the Isle of Jersey, in the English Channel off the coast of France. Early ancestors are believed to have originated in Africa, which explains the high tolerance to heat and humidity that the breed has developed. In 1819 a law was passed on the Islands prohibiting live cattle from being imported to the Islands, resulting in a pure population of the breed on the Isle of Jersey.

Jerseys were first brought to Canada in 1868. They came to Quebec and the American Jersey Cattle Club processed registrations until a Canadian Association was founded in 1901 and started its own herdbook in 1905. The breed was very popular in the 1950s and 1960s when there was an All-Jersey milk program, but declined when this program ended until Multiple Component Pricing helped to renew its popularity.

Distinguishing Characteristics: Jerseys are well known for having the highest percentages of fat and protein in their milk. Their small size results in easy calvings.

Breed Association: Today, while provincial and regional organizations exist in Atlantic Canada, Ontario, Quebec, and the Maritimes, the national breed association is known as Jersey Canada.

Milking Shorthorn

Descriptive Traits: Milking shorthorns are red and white. Their markings can vary from almost a solid roan colour to very speckled roan and white. They are medium sized animals.

Origin: The breed was established in the 1700s in Northwestern England. In Canada, the breed was known as Dual Purpose Shorthorns until the early 1990s when the name was changed to Milking Shorthorns to reflect the dairy genetic focus of the breed.

Distinguishing Characteristics: Shorthorns are well known for their feed efficiency, maternal instinct, soundness and longevity.

Breed Association: The breed is represented in Canada by the Canadian Milking Shorthorn Society.

Comparing Breed Production

The chart below compares production levels of the Canadian breeds of dairy cattle based on 2006 production numbers:

Breed	Number of Records	Milk (kg)	Fat (kg)	Fat (%)	Protein (kg)	Protein (%)	BCA		
							Milk	Fat	Protein
Ayrshire	9,323	7,423	293	3.96	246	3.32	213	204	214
Brown Swiss	1,528	8,064	326	4.06	278	3.46	208	209	205
Canadienne	203	5,412	228	4.24	193	3.60	188	177	196
Guernsey	422	6,540	296	4.55	224	3.43	198	179	190
Holstein	264,903	9,677	357	3.71	307	3.18	211	209	210
Jersey	8,809	6,331	304	4.83	238	3.77	211	187	209
Milking Shorthorn	230	6,552	238	3.65	214	329	236	213	236

Source: Canadian Dairy Information Centre, www.dairyinfo.gc.ca

Registered or Grade Animals

A registered animal is one that has parents who are also registered and of the same breed. A registered cow has official identification and papers to prove her parentage, just like a person has a birth certificate. Registered cattle have higher sale values than grade animals of comparable quality, because they are thought to be more valuable to a dairy herd.

A grade animal has parents who are not registered. Grade cattle have no official family trees.

Crossbred Animals

Crossbred animals are those of mixed breed parentage. The sire and dam are not the same breed. These animals do not have as high sale values as registered animals, but many farms have started to use them because they reduce the level of inbreeding in a herd and as such have an advantage in increased "heterosis". Heterosis refers to the increased performance of progeny compared to what is expected based on the average of its parents. An example of a crossbred animal would be the result of a mating of a Holstein cow with a Brown Swiss bull.

Genetic Improvement

Genetic improvement is a long name for a simple idea: building better cows. When farmers breed a heifer or cow, they want the resulting calf to be better than her parents. There are several traits that farmers want to improve in their animals, such as:

- Milk production
- Protein production
- Fat production
- Conformation
- Longevity
- Somatic Cell Count
- Other health traits…

Since improving traits helps farmers earn more money in the future, it is very important to select the right bull to breed each cow in the herd to. It is kind of like matchmaking for cows!

Inheriting Genes

Genes are inherited. That means they are passed on from parents to their offspring. Cattle (and people too!) get half of their genes from their mother (dam) and half from their father (sire).

Farmers hope that the best traits will be passed down from both the dam and sire to the calf. This does not always happen though. Some genes pass down from one generation to the next easier than others do. This is called **heritability**. Highly heritable genes are easy to pass on to offspring, while less heritable genes are more difficult to pass on.

In general, some traits are more highly heritable than others:

Highly heritable
- Percentage of fat and protein in milk
- Size as adults

Moderately heritable
- Milk yield
- General appearance
- Mammary system
- Milking speed

Slightly heritable
- Life span
- Strength of feet and legs
- Fertility
- Calving difficulty
- Resistance to mastitis

The charts below show the heritabilities of different production, functional and type traits of different breeds of dairy cattle that are used in genetic evaluations:

Production Trait	HO	AY	JE	BS	GU	CN	MS
Milk Yield	41	38	44	41	41	42	42
Fat Yield	34	34	39	36	35	38	40
Protein Yield	37	37	41	38	38	40	41
Fat Percentage	Not Directly Used – Literature estimate is ~50%						
Protein Percentage	Not Directly Used – Literature estimate is ~50%						

Functional Traits	HO	AY	JE	BS	GU	CN	MS
Somatic Cell Score	24	26	27	26	28	27	33
Lactation Persistency	40	42	40	42	39	42	43
Herd Life	10						
Calving Ability	6						
Daughter Calving Ability	6						
Milking Speed	21						
Milking Temperament	8						
Daughter Fertility	7						

Major Type Trait	HO	AY	JE	BS	GU	CN	MS
Conformation (Final Score)	26	23	23	23			
Rump	23	24	17	20			
Feet & Legs	15	21	13	17			
Mammary System	25	22	20	21			
Dairy Strength	36	37	32	35			

Descriptive Type Trait	HO	AY	JE	BS	GU	CN	MS
Angularity	26	26	26	26			
Stature	53	55	46	50			
Height at Front End	26	26	26	26			
Chest Width	22	25	17	21			
Body Depth	32	32	32	32			
Loin Strength	25	22	22	22			
Pin Width	34	30	21	26			
Pin Setting (Desirability)	9	20	4	12			
Rump Angle	37	35	29	32			
Bone Quality	30	34	15	25			
Foot Angle	11	8	6	7			
Heel Depth	8	8	8	8			
Set of Rear Legs (Desirability)	5	11	7	9			
Rear Legs Side View	24	18	14	16			
Rear Legs Rear View	13	13	13	13			
Udder Depth	42	32	30	31			
Udder Texture	14	13	12	13			
Median Suspensory	14	17	19	18			
Fore Attachment	28	23	22	23			
Fore Teat Placement	31	17	22	20			
Teat Length	29	29	29	29			
Rear Attachment Height	23	19	22	20			
Rear Attachment Width	20	19	18	19			
Rear Teat Placement	29	24	29	26			

Source: 'Heritability Estimates used for Genetic Evaluation in Canada', Canadian Dairy Network, 2007

Parent Averages

How do you know how much milk a young calf will produce when she gets older? While it is impossible to know for sure, you can predict her production and conformation traits by looking at her parent averages.

Cows have records on their milk production and bulls have records on how their daughters have produced. You can add up the production numbers from the calf's dam and sire, then divide this total by two. This gives a Parent Average for the calf. The Parent Average predicts what the calf will be like when it grows up.

How do you tell if a calf has a good Parent Average? Look for lots of plusses (+) beside her numbers!

A parent average example:

Dam: Clover

	Milk	Butterfat	Protein	
	+2162kg	+81kg	+78kg	
Sire: Freddie				
	+1150kg	+69kg	+42kg	
Total	+3312kg	+150kg	+120kg	(sum of sire & dam numbers for each trait)
÷ 2	+1656kg	+75kg	+60kg	= Parent Averages for the offspring of Clover and Freddie

Toolkit for Genetic Improvement

Now that we know what traits are heritable, how do we figure out how to use them to improve our herd?

The first step into mating cows with appropriate bulls is to know as much information as possible. Knowing more information about your cows will give you a better idea of what traits need to be improved. Types of information available are:

- *Registration* – registered cows have a complete family tree. You can study their parentage and use it to make breeding decisions.
- *Milk Production Records** – milk recording companies (DHI and Valacta) record milk production for dairy herds. These records are used to calculate genetic evaluations. You can use these evaluations to get rid of genetically lagging cows and to find your best cows. Milk records also contribute to bull proofs based on the production levels of a bull's daughters.
- *Classification** – classifiers come to your farm to rate the conformation (body type) traits of milking animals. This classification rating makes up a cow's genetic record for conformation.
- *Artificial Insemination Units* – AI allows a bull's superior genetics to reach a greater number of cows than by natural service. AI units seek out new bulls, obtain information about existing bulls, and offer advice to farmers.
- *Bull Proofs and Cow Indexes* – the facts and figures in genetic indexes and bull proofs are excellent tools for improving genetics. From these numbers you can make concrete decisions about the genetic worth of one animal over another. The Canadian Dairy Network is the database holder for this information for all dairy breeds in Canada.

**More information on Milk Production Records and Classification can be found in the Business Section of the 4-H Dairy Resource Guide.*

Registration

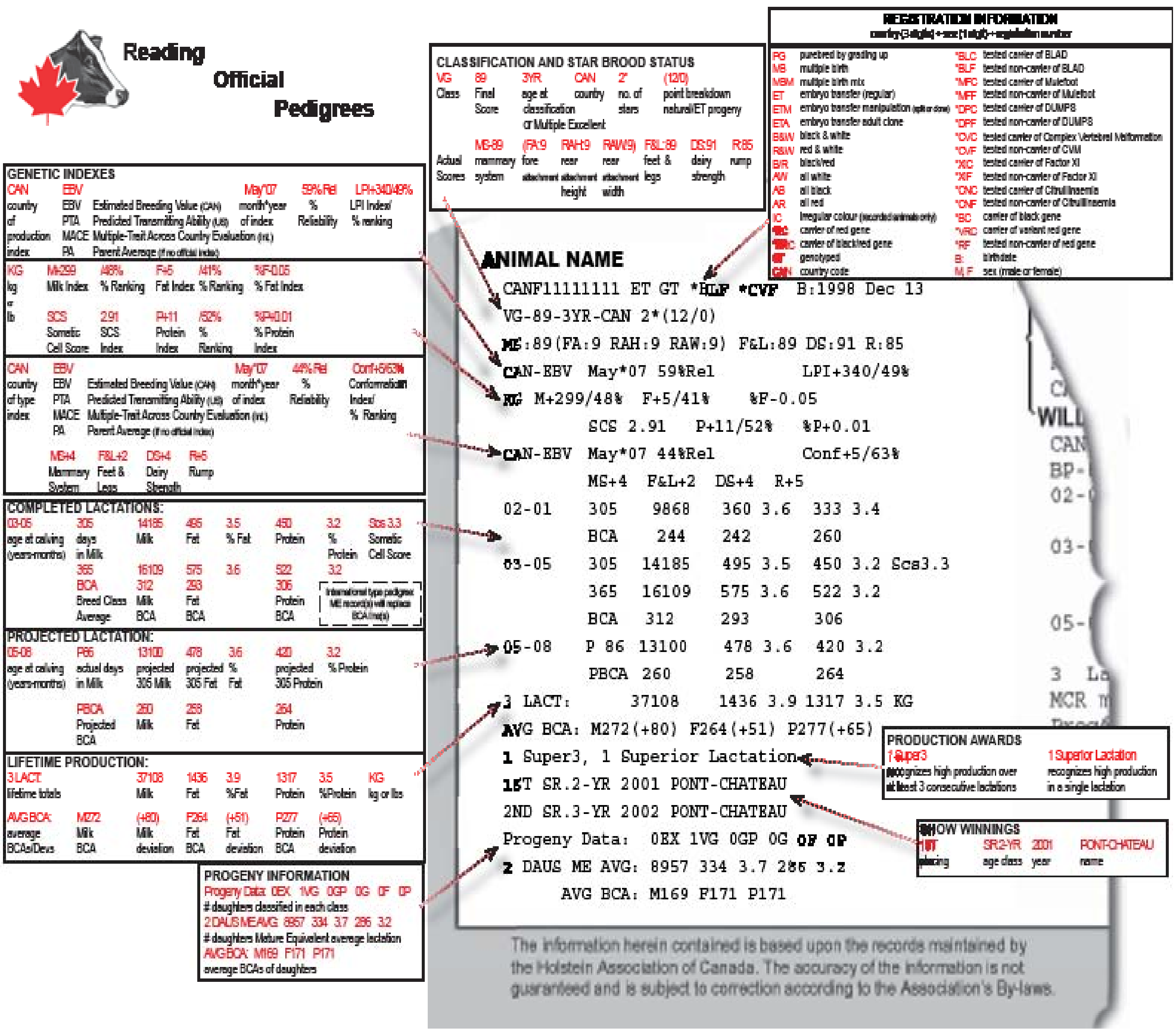
There are many benefits to registering animals on your farm:

- Increased resale value of animals
- Know where they came from and who their parents are
- Helps to make future breeding decisions

When animals are registered or recorded as a percentage purebred with their breed association, a pedigree is generated. A pedigree is a family tree. A registration paper shows basic pedigree information, but more detailed pedigrees, containing production, functional and type trait information for several generations can also be obtained. Many breeds even have pedigree information available on their websites!

It is important to know how to read a pedigree so that it can be used as a tool for genetic improvement. The chart below outlines some of the key information in a Holstein pedigree. Other breeds' pedigrees contain similar information.

Source: Holstein Canada



Ranking Genes

To make breeding decisions, you must know how good the genes of sires and dams are and be able to compare them to other sires and dams in the breed. A sire's genetic 'report card' is called a **bull proof**. A cow's genetic 'report card' is called a **genetic index**. All of these reports are based on the Animal Model. That means that all of the daughters and other relatives of a sire are compared for type and production each year. These numbers are then used to create both indexes and proofs. Since cow indexes and bull proofs are based on the same numbers, they can be compared directly. This makes decision making much easier!

When looking at different traits on a genetic index, cows and sires that are above average are rated as a "+". Cows and sires that are below average for a particular trait are rated with a "-".

The Canadian Dairy Network (CDN) compiles and publishes indexes and proofs three times per year. Herds can contact CDN to obtain their **Genetic Herd Inventory (GHI)**, which ranks their cows against other cows in Canada. There are several components to the GHI and individual animal indexes:

1. Identification
    - Name, registration number, sire short name or registration number, dam registration number, birth date
    - % INBR – the animal's level of inbreeding
2. Production Record
    - Last calving date
    - Days in Milk (DIM) for the current record
    - #HRD – the number of herds a cow has been milked in
    - #REC – the number of production records in the evaluation
3. Milk, Fat and Protein Index/Proof
    - REP – repeatability – a measure of accuracy of the index (1=low, 99=high)
        - To have a published index a minimum REP of 30 is required
    - %RK – percentile rank for milk, fat or protein yield. Percentiles refer to the % of animals that rank below that animal. For example, a cow in the 80th percentile is better than 80% of the cows of her breed for that trait. She is in the top 20% for her breed.
    - MILK, FAT, PROTEIN – index for milk, fat or protein in kgs. This number is an EBV (estimated breeding value) which is an estimate of the worth of the genetic material of the animal. Half of this genetic material will be passed on to her offspring.
    - FAT % PROT % - fat or protein in the total milk volume, expressed as being above or below average
4. Type Index
    - REP – repeatability of the conformation index
    - %RK – percentile ranking for overall conformation
    - CONF – cow's index for overall conformation
    - EBVs are also given for Mammary System (MS), Feet & Legs (F&L), Dairy Strength (DS), and Rump (RP)
5. Somatic Cell Score
    - SCS – the genetic evaluation for somatic cell score
        - Under 3.00 is desirable
6. Lifetime Profit Index (LPI)
    - %RK – percentile rank for LPI

- LPI Code – Indicates that LPI values are based on parent averages (PA) instead of genetic indexes/proofs (i.e. for a heifer that does not yet have her own information)
- LPI – A genetic selection index provided for bulls, cows, heifers and young sires representing the expected lifetime profitability of future daughters. The LPI combines conformation, the three components of production, durability and health and fertility into a single value

Bull Proofs

Bull proofs contain the same basis information as cow indexes. A bull's proof is based on the result of his daughters.

In January 2008, functional traits for bull proofs started to be expressed as Relative Breeding Values (RBVs) whereby the average bull of a given breed is rated 100. Most bulls will range between 85 and 115 for any given functional trait. The only trait that is not expressed as an RBV is Somatic Cell Score (SCS). It is just like the scale for type traits except for type the average is 0 instead of 100, which is the average for SCS.

What are functional traits?
Functional traits are related to animal health and management and can be useful in helping to meet herd goals. Functional traits include:

- Herd life
- Milking speed
- Milking temperement
- Lactation persistency
- Daughter fertility
- Calving ability
- Daughter calving ability
- Somatic cell score

Look for the positive!
Cows and sires who have above average rankings for individual traits are given a "+" score, while those who are below are given a "-" score. If an animal has a score of "0" (zero), it means that it is average for its breed.

There's a lot of information in there!
Production data in genetic indexes contains over 50 million test day records, dating since the early 1990s. Conformation data is based on first lactation classifications and dates back to 1993 for Holsteins and the early 1980s for other breeds.

CDN calculates and publishes evaluations for 78 different traits: 20 production, 29 conformation and 29 functional traits.

Developing Mating Strategies

Mass selection involves mating the best sires to the best cows. That way, poor individuals do not contribute to the next generation of cattle. In simple terms, "breed the best and cull the rest".

The rate of genetic improvement using this method can vary based on a number of factors:

- Selection intensity (how closely you follow this program)
- Variation and accuracy of records and genetic indexes you based decisions on
- Generation interval – shorter generation time means you get to breed those better genes again faster to better more up to date sires

Corrective mating involves trying to correct a cow's faults by breeding her to a bull that is strong in those areas. Usually, breeders use this strategy to correct conformation problems. For example, a cow with a poor suspensory ligament in her udder would be bred to a bull proven to produce cows with excellent udders.

While this method usually leads to some genetic improvement, it is important to remember that you cannot change every trait at once. Selecting a few key traits that you want to correct will usually be more successful and make breeding decisions more straightforward than trying to improve 10 traits at once.

Linebreeding

Linebreeding, otherwise known as inbreeding, is a mating strategy whereby two closely related members of the same family are bred to produce offspring. It is a common myth that inbreeding always has a negative effect, but many successful breeders have linebred elite genetics to concentrate desirable genes in the progeny. Since the resulting animals with more desirable characteristics do not have as much genetic variation so they are a more uniform group. However, negative traits can be concentrated with linebreeding as well. Heterosis – when the progeny perform better than is predicted from the average of their parents – is decreased with linebreeding. Inbreeding will cause inbreeding depression – a reduction in performance of some traits – just because the animals are inbred. As such, when mating animals, levels of inbreeding depression should be kept low. .

Selecting Sires

Once you know how to read genetic indexes you can start choosing bulls to breed to cows in your herd.

Selecting a sire is the most important decision you make to improve the genetics in your herd. If you use bulls with poor genetics than your herd will not improve and will fall quickly behind the rest of the breed.

When picking sires, there are more things to look at than just the "+" and "-" numbers on bull proofs. A couple of important things to pay attention to are **repeatability** and **young sire usage**.

Repeatability – Choosing the right bull is a little bit like gambling – there's always the risk that the traits you are looking for will not be the ones that are passed on. To increase the accuracy of your selections, check out the bull's repeatability ranking. The higher the ranking, the more daughters the bull has had. Therefore, the numbers on the bull's proof are more accurate. He can repeat the results in breeding after breeding. "Surprises" such as calving difficulties or low component production are less likely to show up in the offspring.

Young Sires vs. Proven Bulls – Young sires are bulls that have not had many daughters. This means that it is harder to judge their genetics. Generally, the repeatability of young sires is 30-40%. To have an official proof, the bull must have a repeatability of 60%. You can estimate how the sire should turn out by adding the genetic index of the bull's sire and dam together and dividing by two (the parent average).

To get new sires being used and to "prove" more sires, semen companies offer rewards for using young sires. Since their results are not as reliable, it is advisable not to breed too many animals to any one young sire. Using these bulls can be advantageous though, because they offer the newest genetics that are available.

VO-COW-BULARY

A glossary of breeding & reproductive terms

Abortion — The expulsion of a fetus prematurely

Birth — The act or fact of being born

Cervix — Any neck like part, as the constricted end of the uterus, joining the uterus and vagina

Chromosome — One of the rod-like bodies formed from chromatin in the nucleus during cell division, acting as a carrier of the genes or units of hereditary information

Crossbred — The animal has a sire and dam who are not the same breed as one another

Dam — The mother of a calf

Dystocia — A difficult birth, particularly with the calf in an abnormal position

Embryo — An animal in the early stages of development of the fertilized ovum prior to implantation to the uterine wall

Estrus (Heat) — The peak of the estrous cycle, coinciding with ovulation, when a cow can be bred

Fertilization — To render an ovum capable of growth by fusion with a male gamete (sperm)

Fetus — Developing young in the womb of a cow

Follicle — A small cavity or sac-like structure within which an ovum develops during the estrous cycle

Grade — An unregistered animal

Heritable — Traits that can be passed on from one generation to the next.

Heterosis — The increased performance of progeny compared to what is expected based on the average of its parents

Implantation — When the fertilized ovum, now called an embryo, attaches itself to the tissue on the inside of the uterus

Inbreeding depression — The reduction in performance of some traits caused by inbreeding (linebreeding)

Lactation — The period during which a cow forms and secretes milk

Linebreeding — A mating strategy whereby two closely related members of the same family are bred to produce offspring, to increase the concentration of desirable genetics. Also called inbreeding.

Ovary The reproductive organ of the cow which produces the eggs and certain sex hormones

Oviducts Two slender ducts through which ova are transported from an ovary to the uterus

Ovulation To produce and discharge ova from an ovary

Ovum A single female reproductive cell, also called an egg; plural is ova

Palpation To examine by touch using an arm inserted into a cow's rectum

Placenta The vascular organ of interlocking fetal and maternal tissue by which the fetus is nourished in the uterus

Pregnancy The condition or a time of carrying a developing offspring in the uterus

Progesterone An ovarian hormone active in preparing the uterus for reception of the fertilized ovum and sustaining the uterine lining during pregnancy

Purebred An animal whose sire and dam are the same breed as one another.

Rectum The terminal part of the large intestine ending at the anus

Registered An animal that has parents who are also registered and of the same breed. A registered cow has official identification and papers to prove parentage.

Reproductive System The system in which offspring are produced

Semen The fluid containing sperm that is produced by bulls

Sire The father of a calf

Sperm The male fertilizing fluid contained in semen; the male reproductive cell carrying one half of the genetic makeup for a cow

Ultrasound The image produced on a screen by bouncing very high sound waves off the fetus

Umbilical cord The rope-like structure connecting the navel of a fetus with the placenta of the mother

Uterus The organ of a cow in which the fertilized ovum is deposited and develops until birth; the womb

Vagina The canal leading from the external genital orifice in the cow to the cervix at the opening of the uterus

Vulva The external genital parts of the cow that can be seen outside her body

References and Resources - Breeding & Reproduction

Ayrshire Canada. www.ayrshire-canada.ca

Canadian Brown Swiss and Braunvieh Association. www.browncow.ca. Accessed January 19, 2008.

Canadian Milking Shorthorn Society. www.cmss.on.ca. Accessed January 19, 2008.

Canadian Guernsey Association. www.guernseycanada.ca. Accessed January 19, 2008.

Holstein Canada. www.holstein.ca. Accessed February 1, 2008.

Jersey Canada. www.jerseycanada.com. Accessed February 1, 2008.

National Livestock Identification for Dairy. "One National Tagging System for Canada's Dairy Industry" January 2005.

OMAFRA Factsheet: Maximizing Conception Rate in Dairy Cows

Rare Breeds of Canada. "Canadienne Cow".

Van Doormal, Brian. "Demystifying Inbreeding", Canadian Dairy Network www.cdn.ca, January 2008.

University of Tennessee Cloning Project - http://animalscience.ag.utk.edu/utcloneproject/Q&A.html, accessed September 2008

References and Resources from the previous 4-H Ontario Dairy Manual.

Related Activities

Promoting the Breeds	Breeding	All ages
Reading Genetic Indexes	Breeding	Senior & Junior members
Selecting Sires	Breeding	Senior & Junior members
The Genetic Puzzle	Breeding	Junior members
Cow Mating - You Make the Decision	Breeding	Senior & Junior members
Genetic Improvement	Breeding	All ages
Reading Bull Proofs	Breeding	Senior & Junior members
The Facts of Life	Breeding	Junior members
Al vs. the Farm Bull	Breeding	All ages
Breeding Trivia	Breeding	Senior members
Artificial Insemination Demonstration	Breeding	All ages
Build a Ruminant Reproductive System	Reproduction	All ages
The Successful Calving Baord Game	Reproduction	Junior members
Stages of Calving	Reproduction	All ages
Calf Pulling Demonstration Series	Reproduction	All ages
Identifying a Newborn Calf	Reproduction	All ages
Caring for a Newborn Calf	Reproduction	All ages
Making a Calving Diagnosis	Reproduction	Senior members
Dystocia Drama	Reproduction	Junior members