Introduction

This manual has been developed as a study guide for the Florida State Fair Skillathon which is part of the Champion Youth Program. The topic for this year's Skillathon is **reproductive management**. Animal reproduction has become a complex science that involves a series of physiological and psychological events that must be properly timed and managed. Reproduction has at least three purposes within the animal industry: 1) perpetuation of the species; 2) genetic improvement; and 3) to provide food.

The Florida State Fair recognizes that agricultural education instructors, 4-H agents, parents, and leaders provide the traditional and logical instructional link between youth, their livestock projects, and current trends in the animal agriculture industry. **PLEASE NOTE:** This manual is provided as a ***study guide*** for the Skillathon competition and should be used as an additional aid to ongoing educational programs.

Sections are labeled **Junior, Intermediate & Senior, Intermediate & Senior, or Senior** to help exhibitors and educators identify which materials are required for each age level.

The knowledge and skills vary by age group and may include:

Juniors (age 8-10 as of September 1, 2023)
Breed Identification
Selection: Visual Evaluation

Intermediates (age 11-13 as of September 1, 2023)
all of the above plus...
Male and Female Reproductive Anatomy
Reproductive Functions
Processing Newborns/Reproductive Equipment & Use

Seniors (age 14 and over as of September 1, 2023)
all of the above plus...
Breeding Management Practices
Selection: Pedigree/Performance Evaluation
Genomics

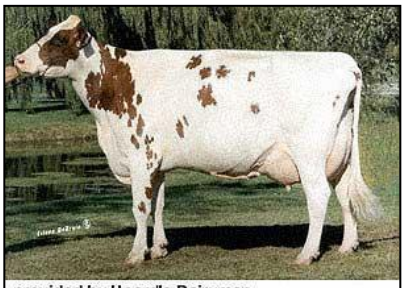
GOOD LUCK!

Jr., Int. & Sr.

Dairy Cattle Breed Identification

Animals are selected for traits that are considered economically important. A *purebred* animal has the characteristics defined by the breed registry and purebreds are expected to pass those traits on to their offspring with a high degree of predictability. When animals of different breeds are mated, we call it *crossbreeding*. Sometimes dairy cattle are bred to beef-type bulls to produce a calf that will be fed out and marketed for beef. If the goal is to produce dairy-replacement females, they will almost always be purebreds. There are five commonly recognized dairy breeds in the U.S. today as well as some other minor breeds that have been developed as dual purpose (meat and milk).

DAIRY CATTLE BREEDS


provided by Hoard's Dairyman

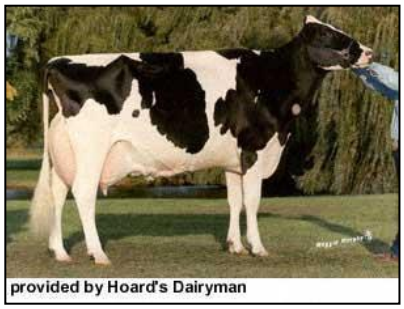
Ayrshire:
This breed originates in the county of Ayr, Scotland. It is deep cherry red, mahogany, or brown with white. This breed is characterized by strongly attached, evenly balanced udders with a resistance to mastitis. At maturity, they weigh 1,200 pounds.


provided by Hoard's Dairyman

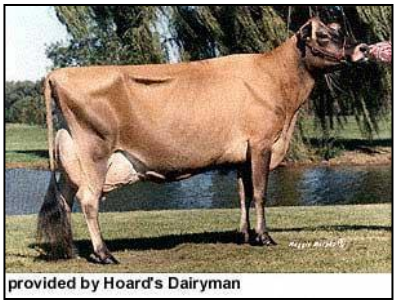
Brown Swiss:
This breed, developed in Switzerland, is known as a dual-purpose breed. They are strong, hardy, and have outstanding feet and legs. Brown to gray in color, these animals are heavier muscled than other dairy breeds and have a heat tolerance.


provided by Hoard's Dairyman

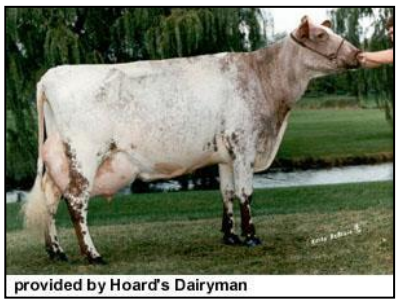
Guernsey:
Known for the superior flavor of its golden-colored milk, this breed of dairy cattle originated near the English Channel and was once known as "The Royal Breed". They are characterized by their fawn color, either solid or with white markings.


provided by Hoard's Dairyman

Holstein:
Developed in the Netherlands, this breed has the most registrations in the United States. Animals of this breed are black and white or red and white in color. They have an outstanding milking ability and are known for their vigorous appetites.


provided by Hoard's Dairyman

Jersey:
The smallest of all dairy breeds. What these cows lack in quantity they make up in quality. Jersey milk is higher in protein and butterfat than other breeds. Originating near the English Channel, this breed varies greatly in color from red to fawn with a black muzzle and switch, and a dished forehead.


provided by Hoard's Dairyman

Milking Shorthorn:
This breed is red, red, and white, or roan in color. They are of average size and are known for their excellent reproductive efficiency and longevity. Originating in England, this breed is considered a dual purpose.

Adapted from: Learning About Dairy...A Resource Guide for the 4-H Dairy Project, North Central Region Extension, 1996 and http://www.purebreddairycattle.com/pages/Breeds.php.

Selection: Visual Evaluation

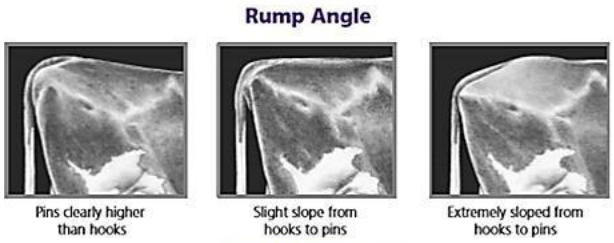

Jr., Int. & Sr.

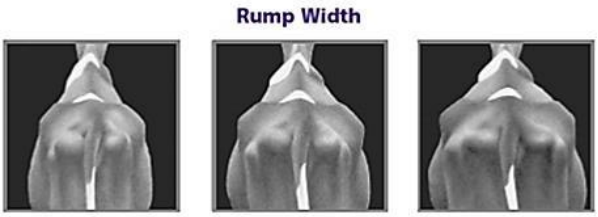
Many traits of economic importance can be evaluated by simply looking at the animal. In purebreds or registered animals, "ideal" is usually described or illustrated by the breed registry. Dairy cattle judges use the unified scorecard point system to evaluate animals. Use additional resources to learn more about the visual evaluation of dairy cattle and find classes to place.
http://www.uvm.edu/~jagilmor/judging/judging.html

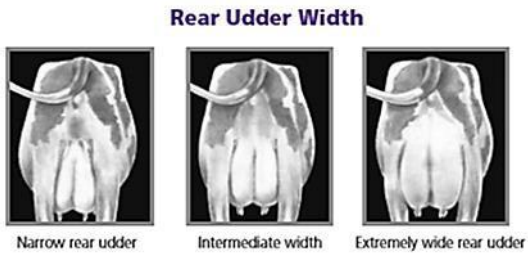
Purebred Dairy Cattle Association (PDCA) Score Card

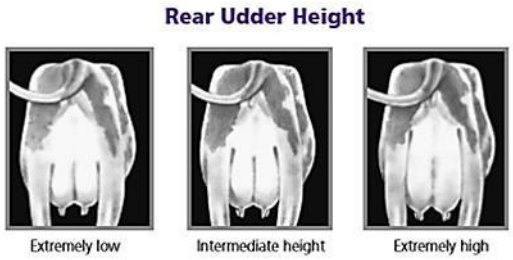
The PDCA developed a scorecard as a frame of reference for evaluating dairy cattle conformation and comparing them to an "ideal". The traits associated with high milk production over a long reproductive life are placed into four major categories. Frame counts 15% (skeleton minus the rear legs), dairy strength counts 25%, rear feet, and legs 20% and the udder counts 40%. Be prepared to compare pictures of cows considering these traits and rank the cows in order of preference.

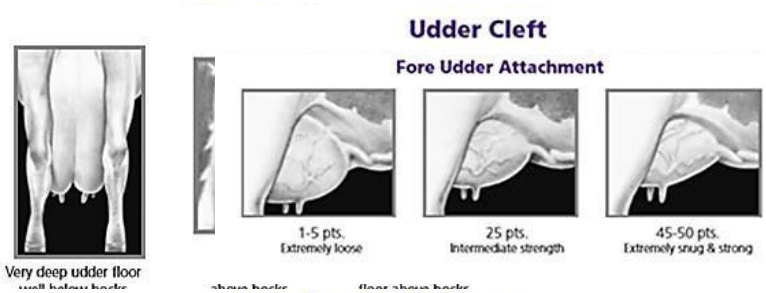
Pin bones should be slightly lower than hip bones. Ribs should be wide apart and slanted toward the rear. Cows should stand fairly upright but need enough set to the hocks and pasterns to provide a cushion. Rear udder height and width relate to udder capacity. Udder depth is the most important udder trait because it relates to longevity in the milking herd. The cleft of the udder is an indicator of udder strength as is fore udder attachment. Teat placement is the second most important udder trait as it affects the milking process. Udders of heifers have not developed yet so are not considered in the same way as a cow that has freshened.











http://www.holsteinfoundation.org/pdf_doc/workbooks/Dairy_Judging_Workbook.pdf

https://afs.ca.uky.edu/livestock/dairy/judging

Reproduction Overview

Int. & Sr.

Reproductive Process in Cattle

Sexual reproduction begins with mating, called ***copulation*** when the bull deposits ***semen*** *(seminal fluid + sperm)* into the reproductive tract of the cow or heifer. This occurs during the time period called ***estrus*** or heat when the female will accept the male for breeding. ***Ovulation*** is the release of the ***egg*** cell from the ***follicle*** on the ***ovary***. ***Fertilization*** is the union of the sperm and the egg cell. Cows typically give birth to only one calf at a time but the release of more than one egg is possible and twins are not out of the question. ***Gestation*** is the period of time during which the animal is pregnant, and ***parturition*** is the process of giving birth called calving. ***Dystocia*** is a difficult birth and cows or heifers experiencing dystocia may have trouble re-breeding.

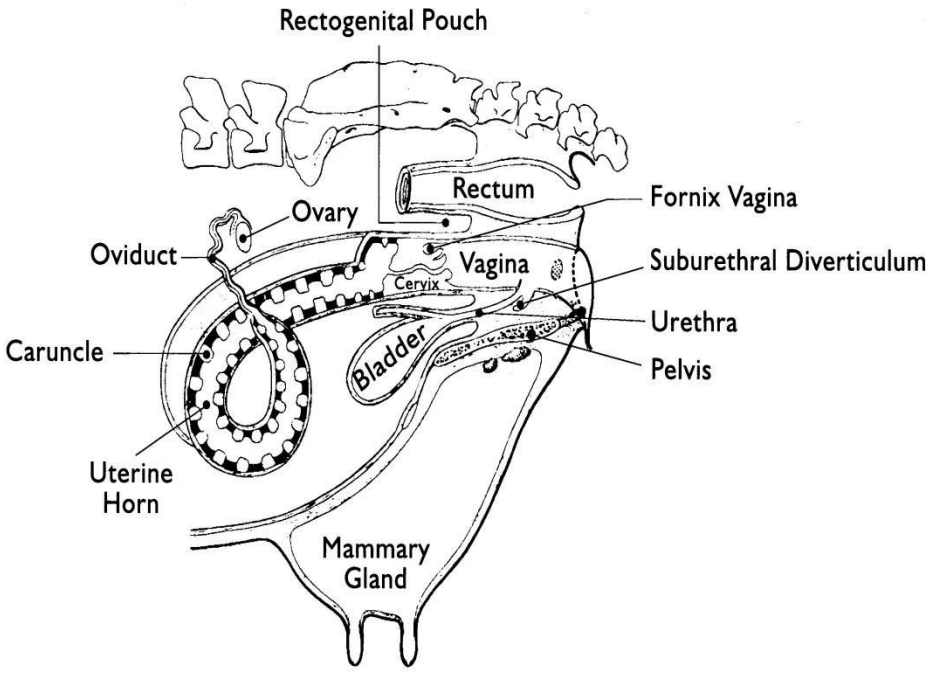
Gender Names and Terminology

Baby – Calf	Young Female – heifer	Mature Female – Cow,
Male – Bull	Castrated Male – Steer	

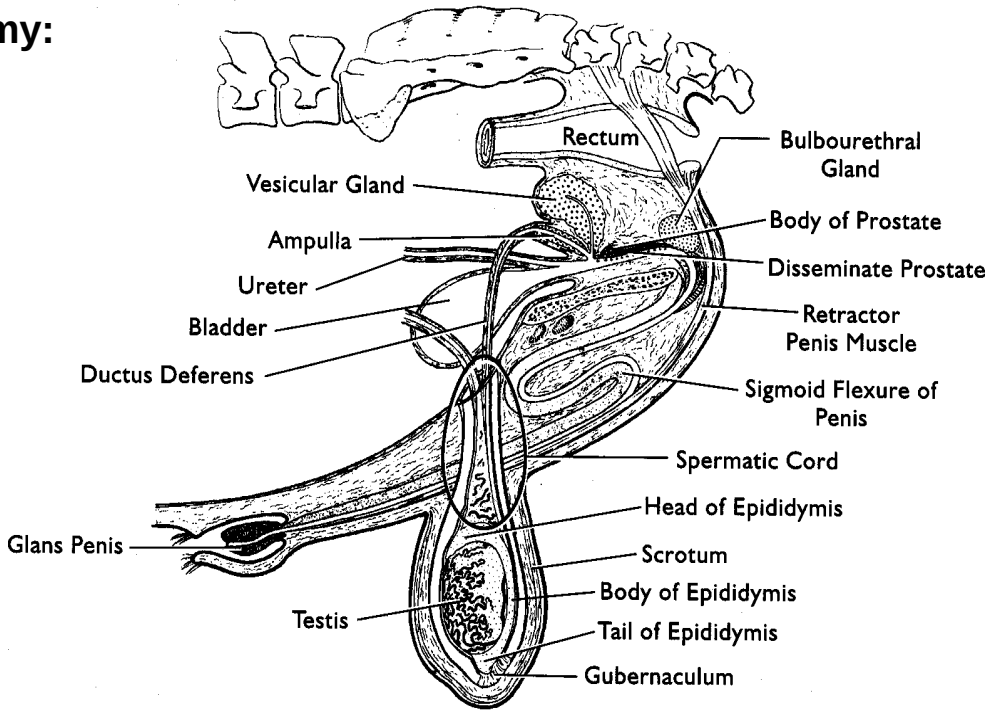
Reproductive Anatomy

Most cows give birth to a single calf each year. Understanding reproductive anatomy is basic to managing reproduction.

Female Anatomy:



Male Anatomy:



Reproductive Functions

Once you know the names of all of the reproductive structures, the next step is to understand the role of each part. Understanding normal functional anatomy allows the manager to properly use reproductive management tools.

Female Functional Anatomy

Ovaries The paired female gonads that produce eggs and hormones. *Follicles* are blister-like structures that grow on the ovary and produce the hormone *estrogen*, causing heat or estrus, and release the egg at *ovulation* (rupture of the follicle). Following ovulation, the remaining cells change and form the *corpus luteum* which produces the hormone *progesterone* to maintain pregnancy.

Oviducts Tubes connecting the two ovaries to the uterine horns. The oviduct (also called the Fallopian Tube) *transports* egg and sperm cells, is the *site of fertilization,* and moves the fertilized ova (embryo) into the uterus. The *infundibulum* is the funnel-shaped opening at the end of each oviduct that partially surrounds the ovary and "catches" the egg at ovulation.

Uterus *Supports*, *nourishes*, and *protects* the embryo as it develops and *expels* the fetus at parturition. Walls are soft and spongy for non-pregnant animals. It is made up of the *uterine body* which divides into *two uterine horns*.

Cervix A thick-walled tube with an irregular passageway that serves as a connection between the outside organs and the delicate inner organs. It contains tough cartilage, making it firm and dense to the touch. The cervix *prevents microbial contamination* of the uterus and *closes tightly during pregnancy* and then must *open (dilate) at calving*. It serves as a reservoir for sperm, a *passageway for sperm* during estrus.

Vagina The passageway from the vulva to the cervix that serves as the *organ of copulation and birth canal* during parturition. This is the *site of semen deposition*. The rear of the vagina conducts urine to the outside of the cow.

Urethra Tube connecting the bladder to the vagina that serves as a passageway for *urine excretion*.

Vulva *External opening* of the female reproductive tract.

Male Functional Anatomy

Scrotum External sac; *contains, supports, protects, and provides temperature control* for the testes.

Testicles or Testes Paired male gonads that *produce the sperm cells* and the male sex hormone, *testosterone*.

Epididymis Long coiled tube that sperm enter upon leaving the testicles. It is the *site of sperm storage, concentration, maturation, and transport*. It is subdivided into the *head, body, and tail*.

Ductus Deferens Long tubes that *connect* the epididymis in the scrotum to the urethra near the bladder, and *transport sperm*. The *ampulla* is the section of the vas deferens that dumps into the urethra.

Vesicular Glands Paired glands that *secrete seminal fluid* into the urethra which serves as a *transportation* medium and provides *nutrition and protection* for sperm.

Prostate Gland Found near the urethra and the bladder. It *adds fluid* to the semen.

Bulbourethral Glands (Also called the *Cowper* gland.) Secretes a fluid similar to that of the seminal fluid which *flushes urine residue* from the urethra.

Urethra Tube that passes through the penis and is the *common* passageway for semen and urine.

Penis Organ used for copulation that *deposits sperm* into the female reproductive tract. An S-shaped bend called the *sigmoid flexure* allows the penis to be retracted into the body by the **retractor penis muscles**.

Glans Penis The *free end* of the penis contains *sensory nerves* and the opening of the urethra.

Prepuce Fold of skin serving to *protect the penis* by enclosing the free end when retracted.

Pregnancy and Parturition

Int. & Sr.

It is important to know if a cow is pregnant to feed her properly and to prepare for delivery. After breeding, failure to return to estrus is the first sign of pregnancy. In cattle, a gloved arm can be placed into the rectum and the uterus can be *palpate*d (felt) for pregnancy after about 40 days. In addition, an *ultrasound* machine can be used to detect pregnancy at about 25 days. This machine sends out sound waves which bounce back and register as a picture on a monitor.

If you know when a cow was bred and the length of gestation, you can figure out when to expect her to give birth. Pregnancy ends with the process of *parturition*. There are several signs of approaching birth: udder fills with milk, teats appear full, vulva relaxes and stretches and may appear moist, female becomes restless, may go off by herself.

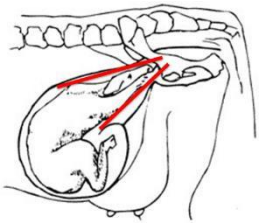
As delivery begins, the female usually lies down and begins to push the calf out with her abdominal and uterine muscles. The first thing to appear from the vulva is the 'water bag' followed by two front feet and a nose.

When everything is normal, cows or heifers deliver their offspring without assistance. Sometimes if an animal is experiencing dystocia, the manager must help by carefully pulling along with the contractions of the female (pushes). Once the calf is delivered, the placenta (afterbirth) should be passed out as well. Difficult births (dystocia) and retained placenta usually lead to problems with the cow breeding back. Know what is normal so that you can get help when things go wrong.

Stage 1 is the preparation phase of delivery. During this time the cow will go off by herself, get up and down, and may urinate a lot. It lasts 2-6 hours and ends when her water bag breaks.

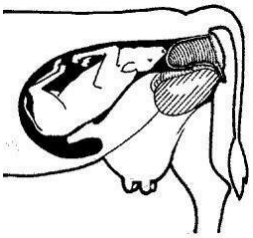
Stage 2 is when the cervix is fully dilated (open wide) and the cow is actively pushing. It may last 1-2 hours for cows and 2-4 hours for heifers. The cow often lays down. Stage 2 ends with the delivery of the calf.

Normal delivery means the calf is positioned in the birth canal correctly.



Presentation refers to the calf coming headfirst with both front legs (normal) or backwards with hind feet first or sideways with all four legs first or the back of the calf first. Headfirst is best. The back end first is still an okay position for delivery but the umbilical cord may break before the calf's head is out, it is a higher risk. Sideways is never good and assistance from your veterinarian will be needed.

Position addresses if the calf's back is up towards the cow's back which is normal. Upside down is not normal nor is sideways.



Posture refers to where the calf's limbs and head are in relation to its body. If the head and both front limbs are not extended into the birth canal, repositioning may be required before stage 2 can be completed.

Stage 3 is the passing of the placenta which should occur within 6 hours after delivery of the calf. If the placenta has not been passed by 12 hours, seek veterinary assistance. Never pull on the placenta. Pieces can be left behind potentially causing infection and preventing uterine repair.

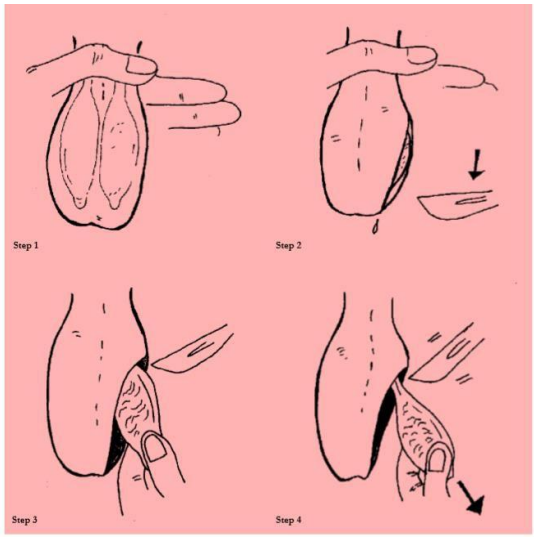
Processing Calves

Int. & Sr.

The newborn calf is fragile and requires special care. They must nurse within the first few hours after birth to get antibodies to fight disease. The first milk, called *colostrum*, contains antibodies, is thick and yellow, and is only produced for a few days. If possible, to help prevent infection, the navel stump is dipped in a disinfectant like iodine or chlorhexidine. If calves are to be castrated (testicles removed), it should be carried out as early as possible to reduce stress, minimize bleeding, and prevent the development of secondary sex characteristics. Other management practices carried out for identification or safety (like ear tagging or dehorning) should be done as early as possible for similar reasons. You should be able to describe the equipment used and/or demonstrate the techniques involved in the processes listed below.

Castration

Bull calves are castrated in several different ways. The most common method of castration in cattle is the use of a knife. This method should be used at times of the year when flies are not a problem. Calves should not be more than 3 to 4 months of age. In this method, the lower 1/3 of the scrotum is cut off and the testicles are removed by scraping the spermatic cord with the knife blade. The wound is left open to drain. Infection and excessive bleeding can occur.



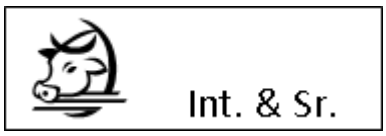
http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/174167/castrating-calves.pdf

Two methods are used which are bloodless. One method is the use of Burdizzo pinchers which crush the cords above the testicles. However, if not used correctly, they may not crush all of the cords and the animal may not be truly castrated. Another method is the use of elastrator bands. A special instrument is used to place a tight rubber band around the scrotum above the testicles. This cuts off the blood supply to the testicles and will cause the testicles to waste away. There is no open wound with either of the last two methods, but complications may still occur. https://livestock.extension.wisc.edu/articles/castrating-beef-x-dairy-calves/

Dehorning

There are several reasons for dehorning calves. Cows are safer for one another and for handlers in barns and milking parlors. Horned calves often bring less when sold. When calves are dehorned, they require less space in barns and trailers and there is less chance of cattle bruising one another. They also cause less damage to facilities. Calves should be dehorned when they are very young. It is much easier to handle calves and it causes less stress to them when they are young. If possible do not dehorn during fly season. Several methods are in use for dehorning cattle. One method is the use of chemicals. These can be in the form of liquids, pastes, or caustic sticks which are applied to the horn button. The chemical must be dry before returning the calf to the mother. They must also be kept dry for several days after the chemical is applied. If using a paste, the hair does not need to be clipped first. Horns or horn buds can be removed with a hot iron for a fast and almost bloodless removal. Calves under 60 days of age may be dehorned with spoons, gouges, or tubes. Animals that have been dehorned by any cutting method should be watched closely to see that the bleeding has stopped. http://www.thebeefsite.com/articles/2261/dehorning-of-calves

Reproduction Equipment



It is important to recognize different equipment that is used in breeding, aiding parturition, and processing newborns. The following are some ideas of things to be able to identify. There may be others that are not listed so know about the equipment that is used for practices which are explained in this manual. Livestock supply companies' catalogs are a good study reference. **Search images of each item listed so that you can visually identify them and understand their use in reproductive management.**

Semen tank	Thermometer
Breeding gun	Straw cutter or scissors
Breeding sheath	Forceps
Palpation sleeve	Lubricant
Electric thaw box or thermos and water	Pelvimeter
Insemination pipette	Ultrasound machine
CIDR and CIDR insert	Artificial vagina
Heat detection devices	Obstetrics chains
Calf puller	Scrotal circumference tape
Branding irons (heat or freeze)	Knife, scalpel
Burdizzo	Nursing bottle
Iodine/disinfectant	Syringe and needle
Horn spoons, tubes, scoops	Tattoo numbers &/or letters
Dehorning paste (chemicals), irons	Elastrator
Ear tagger	Emasculators
Semen straw	Chin ball marker

Breeding Management Practices

 Seniors

Natural Mating

The easiest way to breed cattle is to let nature take its course. If bulls are allowed to be with the cows, they can find the ones ready to breed. The breeding season is the period of time that the cows are in the presence of the bulls and mating is occurring. Managers can limit the breeding season by removing the bulls after a specified period of time, typically 60 to 90 days. This shortens the subsequent calving season, reduces labor, and increases the uniformity of the calf crop at marketing. Natural mating is rarely used in large-scale dairy operations.

Heat (Estrus) Detection

In most dairy herds artificial insemination is practiced and one of the most important management practices is detecting *estrus* so that insemination can be performed at the proper time. The key to heat detection is *frequent and careful visual observation* of the herd. Cows in heat often attempt to mount other cows or show *"riding*" behavior and *stand to be mounted*. Cows that are not in estrus will sometimes mount cows that are in estrus. However, mounting activity is more frequent when two or more cows are in estrus than when a single cow is in estrus. Mounting is more frequent in the evening and early morning hours than during the day, especially in the summer. Cows in estrus spend more time walking with less time resting and feeding. They may smell the vulva of other cows. Frequently they raise and switch their tail. They will have a swollen vulva and clear mucus can often be seen streaming from the vulva. Cows in other periods of the estrous cycle will not stand to be mounted. Therefore, standing for mounting is the strongest single behavioral indication of estrus. There are several aids in determining heat in cattle. Some of these aids include a chin-ball marker placed on a teaser animal or paint stick on the tailhead and heat-check patches. A good record-keeping system is critical for managing breeding and parturition. When managing an estrus detection and AI program, the actual insemination is conducted 8 to 12 hrs. after an animal is detected in estrus. Therefore, most producers use the AM/PM rule: cattle detected in heat in the AM are bred in the PM, and those detected in heat in the PM are bred in the AM.

Hormones of the estrous cycle are listed below:

Estrogen – from the follicle on the ovary; causes estrus

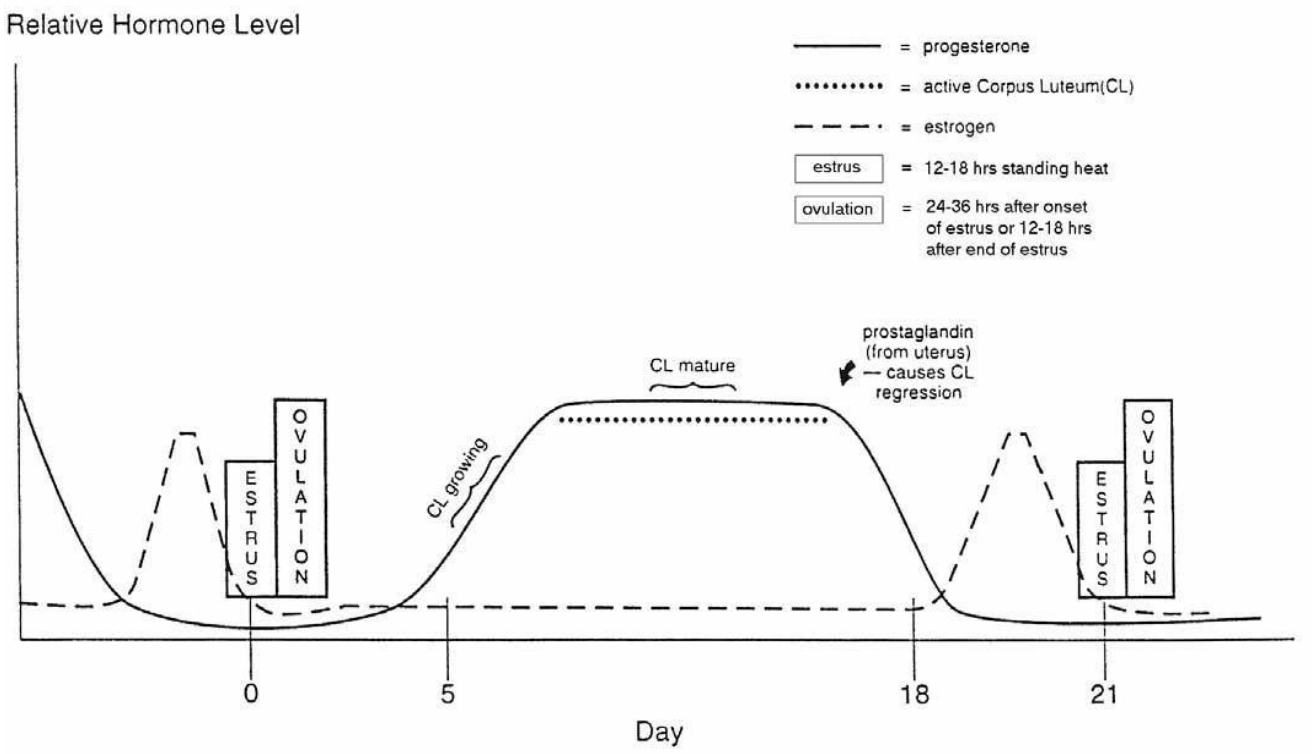
Progestogen – from the corpus luteum (CL) on the ovary formed after ovulation; maintains pregnancy, prevents estrus and ovulation

Prostaglandin – from the uterus of the non-pregnant cow; causes regression of the CL and returns to estrus.

Follicle Stimulating Hormone (FSH) – causes follicle recruitment and growth and production of estrogen

Luteinizing Hormone (LH) – stimulates follicle maturation, causes ovulation, stimulates formation and maintenance of CL

Gonadotropin-releasing hormone (GnRH) – from the hypothalamus (brain) causes FSH and LH release

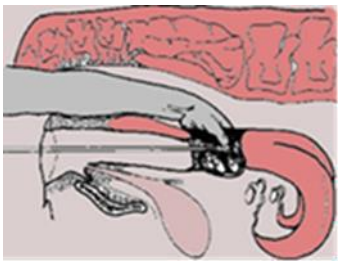


Timing of Reproductive events:

	Puberty*		Breeding Information*		
Breed/Type	Weight (lbs)	Age (mos)	Estrus (hrs)	Estrous Cycle (days)	Gestation Length (days)
Holstein	583-635	12-13	12-18	21	279-284
Jersey	352-396	8-10			
Brown Swiss	616-660	10-11			

Artificial Insemination

Few dairy cows are bred naturally in the United States. Semen is collected from genetically superior dairy sires then processed, frozen, cataloged, and stored for later use. Artificial insemination (AI) accelerates genetic progress by allowing outstanding bulls to breed more cows than they could with natural mating. Key components of artificial insemination are selected matings, heat detection, semen collection, proper handling and storage of semen, proper insemination technique, and accurate record keeping. Success (high conception rate) depends on all of the factors listed above and the management of the cattle, particularly with regard to nutrition and health.



Seniors

Artificial Insemination Procedures

Bull semen is typically stored in 0.5ml straws in a liquid nitrogen tank at -320°F. When you have decided which bull you are going to use you must go to the tank and retrieve a straw to be used to breed the cow. While at the tank you must pull out the plug and select the canister that has the correct semen. Pull the canister up into the neck until the cane is 2 to 3 inches below the top of the tank. Locate the cane that you want and pull it out. Using the forceps, remove one of the straws from the cane. Now the canister should be let back down into the tank to prevent any damage to the semen via heat stress.

Quickly place the straw of semen into a thaw box or thermos which should have a water temperature of 95° degrees F. The semen should be left in the water for approximately 30-40 seconds.

Before loading the insemination gun, warm the barrel of the gun by stroking it vigorously five or six times. This prevents the sperm from being cold-shocked when the warm straw touches the gun. The plunger on the gun must also be pulled back about 6 inches.

Next, allow the split end of the individually wrapped breeding sheath to be exposed from the plastic about 3 inches while keeping the rest of the sheath covered. After 30-40 seconds, remove the straw from the water and wipe it dry with a paper towel.

Check the printing on the straw to see that you retrieved the correct semen and make sure the air bubble is at the crimped end. If the bubble is not at the crimped end, *gently* tap the straw until the bubble is in the correct place. Place the cotton plug end of the straw into the gun and it will stop at the right depth.

Cut the straw about 1/4 of an inch from the crimped laboratory seal. Make sure that the cut is at a 90-degree angle. Next slide the sheath over the straw and gun. Make sure that the ring is halfway on the gun to allow the sheath to slide under it. Slide the sheath as far as it will go and push the ring tightly around it. The gun is now ready for breeding. Keep the gun away from any contaminants and the sun.
After restraining the cow, insert a lubricated, gloved left hand into the rectum of the cow to locate and grasp the cervix. The straw gun is inserted through the vulva and into the vagina at a slight angle to prevent it from entering the urethra. Move the gun through the vagina and to the opening of the cervix. Manipulations of the cervix with your hand in the rectum allow the straw gun to be threaded through the cervical channel, stopping at the anterior end. The plunger is depressed to release the semen into the uterus. The straw gun is removed, and the insemination is recorded.

For detailed descriptions and illustrations: https://extension.psu.edu/artificial-insemination-technique-cattle.

Estrous Synchronization in Dairy Cattle

Seniors

Synchronization is the altering of the normal estrous cycle through the use of hormones to cause cows to come into heat during a specific time period. Synchronized breeding reduces the time required for heat detection and breeding. There are several ways to synchronize cattle, some are listed below. By understanding how each product works, the best system can be selected. Estrous *cycling* females respond most effectively to synchronization so most cows must have passed the postpartum anestrus, and heifers reached puberty. For any of the systems to work, it is important to have good nutritional management.

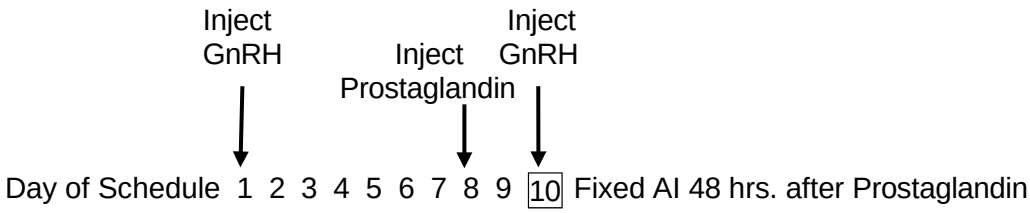
Prostaglandin Method

Prostaglandin given to a cycling cow any time between day 6 and 17 of her cycle will cause her to come into heat within 2 to 5 days. Prostaglandin works by causing the corpus luteum to regress so it *only works in cycling cows*. Cows may be bred on observed heat up 120 hours after the injection. Prostaglandins can cause abortion, so it is important to know that the animal that will be administered the drug is not already pregnant. Many different brands of this hormone are marketed under many different names (ex. Lutylase®, Estrumate®, Prostamate®). The dosage and route of administration depend on the manufacturer's recommendations. All can be injected intramuscularly and preferably in the triangle area of the neck between the shoulder and head. There are one-shot and two-shot options used in combination with estrus detection and AI.

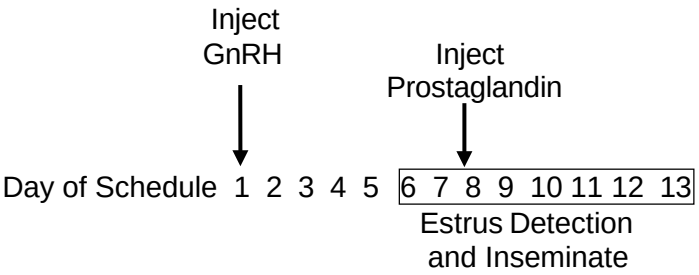
GnRH and Prostaglandins

Begin with an injection of the hormone GnRH to initiate ovulation and follicle turnover so a majority of cattle have a fertile follicle to ovulate at AI. Seven days later prostaglandin is given to regress the corpus luteum. Several AI protocols can be used with the GnRH + prostaglandin system depending on a producer's ability/desire to use estrus detection and AI versus timed insemination.

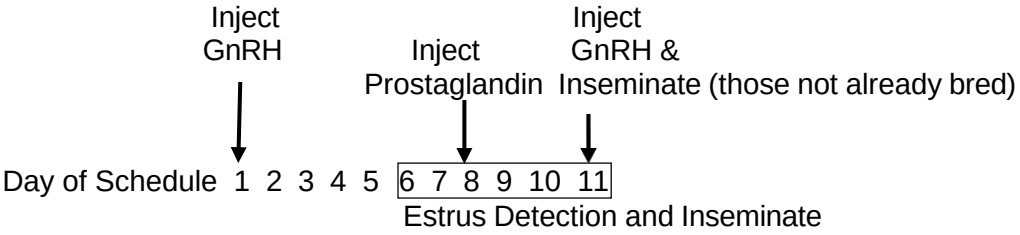
CO-Synch Program



Select-Synch Program



Hybrid-Synch



Progestin Systems

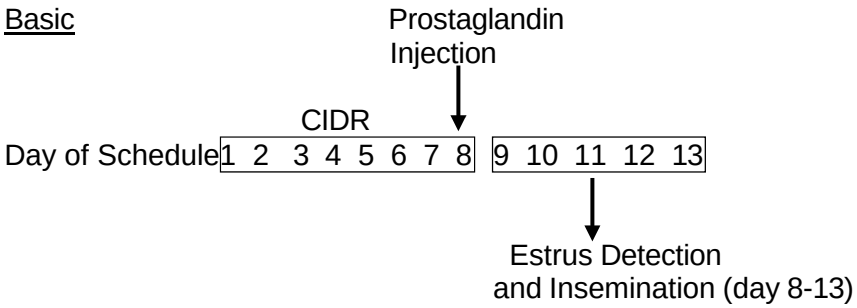
Progestins keep the cow from coming into heat and ovulating during the duration of the progestin even if the animal's CL regresses. An added benefit to progestin is that it can induce estrus in some anestrus cows and heifers that have not reached puberty. Depending on the progestins, they are approved for use in lactating beef and dairy cows as well as beef and dairy heifers. There are different progestin products, but most are used in combination with prostaglandin.

Intravaginal Progestin Inserts

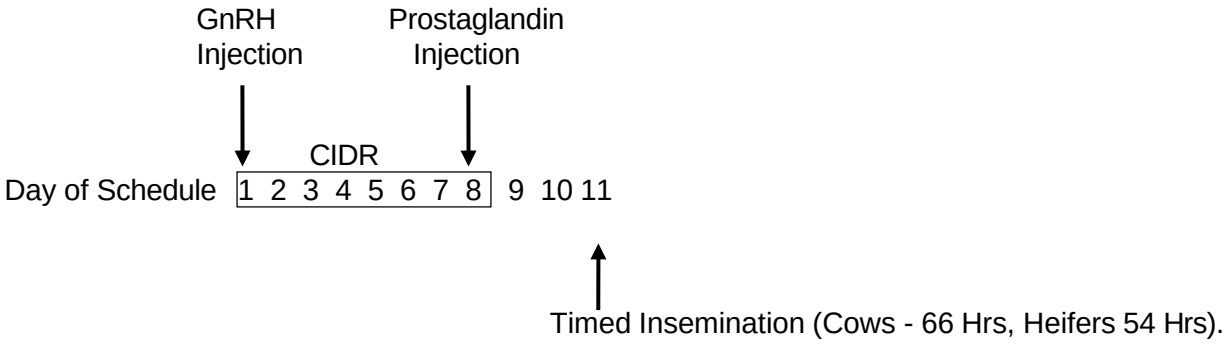
The primary progestin used by beef producers today is the Controlled Internal Drug Release device or CIDR® for short. The device is T-shaped and impregnated with progesterone. The CIDR is inserted into the vagina with a special applicator and left for 7 days with a shot of prostaglandin administered on the day the device is removed. The CIDR releases progesterone into the bloodstream to prevent the animal from coming into estrus. The CIDR is used in conjunction with the GnRH _+ prostaglandin synchronization and AI systems. Hence, one can just superimpose the CIDR on top of any of the three GnRH + prostaglandin systems previously described in the GnRH and prostaglandin section. The two primary benefits of the CIDR are that estrus detection can be eliminated for the two days before prostaglandin in the GnRH + prostaglandin systems and the CIDR induces estrus in some anestrus cattle.

Estrus Synchronization Using CIDR

Basic

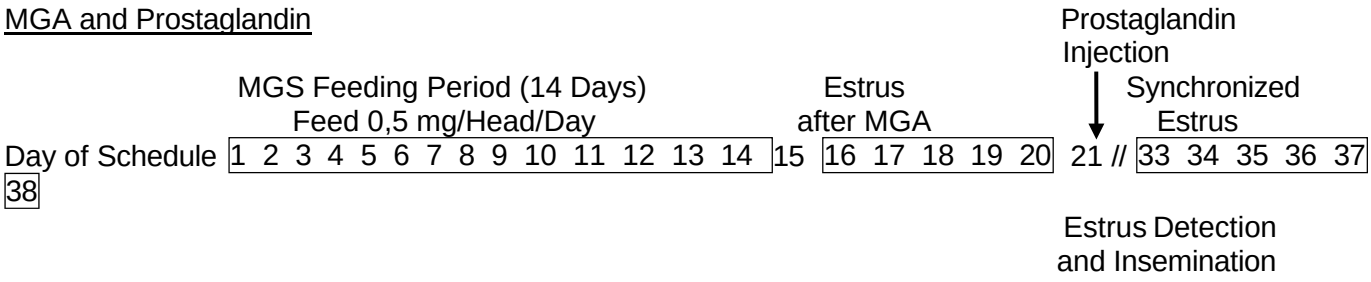


Co-Synch +CIDR



MGA and Prostaglandin

Melengestrol acetate (MGA) is an orally active progestin that will suppress heat and prevent ovulation when consumed by cattle on a daily basis. MGA is label-approved for use in beef and dairy heifers. MGA can be fed as a top dress or mixed into a batch of feed for 14 days. On day 14 MGA is stopped and animals will show estrus over the following 8 days. The cattle are not AI at this estrus since it is an infertile estrus. An injection of prostaglandin is given 19 days after the last day of MGA feeding. Two AI systems can be used including 1) heat detection and AI for 6 days after prostaglandin; 2) heat detection and AI for 72 hours after prostaglandin and all cattle not showing heat receive GnRH and are timed-AI 72 – 84 hours after prostaglandin.



Please go to the following website to review more details regarding the schedules and procedures described above: https://extension.uga.edu/publications/detail.html?number=b1227

Selection: Performance/Pedigree Evaluation

Proper selection is a critical factor in establishing a good breeding program. The goal of animal selection is to produce an animal that will yield/produce high-quality products at a low cost to the farmer and the consumer. This goal is the foundation of the standard “ideal animal” in the various species. That is, the animal that expresses, to the highest degree, traits that are of economic importance like milking ability, body weight, carcass merit, or even coat color is the type selected.

The expression of observable or measurable traits is called the animal’s *phenotype*. Phenotype is affected by both heredity and environment. The inherited portion of a trait is referred to as a *genotype*. How well an animal expresses its genotype is affected by the environment in which it is raised. Therefore, when making selected matings, the use and management of the offspring should be considered.

We use both visual appraisal and performance records when selecting breeding stock. The following section outlines various traits and methods used to evaluate breeding animals. Use and management are expressed as *scenarios*.

Performance Evaluation

How an animal looks may be important in the show ring but how that animal performs is more important to the farmer. With advancements in the understanding of heredity and the increased use of computers for keeping records, the use of genetic information in selected matings has become easier. By keeping

records on desirable traits and then carefully selecting bulls and cows to be mated using the available data, producers can improve the genetics, and thus the performance of their offspring. The National Dairy Herd Improvement Association is an organization that strives to promote the accuracy, credibility, and uniformity of dairy records.

https://dairyone.com/dairy-herd-improvement-association-what-is-it-who-is-it/

https://extension.psu.edu/dairy-sense-reviewing-the-dhia-202-sheet

Traits of importance Include:

Milk, Fat, Protein, Cheese yield dollars, Udder composite score, Somatic cell score, Type
Be prepared to view performance records and rank dairy herds/animals based on performance. For an example visit:
https://www.texasffa.org/docs/2017-21%20Dairy%20Cattle%20Herd%20Record%20Example_40544.pdf

Pedigree evaluation

Basically, a pedigree provides genetic and performance information on the individual animal and its ancestors. Genetic information is provided for each male relative on the pedigree. Estimates of his ability to transmit superior production and type traits to his daughters are printed. These genetic estimates are based on the performance of the bull's daughters as compared to other cows in the same herd. The classification score and production records for each female ancestor are shown on a pedigree. The cow's genetic estimates for production and type traits also are included. The genetic value for an individual animal with no performance or progeny information is predicted from its ancestor's information and shown on the pedigree. For a mature animal, the pedigree contains genetic values for production and type traits based on the animal's own performance, performance of the animal's offspring, and ancestor information.

Predicted Transmitting Abilities (PTAs)

PTAs are assigned to different traits of dairy cattle. PTAs are derived by a complex process. PTAs have reliability estimates that increase as more information is available on an animal. Animals can be ranked based on the PTA values listed on their pedigrees. https://vtechworks.lib.vt.edu/bitstream/handle/10919/75822/VCE404_082.pdf?sequence=1#:~:text=PTA%20(predicted%20transmitting%20ability)%20is,procedure%20called%20the%20animal%20model.

Selection Services

The science of combining genetic and statistical models is called *Animal Breeding* (not to be confused with reproduction). Most breed associations provide their members with extensive data on the cattle in their registry. Semen companies do as well. Bull test stations across the country contribute to the data. For definitions of performance evaluation terms, go to: https://www.aipl.arsusda.gov/kc/more/glossary.htm

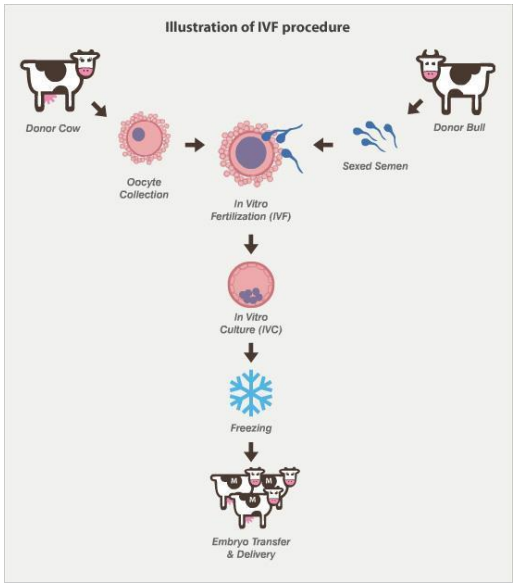
Advanced Breeding Technologies

Biotechnology continues to provide additional options in breeding management that are called Assisted Reproductive Technologies (ART). Many are extremely expensive and not available to the average producer. However, as with most technology, as our knowledge advances, the cost typically comes down. Below are a few that you may hear/read about:

Superovulation, Embryo Collection, and Embryo transfer – allows a superior cow to produce large numbers of fertile eggs that can be transferred to recipient cows that will carry them to term. Embryos can be frozen and stored indefinitely.

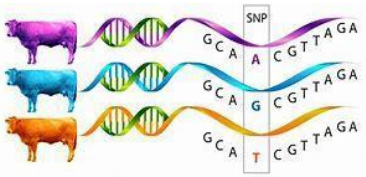
Clones have been produced through micromanipulation from split embryos and even nuclear transfer.

In vitro fertilization, oocytes aspirated from the follicles of a donor cow or heifer, fertilized in the lab, cultured for a week, and then transferred to a recipient cow.



Sexed semen – 90% accuracy on male or female-bearing sperm is commercially available.

DNA testing – DNA kits can be purchased, and you can test your cows or bulls for specific genetic disorders. https://articles.extension.org/pages/73798/how-to-get-started-with-DNA-testing



Single Nucleotide Polymorphism or SNP – There are 50,000 genetic “markers” that can be identified, and they are used to predict the animal’s breeding values – often expressed as EPDs.

Genomics

Genomics is the study and mapping of a species or individual animal's genome, or all of the animal's genes and their interactions with one another, to create what one sees in the animal's phenotype. In short, genomics is the study of all of an animal's DNA. DNA, or deoxyribonucleic acid is composed of two polynucleotide chains that coil around each other to form a double helix. The chain is the genetic instructions for the development, functioning, growth, and reproduction of all known organisms. For the purposes of animal agriculture, the genome also influences (along with nutrition, health, environment, etc.) the animal's quality and quantity of meat, milk, reproductive life, growth rate, heat tolerance, and any other trait one can imagine. Understanding the blueprint of a particular animal at the genetic level by studying the animal's genetic code has immense ramifications for animal agriculture. Livestock genomics is an emerging field in which breeding sires and dams with specific genes that directly influence specific traits is possible (muscling, marbling, milk fat, milk production, sexual maturity, etc.). Over the past 20 years, the use of genomics has emerged in livestock and poultry production. Prior to this animal scientists studied genetics, or one particular gene. Genomics studies the entire genetic makeup including all of the interactions of each gene with all the other genes in an animal. Producers can utilize genomic testing to predict future profitability.

To this point, the genome of just about every major livestock species has been mapped, including cattle, goats, sheep, swine, and poultry. Genomics is currently primarily used as a tool to make decisions on selected breedings to result in offspring with targeted genetics. The potential for editing genes to produce offspring with targeted traits exists but is not currently utilized because of regulatory frameworks are still being developed. Still, genomics is among the latest cutting-edge technologies in animal agriculture and animal reproduction management.

Here is an excellent source from the Holstein Foundation on understanding the genetics of sire summaries that includes a discussion of genomics:
http://www.holsteinfoundation.org/pdf_doc/workbooks/Gen_Sire_WKBK.pdf

Sources:

https://www.mdpi.com/journal/agriculture/special_issues/livestock_genetics
https://www.zoetis.com/news-and-insights/featured-stories/what-is-genomics-and-how-does-it-help-livestock#:~:text=How%20does%20genomics%20help%20livestock,selection%20and%20strategic%20breeding%20decisions.
https://www.frontiersin.org/articles/10.3389/fgene.2019.00327/full
https://www.illumina.com/content/dam/illumina-marketing/documents/products/technotes/technote_ag_genomic_selection.pdf