

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.

****** Denotes additional information in the study manual for preparing for the Champion of Champions competition.

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

GOOD LUCK!



Animal Breed Identification

The Beef Cattle Industry has two main facets. The *Commercial* industry makes up the largest sector and is composed of commercial grade or crossbred females bred to purebred or crossbred bulls. Their product is weaned calves, sold by the pound to go to a stocker or feedlot operation where the animals are finished to market weight and the animals are harvested for beef and beef byproducts. The *Seed stock or Purebred* facet makes up only 5% of total beef production in America. The purebred producer sells genetics in the form of purebred breeding stock, primarily bulls, but also replacement heifers, semen, and embryos.

Animals are selected for traits or characteristics 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, it is known as *crossbreeding*. The resulting offspring often outperform the parents due to a phenomenon called hybrid vigor. A *composite* breed is a new breed or new line of cattle that are the result of crossbred animals to take advantage of the good traits of both breeds and to improve hybrid vigor. They have a set of traits that they consistently pass on and they have an established breed registry. Some common breeds of beef cattle and their descriptions are listed below.

BREEDS:



Shorthorn (American Shorthorn Association):

This breed was developed in England as a dual-purpose breed (milk and beef). These animals can be red, white, or roan in color. They are noted for their good disposition and mothering and milking abilities. They can be horned (H) or polled (P).



Simmental (American Simmental Association):

One of the oldest cattle breeds in the world, imported into the United States from Switzerland, France, and Germany. Can be red and white, gold and white with white faces and pigment around the eyes, or black. They are noted for their fast growth and milking abilities. H or P.



Hereford (The American Hereford Association):

Developed in England, Hereford cattle have red bodies with white faces, and are known for their foraging ability, vigor, hardiness, and quiet dispositions. Originally horned cattle, Herefords can also be polled.



Limousin (North American Limousin Foundation):

Developed in the west-central part of France, Limousin were first imported to Canada. Solid to golden-red in color with lighter circles around the eyes and muzzle. (Can also be black, H, or P) They have excellent carcass traits and feed efficiency making percentage Limousin steers highly sought after by packers and for the showing.





Santa Gertrudis (Santa Gertrudis Breeders International): The King Ranch in Texas crossed Shorthorn cows with Brahman/Shorthorn bulls to produce a 5/8 Shorthorn and 3/8 Brahman USDA-recognized breed. These cattle are known for their growth rate, long life, and hardiness in harsh conditions. H or P.



Angus (American Angus Association): Originating in Scotland, Angus is the largest beef breed registry. Angus are polled with a black, smooth coat. They are known for their carcass quality, milking, mothering, and reproductive ability. There is also a Red Angus registry which was the first performance breed registry.



Brahman (American Brahman Breeders Association): Imported Bos indicus-type bulls (primarily Guzerat, Nellore, and Gir) were bred to US cows to produce the American Brahman. These animals vary from light gray or red to almost black. Longevity, the ability to withstand heat, and insects are the breed's most important economic traits. H or P



Charolais (American-International Charolais Association): This breed was developed in France and imported into the United States from Mexico. These large, white cattle are noted for their fast growth rate and lean meat, making them popular in crossbreeding programs. Originally H cattle, now some are P.



Brangus (International Brangus Breeders Association): This breed was developed to utilize the superior traits carcass traits of Angus (5/8) with the superior production traits of Brahman cattle (3/8). They are known for their resistance to heat and humidity, as well as their high fertility and milking ability. These cattle are polled.



Chianina (American Chianina Association): Developed in Italy, these cattle are white with black skin pigmentation. They are very large: mature bull weighs up to 4,000 pounds and stands 6 feet tall. Originally used as draft animals but now used primarily in terminal crossbreeding programs in the U.S. All are horned.





Gelbvieh (American Gelbvieh Association): Originating in Germany, selected for meat, milk, and work. Introduced into the US through the importation of semen. Red or black in color with strong skin pigmentation. Known for superior fertility, calving ease, mothering ability, and growth rate of calves. H or P.



Maine-Anjou (American Maine-Anjou Association): From France, Maine-Anjou is one of the larger breeds. Mature bulls 2200 - 3100 pounds & mature cows 1500 - 1900 pounds. Very dark red or black with white markings on the head, belly, rear legs, and tail with white on other parts of the body common. Dual-purpose breed for milk and meat. Introduced to the US by importation of semen from Canada.



To learn more about breeds of beef cattle, visit <http://www.ansi.okstate.edu/breeds/cattle> .

Selection: Visual Evaluation

Many traits of economic importance can be evaluated by simply looking at the animal. In purebreds or registered animals, the “ideal” is usually described or illustrated by the breed registry and is referred to as breed character. There are many aspects of appearance that relate to reproductive efficiency. Most livestock show judges rely totally on the way the animal looks, moves, and/or feels to make their decisions on class placings.

Feet and Leg Structure

How well an animal can stand and move around will have a major impact on its ability to find food, mate, and care for its young. Often, an animal that stands correctly will move freely while a crooked-legged animal may have trouble getting around and may become sore or lame. Feet and leg structure as well as movement are important evaluation criteria for breeding animals. ***You should be able to visually recognize structural correctness as well as problems such as post-legged, sickle-hocked, cow-hocked, splay-footed, buck-kneed, calf-kneed, and knock-kneed animals.***

Muscling

There are several muscle indicators on beef cattle such as the forearm, gaskin, stifle, back, loin, and round. Bulls should have thick, heavy, long muscling while heifers should be more moderately muscled. Too little muscle is undesirable but excessive muscle is also considered a negative as it can interfere with movement in bulls and lower reproductive efficiency and milking ability in heifers. Visit the website shown bottom pg. 5.

Body Structure

A long side with a strong top line indicates faster, more efficient growth and larger mature weight. Excessively short cattle are prone to excessive fattening while excessively large cattle reach maturity later and produce calves with lower-quality grades. Though frame size varies by breed type and use, generally a moderate size is preferred. Depth of body and spring of rib are indicators of body capacity, an important trait in the selection of beef breeding animals.

Reproductive Soundness

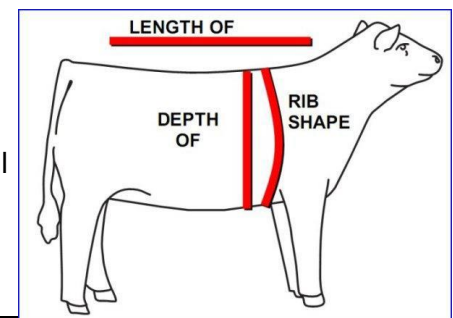
Testosterone is the male hormone that causes bulls to be heavy-boned and heavy-muscled, coarse-haired, often with a cresty, thick neck. Testicles should be well-developed and scrotal circumference is an important evaluation tool in predicting a bull’s sperm-producing potential. Cows and heifers should be more refined of bone and smoother in their muscle patterns. They should have an angular appearance, being clean in the shoulders, wide in the hooks, and long from hooks to pins. They should have udders with strong attachments and teats that are not too small and not too big.

Degree of Fat

The amount of fat or finish on a breeding animal will vary by age, season, feed availability, and level of production. Excessive fat in bulls may cause a reduction in sex drive (libido) and too much fat in cows and heifers can reduce fertility and milk production. Cows should be allowed to put on some fat before calving.

You should take the time to look at live cattle as well as breed magazines and judging manuals to get a better idea of what the descriptions above look like.

A good publication to visit to see photographs and study in more detail is: <https://edis.ifas.ufl.edu/publication/4H329>



Reproduction Overview**

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 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, also called **calving**. **Dystocia** is a difficult birth and cows or heifers experiencing dystocia may have trouble re-breeding.

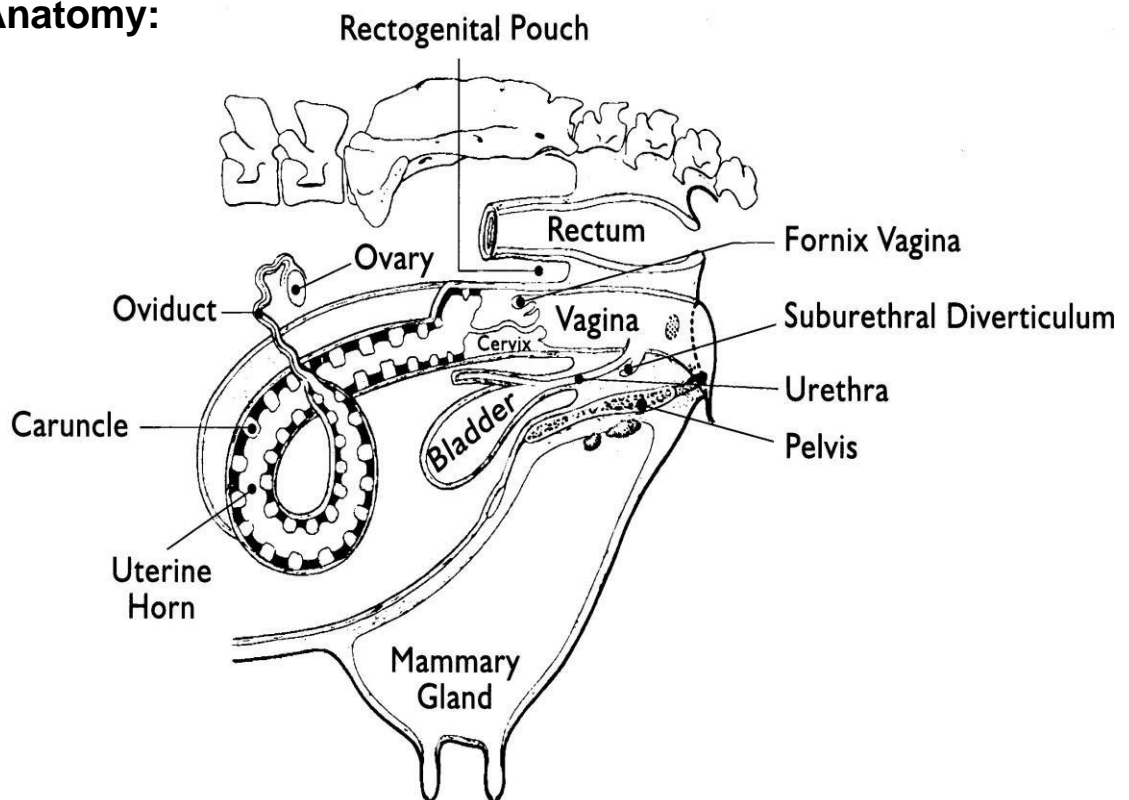
Reproductive Anatomy

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

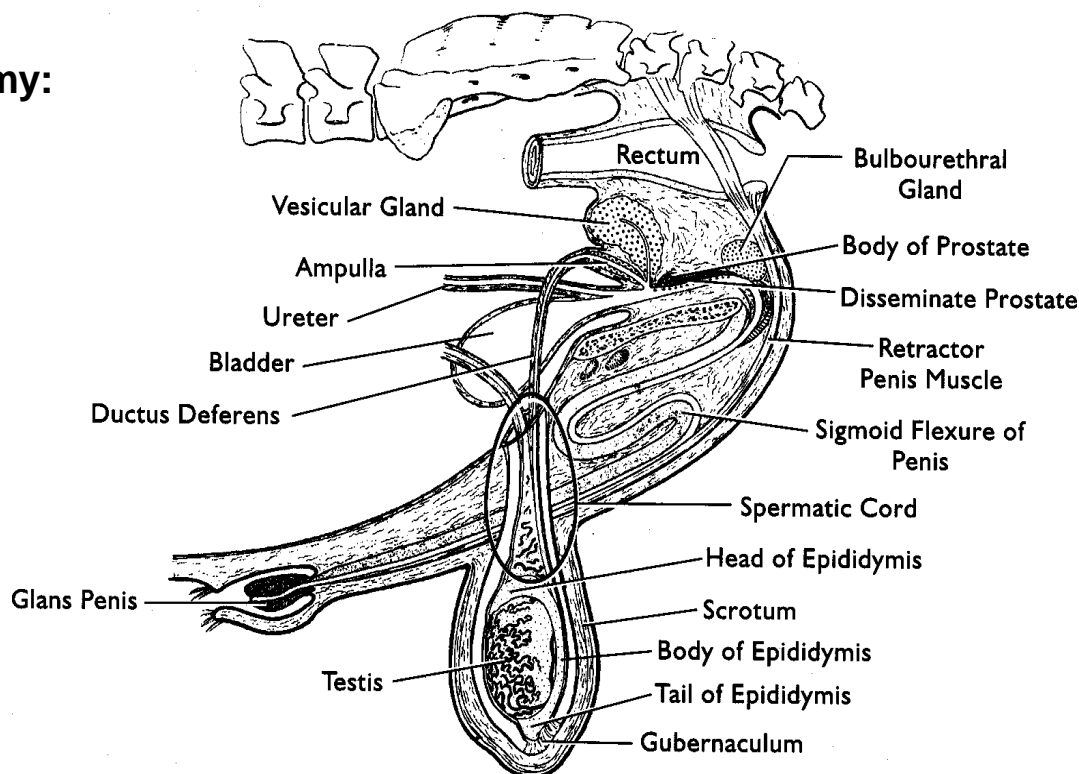
Gender Names and Terminology

Baby – calf, young female – heifer, mature female – cow, male – bull, castrated male – steer.

Female Anatomy:



Male Anatomy:



Reproductive Functions



Int. & Sr.

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*. Estrogen causes heat or estrus and releases 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	<i>Supports, nourishes, and protects</i> the embryo as it develops and <i>expels</i> the fetus at parturition. Walls are soft and spongy in non-pregnant animals. It is made up of the <i>uterine body</i> which divides into two <i>uterine horns</i> .
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 <i>prevents microbial contamination</i> of the uterus and <i>closes tightly during pregnancy</i> and then must <i>open (dilate) at calving</i> . It serves as a reservoir for sperm, a <i>passageway for sperm</i> during estrus.
Vagina	The passageway from the vulva to the cervix that serves as the <i>organ of copulation and birth canal</i> during parturition. This is the <i>site of semen deposition</i> . 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 <i>urine excretion</i> .
Vulva	<i>External opening</i> of the female reproductive tract.

Male Functional Anatomy

Scrotum	External sac; <i>contains, supports, protects, and provides temperature control</i> for the testes.
Testicles or Testes	Paired male gonads that <i>produce the sperm cells</i> and the male sex hormone, <i>testosterone</i> .
Epididymis	Long coiled tube that sperm enter upon leaving the testicles. It is the <i>site of sperm storage, concentration, maturation, and transport</i> . It is subdivided into the <i>head, body, and tail</i> .
Ductus deferens	Long tubes that <i>connect</i> the epididymis in the scrotum to the urethra near the bladder, and <i>transport sperm</i> . The <i>ampulla</i> is the section of the vas deferens that dumps into the urethra.
Vesicular Glands	Paired glands that <i>secrete seminal fluid</i> into the urethra which serves as a <i>transportation medium</i> and provides <i>nutrition and protection</i> for sperm.
Prostate Gland	Found near the urethra and the bladder. It <i>adds fluid</i> to the semen.
Bulbourethral Glands	(Also called the <i>Cowpers gland</i> .) <i>Secretes a fluid similar to that of the seminal fluid</i> which <i>flushes urine residue</i> from the urethra.
Urethra	Tube that passes through the penis and is the <i>common passageway</i> for semen and urine.
Penis	Organ is used for copulation that <i>deposits sperm</i> into the female reproductive tract. An S-shaped bend called the <i>sigmoid flexure</i> allows the penis to be retracted into the body by the retractor penis muscles .
Glans Penis	The <i>free end</i> of the penis containing <i>sensory nerves</i> and the opening of the urethra.
Prepuce	Fold of skin serving to <i>protect the penis</i> by enclosing the free end when retracted.

Pregnancy and Parturition

It is important to know if a cow is pregnant to feed her properly and 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 *palpated* (felt) for pregnancy after about 40 days. In addition, an *ultrasound* machine can be used to tell if the female is pregnant at about 25 days. This machine sends out sound waves which bounce back and register as a picture on a monitor. Blood and urine pregnancy tests also exist for cattle.

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, and she may go off by herself.

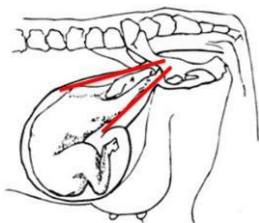
As delivery begins, the female usually lies down and begins to push the calf out with her abdominal and uterine muscles. The first thing to appear from the vulva is the 'water bag' followed (in normal parturition) by two front feet and a nose.

When everything is normal, cows or heifers deliver their offspring without assistance. Sometimes things don't go well, and 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.

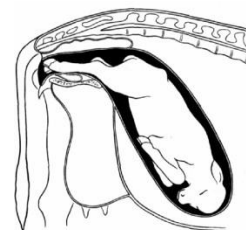
Stage 1 is the preparation phase of delivery. During this time the cow will go off by herself, get up and down, and may urinate a lot. It lasts 2-6 hours and ends when her water bag breaks.

Stage 2 is when the cervix is fully dilated (open wide) and the cow is actively pushing. It may last 1-2 hours in cows and 2-4 hours in 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.

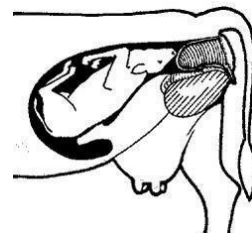


Presentation refers to the calf coming headfirst with both front legs (normal) or backwards with hind feet first or sideways with all four legs first or the back of the calf first. Headfirst is best. The back end first is still an okay position for delivery but the umbilical cord may break before the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

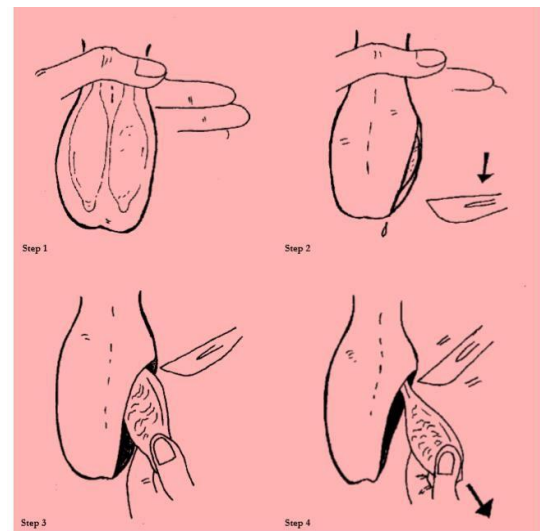
The newborn calf is fragile and requires special care. They must nurse within the first few hours after birth to get antibodies to fight disease. The first milk, called *colostrum*, contains antibodies, is thick and yellow, and is only produced for a few days. If possible, to help prevent infection, 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.

There are two methods that 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/>



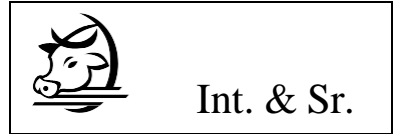
http://www.dpi.nsw.gov.au/data/assets/pdf_file/0008/174167/castrating-calves.pdf

Dehorning

There are several reasons for dehorning calves. First, horned calves are often less valuable when sold. When calves are dehorned, they require less space in feedlots 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 and Use



Equipment

It is important to recognize different equipment that is used in breeding, aiding parturition, and processing newborns. 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

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.

Heat (Estrus) Detection

In herds where artificial insemination is to be practiced, 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. Most let you know if the cow stood to be mounted. Some examples are a chin-ball marker placed on a teaser animal, a paint stick on the tailhead, or 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.

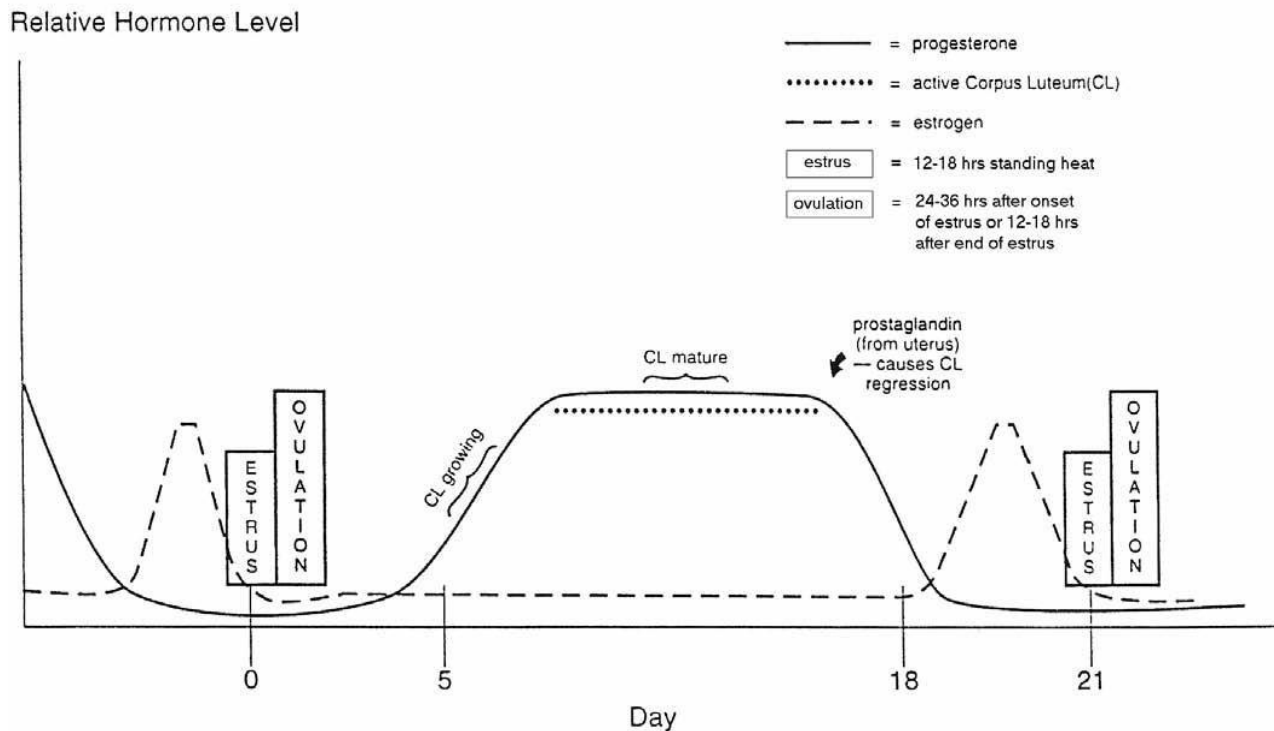
Progesterone – from the corpus luteum (CL) on the ovary formed after ovulation; maintains pregnancy, prevents estrus and ovulation.

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, and stimulates the formation and maintenance of CL.

Gonadotropin Releasing Hormone (GnRH) – from the hypothalamus (brain) causes FSH and LH release.



Timing of Reproductive events:

Breed/Type	Puberty*		Breeding Information*		
	Weight (lbs)	Age (mos)	Estrus (hrs)	Estrous Cycle (days)	Gestation Length (days)
Bos Taurus	575	10-15	12-18	21	279-284
Bos Indicus	675	17-27	4 - 8	21	293

Artificial Insemination

If you do not own a bull, or if you want to breed to an animal that is too expensive for you to own, it is possible to buy semen and breed artificially. Semen is collected from genetically superior sires where it is processed, frozen, 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. AI is practiced extensively in dairy cattle but to a lesser degree in beef cattle. Success (high conception rate) depends on all the factors listed above and the management of the cattle, particularly with regard to nutrition and health.



Artificial Insemination Procedures

Bull semen is typically stored in 0.5 ml 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.

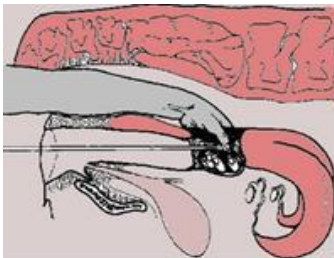
Quickly place the straw of semen into a thaw box or thermos which should have a water temperature of 95 degrees F. The semen should be left in the water for approximately 30-40 seconds.

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 Beef Cattle

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 *cycl*ing 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.

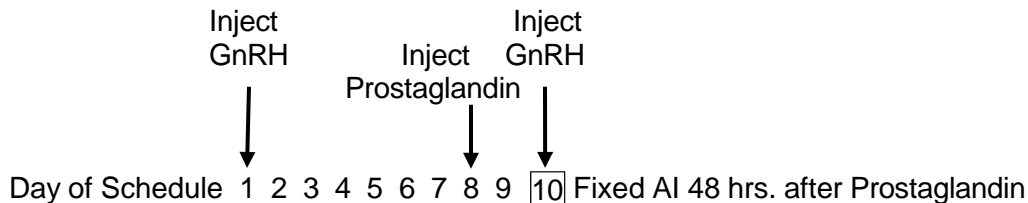
Prostaglandin Method

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®, Prostate®). 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.

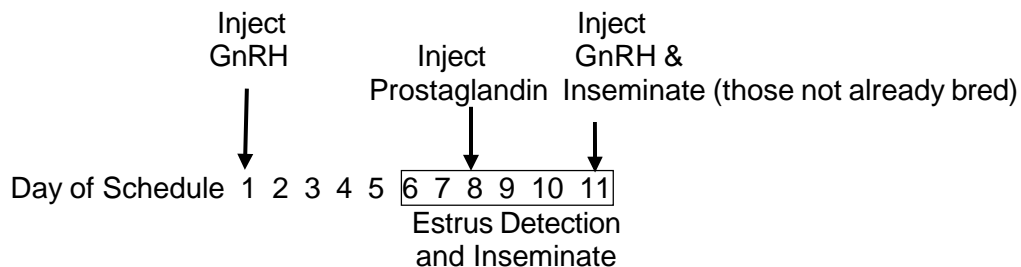
GnRH and Prostaglandins

This procedure starts 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



Hybrid-Synch

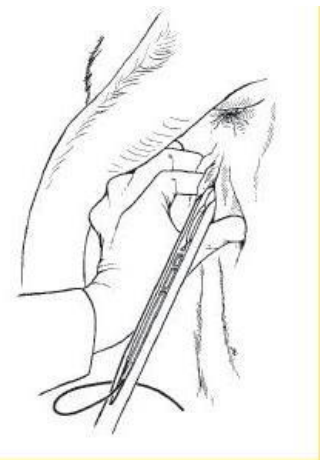


Progestin Systems

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.

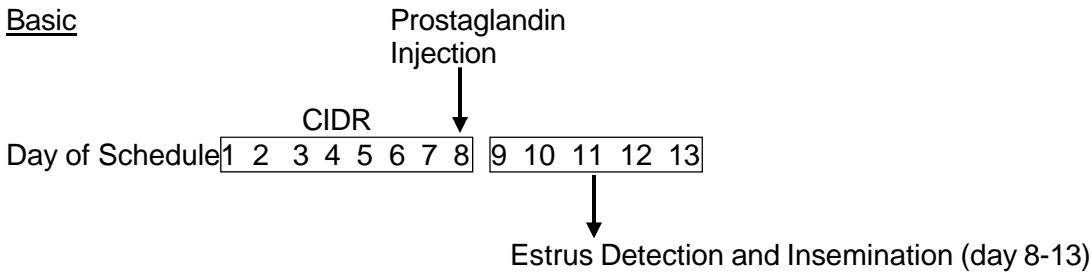
Intravaginal Progestin Inserts

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 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.

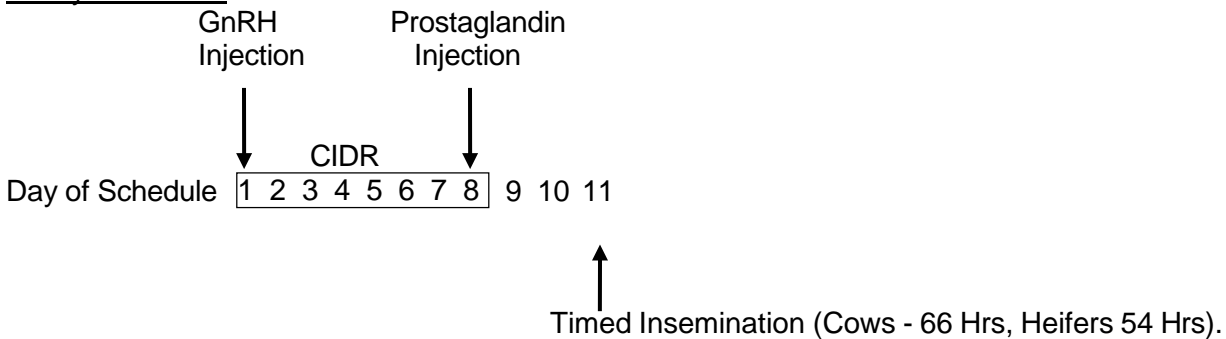


Estrus Synchronization Using CIDR

Basic



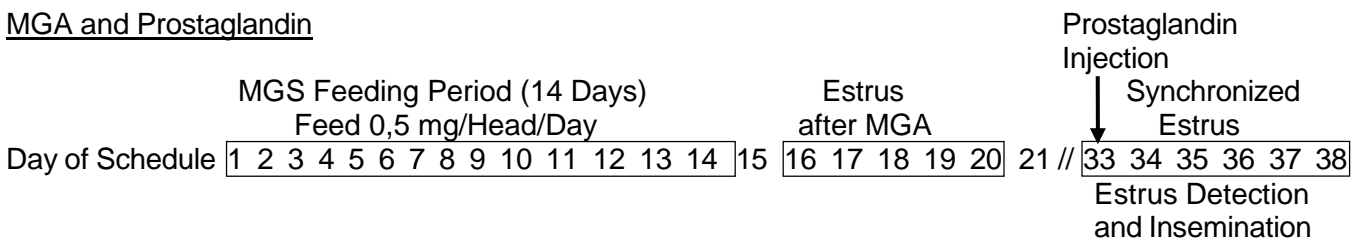
Co-Synch +CIDR



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.

MGA and 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=B1232>

Selection: Pedigree Performance/Evaluation

Proper breeding stock selection is a critical factor in establishing a good breeding program. The goal of cattle selection is to produce cattle that will yield/produce high-quality products at a low cost to the rancher 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, growth rate, birthing ease, or carcass merit is the type selected.

The expression of observable or measurable traits is called *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 the genotype is affected by the environment in which it is raised. Therefore, when making selected matings, the environment, 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 rancher and packer. 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.

Performance Data

There are several types of performance data that, when used properly, are important tools in the selection and genetic improvement of animals. Many breed associations and commodity groups provide information, assistance, and technical support to producers wishing to collect and use performance data.

Adjusted Performance

Adjusted performance consists of an animal’s actual performance record with an adjustment for age or other factors. For example, instead of weighing animals on the same day of age, they are weighed on the same day and the weights are adjusted for age. Below are examples of the most common data used in beef cattle. The desirability of a high or low value for the trait is dependent on the scenario.

Birthweight Weaning weight Yearling weight Scrotal circumference Maternal milk

Ratios

Ratios rank an individual’s deviation of performance from the herd average in a certain trait. The herd average is represented by a ratio of 100. For example, if a bull had a weaning weight ratio of 110, then his weaning weight was 10% higher than the herd average.

Expected Progeny Differences (EPDs)

EPDs estimate how the future progeny of an animal will compare to the progeny of other animals within a breed and are computed in the units of the trait being measured. They are accompanied by an accuracy value between 0 and 1 which represents the reliability of the prediction. EPDs are based on an animal’s performance along with measures of the performance of an animal’s relatives, including ancestors, siblings, and progeny. When comparing EPDs for selections, always keep in mind the situation or scenario in which the animals are to be used. For instance, a low birthweight EPD would be highly desirable for a bull that is to be bred to first calf heifers.



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. You can shop through online catalogs for bulls that fit your needs and purchase semen for artificial insemination.

The organization dedicated to “improving the beef industry through performance evaluation” is the *Beef Improvement Federation*. For definitions of performance evaluation terms, go to: <http://www.iowabeefcenter.org/bch/BeefPerformanceGlossary.pdf>

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.

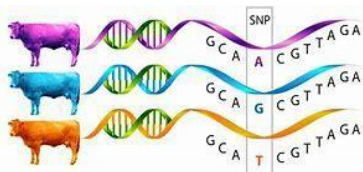


Clones have been produced through micromanipulation from split embryos and even nuclear transfer.

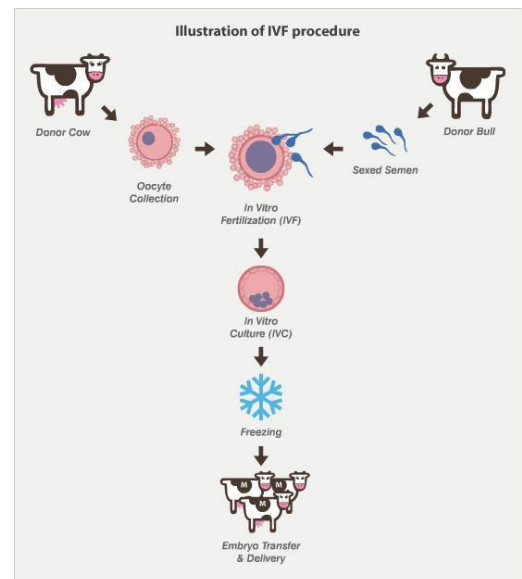
In vitro fertilization, oocytes aspirated from the follicles of a donor cow or heifer, fertilized in the lab, cultured for a week, and then transferred to a recipient cow.

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://beef-cattle.extension.org/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. The expression of the genome is what one sees in the animal's phenotype or performance/appearance. In short, genomics is the study 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 contains the genetic instructions for the development, function, growth, and reproduction of an organism. For 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 about 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. Unlike simple genetics, 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, rabbits, 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 the regulatory frameworks are still being developed. Still, genomics is among the latest cutting-edge technologies in animal agriculture and animal reproduction management.

