Dairy Cattle Reproduction

HOLSTEIN FOUNDATION

Est. 1989

"Developing Future Leaders for a Vibrant Dairy Community"

Table of Contents

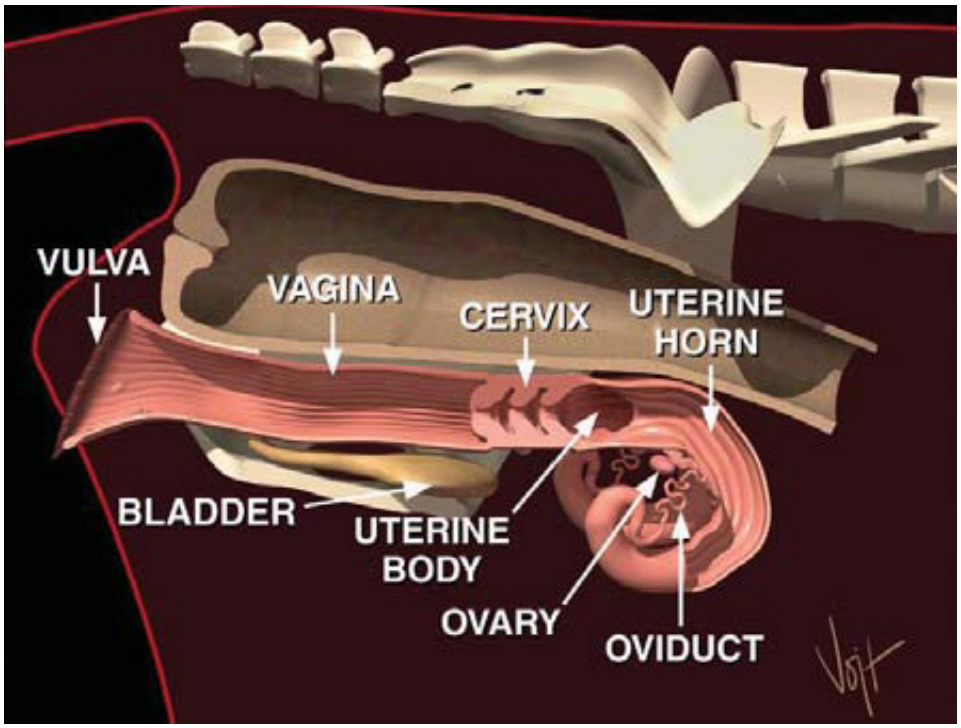
Introduction

On a dairy farm, one of the most rewarding events is the birth of a healthy calf. Each calf is the result of almost a year's worth of planning and preparation. Careful consideration has gone into sire selection, breeding and caring for the cow as she carried the calf to birth. In this workbook, you'll learn about the reproductive cycle of a dairy cow, from breeding to calving, and will gain a better understanding of the anatomy and physiology of the cow and bull. Anatomy is the study of the structure and relationship between body parts. Physiology is the study of the function of body parts and the body as a whole.

Female Reproductive Tract

The structure of a cow's reproductive tract is very similar to that of a human's. Working from the outside to the inside, the reproductive tract of a cow is composed of the vulva, vagina, cervix, uterus, two uterine horns, two oviducts and two ovaries, all attached by a series of flexible ligaments. The rectum is located above the reproductive system and the bladder is found below.

Reproductive Tract Of Cow — Side View



The **vulva** is the only part of the tract that can be seen outside the cow and is the vaginal opening. It offers protection to the entrance of the internal part of the reproductive system and houses the urethra, from which urine exits the body.

Immediately inside the vulva is the first internal part called the **vagina**. This is an open channel about six inches in length and where semen is deposited when a cow is bred naturally by a bull. The vagina serves as the birth canal at calving.

The **cervix** is a narrow tube made up of dense connective tissue, which connects the vagina and uterus. It is a primary landmark when inseminating cattle. The inner surface of the cervix has many folds which acts as a physical barrier and protects the uterus from any foreign material or bacteria during pregnancy.

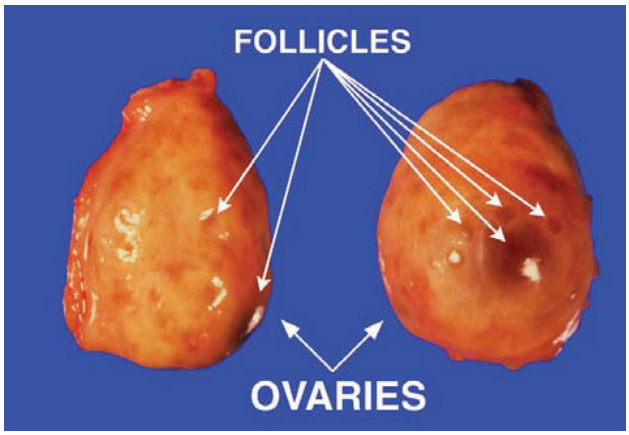
The reproductive tract separates from the uterine body, where all further structures come in pairs. The **uterus** consists of a body and two horns. The main function of the uterus is to provide an appropriate environment for fetal development. In a non-pregnant state, it extends less than two inches before it divides into two long separate uterine horns, which mirror each other. When a cow is artificially inseminated, this is where semen should be deposited.

The **oviducts** are located at the end of each uterine horn. These small channels carry the cow's eggs from the **ovaries** to the uterus. The ovaries extend just beyond the oviducts, whose function is to store eggs and produce hormones. Each ovary is about the size of a half dollar coin, but size varies greatly depending on the stage of the estrous cycle or gestation.

On the surface of the ovaries, you can find two predominant structures known as follicles and corpus luteums (CLs). **Follicles** are the fluid-filled, blister-like structures that contain the developing egg. An ovary can often have several follicles on it which vary in size. The largest one is often called the dominant follicle and typically will rupture during ovulation, releasing the egg.

A **corpus luteum** (CL) develops after the follicle ruptures and is ovulated. CL is Latin for "yellow body." While the outside of this structure is usually dark red in appearance, a cross section reveals a bright yellow interior. The CL develops as a dense cellular mass that protrudes from the ovary's surface. If the egg is not successfully fertilized, the cow will not become pregnant and the CL will degenerate and then the cycle repeats itself.

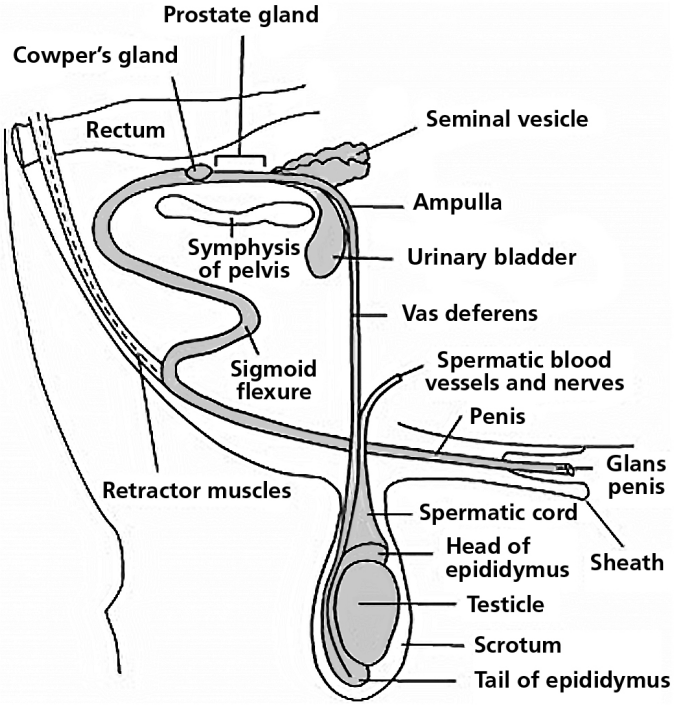
Follicle & Ovaries



Male Reproductive Tract

Bulls become fertile at about seven months of age. The reproductive tract of the bull consists of the testicles, secondary sex organs, and accessory sex glands.

Reproductive Tract Of Bull



Drawing of the reproductive tract of the bull (from Nebraska Guide G80-536)

These organs work together to form, mature and transport sperm, which is eventually deposited in the female reproductive tract. The secondary sex organs are the epididymis, vas deferens and penis. The accessory sex glands include the seminal vesicles, prostate and bulbourethral gland, also called the Cowper's gland.

Two **testicles** are located outside the body cavity in an external sac called the scrotum. Their function is to produce sperm and testosterone. The scrotum provides protection to the testicle and regulates the temperature for optimum sperm development. The location of the testicles exterior to the body cavity is essential for sperm formation, which occurs at four to five degrees below body temperature. Measuring scrotal circumference is a simple way to evaluate fertility.

The testicle has many long, tiny, coiled tubes within which the sperm are formed and begin to mature. Testosterone is produced by specialized cells that are in the loose connective tissue surrounding the testicles. Sperm accumulate and mature within the epididymis.

The **epididymis** is the outlet for all sperm produced in the testicle. Its compact, flat, elongated structure is attached to one side of the testicle which is divided into the head, body and tail. The tubules that enter the head of the epididymis from the testicle unite to form a single tubule, 130 to 160 feet in length. This complex tubule is packed into the six to eight inch epididymis. Sperm pass through the epididymis into larger tubes called the vas deferens.

The **vas deferens** appears from the tail of the epididymis as a straight tubule and passes as part of the spermatic cord through the inguinal ring into the body cavity. Sperm are transported along the reproductive tract to the pelvic region through the vas deferens by contraction of the smooth muscle tissue surrounding this tubule during ejaculation. The vas deferens unites into a single tube called the urethra. This is the channel that passes through the penis. The urethra is the passageway for semen and urine.

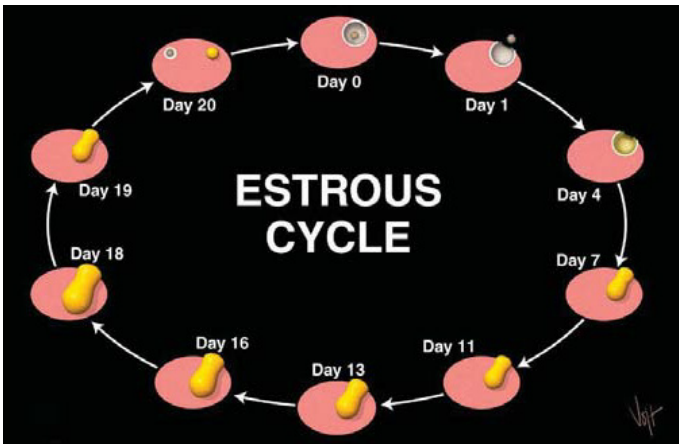
Two **accessory glands** are found in the area where the vas deferens becomes the urethra. Secretions from these glands make up the liquid portion of semen. These seminal vesicles consist of two lobes about four to five inches long, each connected to the urethra by a duct. The prostate gland is located at the neck of the urinary bladder where it empties into the urethra. The third accessories are the Cowper's glands, located on either side of the urethra. These glands flush and cleanse the urethra of any urine residue that may be harmful to sperm.

The **penis** is the organ of insemination. The penis is held inside a sheath, except during service. Retractor muscles hold the penis in an S-shaped curve. Spongy material within the penis is filled with blood during sexual arousal which results in erection of the organ discharging semen. Semen consists of sperm and fluids.

Estrous Cycle

Recurring changes in hormone levels trigger a series of events within the cow's reproductive system. From the time a heifer reaches puberty until she becomes pregnant, this cycle repeats every 18 to 21 days, or up to 23 days in lactating dairy cows. This is known as the estrous cycle.

The cycle begins on Day 0, when a cow is in **estrus**, also known as standing heat. At this time, one ovary has a dominant, large follicle with an egg inside that is ready to be released or ovulated. The cells lining the follicle produce the hormone estrogen.



Estrogen is responsible for all visible signs of heat. It enters the cow's bloodstream, making the uterus more sensitive to stimulation and aiding in semen transport, causing the cervix to secrete mucus lubricating the vagina.

On Day 1, the follicle ruptures and releases the egg. This is called **ovulation**. As the estrogen level decreases, the cow stops showing signs of heat. Over the next five to six days, the corpus luteum (CL) forms at the site where the egg was released from the ovary, producing progesterone.

Over the next several days, **progesterone** prepares the uterus for pregnancy. It prevents the cow from returning to estrus by regulating the release of hormones by her brain. **Follicle stimulating hormone** (FSH) stimulates the growth of small follicles. **Luteinizing hormone** (LH) supports progesterone production by the CL and stimulates estrogen production in large follicles. Progesterone's regulation of FSH and LH is critical to maintaining pregnancy.

During days 16-18, the uterus searches itself for the presence of a growing embryo. If no embryo is detected the uterus produces **prostaglandin**. Prostaglandin destroys the CL so no more progesterone is released. The production of prostaglandin triggers increased secretion of LH, stimulates the dominant follicle to produce estrogen and brings the cow back into heat.

The estrous cycle can be divided into two phases. The **luteal phase** starts at day five to six and ends at day 17-19. During this phase, progesterone levels are high, and estrogen levels are low. The **follicular phase** occurs during the days surrounding estrus, when estrogen levels are high and progesterone levels are low.

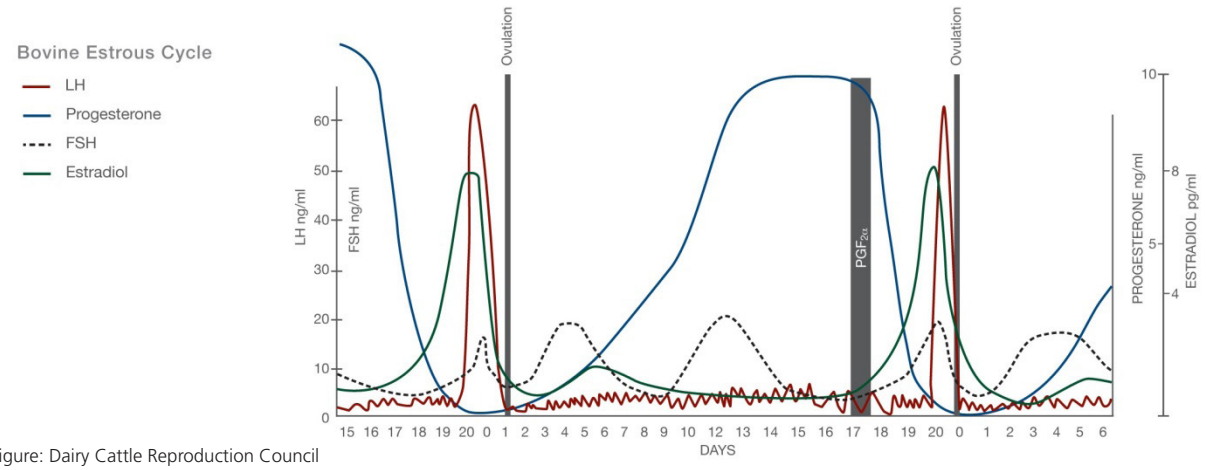


Figure: Dairy Cattle Reproduction Council

Heat Detection

The most reliable sign that a cow is in heat is when she stands to be mounted. This is when a cow will allow another cow to mount them for an average of four to six seconds at a time. You should base the timing of insemination on when you observe standing heat. This is the primary sign of heat and determines time of insemination since ovulation occurs 25 to 30 hours after an animal first stands to be mounted. Additional signs to look for when determining if a cow is in heat include:

- Roughed up hair on tailhead or rump
- Vocalization such as bawling
- Erect ears
- Cows head resting on another cow's back or loin
- Smelling other cows and licking
- Clear mucus discharge coming from the vulva
- Moistness and redness of vulva
- Frequent urination
- Decreased milk production
- Decreased appetite
- Mounting other cows
- Unusually friendly
- Restless activity

Careful monitoring of your herd will allow you to observe when a cow is in heat so you can breed her accordingly. As a rule, watch cows for 20 to 30 minutes at a time in the early morning, noon and late evening. This practice will let you observe more than 90 percent of heats. Cows typically will not exhibit as many signs of heat during feeding, milking time and during heat and cold stress. Cows will often show more signs of heat on pasture or dirt surfaces. Watch cows closely within the first 30 minutes of being turned out to pasture or the exercise lot.

Other heat detection aids are available that can help dairymen with their heat detection.

Pressure-sensitive heat mount detectors are applied with glue and placed on the rump between the hip and pin bones. These small devices are activated after four to five seconds of continuous pressure such as a cow mounting another cow's rump. The pressure causes the detector to change colors so dairymen can identify cows that have been ridden and are likely in standing heat.

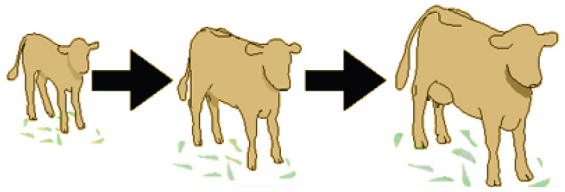
Tailhead chalk or paint is applied to a cow's tailhead, in a strip about 12 inches long and two inches wide. Tailhead markings must be touched up daily so they have a consistent look and changes are easily detected. Some herds use different colors to indicate the reproductive status of a cow or group identification.

Advances in technology give producers even more options for monitoring cow behavior. Using automated heat detection systems, much of the labor required for other heat detection methods is eliminated. Two primary devices utilized with activity monitoring systems include pedometers and accelerometers.

Pedometers measure steps cows take throughout the day. After a pattern of activity is established, a formula will calculate when the cow is taking more or fewer steps in a day. A decrease in activity could mean the cow is sick or lame, while an increase can be a sign of the cow coming into heat, especially if the activity is increasing on a 21-day interval. Accelerometers also calculate the cow's movements side to side, up and down, and front to back. Having this extra data can help explain more of the cow's movements. Dairy producers can access daily reports and look up individual animals on the computer. Activity monitoring systems are relatively costly to set up and take time for workers and cows to get used to; however, when used correctly, these systems have great potential for improved heat detection and overall cow management.

Ideal Breeding & Calving Age

Breed	Birth weight (lbs.)	Breeding		Calving		Average daily gain (lbs.)	Adult weight (lbs.)
		Weight (lbs.)	Age (mo.)	Weight (lbs.)	Age (mo.)		
Holstein, Brown Swiss	88 — 100	793 — 881	14 — 16	1199 — 1366	23 — 25	1	1433 — 1598
Guernsey, Ayrshire	77 — 88	606 — 683	13 — 15	992 — 1102	22 — 24	1	1157 — 1278
Jersey	55 — 66	496 — 573	13 — 15	793 — 936	22 — 24	1	936 — 1102



Effect Of Body Weight At Various Stages Of Development And Overall Desirable Growth Rate Of Heifers Babcock Institute Graphics

An industry benchmark many producers follow is to have heifers calve at 22 to 25 months of age and be 80 to 85 percent of their mature body weight at first calving (bred at 65% of body weight). Sexual maturity for heifers is based more upon weight than age. Growth rate has a considerable influence on the age puberty is reached and when a heifer is able to be bred for the first time. Nutrition is very important as some animals are better managed than others.

There are several advantages to calving heifers at 22 to 25 months of age:

- Quicker return on investment
- Reduction in number of heifers needed to maintain herd size
- Increased lifetime performance
- More rapid genetic progress
- Reduction in total amount of feed needed from birth to calving

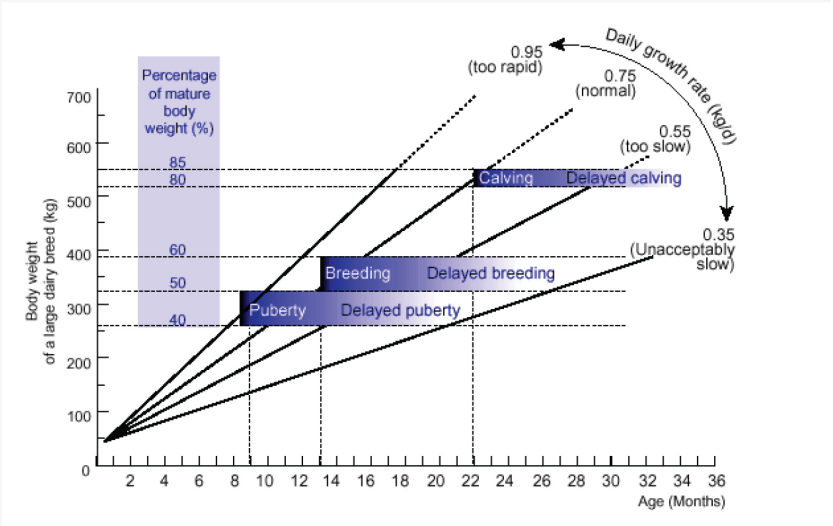


Figure 2: Heifer growth rate and reproductive performances

Breeding Methods

Getting cows pregnant in a timely manner is an important part of having a profitable dairy operation. Artificial insemination (AI) and natural service bulls are both commonly used by U.S. dairy producers.

Natural Service

The number of cows in the U.S. bred naturally by a bull has decreased dramatically over the years because of technological advances. With natural service, bull information may be available, but it will be less reliable then using and AI sire because fewer daughters of the bull have been observed. Also, keeping mature bulls on a dairy farm can be very dangerous and they can also introduce venereal disease into a herd.

Artificial Insemination

Artificial insemination is a common procedure that involves a trained technician placing semen from a bull into the body of the uterus of a cow at the time of heat. The biggest advantage of AI is having access to thousands of sires instead of just one or two that would be on your farm with a natural service program. Another benefit is the genetic progress that is available with using AI. Bulls in stud have been intensely selected for genetic merit and possess the most elite genetics available. Because of this, daughters of AI sires produce more milk per lactation than daughters of natural bulls, on average.

Many producers go by the AM/PM rule, since ovulation occurs 16 hours post standard heat. If a cow is in standing heat in the morning (AM), then breed her in the afternoon. If a cow is in standing heat in the afternoon (PM), then breed her the next morning.

Learning how to breed your own cattle can be a useful skill, as it is more convenient and can save time and money when compared to relying on a technician. The information below is meant to introduce you to the method used to artificially inseminate cows. We recommend taking an AI training course before attempting it yourself.

Facilities play an important part of the success of AI. When an animal is ready to be bred, secure her in a chute or headlock. After the cow is where you can easily work with her, go to your semen tank and acquire the semen you will use. Make sure you keep the semen below the frost line. It is recommended to thaw one straw of semen at a time. The time between the semen being removed from the tank and when it is deposited in the cow should not be more than 15 minutes. Generally, semen should be thawed in water that is 95 to 98 degrees Fahrenheit for 45 seconds (a minimum of 30 seconds).

After the semen has thawed, dry the straw with a paper towel, as water is lethal to sperm. Place the end of the straw with the cotton plug in the breeding gun. Cut the sealed end at a 90 degree angle about ¼ inch from the lab seal. If the straw is not cut squarely, the plastic sheath may not fit snuggly around the straw, this could lead to some of the semen not going into the cow.

Once the semen has been thawed, it must be kept warm. Wrap the gun in a paper towel and place it under your armpit or inside your shirt until you reach your destination. During the summer, keep the gun out of direct sunlight and away from hot surfaces.

The landmark parts of the reproductive tract will be hard to identify at first, but with practice, it will become easier. The interior of each cow will feel different depending on her age, stage of heat and disposition. Some cows will be more difficult to inseminate than others. Be patient and remember, breeding a cow should never require a lot of force.

1. After the gun is ready, prep the cow. Clean the cow's vulva with a paper towel to help prevent contamination of the vagina and uterus. Most people who are right handed place a breeding glove on their left arm, the arm that is inserted into the cow's rectum and helps guide the gun into the uterus. Place a small amount of lubricant on your glove, as this will help your arm enter the cow easier.
2. Feeling through the rectal wall, the cervix will feel like a turkey neck – a firm, muscular tube. Wrap your palm and forefingers on top of the cervix. Your forefingers should extend over the far end of the cervix. Moving and handling the cervix gently will not hurt it or impact fertility.
3. With your arm in the cow, it is time to insert the gun. To avoid going into the bladder, point the gun upward and run it along the top of the vagina until you get to the cervix.
4. To find the opening of the cervix, form an O with your fingers and aim the gun toward the center of the O. If you think you are inside the cervix, but can only go another inch, you are probably not, so pull back and try again.
5. As you pass through the cervix you will feel three rings of tissue. Gently rock the gun with your gloved hand up and down. Apply a slight pressure on the gun (too much pressure could damage the cervix) and you should be able to move through each fold. It is harder to find the gun tip in the cervix, even though it is easy to find in the vagina and uterus.
6. Using the forefinger of your gloved hand you should feel the tip of the gun as it exits the cervix. Now the gun tip is at the entrance of the uterine body.
7. Slowly push the plunger of the gun and release the semen into the uterine body.
8. Finally, remove the gun and release the cow.

After you are done breeding the cow, record the semen that you used, which cow was bred and the date. Animal identification and a good record keeping system are essential elements of a successful AI program. Breeding records will help you detect which cows have reproductive problems and assist you in making culling decisions.

Pregnancy Determination

Now that you've mastered breeding, let's see if she's pregnant. With today's technology, there are many ways to determine if a cow is pregnant.

Palpation

Rectal palpation is the easiest, fastest and cheapest method of determining pregnancy. Palpation is done by going through the rectum and examining the entire reproductive tract to identify if the cow is pregnant or open. The only positive signs that a cow is pregnant include: fetus, cotyledons/caruncles, amniotic vesicle and fetal membrane slip.

To palpate a cow you need to put a plastic sleeve over one of your arms. The plastic sleeve should stretch to your shoulder. This helps eliminate irritation and the potential for diseases for both the cow and yourself. To allow your arm to slip easier into the cow's rectum, apply lubricant to your hand.

The safest location to palpate a cow is in a headlock or a chute, where she has limited side-to-side movement. For the cow's protection, ensure the area has good footing such as a grooved floor, rubber mat or dirt.

Palpation should be done by a trained professional, such as your veterinarian. This section is designed to tell you what the vet is feeling for at each stage of pregnancy. Always assume a cow is pregnant when palpating, and be gentle in handling the reproductive tract so you do not disturb the pregnancy.

As you remember from learning to perform AI, the cervix has a firm feel and is a good landmark to orient yourself. After locating the cervix, move on towards the uterus to see if the cow is pregnant. Pregnancy can be detected as early as 30 days after breeding, however, palpation before 40 days can cause abortion. Good breeding records will help the person palpating gauge whether or not the cow is pregnant.

In the early stages of pregnancy, the uterus will be filled slightly with fluid and will feel thinner. One horn will be enlarged more than the other. The embryo will be surrounded by a ¾-inch diameter sack filled with fluid, like a balloon filled tightly with water. On this same side, the ovary will have a CL.

At 60 days of pregnancy the cervix remains on top of the pelvis and the uterine horns move forward and downward over the brim. Ninety days of pregnancy the uterus is on the abdominal floor and is considerably stretched. In larger animals, it may be difficult to feel the fetus because of the distance the fetus is from the anus. Holsteins and Brown Swiss are the hardest to palpate because of their large frames. The fetus is easier to feel at four to five months because it takes up a larger part of the abdominal cavity. Any fetus more than five months of age will feel about the same except for the size will continue to increase.

Ultrasound

Ultrasound technology gives a more in-depth picture of a cow's reproductive tract and pregnancy than a rectal palpation. Many vets and farms use this technology on a regular basis. Other benefits with using ultrasound are visualization of ovarian structures, early detection of pregnancy, sex of the fetus and identification of twins.

The machines used today are real time and produce two-dimensional images on the screen. Ultrasound can be used to detect a pregnancy as early as 26 to 28 days in cows. The fetal heartbeat can be seen at 21 days. By using ultrasound, cows that are found to be open can be put back into the breeding program an average of 10 to 15 days sooner than they would have been with rectal palpation.

Lactating cows often have a high percentage of lost embryos early on in pregnancy. For the best results see if the embryo is surrounded by fluid and if it has a heartbeat, proving the cow has a viable pregnancy. The fetal heartbeat can be detected at 21 days. The rate of embryonic losses between 28 to 56 days can range from 10 to 35 percent. To ensure the cow is still bred, ultrasound or palpate her again later. If the cow is open, she can be put back on a breeding program sooner and if she still is bred you have confirmation. Ultrasound will give you information about the viability of the fetus, which a rectal palpation cannot.

Determining the gender of the fetus (called "sexing") can be done 50 to 60 days after breeding, and requires much more practice to be accurate. Knowing the sex of the fetus can help manage close-up cows. If the cow is carrying a bull, chances are the calf will be larger than a heifer. Knowing the size of the calf will allow you to be better prepared to assist the cow if she is having difficulty calving.

Blood Test

A blood test can detect the presence of pregnancy-specific protein B (PSP-B) in the blood circulation of the animal. A sample can be collected 28 to 30 days after breeding. However, it is recommended the test be done on cows having calved 90 days or more. Cows that calved more recently can still have PSP-B in their blood from the previous pregnancy. Once samples are taken, they need to be shipped to a laboratory. The test results are typically read within 48 hours after being received.

Milk Test

The purpose of the milk test is to detect those cows that are pregnant, as well as those cows that are open in a timely manner. Once milk samples are obtained, they are sent to a laboratory where an enzyme-linked immunosorbent assay (ELISA) is performed. This is a cost effective and labor saving means to quickly determine the status of a cow. There is a high level of accuracy when samples are taken 35 days or more after breeding.

Many Dairy Herd Information Association (DHIA) testing centers offer milk pregnancy tests as a routine service which reduces the stress on the animal as milk samples can be taken in the parlor.

Fetal Development

Calf development is divided into stages. The first is the embryo, which is the time from fertilization until the egg has divided enough to take on a particular shape. This embryonic stage lasts until the developing membranes attach to the wall of the uterus, which is about 38 days. The placental sides of these attachment points are called cotyledons while the uterine side has caruncles. The respiratory system, nervous system, digestive system, circulatory system and reproductive system are in development during this stage. Around the 38th day, the embryo begins the fetus period and is referred to as a fetus until birth.

Embryonic membranes attach to the caruncles to form placentomes. Cells continue to form and the membranes and placentomes become the placenta. The fetus gets its nourishment through the placenta via a "lifeline," the umbilical cord. The placenta separates the maternal and fetal organisms to ensure separate development of the fetus. Complete attachment occurs by the 45th day of gestation.

For the remainder of gestation (45 to 280 days), the fetus grows and develops. Both genetic and environmental factors affect the development and growth of the calf. Gestation varies around nine days for dairy breeds. Holsteins have the shortest gestation (279 days), while Brown Swiss have the longest (288 days). All other dairy breeds fall in the middle.

Fetal Size and Characteristics Used in Determining Pregnancy

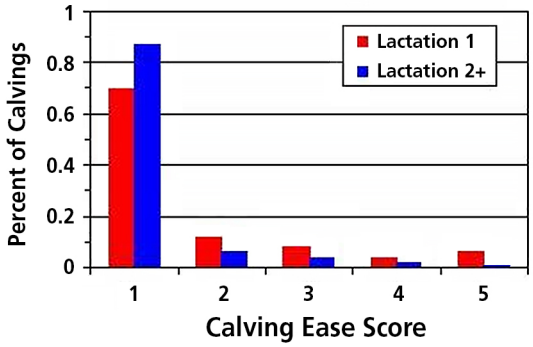
	Fetal Size		
Days of Gestation	**Weight**	**Length (Inches)**	**Identifying Characteristics**
30	1/100 oz.	2/5	One uterine horn slightly enlarged and thin; embryonic vesicle size of large marble. Uterus in approximate position of nonpregnant uterus. Fetal membranes may be slipped between fingers from 30 to 90 days.
45	1/8-1/4 oz.	1-1 1/4	Uterine horn somewhat enlarged, thinner walled and prominent. Embryonic vesicle size of hen's egg.
60	1/4-1/2 oz.	2 1/2	Uterine horn size of banana; fluid filled and pulled over pelvic brim into body cavity. Fetus size of mouse.
90	3-6 oz.	5-6	Both uterine horns swollen (3 to 3" in diameter) and pulled deeply into body cavity (difficult to palpate). Fetus is size of rat. Uterine artery 1/8 to 3/16" in diameter. Cotyledons 3/4 to 1" across.
120	1-2 lb.	10-12	Similar to 90-day but fetus more easily palpated. Fetus is size of small cat with head the size of a lemon. Uterine artery 1/4" in diameter. Cotyledons more noticeable and 1 1/2 inches in length. Horns are 4 to 6" in diameter.
150	4-6 lb.	12-16	Difficult to palpate fetus. Uterine horns are deep in body cavity with fetus size of large cat—horns 6-8" in diameter. Uterine artery 1/4-3/8 in diameter. Cotyledons 2 to 2" in diameter.
180	10-16 lb.	20-24	Horns with fetus still out of reach. Fetus size of small dog. Uterine artery 3/8-1/2" in diameter. Cotyledons more enlarged. From sixth month until calving a movement of fetus may be elicited by grasping the feet, legs or nose.
210	20-30 lb.	24-32	From 7 months until parturition fetus may be felt. Age is largely determined by increase in fetal size. The uterine artery continues to increase in size—210 days, 1/2" in diameter, 240 days, to 5/8" in diameter; 270 days, 1/2 to 3/4" in diameter.
240	40-60 lb.	28-36	
270	60-100 lb.	28-38	

Source: ASC-61 Southern Regional Beef Cow/Calf Handbook: Determining Pregnancy in Cattle

Calving

Approximately three weeks before calving dry cows are moved to an area where they can be closely monitored. It is extremely important to provide the cow with a clean, comfortable environment to have her calf. Moving cows can cause stress, so it is important to move cows as early as possible to minimize this. When calving appears imminent, it is best to have a dedicated maternity pen that is sanitized and located in a quiet, dry, well-lit area. Calving pens should be checked for progress every hour. When a cow is ready to calve, she'll begin having contractions. This is when the uterine muscles will start to contract working to expel the calf. The cervix and vagina will also dilate.

A normal delivery position is when the calf is born headfirst with its head placed on top of both front legs which are extended out in front of the body. This is called frontal or anterior position. When the hind legs and tail come first, this is called a backward posterior position. A breech delivery is when both legs are retained at the hips, meaning the tail and butt is coming first. Twins are more likely to be born breech than single births. Remember to always feel for another calf just in case there is more than one.



Calving Difficulty Chart

Most cows should calve without assistance. A key indicator of a difficult calving is the amount of time spent in labor. Dairy cows are generally in labor from two to six hours. Calving personnel should start assisting cows 70 minutes after the amniotic sac appears. If complications occur after several hours of unrest, getting up and down and straining, then the cow should be examined by a veterinarian. When a cow has a difficult or obstructed calving it is called dystocia. Calving in a clean environment and proper treatment of the cow after a difficult calving will help prevent future reproductive problems.

National Association of Animal Breeders scoring system for calving ease	
Degree of Difficulty	**Calving Ease Score**
No problem	1
Slight problem	2
Needed assistance	3
Considerable force	4
Extreme difficulty	5

Benchmarks

Benchmarks provide a convenient method of comparing the performance of your herd with the performance of similar herds. Complete and accurate herd record analysis should provide the tools necessary to define past performance and assist in establishing goals to improve your future performance. Numerous resources are available for use in herd management analysis.

Getting cows pregnant in a timely manner is important, not just because it yields another replacement, but because of the impact on overall farm profitability. The period of time after calving during which we do not breed cows even if they show heat is referred to as the voluntary waiting period (VWP). Generally, dairy producers set a VWP of 45 to 60 days. Conception rate, heat detection efficiency and postpartum breeding all strongly influence the calving interval. Detection of the first estrous period after calving provides a reference point in which you can expect subsequent estrous periods. It is also helpful in determining if the cow is recovering normally from calving. To be successful, a heat-detection program must be routine and habitual as it is a major factor affecting days open and calving interval. The percent of heats observed is an indicator of the overall success of a heat detection program. After estrous is observed breeding must be done in a timely basis for conception to occur. Measures of conception rate include services per pregnancy and percent of successful services.

Every stage of the breeding process can affect your conception rate. A 40 percent conception rate among lactating cows and fewer than 2.5 services per conception is a good goal to start with. Set goals that are challenging and realistic, so that you can improve your skills.

The ultimate goal of dairy cattle reproduction is to produce the next generation of viable offspring. Dairy cows must freshen regularly to maximize milk production and herd replacements. The best investment in your herd's future is most likely your heifers. As you will discover, lactation is highly dependent on successful reproduction. If you want to improve the reproductive performance of your herd, you should focus your attention on setting a voluntary waiting period and achieving the goals that your management team has set for heat detection and conception rates.

Technology In Animal Breeding

Timed AI/Synchronization

The natural estrous cycle can be altered by various synchronization programs. Timed AI and synchronization involve giving cows' hormone injections over a specific period of time. These programs are useful if you want to breed a group of cows at the same time, are planning to perform embryo transfer work or if you have a cow that is not cycling normally.

For recommendations on which synchronization or Controlled Internal Drug Release (CIDR, pronounced "seeder") program will work best for your operation, contact a reproduction specialist or consult with your veterinarian to design and implement proper protocols.

Sexed Semen

The goal of gender sorted semen is to produce a calf of a specific gender. This method is 90 percent accurate and allows producers to increase the number of heifer calves while lowering calving difficulty. The sorting and selecting of sexed semen is based on the DNA content of sperm, separating the sperm containing the X (female) and Y (male) chromosomes. Sperm is stained with a DNA-binding fluorescent dye. The X chromosome, which is the female chromosome, is larger than the Y chromosome. The dye enables sperm to be electrically charged differently by the laser machine.

Using sexed semen does increase cash outflow, but it also substantially increases cash inflow as more high-valued heifers are produced. Sexed semen is mostly used on virgin heifers because of its higher cost per dose and reduced conception risk, as it contains a lower amount of sperm per straw than non-sexed semen. The fertility of sexed semen is about 25 percent less than conventional semen. A conventional straw of semen will have 20 million sperm whereas sexed semen has two million sperm. It is often not used on an animal after the second try at breeding because of the higher cost. Today, sorting technology is constantly being improved.

Embryo Transfer

Embryo transfer (ET) involves removing fertilized eggs from a cow or heifer and transferring those eggs into recipient animals. This allows owners to produce more offspring from an elite female than would be possible through normal calving. Embryo transfer is useful to breeders that want to speed up the genetic progress of their herd by multiplying the offspring from their top animals.

Embryo transfer consists of two parts: producing and collecting the embryos from a donor, and transferring those embryos into recipients. The embryos can be transferred fresh, shortly after they are

flushed from the donor, or frozen and transferred at a time that is more convenient for the producer. This allows for embryos to be sold, put into other producers' cattle, or planning scheduled calvings for specific times of the year.

Embryos were first surgically removed in the 1950s, but today the procedure is done without surgery. This has allowed ET to be more widespread throughout the dairy industry. Today, embryo transfers can be done every 60 days on each donor.

Superovulation

Superovulation causes cows to ovulate more than one oocyte (egg). This process is induced through hormones given to the donor on a set schedule over the course of several days. If the donor comes into heat on schedule she can continue on in the process. If she does not show a heat, she should not be flushed.

Donors and Recipients

Visually monitor the donors and the recipients as often as possible to try and observe those that come into heat. Once the donors are in estrus, it is time to breed them. Unlike traditional AI, flush cows are bred several times in a short window of time to give the best chance for their ovulated eggs to be fertilized. The eggs will be ovulated over a period of time, so that is why they are bred multiple times. Cows are typically bred 12, 24 and 36 hours after standing heat.

Recipient animals will also be coming into heat about the same time. This will allow fresh embryos to be transferred into each of the recipient's uterine horn to establish a pregnancy, as the recipients will be at the same stage of the reproductive cycle as the donor dam. The stage in the estrus cycle of the recipients needs to match that of the donor's cycle so the recipient can accept the embryo and carry the pregnancy. Monitor your recipients closely and record which ones were in heat and at what time. The technician will use this information, when palpating recipients to detect a corpus luteum (CL), to determine whether or not the recipient should be used. Potential recipients with reproductive tract abnormalities or irregularities, as well as those that have a cyst on the ovary should not be used.

Embryo Collection

The technician will arrive seven days after the donor cows were bred. An epidural is given to the donor animal in her tailhead to eliminate muscle contractions that normally occur in the rectum. Doing this allows the technician to more easily manipulate the uterus and tubing in the reproductive tract.

A catheter is placed over a metal stylette and is inserted through the cervix into the uterus. After the catheter is in place, a small balloon is slowly inflated internally to keep the catheter in place and prevent any fluid from leaking from the uterine body. The metal stylette is then removed and the plastic tubing is attached to the catheter, which is connected to a bag of flushing media (a sterile solution). The fluid flows into the uterine body. The technician will massage the uterus to allow the fluid to retrieve the embryos. The fluid then flows out of the uterus through the tubing and into a very fine filter that catches the embryos. More media is placed in the uterus and this process is repeated several times until the technician believes all of the embryos have been collected.

After the technician is finished, the balloon at the end of the catheter is deflated and removed from

the cow. A shot of prostaglandin should then be given to the donor so that any fertilized embryos that were not collected will not implant into the uterus and develop into a pregnancy or multiple births.

Evaluation of Embryos

Each embryo is evaluated individually under a microscope for quality and then is classified numerically. Embryos are identified as fertile, nonfertile or degenerate. Fertile is a healthy embryo. Nonfertile means the egg was never fertilized and degenerate means the embryo was fertilized and started to divide, but did not survive. Fertile embryos then receive a grade of 1, 2, 3, or 4. Embryos graded a one or two can be successfully frozen. Embryos graded three or four should be put in fresh (not frozen) if the technician deems there is a chance it could develop into a pregnancy. If not, the poor quality embryos should be discarded. On average, each flush will yield about six embryos, but results can vary widely between donors.

Embryo Grades:

Grade 1	Excellent or good
Grade 2	Fair
Grade 3	Poor
Grade 4	Dead or degenerating

Fresh Embryos and Recipients

After embryos are graded, the decision must be made whether they will be transferred into recipients, frozen for later or marketed. In either case, embryos are placed in 0.25 cc straws. A transfer gun, rod, similar to an artificial insemination gun, will be used to transfer the embryo into the recipient animal. Embryos that are implanted fresh have a 65 percent conception rate when recipients are at the correct stage of the estrous cycle. If the recipient does not have a corpus luteum at the time of transfer, she should not be used.

Freezing Embryos

Embryos being prepared for freezing will be rinsed with specialized fluids and surrounded by a cryoprotectant, a fluid which helps protect the embryos from damage in the freezing and thawing process. Each straw is labeled with the ET technician's code (assigned by the International Embryo Transfer Society), dam and sire breed, dam and sire registration numbers, the number of embryos in each straw (typically only one embryo is in each straw) and the date the embryos were collected. Embryos should be frozen within three to four hours of recovery and stored in a liquid nitrogen tank, just like semen.

To thaw frozen embryos, the straw should be carefully removed from the tank. Hold the straw in the air for 10 seconds and then place it into a water bath between 77 and 86 degrees Fahrenheit; notice this temperature is cooler than that used to thaw semen. The straw should stay in the water for about 30 seconds or until the ice is melted from the straw. The outside of the straw should be wiped dry.

It is then treated similar to a semen straw and is transferred into the recipient. Transferring does require more precision (than artificial insemination) as embryos should be placed into the uterine horn on the same side as the ovary with an active corpus luteum rather than just inside the uterine body with artificial insemination. Pregnancy rates vary, generally between 50 to 70 percent. Frozen embryos have a lower conception rate than those transferred fresh.

Embryo Transfer Services

Successful ET programs have skilled technicians, as embryo transfer requires special training. Select someone you are comfortable working with and trust handling your animals. Getting references about the technician is wise, especially if you do not have experience with them.

Cost of ET will vary greatly depending on how close you are to a technician, the semen you use and the number of embryos collected. Fees are also charged for drugs used, travel, recovery charges and transferring or embryo freezing. Different companies have their own pricing protocols.

In Vitro Fertilization

In vitro fertilization (IVF) is a process where unfertilized eggs (oocytes) are collected from the cow's ovary. A specially designed probe with an ultrasound device on the end, is used so the technician can see the ovary during the aspiration procedure. The ultrasound device and the ovary are only separated by the vaginal wall during this process. The probe has a 55 cm long needle attached to the end. This needle goes through the vaginal wall to collect the oocytes. The collected oocytes are then taken to the lab to be counted and evaluated.

The viable oocytes will be placed in a maturation media in a petri dish that will help them mature. The dish is then placed into an incubator for 18 to 24 hours. The sperm are then added the next day and hopefully, fertilization occurs. However, first the semen must be prepared so that it gains the ability to fertilize an egg (capacitation). The oocytes with the sperm cells are then returned to the incubator for seven more days. The incubator and petri dish's content are designed to mimic a cow's uterus. After seven days, the oocytes become embryos and are evaluated just like traditional embryos.

Recipient cattle should be ready to have the fresh embryos transferred. These recipients are just like ET recipients; they were in standing heat seven to eight days prior to the oocytes being extracted from the donor cow. IVF embryos can be frozen, even though this is not the preferred method. Freezing IVF embryos will decrease conception rates by another 10 percent.

With a skilled technician, IVF work can be done on pregnant cows and heifers, as long as it does not disturb the growing fetus. Donors can go through the aspiration process from about 45 to 100 days of gestation. IVF can also be done on virgin heifers, open cows and females who will not produce offspring any other way.

IVF can be done more frequently than ET. Embryo transfers can be done every 60 days, whereas IVF can be performed weekly. IVF also uses less semen than conventional ET. Embryo transfer can use two to three straws and IVF can use one straw for oocytes from up to eight different donors, depending on the number of oocytes. Quality sexed semen tends to do well with IVF. The potential to produce more calves per donor per year is the reason that most breeders choose IVF.

Conventional semen can be sorted after it is frozen. This process takes the conventional semen and runs it through the same machine used for fresh semen being sexed. The sorting of the semen is done before fertilization to increase the chances of having one gender over another. Unaltered conventional semen is recommended for the highest development rate of the oocytes.

IVF works well with donors that are prone to overstimulation, or those who produce a high percentage of unfertilized eggs with embryo transfer. Donors who do not stimulate or ovulate very few eggs during ET will not necessarily do better with IVF.

Embryos that are created in the lab are not as hearty as embryos collected through superovulation. The best environment for an embryo is the cow's uterus. Lower pregnancy rates can be expected with IVF as compared to superovulation.

Definitions

Cervix
The neck of the uterus that is a thick walled organ forming a connection between the vagina and uterus that is designed to protect the uterus from the external environment

Corpus luteum (CL)
Gland referred to as yellow body that grows at the site of the collapsed follicle on the ovary and produces progesterone

Egg (Oocyte)
Female reproductive cell produced in the ovary

Embryo
Calf in early development stage in the uterus

Epididymis
Compact, flat, elongated structure closely attached to one side of the testicle that is divided into the head, body and tail, that serves as an outlet for all the sperm produced in the testes to the vas deferens

Estrogen
Female sex hormone causing changes in the body these are recognized as signs of heat

Estrus
Portion of the female estrous cycle called heat, when cows are fertile and normally lasts approximately 18 hours

Estrous cycle
Cycle that is regulated by reproductive hormones. Continually occurs after puberty when the animal is not pregnant; the cycle averages 21 days and starts over after each ovulation

Follicle
Fluid filled, blister like structures that contain developing oocytes or eggs

Gestation
The process of carrying young in the uterus

Hormones
Chemicals released that circulate the body to bring about changes that affect organs

Luteinizing hormone (LH)
Chemical substance produced by the pituitary gland that causes the follicle to undergo changes which lead to egg release

Ovaries
Primary organs in a cow's reproductive tract that produce tiny eggs and hormones. Passageway between ovary and uterine horn

Oviducts
Passage from the ovaries to the uterus, where the egg is fertilized by the sperm

Penis
External male organ that enters the cow to deposit semen during insemination

Progesterone
Hormone released by the CL that stops follicle and egg development

Semen
A combination of sperm and fluids from the accessory sex glands

Sperm
Male reproductive cell produced in the testes

Testicle (testes)
Male sex gland located outside the body cavity, in the scrotum, that produces sperm

Urethra
Canal that runs through the penis allowing passage of semen and urine in males

Uterus
Organ that protects the embryo as it develops and grows into a calf

Vagina
Passageway that connects the vulva with the cervix in females and the birth canal at calving

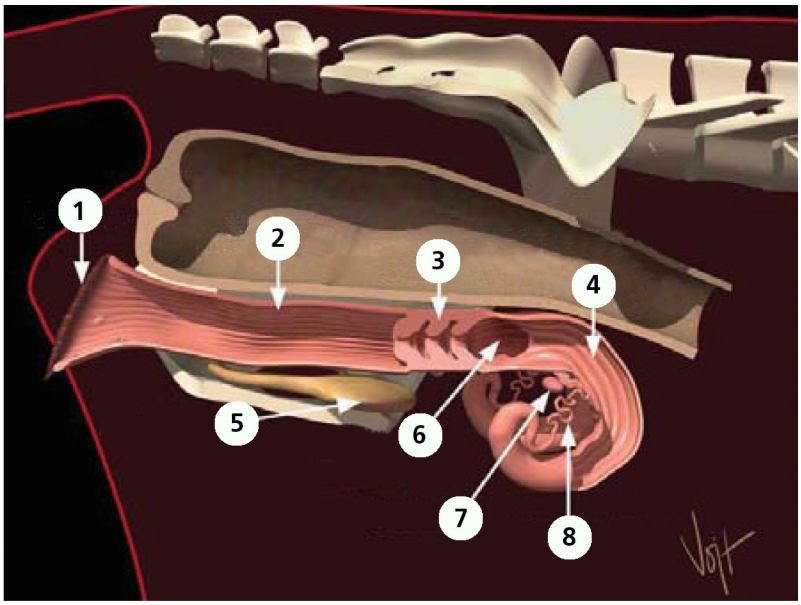
Vas deferens
Tube that lead from each epididymis through the body wall that unite with the urethra

Voluntary waiting period (VWP)
Period of time after calving during which we do not breed cows even if they show heat

Vulva
The external opening of the female reproductive tract which appear as two lips separated by a slit beneath the tail

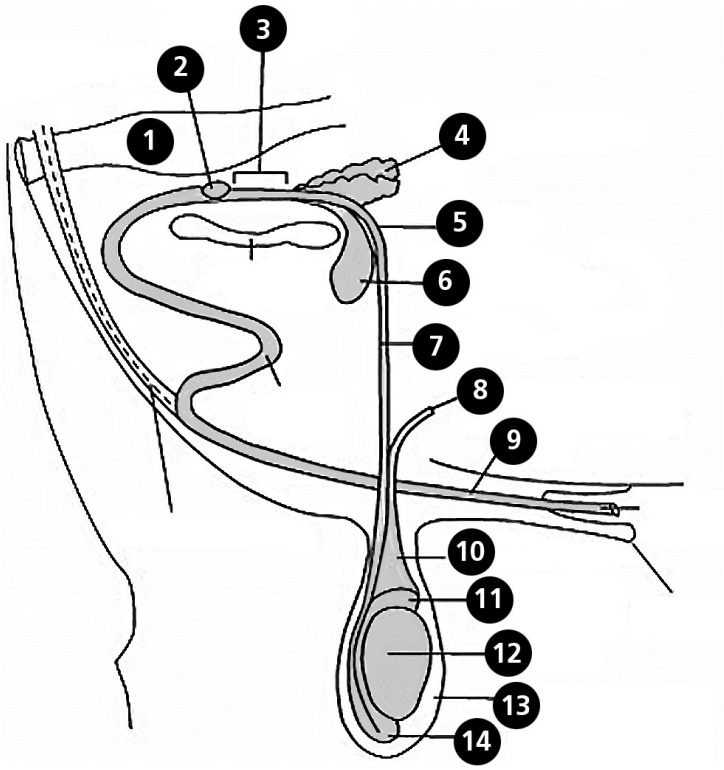
Activities

A. Label the reproductive tract of a cow.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

B. Label the reproductive tract of a bull.



Drawing of the reproductive tract of the bull (from Nebraska Guide G80-536)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

C. Match the Hormones

Estrogen	1. Prepares the uterus for pregnancy and prevents the cow from returning to estrus. It also regulates the release of FSH and LH.
Follicle Stimulating Hormone	2. Supports progesterone production by the corpus luteum and stimulates estrogen production in large follicles.
Gonadotropin Releasing Hormone	3. Stimulates the growth of small follicles.
Luteinizing Hormone	4. Makes the uterus more sensitive to stimulation and is responsible for all visible signs of heat.
Progesterone	5. Destroys the CL so no more progesterone is released.
Prostaglandin	6. Naturally produced in a cow that causes the release of LH.

D. Match the Definitions

Gestation	1. Female reproductive cell produced in the ovary.
Semen	2. Period of time after calving during which we don't breed cows even when they exhibit heat.
Hormones	3. Fluid filled, blister like structure that contain developing eggs.
Egg or oocyte	4. Canal that runs through the penis allowing passage of urine and semen in bulls.
Estrus	5. The process of carrying young in the uterus.
Voluntary waiting period (VWP)	6. Chemicals released that circulate the body to bring about changes that affect organs.
Follicle	7. Portion of the female estrous cycle known as heat.
Uretha	8. A combination of sperm and fluid from the accessory sex glands.

E. Scenario 1

One of your top producing cows does not appear to be coming into heat. How can you fix this problem?

F. Scenario 2

Your cow is not getting pregnant through AI despite two times a day daily heat detection at 30 minute intervals. The sire you want to use is expensive and you cannot afford to keep breeding the cow if she is not going to become pregnant. What is the best option you would consider for getting offspring from this cow and why?

G. Scenario 3

A group of your cows have been synchronized together. They will start coming into heat soon. To ensure you see every cow in heat, what heat detection aid would you use and why? What makes this option stand out?

References

"Back to the Basics: Explaining the Estrous Cycle." *Fertility*. Dairy Cattle Reproduction Council, n.d. Web. July 2012.<http://www.dcrcouncil.org/media/Public/Back%20to% 20the%20Basics_Explaining%20the%20Estrous%20Cycle.pdf>.

Black, Randi, et al. "Effect of Heat Stress on Reproduction." *Heat Stress*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy/extension/ reproduction/performance/heatstress/effectofheatstress>.

"Dealing with Heat Stress' Effect on Reproduction." *Heat Stress*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy/extension/ reproduction/performance/heatstress/dealingwithheatstress>.

Brown, Herb. "Donor Programming Schedule." Green River Embryo Transfer Service Print.

Coffeen, Peggy. "Blood Pregnancy Testing Offers Cattle Producers Benefits." *Livestock News*. AGRI-VIEW, n.d. Web. July 2012. <http://www.agriview.com/news/livestock /blood-pregnancy-testing-offers-cattle-producers-benefits/article_d41d9df4-8a2c-11e1-b73a-001a4bcf887a.html>.

"Cooling Strategies During Heat Stress." *Dairy Cattle Reproduction*. extension, 25 May 2012. Web. July 2012. <http://www.extension.org/pages/63354/cooling-strategies-during-heat-stress>.

"The Economics of Sexed Semen in Dairy Heifers and Cows." *Dairy Cattle Reproduction*. extension, 17 Aug. 2010. Web. July 2012. <http://www.extension.org/ pages/25983/the-economics-of-sexed-semen-in-dairy-heifers-and-cows>.

"Effect of Dairy Breed on Body Weight at Various Stages of Development and Overall Desirable Growth Rate of Heifers." *Dairy Essentials*. Babcock Institute for International Dairy Research and Development, n.d. Web. July 2012. <http://babcock.wisc.edu/node/258>.

Fredricks, Gary. "A Combination of Science and Skill: Artificial Insemination." *Hoard's Dairyman* June 2012: 430-30. Print.

Graves, W. M. "Heat Detection Strategies for Dairy Cattle." Dairy. University of Georgia Cooperative Extension, May 2012. Web. 28 June 2012. <http://www.caes.uga.edu/Publications/pubDetail.cfm?pk_id=6304>.

Heersche, George, Jr. "Diagnose Freemartins Early." *Reproductive Management*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Diagnose_Freemartins_Early.pdf>.

"Good Footing Improves Estrous Detection." *Reproductive Management*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Good_Footing_Improves_Estrous_Detection.pdf>.

"Higher Production and Twinning." *Reproductive Management.* U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Higher_Production_and_Twinning.pdf>.

"Improved Ovsynch Protocol." *Synchronization Protocols in Milking Cows*. U of Kentucky Dairy Extension, n.d. Web. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Improved_Ovsynch_Protocol.pdf>.

"My Three Favorite Synchronization Protocols." *Synchronization Protocols for Milking Cows*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairyfiles/extension/reproduction/My_Three_Favorite_Synchronization_Protocols.pdf>.

"Proper Timing of Insemination is Important." *Reproductive Management*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Proper_Timing_of_Insemination_is_Important.pdf>.

"Semen Storage." *Reproductive Management*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Semen_Storage.pdf>.

"Use an A.I. Sire as the Cleanup Bull." *Natural Service versus AI*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/Use_an_AI_Sire_as_the_Cleanup_Bull.pdf>.

"Improving Artificial Insemination Techniques." *Dairy Cattle Reproduction*. extension, 17 Aug. 2010. Web. July 2012. <http://www.extension.org/pages/25368/improving-artificial-insemination-techniques>.

References *continued*

In Vitro Fertilization. Trans Ova Genetics, n.d. Web. July 2012. <http://www.transova.com/Articles/IVF/IVF_powerful_tool.pdf>.

In Vitro Fertilization. Trans Ova Genetics, n.d. Web. July 2012. <http://www.transova.com/Articles/IVF/ETvsIVF.pdf>.

"It's Sire Summary Time...Zero in on the Information You Really Need." *Dairy Cattle Reproduction*. extension, 10 May 2010. Web. July 2012.<http://www.extension.org/ pages/11782/its-sire-summary-timezero-in-on-the-information-you-really-need>.

Larson, Jamie E. "Embryo Transfer in the Dairy Herd." *Dairy Cattle in Mississippi*. Mississippi State University Extension Service, July 2011. Web. July 2012. <http://msucares.com/pubs/publications/p2682.pdf>.

Mackinson, Rayme, et al. "Automated Heat Detection May Change the Way You Breed Cows." *Reproductive Management*. U of Kentucky Dairy Extension, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy/extension/reproduction/management/automatedheatdetection>.

Norman, H. D., et al. "Genetic and Environmental Factors that Affect Gestation Length in Dairy Cattle.» *Journal of Dairy Science* 92 (2009): 2259-69. PDF file.

Prange, R. W., and R. T. Duby. "Anatomy of the Cow's Reproductive Tract." *Cattle*. West Virginia University Extension Service, n.d. Web. July 2012. <http://www.wvu.edu/~agexten/forglvst/Dairy/dirm1.pdf>.

"Semen Tank Record Sheet." *Mississippi Beef Cattle Production*. Mississippi State University Extension Service, n.d. Web. July 2012. <http://msucares.com/livestock/beef/semenrecord.pdf>.

Sorensen, A. M., Jr., and J. R. Beverly. "Determining Pregnancy in Cattle." *Southern Regional Beef Cow/Calf Handbook*. Texas AgriLife Extension Service, n.d. Web. July 2012. <http://www.ca.uky.edu/agc/pubs/asc/asc61/asc61.htm>.

"Temperature Humdity Index Chart." *Hoard's Dairyman*. Hoard's Dairyman, n.d. Web. July 2012. <http://www2.ca.uky.edu/afsdairy-files/extension/reproduction/temphumidityindex.pdf>.

The Virtual Dairy Cattle Encyclopedia Reproduction. Michigan State University, n.d. Web. July 2012. <https://angel.msu.edu/section/default.asp?id=GROUP-050706-182227-DAK>.

University of Missouri Extension. "Reproductive Anatomy and Physiology of the Bull."

Wattiaux, Michel A. "Heifer Raising - Weaning to Calving 34) Growth Rate." *Dairy Essentials Chapter 34*. Babcock Institute for International Dairy Research and Development, n.d. Web. July 2012. <http://babcock.wisc.edu/node/258>.

Activities Answer Key

COW REPRODUCTION TRACT

1. Vulva
2. Vagina
3. Cervix
4. Uterine Horn
5. Bladder
6. Uterine Body
7. Ovary
8. Oviduct

BULL REPRODUCTION TRACT

1. Rectum
2. Cowper's gland
3. Prostate gland
4. Seminal vesicle
5. Ampulla
6. Urinary bladder
7. Vas deferens
8. Spermatic blood vessels and nerves
9. Penis
10. Spermatic cord
11. Head of epididymis
12. Testicle
13. Scrotum
14. Tail of epididymis

HORMONES

1. Progesterone
2. Luteinizing Hormone
3. Follicle Stimulating Hormone
4. Estrogen
5. Prostaglandin
6. Gonadotropin Releasing Hormone

DEFINITIONS

1. Egg or oocyte
2. Voluntary waiting period (VWP)
3. Follice
4. Urethra
5. Gestation
6. Hormones
7. Estrus
8. Semen

SCENARIO 1

- Have a veterinarian perform an ultrasound to help determine if she has any problems within her reproductive tract.
- Consult a nutritionist.
- Check the Temperature Humidity Index, she may be heat stressed. Make sure she is in a cool place with free access to food and water.
- A synchronization protocol can be used to bring the cow into heat. If she does not show a heat you can still breed her with a timed AI method.
- Use heat detection aids. Also observing her more can lead to seeing her in standing heat.

SCENARIO 2

Depending on your personal breeding goals and budget and the value of the cow, here are a few options:

- Timed AI/Synchronization
- Embryo transfer
- In Vitro Fertilization
- Put with a bull for natural service
- Cull

SCENARIO 3

- Observation - Seeing the cow in standing heat is the best indication that a cow really is in heat and ready to breed in a few hours.

- Beacon - The beacon is only activated by pressure. If the cows are mounting each other the color will change, pressure from four to five seconds of mounting will activate the beacon. Other actions the cow may do will not, typically, trigger the beacon to change color.

- Chalk/Crayon/Paint - This method is something is inexpensive. With this method the chalk, crayon or paint is rubbed off often indicating the cow is in heat. Extra observation will need to be in place to determine if the cow actually is in heat.

- Accelerometer/Pedometer - The technology can be reliable and accurate. If the cow is in heat she will most likely show a higher level of activity than her baseline, which is established by the computer.

HOLSTEIN FOUNDATION
Est. 1969
"Developing Future Leaders for a Vibrant Dairy Community"

Holstein Foundation Workbook Contribution Form

Our series of Holstein Foundation workbooks are provided free of charge as an educational resource for dairy youth and adults around the world. The development of these workbooks is supported by contributions from generous individuals who believe in the Holstein Foundation's mission of promoting and supporting programs that provide leadership for the dairy industry. If you would like to make a gift to help ensure we can continue providing these resources, please complete this form and return it to the address below. Donations may also be made with a credit card online at www.holsteinfoundation.org.

Full name, as you would like to be recognized for your gift:

_____

Address _____

City _____ State _____ Zip Code _____

Preferred Phone Number _____ ☐ Home ☐ Mobile ☐ Office

Preferred Email Address _____

☐ I would like to receive the Holstein Foundation E-Newsletter

I would like to make a one-time / monthly (circle one) donation to the Holstein Foundation, in the amount of $_____ for a period of _____ months.

☐ This gift is a memorial gift in memory of _____.

Instructions _____

A note will be sent to the family of the above individual, notifying them of your gift.

Checks should be made payable to "Holstein Foundation" and sent to the address below.

Thank you for your contribution to the Holstein Foundation, and your support of young people in the dairy industry. Your gift makes the programs of the Foundation and our mission of developing dairy leaders for tomorrow a reality.

Please mail this form along with your contribution to:
Holstein Foundation
PO Box 816
Brattleboro, VT 05302-0816

With questions, contact Jodi Hoynoski at 800.952.5200, ext. 4261 or jhoynoski@holstein.com.