Dairy Facts from Hoard’s Dairyman 4-H Dairy Quiz Bowl

Topics: General, Youth, Genetics, Breeds, Behavior, Health, Management, Feeds and Nutrition, Reproduction, Hormones, Milking, Marketing and Dairy Products

General

Hoard’s Dairyman website address is http://www.hoards.com.

The annual index of dairy subjects is found in the December issue of Hoard’s Dairyman. Hoard’s Dairyman is published in Fort Atkinson, Wisconsin.

A favorite cartoon in Hoard’s Dairyman is “Ed and Emma”.

Elsie is the Borden Company’s famous cow.


The World Dairy Expo is held at Madison, Wisconsin the first week of October each year. The Junior Holstein Show is on Tuesday. The Holstein heifer open show is on Friday. The Holstein cow open show on Saturday.

The National Dairy Cattle Congress was held at Waterloo for over 50 years. The show began to decline in 1965 when breed organizations withdrew their support. Eventually, the shows at the World Dairy Expo completely overshadowed the Congress.

The Klussendorf trophy is awarded to the top showman at the World Dairy Expo.

The Royal Highland Show is held in Scotland. The All American Jersey Show is held in Louisville, Kentucky.

The People for the Ethical Treatment of Animals (PETA) are generally against the keeping of animals for food production purposes. Other big names in the animal rights movement include: Humane Society of the United States (HSUS), American Society for the Prevention of Cruelty to Animals (ASPCA), Farm Sanctuary, Mercy for Animals (MFA), and In Defense of Animals and Compassion over Killing. The Animal Agriculture Alliance is the largest and oldest national coalition speaking on behalf of animal agriculture.

In 2004, Hispanics were employed on 13 to 14% of U.S. Dairies.

June as dairy month was started in 1937. Demand for dairy products is lowest in the summer months. The winner of the Indy 500 drinks a glass of milk.
Youth

4-H celebrated its 100th birthday in 2002. The term 4-H Club was used not until 1918.

The 50th National 4-H Dairy Conference was held in Madison, Wisconsin in conjunction with the World Dairy Expo in 2004. The first National 4-H Dairy Conference was held in Chicago.

The North American Intercollegiate Dairy Challenge began in 2002. The event challenges collegiate teams to analyze a dairy and develop management recommendations.

Genetics and Conformation

Each bull is AI is assigned an NAAB code. An example is 29HO9558. The first numbers refer to the AI stud that the bull belongs to. The NAAB codes for various AI studs are: Genex/CRI, 1; Select Sires, 7; Alta Genetics, 11; Accelerated Genetics, 14; and ABS Global, 29. The two letters refer to the breed of the bull. “HO” refers to Holstein; “JE”, Jersey; “BS”, Brown Swiss; “AY”, Ayrshire; “GU”, Guernsey; “MS”, Milking Shorthorn; and “WW”, Red and White. The last digits indicate the bull’s number within the stud.

Sire Conception Rate (SCR) is a measure of the probability that a straw of the bull’s semen will produce a pregnancy compared to straws of semen from other bulls.

Bull fertility increases from 2 to 5 years of age and then declines gradually as bulls get older.

Daughter Pregnancy Rate (DPR) genetic evaluations were published for the first time in February 2003. DPR is calculated from the average days open of a bull’s daughters. Cows calving in September have the fewest days open.

The initials TPI stand for total performance index. The reliability (Rel) of a bull’s genetic evaluation is a measure of its accuracy.

Every five years the genetic base is changed so that the average PTAs of cows born five years previous is “0” for each of the traits. There was a base change in February 2005, with the average genetic evaluation of cows born in 2000 set to zero. At the January 2010 base change, the average genetic evaluations of cows born in 2005 was set to zero. After the December 2014 base change, the average genetic evaluations of cows born in 2010 was set to zero.

Countries with the most registered Holsteins ranked from 1st to 7th: Germany, Italy, The Netherlands, Canada, France, Denmark, and the U.S.

Starstruck J-Paradox2-Red-ETN was the first cloned dairy bull commercially marketed in the U.S. He is a Red & White Holstein.

GMO stands for genetically modified organisms.

In 1999, only two Holsteins in the U.S. were classified EX96. In 1999, 1.4% of Holsteins classified were classified in the excellent category.

The USDA ran genetic evaluations four times per year up until 2007 at which time number of runs was reduced to three times per year. Progeny tested bulls with the highest net merit $ for November
sire summaries from 2000 to 2006 and August summaries from 2006 to 2012 and December summaries after 2012 for three breeds in the last few years are:

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<th>Year</th>
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In March 2013, the U.S. genetic evaluations transitioned from the USDA to the Council on Dairy Cattle Breeding (CDCB). The CDCB has membership from NAAB, DHIA, breed associations, and dairy record processing centers. The CDCB funds the evaluation system through fees on genomic tests.

On average, a calf receives one half its genes from each parent, one-fourth from each grandparent, and one-eighth from each great-grandparent. A transgenic animal has a gene from another animal or species incorporated into its genome through genetic engineering.

Genomic testing is the genetics test that analyzes DNA in tissue samples and determines genetic potential. Because more data is available, genomic testing results in the most reliability gain for Holsteins. A haplotype is a segment of DNA that is inherited intact from parent to offspring. Haplotypes in each sperm or egg from an individual can be different because of crossovers between the paired chromosomes during gamete formation. The average rate of crossovers is one per chromosome pair in cattle.

Relative to genomics, SNP stands for Single Nucleotide Polymorphisms. With genomics, a young sire without a progeny test had a reliability for PTA milk of about 70% in 2009.

The first livestock to be genetic sequenced was a Hereford in 2004. The first Canadian bull to have his 3 billion DNA molecules sequenced was Braedale Goldwyn. Cows have about 22,000 genes and share about 80% of their genes with humans.

The Estimated Relative Conception Rate (ERCR) ranks bulls for the fertility of their sperm.

The average inbreeding levels have been increasing for the dairy breeds. The average Holstein born in 2009 has an inbreeding coefficient of 5.5%, Brown Swiss were inbred by 6.5% and Jerseys by 7.1% relative to the base year of 1960 when inbreeding was set to zero. EFI stands for expected future inbreeding levels of a sire’s offspring. A 2014 paper by Wisconsin researchers showed that for each 1% increase in inbreeding, daily milk yield decreased by .5 lbs., days open increased by 1 day, and there was an increase in calving difficulty.
The paternal line of all current (2015) Holstein A.I. sires can be traced back to three bulls that were born in the 1960s. Those three bulls were Round Oak Rag Apple Elevation, Pawnee Farm Arlina Chief, and Penstate Invahoe Star. All bull calves inherit the Y chromosome from their fathers. The Y chromosome in all AI bulls today are the same as the three bulls above.

The percent of hybrid vigor or heterosis maintained by crossbreeding varies by number of breeds in the rotational crossbreeding system. The first generation of crossing results in 100% of the maximum heterosis. Long-term maximum level of heterosis is 67% for 2-breed rotational crosses, 86% for 3-breed, and 93% for 4-breed.

**Breed facts:** For cows on DHI test 2014, 85% were Holsteins, 8.3% Jerseys, 4.5% crossbreds and 1% other.

**Ayrshire:**
- Top Ayrshire Milk Record: Mini-Ayr Charlene C, at 8 years 7 months, produced 69,460 milk, 2,538 fat and 2,189 protein in 365 days. She is also the lifetime Ayrshire producer completing 420,309 milk, 16,358 fat and 13,462 protein in 2002.

**Brown Swiss:**
- The Brown Swiss cow is referred to as “The big brown cow”.
- Brown Swiss are 2nd in pounds of milk production.
- The Brown Swiss and Milking Shorthorn Associations decided to share a national executive secretary in 2002. Jerseys recorded the second largest number of registrations.
- Wisconsin has the most Brown Swiss.
- The first Brown Swiss was imported into the U.S. in 1869.
- 2008 new record: Lost Elm Prelude Pixy – 58,825 milk, 3,286 fat and 1,889 protein.
- Top lifetime milk production was IE Fabs Maple Sugar – 342,240 lb milk, 13,316 fat and 9,972 protein completed in 1995.
- Top lifetime in 2014 was Paris: 431,001 lbs. milk, 18,525 fat lbs.and 14,444 lbs. protein (incomplete). Her combined fat and protein is top over all breeds.

**Guernsey:**
- Top Classified Guernsey: For four consecutive years beginning in 1993, Westlynn Tom Dee, EX-96, was named Grand Champion of the Guernsey show at the World Dairy Expo.
- The first registered Guernsey was imported into the U.S. in 1830.
- Top lifetime milk producer was Lindenhof Agri Beatrice – 250,351 milk, 10,496 fat and 8,402 protein completed in 2001.

**Holstein:**
- Holsteins record the greatest number of registrations; Jerseys are 2nd, Brown Swiss are 3rd.
- In 2005, about 30% of Holstein registrations were animals with less than 100% U.S. Holstein ancestry.
- Holsteins produce the most pounds of milk, fat and protein per lactation.
- Record Production Holstein Cow: In 2010 a Holstein, Ever-Green-View My 1326 - ET topped the milk and protein production records with a lactation production record of 71,170 milk, 2,787 fat, and 2,142 lb of protein in 365 days.
- The top cow for lifetime milk production in the U.S. was a Holstein named Koepke K0017229-1660 with 458,616 lb of milk completed in 2005. In 2012, her record was
eclipsed by the Canadian Holstein, Gillete E Smurf, who produced 480,690 lb of milk by March 2012 and was still producing.
- In 2011, Jenny-Lou Mrshl Toy Story set a new record for semen sales at 1.767 million units. He was only ten years old at the time and still producing.

**Jersey:**
- Jerseys have seen the greatest increase in registrations over the last ten years.
- California had the most Jersey registrations in 2001.
- Jerseys and Guernseys are known as the Channel Island breeds.
- The top Jersey for lifetime production was Maplerow Mercury Aron-PTL-P – 301,154 lb milk completed in 1998.
- In 2009, Duncan Hibrite of Family Hill became the lifetime production winner with 340,056 lb of milk.

**Milking Shorthorn:**
- The Milking Shorthorn breed has the fewest registrations of the seven recognized U.S. breeds.
- The Milking Shorthorn produces the lowest pounds of milk per lactation.
- The top Milking Shorthorn for lifetime milk production was Idalee Garnet Topsy - 318,330 lb of milk completed in 2003.

**Red and White:**
- The Red and White Dairy Cattle Association is headquartered in Wisconsin.

The Net Merit index was updated in December 2014. Traits in the Net Merit Index 2015 and their relative weights are: milk, -1%; fat, 22%; protein, 20%; productive life, 19%; SCS, -7%; udder composite, 8%; feet and legs, 3%; body size, -5%; Fertility 10% (Fertility includes DPR 7%, cow conception rate 1% and heifer conception rate 2%); and calving ability composite (CA$), 5%. The CA$ includes service sire calving ease (SCE), daughter calving ease (DCE), service sire stillbirths (SSB), and daughter stillbirth (DSB). PL is a measure of how many months a cow produces milk until she dies. Rankings of the three most common breeds in the U.S. for PL in shows that Jerseys have the longest PL.

In 2006, the average stillbirth rate in Holsteins was 12% for first lactation heifers and 5% for older cows.

The Holstein Association changed their classification scorecard in 2005 to Udder, 40 points; Front end/capacity, 20; dairy strength, 20; feet and legs, 15; and rump, 5 points.

Heritability is a proportion of differences between individuals that is due to genetics. Stature has the highest heritability of any of the type traits. Health traits usually have heritabilities around 10%. The heritability of testing positive for leukosis is 8% according to a 2012 study of 14,000 milk samples which found that 38% of the cows were infected with the leukosis virus.

From 1995 to 1998 the average number of bulls progeny tested per year by major AI organizations in the U.S. was: Ayrshires, 11; Brown Swiss, 24; Guernseys, 21; Holsteins, 1261; Jerseys, 112; and Milking Shorthorn, 3. Approximately 80% of Holstein AI young sires are from ET. The top five states for progeny test daughters are California, Wisconsin, New York, Pennsylvania, and Minnesota. Minnesota ranks 1st for use of Milking Shorthorn progeny test sires.
Complex vertebral malformation (CVM) is a genetic recessive in Holsteins that causes stillbirths, abnormal curvature of the spine, short neck, malformed legs and embryonic death. Bulls shown to be carriers of CVM are designated with the genetic code “CV.” Daughters of “CV” bulls have a 50% chance of being carriers of the CVM gene.

Three “new” dairy breeds from Europe are being used for crossbreeding in the U.S. The Normande and Montbeliarde breeds are from France. The Scandinavian Red breed is from Norway and Sweden.

VRC is a new red coat color code to code for the dominant red gene – Champions Mutant. It originated in a red and white Canadian Holstein – Surinam Sheik Rosabel.

Brachyspina is a genetic recessive condition in Holsteins. In 2011, it was estimated that 6% of Holsteins were carriers (had one copy) with animals tracing back to Sweet-Haven Tradition. Homozygous recessive embryos are usually lost in early gestation but a few go full term resulting in undersized stillborn calves.

**Behavior**
Cows evolved as creatures of prey and escaping from predators. Adverse cow handling will decrease production about 10%. A cow’s time budget: 3 – 5 hours eating and drinking, 7 to 10 hours ruminating, 12 to 14 hours resting, and three hours left for milking, health checks, etc.

Cows are social herd animals and may become stressed when separated from the herd. A sorted cow may be less stressed if she can maintain visual contact with the rest of the herd. Cows have a field of vision of 300 degrees.

Cows have dichromatic vision. They see limited colors and do not like clashing colors. Light and dark areas of buildings can really bother cows. Cows can see well into the distance but have a difficulty focusing quickly on nearby objects. Cows will “spook” with sudden nearby movements. They have poor depth perception. Cattle have a tendency to want to move from dim lit areas to brighter areas.

A range of 30 to 75 degrees is fairly comfortable for most cattle.

A cow’s flight zone is a cow’s personal space around her. If a cow’s flight zone is entered unwelcomed, she will flee. A tame cow has a smaller flight zone.

Cows can be dangerous. Twenty percent of farm injuries involve farm animals.

**Health**
The ideal outdoor temperature for young calves is about 68° F. Cold stress starts at temperatures below 60° F for calves less than 3 weeks of age. Calves need twice the amount of milk solids when the temperature hits 0° F. In most situations, deep straw is the best bedding for calves. For a newborn calf, hypothermia occurs when body temperature goes below 98.6 degrees Fahrenheit.

Calves may show signs of bloat in the abomasums at 5 to 21 days of age. Bloat is caused when there is a large amount of fermentable carbohydrates present in the abomasums from milk, milk replacer, or high energy electrolyte solution. Risk factors for bloat in calves include feeding too much milk replacer or electrolyte solution without enough water, feeding too much milk in a single daily feeding, feeding cold milk, not offering enough water, erratic feeding schedules, and failure of passive immunity from colostrums.
A seven percent tincture of iodine is the most often recommended antiseptic for use on the navel stump of newborn calves. However, a July 2007 ruling by the Department of Justice to prevent its use for methamphetamine makes it more difficult to obtain. A chlorhexidine solution is suggested as an alternative.

Diarrhea is the biggest health problem in young calves. To help prevent scours in calves, dry cows should be vaccinated against rotavirus, coronavirus and an E. coli toxoid. E. coli is the most common cause of scours in young calves. Diarrhea causes dehydration. Assessing hydration status is most accurately done by looking at the calf’s eyeballs or the skin tent test. Dehydrated calves’ eyes are sunken back into their heads. When you roll the bottom eyelid back with your thumb, you will notice a gap between the eyelid and the eyeball. If the gap is greater than 0.2 inch, dehydration is more than 8%. Similarly, if the skin on the side of the neck takes more than 6 seconds to return to normal after it is pinched and rotated 90 degrees, the calf is in need of intravenous fluids.

Antibiotics should be given to a scouring calf if its temperature is >103° or <100° F, it has a poor appetite, stands with an arched back, or has more than a streak of blood in the feces, pneumonia, infected navel or swollen joints.

Diseases that can be transmitted between animals and humans are known as zoonotic diseases. The majority of over 1400 human diseases have originated from animals.

Technically, a true breech presentation is when the tail of the calf is presented first while a posterior presentation is when the hind legs come first. In a practical sense however, most dairy personnel refer to all births where the calf comes backward as breech.

According to Iowa State Researchers, calves born in the winter are 36% more likely to be dead within 48 hours after birth than those born in the summer. Perinatal calf mortality is more commonly referred to as stillbirth. Enteritis is a calfhood disease more commonly known as scours. Milk should be fed, along with electrolytes, to a scouring calf.

Historically, pink-eye has been caused by Moraxella bovis. According to a Hoards 2014 article, Moraxella bovoculi is a newly discovered organism that causes Pink-eye. 40% of Moraxella bovoculi are not sensitive to tetracycline. Pink-eye vaccines need to protect against both organisms.

Seventy-five percent of cow disease occurs within 1 month of calving.

An accumulation of interstitial fluid in the extravascular spaces of the udder at around the time of calving is called udder edema. Excessive swelling can restrict blood circulation and make fresh heifers more susceptible to frostbite during winter months.

The term “downer” is used to describe cattle that are too weak, injured or sick to stand and walk. The most common cause of downer cows is milk fever. Milk fever is low blood calcium caused by the increased demand for calcium on the colostrum or milk as the cow initiates lactation. In addition to obtaining calcium from her diet, a just fresh cow must draw calcium stored in her bones. The two most common ways of administering calcium to cows to prevent or treat milk fever are intravenous injection and oral administration (paste, gel or drench).

Another metabolic cause is low blood magnesium levels or grass tetany. Calving paralysis can occur immediately following the delivery of a large calf that damages the nerves to the rear legs as it passes through the pelvic canal. Cattle can also develop cancer in their spinal column associated with bovine leucosis virus infection.
Tuberculosis (TB) is caused by the bacterium Mycobacterium bovis. The U.S. initiated the bovine TB eradication program in 1917 at which time 5% of cattle were infected. Today, incidence of the disease is about 0.0002 percent but has been difficult to eradicate completely because of the presence of TB in white-tailed deer. The tuberculin test is used to diagnose bovine tuberculosis in live animals.

Modified live and killed BVD vaccines are available for cows. Killed vaccines are safer and will not cause abortions but may require additional doses to give good immunity. BVD stands for Bovine Viral Diarrhea. BVDV stands for Bovine Viral Diarrhea Virus. There are two types of BVDV infection – acute and persistent. In acute infections, the cow usually recovers in 2 weeks. The most common source of BVDV infections is a persistently infected (PI) animal. PIs are the result of fetuses becoming infected from 18 to 125 days of age. The PIs immune system does not recognize BVDV as foreign and allows the virus to multiply unchecked throughout the animal’s life.

The bovine leucosis virus (BLV) can cause cancer that affects lymphoid tissue and can cause tumors in the other bodily organs. It is estimated that 5% of cows that carry the virus may go on to develop cancer. The virus is spread between cattle by direct exposure to infected blood, semen, saliva, or colostrum or milk. In 2013, it was estimated that 75% of dairy farms have greater than 25% of cows infected. BLV positive cows are more likely to be culled prematurely from the herd than BLV negative cows. According to a Hoards 2014 article, 40% of U.S. cows are infected and 89% of herds have at least one cow with the virus.

Vaccines give cattle active immunity. Colostrum gives calves passive immunity.

The term vaccine is derived from the Latin word, vaca, which means cow. There are two types of immunity, active and passive.

Brucellosis is sometimes called contagious abortion or Bang’s disease. For the milk Brucellosis ring test, a suspension of stained, killed Brucella organisms is added to a milk sample. If the milk sample is from a Brucellosis infected cow, a bluish ring forms at the cream line.

If cows are treated with antibiotics, dairy producers must follow drug-withholding times for milk disposal. The most common cause of bulk tank milk antibiotic contamination is mistakenly saving milk from a treated cow. Dairy producers must maintain a record of antibiotic extra-label use for a period of two years.

Copper sulfate, formalin or zinc sulfate are common chemicals added to water for footbaths.

Heel flies lay their eggs above the heel on cattle. Eggs hatch and larvae (known as grubs) migrate through the animal’s body to the back where they pupate and emerge in the spring. Cattle should not be treated with insecticides to kill the grubs in the winter because cattle may have an adverse reaction to dead grubs in their bodies.

If colostrum is thawed rapidly, in a microwave, many of the antibodies will be destroyed. Another name for antibodies is immunoglobins. Pasteurization of colostrums to prevent transmission of disease, especially Johnes, has become common practice. It is recommended to heat colostrums to 140°F for 30 to 60 minutes.

Too much potassium in the close-up cow ration may result in increased ketosis and other metabolic problems – especially milk fever.
Ketosis results when insulin and blood glucose levels drop too low. Ketosis usually occurs 3 to 4 weeks after calving. It can be treated by giving 500 to 1000 cc of glucose intravenously or drenching cows with 7 to 10 ounces of propylene glycol. The most accurate way to diagnose ketosis is to measure the ketone levels in the blood.

When putting on weight, the first place a cow deposits fat is around the internal organs. Fatty liver is an accumulation of triacylglycerol in the liver. The addition of rumen protected choline to the diet helps reduce fat in the liver.

Milk synthesis requires large amounts of glucose. The liver converts fatty acids, amino acids, and the glycerol component of tri-glycerides into glucose. If the liver is unable to turn excess fatty acids into glucose, ketone bodies in the bloodstream become elevated – known as hyperketonemia - which is an indication of ketosis.

The normal temperature range of a cow is 99 to 103 degrees F.

Hypercalcemia is an excess of calcium in the blood.

A cow tested positive for BSE (bovine spongiform encephalopathy) or mad cow disease in Alberta, Canada, in May 2003. A cow imported from Canada in 2001 was diagnosed with BSE in Washington state in December 2003. As of August 2006, there have been three cases of BSE in the U.S. and 7 in Canada.

In 2001, there was a foot and mouth disease (FMD) outbreak in England that caused billions of dollars in damage to the livestock and tourist industry. A symptom of this viral disease is blisters on the lips, in the mouth, and on the feet of cloven-hoofed animals.

According to a USDA survey in 2001, about 20% of U.S. dairy herds were infected with Johne's. Johne's is caused by the bacterium Myobacterium paratuberculosis. According to Hoard’s in 2008, 65% of dairy herds may be infected with Johne’s and it was 95% for herds over 500 cows. The Johne’s bacteria is killed by proper pasteurization. Most animals affected by Johne’s were exposed to the bacteria that causes the disease as young calves. Symptoms usually do not appear until the cow is at least 2 years of age. Clinical signs of Johne’s are chronic diarrhea, weight loss, excellent appetite up until terminal stages, and low milk production. In 2004, it was announced in Hoards Dairyman that the University of Minnesota had developed a rapid fecal test based on DNA called the PCR (polymerase chain reaction) test. In addition to the ELISA and PCR tests, fecal cultures and tissue cultures can identify the bacterium. A milk ELISA test conducted through DHIA can test for Johne’s. Producers who choose to vaccinate their herd for Johne’s must administer the vaccine subcutaneously in the brisket by 35 days of age.

Hardware disease (traumatic reticulitis) is caused by cows ingesting a sharp metal object that perforates the lining of the reticulum. Another name for the reticulum is the hardware stomach. A magnet (one) may be given to a cow to prevent hardware disease and should be placed in the reticulum. The typical treatment for hardware disease is to put a magnet in the stomach and give antibiotics for several days. A compass can be held right behind an animal’s left elbow to determine if she already has a magnet. The most common metals found in a cow’s stomach is from fencing material and wire from radial tires used to cover bunkers.

Approximately, 90% of all dairy cattle hoof lesions occur in the rear feet.
Digital dermatitis or Mortellaro Disease is more commonly known as hairy heel warts. It is characterized by a circular lesion where the skin and heel meet. An abscess in the foot is characterized as a darkened area of the sole in which a pocket of pus is usually found.

Foot rot is characterized by swelling, a foul odor, and redness between the toes. It is also known as Foul or Phlegmon (flēg’mŏn).

Laminitis is an inflammation of the sensitive tissues of the hoof.

A sole hemorrhage is a foot problem characterized by a pink, red, black, or yellow area of discoloration on the sole. It is also known as Sole Bruising.

A sole ulcer is characterized by a soft area at the sole-heel junction that is painful when pressure is applied.

White line disease is characterized by a dark discoloration and separation of the white line area between the sole and hoof wall.

Interdigital dermatitis is an infection between a cow’s toes. The skin is red and may have cracks with a gray discharge. It is also known as Stable Foot Rot or Scald. It is characterized by a raw, bright red or gray circular erosion of the skin.

According to 2006 and 2007 Hoard’s articles, an average of 25% of cows in freestall barns are lame.

A uterine prolapse is when the uterus turns inside out and protrudes from the vulva after calving. Retained placentas affect about 8% of dairy cows. There is really no good effective treatment. Just monitoring the cow’s temperature is the most recommended protocol. If a cow gets a fever, antibiotics may be prescribed.

Metritis is an infection of the uterus.

Displaced Abomasums: On average, 2% of dairy cows get DAs each year. DAs most often occur 10 to 15 days after calving. Left DAs account for 80% and right DAs for 20%. About 80% of cows diagnosed with DAs first have had ketosis. Ketosis, of course, is a disorder of energy metabolism. Roll and toggle is a method to correct DAs without open surgery.

Hemorrhagic bowel syndrome (HBS) is a new bacteria disease that causes large blood clots in the digestive tract. The disease is fatal with animals dying from a combination of blood loss, intestinal obstruction, and toxemia and shock.

Straw-itch mites are also known as harvest mites whose natural hosts are small rodents. They are usually most active after harvest, feeding on other insects in harvested straw, hay, and grain. The straw-itch mite targets the face, feet and lower limbs of cattle, causing intense itching. If the cattle can be removed from the source of the mites, they usually get over the mite infection on their own.

Ringworm is a contagious disease caused by a fungus. It appears on the skin of heifers as round, hairless sots with white or gray scabs near the head, neck and shoulders.

Pneumonia is an inflammation of the lungs. The three stages of most pneumonia cases are stress, viral infection and bacterial infection.
Mulefoot, or syndactylism, is a genetic disorder in Holsteins in which one to four feet on the animal have one toe like a horse rather than being cloven-hoofed.

When heat stressed, cows spend more time standing and if windy, they will stand with their tails to the wind 67% of the time.

**Management**

According to a 2002 USDA survey, 92% of dairy cows are identified by ear tags.

It is recommended that cow free stalls should be 48” wide. About 85% of cows in a group should be lying down if cow comfort is good (those not eating, drinking, or being milked). The average cow rests for 12 to 14 hours per day. In a tie stall barn, the manger should be 4 inches higher than the cows standing surface so that she does not knee to eat. Water should be 24 to 32 inches above her feet.

Sand bedding is known as the Gold Standard of bedding because it supports less bacteria growth than other common bedding materials, lessens mastitis, lessens lameness, and promotes higher milk production but it is more expensive than most other bedding materials. According to a 2008 Hoard’s article, herds that bedded with composted manure solids had the highest somatic cell count. Ranking bedding materials for cow comfort: 1) composted bed pack; 2) sand; 3) waterbeds; 4) rubber-filled mattresses. Sand separation lanes are long, narrow lanes that slow the flushed manure, allowing the sand to separate from the manure solids.

Cows require 100 square feet each in a bedded pack barn.

Covering floors with rubber has been shown to increase cow comfort.

For lactating dairy cows, lights should be kept on 16 hours per day to get the best milk response from long day lighting. Dry cows should be limited to 8 hours of light for maximum production in the following lactation.

Cows need 10 to 14 hours of rest each day for optimal performance.

When manure is applied to corn land to meet nitrogen needs, phosphorus is usually applied in surplus, which can lead to pollution problems. Over-application of manure can lead to water pollution. Farms need a minimum acreage available per cow to spread manure. For example, if one half acre is needed per cow, then one hundred cows would require 50 acres. The EPA enforces environmental regulations. When considering the carbon footprint of milk production, methane is the greenhouse gas occurring in largest amounts.

Cull rate is the measure of percent of cows leaving the herd. Common causes for culling cows from a herd include poor reproduction, mastitis, low production, lameness and death. About 30 to 35% of cows are culled from herds each year. Reproductive failure is the number one reason for cows involuntarily leaving a herd. According to 2013 DHI data, 30.2% of cows left for unspecified reasons and the second leading cause at 20.4 % was low production which is considered a voluntary cull.

Extra teats are removed from calves for the following reasons: looks better, extra teat may become infected, and the extra teat may interfere with milking procedures.
Signs of heat stress in cows are: open mouth breathing, excess salivation, decreased dry matter intake, and decrease conception. Cows typically experience the most heat stress in the holding area. Heat stress reduces the ability of the cow’s liver to make glucose. Increased production of the cortisol hormone occurs when a cow is stressed.

Cows are most comfortable at 50 degrees F. A heifer’s body condition score at first breeding should be around a “3”. At freshening it should be from 3.5 to 3.7.

In 2003, 42% of the cows and 36% of the dairy herds in the U.S. were on DHI test.

It is recommended the heifers be bred so that they calve no later than 24 months of age. It may cost up to $2 per day to house heifers at this age. In 2009, it cost $1649 to rear a heifer from being born to calving age.

Silo gas, otherwise known as nitrogen dioxide, is a lethal gas that has a yellowish-brown color and smells similar to laundry bleach. It is heavier than air.

More labor is required for milking than any other chore on a dairy farm. In 2010, it was estimated that only 43% of the dairy Hispanic workforce felt comfortable with the English language.

The USDA issued new rules for organic milk production in 2010. Organically raised livestock must graze on pasture for the full length of the local grazing season with a minimum of 120 days on pasture. Calves must be on pasture by 6 months of age.

The proportion or percentage of cows in stalls that are lying down (versus standing in the stalls) is defined as the Cow Comfort Index.

**Feeds and Nutrition**

Milk forms a clot… Within 10 minutes after milk or colostrum feeding, the liquid forms a clot in the abomasum due to enzymes (chymosin and pepsin) and hydrochloric acid acting on casein (milk protein) and fat in the milk. Chymosin, also known as rennin, specifically binds with casein. Clotting binds much of the casein and fat into a clump, or curd, to be digested slowly by stomach enzymes over a period of 12 to 18 hours.

The calf’s rumen is undeveloped until a couple months of age. At the time of weaning, the calf’s rumen is about the size of a basketball. Milk and grain leads to faster rumen development in the calf than adding hay to its ration. Butyrate from gain fermentation is the most important source of energy for papillae growth in the rumen. Feed costs are the biggest single cost of rearing a heifer. In fact, feed costs are the single largest annual expense on a dairy farm.

The microbial population of the rumen consists of bacteria, fungi, and protozoa. The rumen is always contracting and moving. Healthy cows have one to two rumen contractions per minute. The omasum is the approximate size and shape of a basketball in a grown cow. The small intestine is about 130 feet long. The primary digestive function of the large intestine is the absorption of water.

Selenium deficiency in calves most critically affects muscle tissue and may be called white muscle disease. Affected calves may appear weak, unable to stand (or tremble when standing) or die from heart failure.
Calves drinking softened water are at an increased risk of developing hypernatremia which is an high blood level of sodium.

Forages are generally high in fiber and include corn silage, alfalfa haylage, and straw. It is often beneficial to apply the mineral sulfur to alfalfa fields. A healthy alfalfa root should be white.

Distillers grains are a popular by-product feed from ethanol production and contains 10-12% fat, 29-30% crude protein, and 39% ADF. Other high protein by-products fed to dairy cows include soybean meal and soy hulls from the soybean milling and processing industries. Soyhulls are high in digestible fiber. Beet pulp is a by-product of sugar beet processing.

Black Nightshade (solanum dulcamera) is a common poisonous weed in the Midwest. The leaves and green berries are especially detrimental to cattle.

Relative Feed Value (RFV) is based on acid detergent fiber (ADF) and Neutral Detergent Fiber (NDF). ADF estimates digestible dry matter. NDF estimates dry matter intake. Relative Forage Quality (RFQ) uses 48-hour in vitro NDF digestibility to more accurately estimate digestible dry matter than the ADF value alone. RFQ is a more accurate measure than RFV in predicting cow performance. High quality alfalfa should be 20-30-40: 20% protein, 30% ADF, and 40% NDF.

Wisconsin produces the most corn silage each year. California produces the most alfalfa. In 2007-2009, the top three states for alfalfa production were California, South Dakota, and Idaho. South Dakota leads all states in acres of alfalfa (less tonnage per acre than California).

Corn should be harvested at 60 to 70% moisture to make silage. Four months of storage are recommended for optimum corn silage fermentation, which increases digestibility by 7% according to UW 2013 research. Highly digestible corn forages can reduce the need for corn grain in the diet. A little more than half of corn silage’s energy value comes from starch. Corn silage provides cows with two of the three things they most need in a diet. Corn silage is a good source of energy and fiber (also 70% water) but corn silage is relatively low in protein. The most common mold found in corn silage is Penicillium. Inoculants help reduce the risk of yeast and mold development when ensilaging feeds. Inoculants are most beneficial for high-moisture corn. Formation of dangerous silo gasses peak 1 to 2 days after filling.

Corn silage can be in storage up to three years before it begins to lose feeding quality. Haylage should be fed within 2 years of storage.

The dry matter is what is left over after the water is removed.

When a cow’s fat test is lower than her protein test, it may be a sign of acidosis.

Sugars, starches, pectins, hemicellulose and cellulose are all carbohydrates and utilized for energy by the cow. Carbohydrates are made up of carbon, hydrogen, and oxygen. Of the carbohydrates consumed by cows, sugar is most rapidly fermented in the rumen. Corn is highest in starch. Pectins are part of the cell wall that is quickly fermented into acetic acid. Acetate, propionate, and butyrate are the three primary volatile fatty acids (VFA’s) synthesized in the rumen. Hemicellulose, cellulose and lignin are also part of the cell walls. The VFA’s are absorbed through the rumen wall into the blood stream and utilized for energy. Hemicellulose is less digestible than sugars and starches but more digestible than cellulose. Feeding a cow a higher starch diet can improve metabolism by providing more precursors to produce glucose, a simple sugar.
Cellulose is about 30 to 40% digestible. Lignin is totally indigestible. Carbohydrates make up about 70% of the dry matter fed to dairy cows.

Fats are also known as lipids.

Feeding drought stressed forages high in nitrates reduces a cow’s blood carrying capacity for oxygen.

The average cow consumes 25 to 50 gallons of water per day. A cow’s motivation to eat rises after 3 hours without feed. Given our inability to consistently feed exactly the amount that cows will eat per day, a feed refusal rate of 3% should be the goal.

The NRC requirement for phosphorus was lowered to 0.38% of the ration. Surplus phosphorus increases the cost of the ration and may cause water pollution.

Surplus protein in the diet results in excretion of surplus nitrogen, which can harm the environment. Most of the surplus nitrogen is excreted in the urine. It is thought that 16.5 % protein in the ration is best to minimize excessive nitrogen excretion without sacrificing milk production.

Amino acids are known as the building blocks of protein. Proteins are made up of a chain of amino acids. Degradable protein is broken down in the rumen into amino acids that the microbes can utilize. The protein not broken down in the rumen is known as bypass or rumen undegradable protein. The elements that make up amino acids are carbon, hydrogen, oxygen, nitrogen, and sometimes sulfur (contained in three of the amino acids).

Lysine, methionine, and histidine are the three most limiting amino acids in dairy cattle diets. A key to boosting milk protein is in getting the correct amino acids to the small intestine.

Dry matter intake decreases about 20% in a dairy cow in the day before calving. A cow will produce 2 to 3 lb of milk for each lb. of dry matter consumed. It is best to feed cows 6 hours after milking to maximize the time they spend eating.

Each day, a cow spends 3 to 5 hours eating (9 to 14 meals), 7 to 10 hours ruminating, 30 minutes drinking, and 10 to 12 hours resting.

In 2004, 54% of dairy farms fed a TMR.

Hybrid seed for alfalfa first became available in 2001. It has the potential of greatly increasing alfalfa yields.

Young calves convert feed nutrients into growth more efficiently than older calves or heifers.

Dairy efficiency or feed efficiency is calculated by dividing lb of component corrected milk by lb of dry matter consumed. The two formulas to standardize for milk components are:

\[
\text{Pounds of 3.5\% fat corrected milk (3.5\% FCM) = 0.4234 x lb milk + 16.0 x lb milk fat}
\]

\[
\text{Pounds of energy-corrected milk (ECM) = 0.323 x lb milk + 12.82 x lb milk fat} \\
+ 7.13 x pounds true milk protein
\]

Lactic acid is the acid most prevalent in properly fermented silage.
A calf will consume 4 lb of water for every 1 lb of dry matter intake or dry calf starter. Cows consume 4 to 5 pounds of water for every 1 pound dry matter. Cows consume the most water right after milking.

Amylase is an enzyme that breaks down starch into smaller molecules during the digestive process. Adding amylase to high starch diets may increase nutrient availability to cows.

According to research at Virginia Tech, it is recommended that feed refusal be at 5 to 10% to maximize dry matter intake for lactating dairy cows.

Cows should be fed a transition diet around calving time. Feeding cows a low potassium diet helps to prevent milk fever. High potassium levels interferes with a cow’s ability to mobilize calcium from her bones.

Cottonseed, citrus pulp and brewer’s grains are by-product feeds. Corn grain is not a by-product.

Alfalfa should be at least 18% moisture when baled as dry hay. When baling large round bales, the moisture should be around 15 to 18%. Corn grain is usually ensilage at 30% moisture (range of 20 to 40%).

Monensin was approved for lactating dairy cows in 2004. Monensin improves feed efficiency. Feeding garlic to cattle has been shown to lower methane production in the rumen (somewhat the same effect as monensin).

A nutritionist may evaluate manure consistency on a 1 to 5 scale with 1 being very watery, runny manure and 5 representing very hard, clumpy manure. A score of 3 is optimal. A primary reason to find grain in the manure is that it was poorly processed or not processed fine enough.

A Penn State “shaker box” is used to evaluate a ration for particle size. It is a collections of four boxes stacked on top of each other. Three of the boxes have holes in them to separate the feed by size. A lactating cow’s diet should contain 37 to 43% NDF.

Body condition scoring is a visual evaluation of body fat and is based on a 1 to 5 scale, with 1 being severely under-conditioned (thin) and 5 being severely over-conditioned. Recommended body condition scores for various stages of lactation are: calving 3.0 to 3.5, breeding 2.5, late lactation 3.0 to 3.5, and dry period 3.0 to 3.5.

Distillers grains is a by-product of the corn ethanol industry.

Vitamin K is supplied by alfalfa and other forage plants. Vitamin K is also created by rumen microbes so is considered a non-essential vitamin for cattle. The target organ for Vitamin K is the liver. Vitamin K is an essential co-factor in the creation of several blood clotting factors produced by the liver. A vitamin K injection is lifesaving for classic moldy sweet clover poisoning and accidental warfarin-type rodenticide ingestion to prevent an animal from bleeding to death. Mold can convert a substance in sweet clover into a potent anti-coagulant. Vitamin K allows the liver to produce additional blood clotting factors to counteract the anti-coagulants.

Supplementing with vitamin E in the last month before calving may reduce the incidence of retained placentas and stillbirths whole improving reproductive performance in the next lactation.
Reproduction

The cervix is a narrow opening that connects the vagina and uterus. Manipulation of the cervix during A.I. causes the cow to release oxytocin.

If breeding heifers at 13 months, they should be 53.7% of their mature body weight. According to Ag Source (2013), 25% of Holstein heifers and 33% of Jersey heifers are bred using sexed semen.

In 2006, it was recommended that sexed semen only be used on first service heifers. Sexed semen generally produces about 90% heifers. 52.9% of calves from regular semen are bulls.

Signs of estrus in dairy cows include: standing to be mounted, attempts to mount other cows, restlessness, bellowing, poor milk letdown, swollen vulva, and clear crystalline discharge from vagina. Cows show the strongest signs of estrus when allowed out on dirt.

It is best to breed a cow 8 to 12 hours before ovulation or just after estrus to maximize conception.

A difficult calving, subclinical ketosis and calving with twins are all reasons that cows become cystic after calving.

In Holsteins (2008), stillbirth incidence was 6.3% for heifer calves and 10% for bull calves. Stillbirths were 12.6% for first calf heifers and 6.1% for older cows.

The twinning rate for first calf heifers is 1 to 2%. It increases for older cows and averages 5 to 6% for all cows. If embryonic membranes of male and female twins fuse during gestation the resulting heifer calf is usually a freemartin. The term “freemartin” originated from England. High producing cows have a higher frequency of twins than lower producing cows. Calves carrying twins usually calve early – before their due date. Detrimental aspects of twinning include chance of late term abortion, stillbirth, dystocia, retained placenta, ketosis, milk fever, displaced abomasums, less milk production, lower fertility, and greater culling.

According to a USDA study in 2004, Jerseys were youngest at first calving, followed by Holsteins as second youngest. Jerseys also had the shortest caving interval of any U.S. dairy breed and have the least amount of calving difficulty. According to a 2007 USDA study, Holstein and Milking Shorthorn had the most calving difficulty. Guernseys have the lowest pregnancy rate.

There are two types of cystic ovaries: follicular cysts and luteal cysts. A cystic follicle is usually greater than 1.1 inches in diameter. Follicular cysts are soft in texture. Cows with follicular cysts may show estrus behavior at irregular intervals (chronic buller). Luteal cysts are thick walled luteinized follicles that secrete progesterone. Follicular cysts can be treated by injecting GNRH (tradenames: Cystorelin, Factrel, or Fertagyl) or human chorionic gonadotropin (hCG is marketed as Chorulon). Followed some days later with an injection of prostaglandin (tradenames: estroPLAN, Estromate, or Lutalyse).

Metritis is an inflammation of the uterus. Endometritis is an inflammation of the lining of the uterus.
The placenta is an organ that facilitates the nutrient exchange between fetus and dam. The button-like structures of the placenta (cotyledons) connect to the caruncles on the lining of the uterus. After calving, the cow’s immune system recognizes the cotyledons as a foreign body and destroys the connection between the cotyledons and the caruncles, allowing the placenta to be expelled within 30 minutes to 8 hours. However, when the immune system is weakened, these connections may not be destroyed and we have a retained placenta (RP). The average RP rate is about 8%. If a herd is averaging more than 10% RP, management changes may be needed. Mechanical factors that increase RP incidence are difficult births, twins, stillborn calves, and abortions. Factors that can impair the immune system and lead to RP’s are low blood calcium, deficiencies in selenium, Vitamin A or E; moldy feeds, or stress. Cows with retained placentas should not be treated unless they become sick. Cows with a RP will normally drop the placenta within a week.

Frozen semen is merchandised in 0.5 and 0.25 milliliter straws. Sexed semen usually results in lower conception rates.

Pregnancy rate is computed by multiplying heat detection rate times the conception rate. Most dairy specialists recommend that 75% of cows should be pregnant by 150 days in milk.

When scoring calving ease, a “1” is no problem; “2” is a slight problem; “3” is needed assistance; “4” is considerable force; and “5” is extreme difficulty.

A progesterone-releasing implant called a CIDR is inserted into the vagina for 7 days to synchronize estrus.

In-vitro Fertilization
In-vitro fertilization is the process of removing eggs from a cow or heifer and fertilizing them in the lab. First the cow or heifer is given 4 shots of FSH to stimulate multiple follicles. To aspirate the oocytes (ovum pick up (OPU)), a probe is inserted into the vagina. This probe has a needle inside a sheath and an ultrasound device. With the left hand in the rectum, the technician places the ovary near the probe. Follicles on the screen appear black. As follicles are found, the technician guides the needle into them to collect the egg. On average a cow will produce 15 oocytes per collection, but there is a huge range in number from cow to cow. The eggs are taken to the lab where they are fertilized. The eggs may be fertilized with conventional frozen semen or reverse sorted semen. Reversed sorted semen is conventional frozen semen that is thawed and then processed through a sex-sorting machine. Frozen sexed semen is not usually used because of a decreased fertilization rate.

Cloning
When cloning animals, the nucleus is removed from an unfertilized oocyte and replaced by a nucleus from a cell of the animal the is being cloned.
**Heat Synchronization Protocols:**

**Ovsynch:**  
GnRH – 7 days – PGF – 48 to 56 hrs – GnRH – 8 to 16 hrs – insemination

**Traditional Pre-synch and Ovsynch:**  
PGF – 14 days – PGF – 12 days – Ovsynch

**G-6-G:**  
PGF – 2 days – GnRH – 6 days – Ovsynch

**Double Ovsynch:**  
GnRH – 7 days – PGF – 3 days – GnRH – 7 days – Ovsynch

**Heatsynch:**  
GnRH – 7 days – PGF – 2 days – ECP – 2 days – watch for estrus and inseminate

With the traditional Pre-synch and Ovsynch protocol, two additional PGF injections are given 36 and 22 days prior to the desired insemination date. With the G6G Pre-synch program, a prostaglandin shot is followed by GnRH 2 days later and followed by the Ovsynch protocol 6 days later. The Heatsynch protocol is similar to Ovsynch except that the 3rd injection is ECP (estradiol cypionate) rather than GnRH and cows are timed-inseminated 24 hours later.

It is recommended to give a GnRH injection 15 or 16 days after insemination in a synchronization program. This does not affect conception rates to the first breeding, but improve conception rates for those cows that had to be rebred.

An alternative protocol to synchronize cows that are found open by ultrasound at 28 to 34 days post breeding is called “ultrasynch”. Open cows that have a C.L. at least 23 mm in diameter are given a shot of prostaglandin and then bred when they come into heat after a few days.

Trade names for Prostaglandin F2 alpha products in 2003 are: Lutalyse, Estrumate, Prostanate, and In-Synch. Trade names for GnRH products are: Cystorelin, Factrel, Fertagyl, and Ovacyst.

Pregnancy associated glycoproteins (PAGs) form in the placental trophoblast. PAGs are pregnancy recognition markers and can be reliably detected in blood and milk at 32 days of pregnancy.

According to a 2007 National Animal Health Monitoring System survey, over half of dairy farms still use a bull to breed some cows naturally. Timed AI protocols were used for the majority of females for 1st service by less than 7% of farms. According to a 2014 Hoard’s article, DHIA records indicate that 30% of dairy cows in the U.S. are bred by timed A.I. (24% in Minnesota). In 2013, 52% of artificial inseminations were to young genomically tested bulls (not progeny tested yet).

Pregnancy can be accurately diagnosed with ultrasound 30 days post A.I. A blood test, BioPRYN, can also diagnose pregnancy at 26 to 30 days post breeding. PRYN = Pregnant Ruminant Yes/No.

<table>
<thead>
<tr>
<th>Gestation Length</th>
<th>1st calf</th>
<th>Later calvings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayrshire</td>
<td>281.8</td>
<td>281.7</td>
</tr>
<tr>
<td>Brown Swiss</td>
<td>287.3</td>
<td>287.5</td>
</tr>
<tr>
<td>Guernsey</td>
<td>284.8</td>
<td>285.8</td>
</tr>
<tr>
<td>Holstein</td>
<td>277.9</td>
<td>279.5</td>
</tr>
<tr>
<td>Jersey</td>
<td>278.5</td>
<td>280.0</td>
</tr>
</tbody>
</table>
Abortion is highest during the summer season.

To reduce stillbirths, calving pens should be checked at least every two hours.

**Hormones in reproduction:**

*Estrogen* is produced by the follicle on the ovary. It is the primary female sex hormone and causes estrus behavior. ECP (estradiol cypionate) is the estrogen infected in the Heatsynch protocol.

*Progesterone* is produced by the CL on the ovary. It helps to maintain pregnancy.

*Prostaglandin* (PGF) is secreted by the uterus and causes the Corpus Luteum (C.L.) to regress.

*Luteinizing hormone (LH)* is secreted by the anterior pituitary gland and causes ovulation.

*Follicle stimulating hormone (FSH)* is secreted by the anterior pituitary gland and stimulates follicular growth.

*Gonadotropin releasing hormone (GnRH)* originates from the hypothalamus and tells the anterior pituitary gland to release LH and FSH.

**Other selected hormones:**

*Epinephrine* – (adrenaline or “fight or flight” hormone). It is released from the adrenal glands (located on the kidneys) in response to stress. It opposes the action of oxytocin and inhibits milk letdown.

*Growth hormone (GH)* – also known as somatotropin. It is produced in the anterior pituitary gland.

*Insulin* – produced in the pancreas and regulates blood glucose levels.

*Insulin-like growth factor -1 (IGF-1)* is mainly produced by the liver in response to growth hormone. It promotes growth, cell reproduction, and inhibits programmed cell death.

*Melatonin* is produced in the pineal gland and released during time of darkness. Melatonin and prolactin are mainly responsible for the increased milk production obtained when cows get 16 hours of light and 8 hours of darkness each day.

*Parathyroid hormone (PTH)* is produced by the parathyroid glands and regulates the amount of calcium in the blood.

*Prolactin* is produced by the anterior pituitary gland and initiates and supports milk production and works with melatonin on photoperiod changes. Prolactin is the hormone that is primarily responsible for initiation of lactation.

*Relaxin* assists calving by relaxing the tendons in the rump and tailhead. Produced by the corpus luteum, udder, and placenta.

*Testosterone* – Females have much less testosterone than males but female testosterone influences muscle mass, fetal development, and dominant behavior. It is thought that cows with higher testosterone during egg development are more apt to have bull calves.
**Milking**

The temperature of the milk when it comes out of the cow is 96° to 98° F and should be cooled to 40° F as quickly as possible in the bulk tank.

During the milk phase, the liner is open and milk flows. During the massage or rest phase, the liner is closed. Most pulsators work with a pulsation rate of 60 cycles per minute. The pulsation ratio is the percentage of time in the milk versus rest phases. A 60:40 ratio is most common, indicating the line is in the milk phase 60% of the time. The average milking class vacuum levels should be in the range of 10.5 to 12.5 Hg (inches of mercury).

**There are three reasons to forestrip:**

1) to keep poor quality milk out of the tank (flush bacteria out of the teat canal)
2) to detect mastitis earlier so it can be treated (check for abnormal milk)
3) to stimulate milk letdown

Pre-dips need to remain on the teat 30 seconds to be effective.

Dirty equipment, dirty udders, and infected udders are the three main sources of on farm bacterial contamination of milk.

Strep mastitis, dirty udders, dirty equipment and improper cooling are the four main causes of an elevated bacteria count in the milk.

Four milking parlor designs are the flat barn, parallel, rotary and herringbone. The rotary enables workers to be stationed in one place.

A robotic milking unit can handle 50 to 70 cows per day. In 2002, The Netherlands had the most robotic milkers of any country, with 500 in use. Relative to robots, AMS stand for automatic milking systems.

The California Mastitis Test (CMT) is used to screen cows for somatic cell count. The CMT reagent causes the DNA in the somatic cells to coagulate. The cost to run a CMT is less than 1 cent.

**National average somatic cell count (SCC) by year:**

<table>
<thead>
<tr>
<th>Year</th>
<th>SCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>316,000</td>
</tr>
<tr>
<td>2006</td>
<td>288,000</td>
</tr>
<tr>
<td>2011</td>
<td>206,000</td>
</tr>
<tr>
<td>2012</td>
<td>200,000</td>
</tr>
<tr>
<td>2013</td>
<td>199,000</td>
</tr>
</tbody>
</table>

Minnesota’s somatic cell count was higher than the national average at 319,000 in 2006 and 264,000 by 2011 and 242,000 in 2012 and 241,000 in 2013. Cows in Florida tend to run higher than most any other state because of the hot, humid weather. The lowest somatic cell count was Rhode Island. In most states, SCC tends to run higher in the summer months. The legal limit for Grade A milk for Somatic Cell Count is 750,000 cells per milliliter. Starting in 2011, farms must maintain a geometric mean of less than 400,000 SCC to sell to many milk plants that export dairy products to Europe.
A linear score of 4 (200,000 cells per ml.) is generally accepted to indicate that a cow has mastitis. When a cow battles a mastitis infection, toxins can destroy the milk producing mammary epithelial tissue and this is replaced by fibrous scar tissue.

Even when there are no clinical signs of mastitis, a cow’s milk production begins to decline when somatic cell count is greater than 100,000 cells per millimeter. Mastitis pathogens are generally classified as environmental or contagious. Contagious pathogens are most often found in the udder. Environmental pathogens are most often found in bedding or walkways. The big MP3 or three major mastitis pathogens include Staphylococcus aureus (Staph), Streptococcus agalactia (Strep) and Mycoplasma.

An on-farm milk culture can be completed in 24 hours that will differentiate between different types of bacterial pathogens.

Hyperkeratosis is teat end calluses.

Staphylococcus aureus can result in high production losses during a heifer’s first lactation. Researchers have discovered 4 potential bacterial risk factors: colonization of the teat-end, suckling by other calves, heifers’ environmental surroundings, and flies that bite the teat ends.

**Heifers may get mastitis prior to freshening. The source of the bacteria may be from:**

1) the udder and teat skin  
2) from suckling by other calves  
3) bedding and manure (environment)  
4) spread by biting flies

Evidence of mastitis in heifers may include swollen quarters, abnormal secretions, teat-end scabs.

Switching from 2x to 3x milking can be expected to increase milk production by 10 to 20 percent. In 2009, about 1/3 of dairy farms milk 3X.

Cold weather, overmilking, and high vacuum levels all can cause teat end damage.

The median and lateral suspensory ligaments have 60% of their attachments to the body wall and 40% to the pelvis.

The cow’s teat has two structures that help prevent the entrance of bacteria; teat canal keratin and the sphincter muscle. Keratin is a waxy material that serves as a physical barrier and contains antimicrobial substances. The sphincter muscle closes tightly between milkings. The sphincter and keratin are the first line of defense against bacteria. White blood cells are the second line of defense.

**Marketing and Dairy Products**

Dairyus is the name of the animated Real Seal character (2013).

Milk prices tend to be lower in spring compared to the rest of the year.

The standard plate count is a milk quality test when technicians pour milk onto a micro plate, incubate it, let it grow, and then count the colonies of bacteria.

In 2006, organic milk made up about 3.4% of U.S. milk sales.
Bacteria that can survive high temperatures are known as thermodurics.

Laboratory pasteurized count (LPC) is the amount of bacteria in pasteurized milk.

Pasteurization destroys 90% of the BST found in milk.

PIC (preliminary incubation count) is a milk quality test used to determine if a high bacteria count is due to faulty cooling.

**Milk was utilized for the following products:**

<table>
<thead>
<tr>
<th>Product</th>
<th>2001</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheese</td>
<td>42%</td>
<td>43%</td>
</tr>
<tr>
<td>Fluid milk</td>
<td>27%</td>
<td>23%</td>
</tr>
<tr>
<td>Frozen dessert</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>Butter</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Specialty products</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Nonfat dry milk</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Other dairy products</td>
<td></td>
<td>17%</td>
</tr>
</tbody>
</table>

The two most popular cheese varieties in the U.S. in 2006-2014 were Mozzarella and Cheddar. Mozzarella took over the top spot by itself in 2012.

Butter can be stored up to 6 months in the refrigerator before losing flavor.

<table>
<thead>
<tr>
<th>Year</th>
<th>Average milk production per cow in the U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>18,200</td>
</tr>
<tr>
<td>2003</td>
<td>18,749</td>
</tr>
<tr>
<td>2010</td>
<td>21,249</td>
</tr>
<tr>
<td>2013</td>
<td>21,822</td>
</tr>
</tbody>
</table>

Milk is high in calcium and often fortified with vitamin D to help prevent rickets in children.

Dairy Farmers of America (DFA) is the nation’s largest milk cooperative (2000-2010). The Capper-Volstead Act of 1922 made farm cooperatives legal. CHS, Inc. is the largest agricultural cooperative (2011).

Land O’Lakes, a Minnesota based cooperative, was ranked 3rd for volume of milk in 2000-2008.

The largest dairy processing company in the world in 2006 was Nestle. The largest milk processor in the U.S. is Nestle USA (2013).

Dairy farmers are assessed fifteen cents per cwt of milk for milk promotion in the U.S. Beginning in 2011, the equivalent of 7.5 cents per cwt is accessed on dairy-based imports for milk promotion.

Beginning in 2012, the National Milk Producers federation took over the management of the REAL seal.
Australia and New Zealand produce about 4% of the world’s milk. India has more cows than any other country. New Zealand was the #1 exporter of dairy products in 2013. China was the #1 importer of dairy products in 2013.

Elsie, the Borden Company’s famous marketing cow, originated in 1939.

Dairy producers in Florida received the highest price per lb. of milk among producers in the 48 states.

In 1999, 97% of the milk in the U.S. was produced as grade A.

In a 2015 report, the FDA found that >99% of milk samples were free of antibiotic residues.

In 1999, Ireland had the highest consumption of fluid milk per capita, while France had the highest per capita consumption of butter. Greek people led the world in per capita consumption of cheese in 1999. In 2002, Denmark had the highest per-capita consumption of cheese at 63 lb. per person. In 2013, the Chinese ate only .08 lbs. of cheese per person.

Milk is 86 to 88% water. Milk is 5% carbohydrates (lactose).


In 2007, the world’s largest dairy herd was located in India.

In 2000, per capita production of milk in the U.S. was 596 lb per person; 576 lb per person in 2005; 618 lb per person in 2009 and 612 lb in 2012. Alaska had the fewest cows until 2003, at which time Rhode Island was ranked last for number of cows 2003 to 2005. Alaska had the fewest cows in 2006 to 2013.

Per capita of fluid milk use in the U.S. was 201 lb in 2011.

New Food Pyramid (2005) guidelines recommend 3 servings of dairy products per day. The USDA food guide morphed into a plate in 2011 that includes five categories: fruits, vegetables, grains, protein, and dairy. Meat is in the protein category.

One percent of milk is sold in vending machines.

California has the most cows on DHIA test. Stearns County leads Minnesota counties in milk production.

After the un-hairing and tanning process, the animal’s skin is known as leather.

Irradiated ground beef is rapidly gaining consumer acceptance. Irradiated beef was first approved by the FDA in 1997 to kill pathogens. Dairy Queen was the first fast food chain to use irradiated beef.
In 2014, Wisconsin had the most dairy farms; Pennsylvania was 2nd, New York was 3rd, and Minnesota was 4th. The average number of cows per herd in 2002 in the U.S. was 130 cows and this increased to 147 in 2006 and up to 172 in 2010 and 196 in 2013 and 204 in 2014. In 2006-2013, Hawaii had the fewest number of herds. In 2013, Wisconsin also had the largest number of certified organic dairies but California had the most certified organic milk cows. Organic milk sales have been increasing with fluid milk being that top organic seller. The region of the country with the smallest average herd size is the Midwest (includes Minnesota). Dairy producers in Florida receive the highest milk price per hundred weight in the continental U.S.

New Zealand’s dairy cow population has reached 3.5 million cows (2002). In 2010, New Zealand had more cows than people. Currently, 56% are Holstein-Friesian, 21% are Holstein-Jersey crosses, 15% Jerseys, 1% Ayrshire, and 7% others. In 2011, New Zealand was the leading dairy exporter in the world.

Cull dairy cows make up 7% of the beef production in the U.S. but provide 18% of the hamburger according to 2007 USDA figures. In 2012, dairy beef (males and females) provided 18 to 22% of the beef supply in the U.S. Veal calves are sent to slaughter at 475 to 500 lb. In 2006, 8% of all cattle slaughtered for beef were Holstein. Holstein steers provide 5.5% of the fed beef supply (2011).

Ground beef accounted for 62% of beef sales in 2014.

A new milk advertising campaign was kicked off in 2006 called, “Body by Milk.”

Coca-cola announced in 2014 that it would market a new milk beverage called Fair Life.

**Dairy cow (including milking water buffalo) populations (2007):**

1) India 119,600,000 (in 2012, India had 55.5 million dairy cows and 112 million water buffalo)
2) Brazil 37,515,000
3) China 14,700,000
4) Russia 9,400,000
5) U.S. 9,224,000

**Total cows’ milk production (2008):**

<table>
<thead>
<tr>
<th>Billion lb</th>
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</thead>
<tbody>
<tr>
<td>1) USA</td>
</tr>
<tr>
<td>2) India</td>
</tr>
<tr>
<td>3) China</td>
</tr>
<tr>
<td>4) Russia</td>
</tr>
<tr>
<td>5) Germany</td>
</tr>
<tr>
<td>6) Brazil</td>
</tr>
<tr>
<td>7) France</td>
</tr>
<tr>
<td>8) New Zealand</td>
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</tbody>
</table>

(average milk production is only 2,661 lb/cow – 2010; lowest of major milk producing countries; this total does not include milk from water buffalo)
Top milk producing states:

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</thead>
<tbody>
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<td>California</td>
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<tr>
<td>Wisconsin</td>
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<tr>
<td>Idaho</td>
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<tr>
<td>Pennsylvania</td>
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<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Minnesota</td>
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<td>7</td>
<td>8</td>
<td>8</td>
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<td>Michigan</td>
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<tr>
<td>Washington</td>
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<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Canadian dairy producers have a quota system with a capped price of $22,750 per cow in 2009. A unit of quota permits a dairy producer to sell 60 lb of 3.8% fat per day.

Composition of Milk:

- Water 87.6%
- Solids 12.4%
  - Butterfat 3.7%
  - Nonfat solids 8.7%
  - Lactose 4.8%
  - Crude protein 3.2%
  - NPN 0.2%
  - True protein 3.0%
  - Casein 2.4%
  - Whey protein 0.6%
- Ash 0.7%

Lactose is comprised of glucose and galactose. Lactose serves as the fermentation base for lactic acid producing bacteria when producing cheese and yogurt. Butterfat or milkfat rises to the top of milk and forms cream when allowed to separate because butterfat is less dense than other milk components. Cream may vary in butterfat content. Casein is the principle component of milk that gives milk the white color. Ash is an all-encompassing term for the vitamins and minerals found in milk. Whey is the by-product of curdling milk. The most important component of whey is the protein. Water makes up 94% of whey on a volume basis.

Cows consuming significant amounts of grass or legume based rations produce milk with significantly more omega-3 fatty acids and CLAs (conjugated linoleic acids) in the milk. These fatty acids contribute to a healthy heart. The acids are contained in the milk fat.

Wisconsin leads the nation in the number of milk goats with 46,000 head in 2010. Goat milk production is increasing in the U.S. The top five states for goat milk production in 2011 are Wisconsin, California, Iowa, Texas, and Pennsylvania.