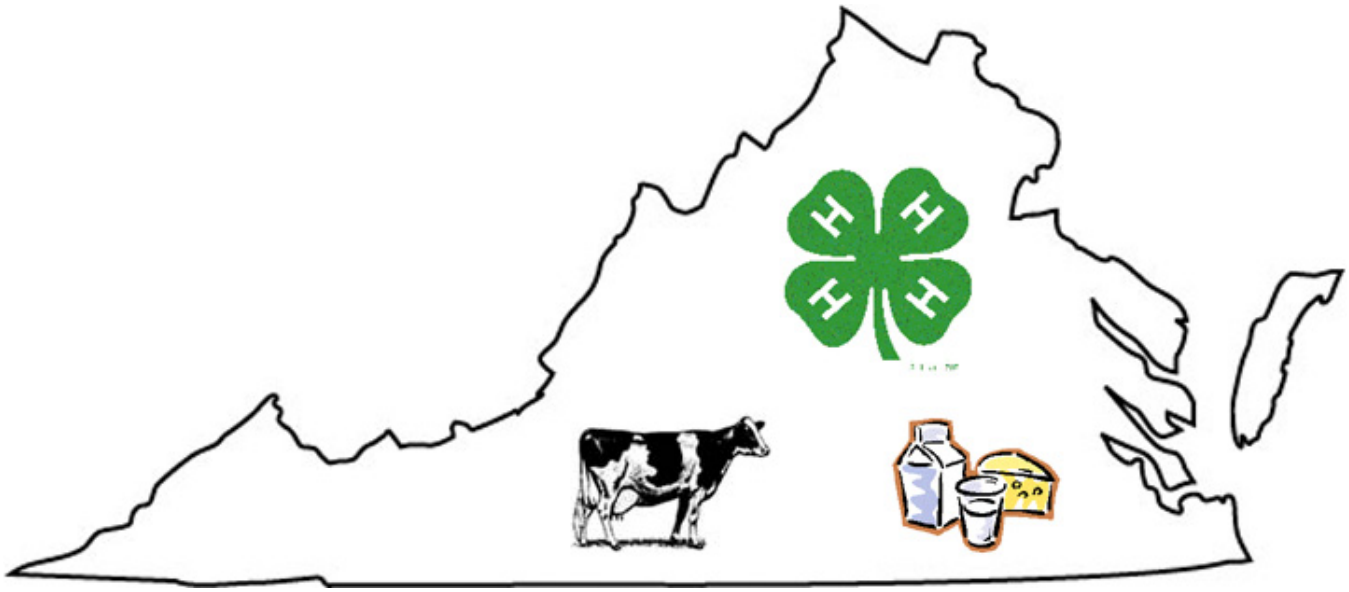
2017 Virginia 4-H Dairy Quiz Bowl Materials



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Note

Senior 4-H'ers competing in district and state 4-H dairy quiz bowl contests in Virginia may be quizzed on any of the information contained within this year's study materials.

Junior 4-H'ers will only be responsible for Chapters 1-9.

Disclaimer

This publication is a living document and is updated on an annual basis. Given the pace of change in today's world, information can become dated very quickly. If you find information that has changed, feel free to contact the editor, so your suggestions may be included in the next revision. Thanks!

Chapter 1: Dates in Dairy History

1611	First cows arrived at the Jamestown Colony
1624	First cows arrived at the Plymouth Colony
1810	First dairy cooperative in the U.S. organized in Goshen, Connecticut
1851	First commercial cheese factory established in New York
1856	First patent for condensed milk
	First commercial butter factory established in New York
1857	First successful condensory built by Gail Borden in Burrville, Connecticut
1862	Morrill Act enacted to create the Land Grant College System
1868	American Jersey Cattle Club founded
1877	American Guernsey Cattle Club founded
1878	Centrifugal cream separator invented
1880	Brown Swiss Breeders Association founded
1884	Milk bottle invented
1885	Hoard's Dairyman magazine first published
	Holstein-Friesian Association of America formed
1886	Automatic bottle filler and capper patented
1887	Hatch Act enacted to create state agricultural experiment stations
1890	Babcock test for butterfat developed
1895	Pulsator invented
1904	American Dairy Goat Association organized
1905	First cow testing association in the U.S. organized in Michigan
1906	American Dairy Science Association founded
	First National Dairy Show held in Chicago
	Brown Swiss cattle recognized as an official dairy breed in the U.S.
	National Dairy Council organized
1914	Smith-Lever Act signed establishing the Cooperative Extension Service
1916	National Milk Producers Federation founded
1917	Journal of Dairy Science first published
1922	Capper-Volstead Act passed by Congress to empower farmers and agricultural producers to market, price, and sell their products through cooperative means
1926	Dairy Herd Information testing program started
1931	Hoard's Dairyman cow judging contest begun
1932	First plastic coated paper milk cartons introduced commercially
1935	National Cooperative Sire Proving Program initiated
1936	First dairy cattle A.I. organization in Denmark

1937	First list of sires proven in DHIA testing published by USDA
	Federal Agricultural Marketing Agreement Act, which provides for federal milk marketing orders, passed
1938	Artificial insemination began in the U.S.
	First A.I. cooperative in the U.S. organized in New Jersey by E. J. Perry
	First bulk tanks used on farms
1940	American Dairy Association founded
	Purebred Dairy Cattle Association formed
1942	National Association of Animal Breeders organized
1943	The PDCA Dairy Cow Unified Score Card was first copyrighted
1945	First edition of National Research Council's Nutrient Requirements of Dairy Cattle published
1949	National Dairy Shrine founded
1951	Computer first used to calculate DHIA records in Utah
	First U.S. young sire sampling program established
	First successful embryo transfer in dairy cattle
	First commercial milk replacer for calves introduced
1953	Frosty, the first U.S. calf resulting from frozen semen, was born
1955	Flavor control equipment introduced commercially
1960	National Mastitis Council founded
1964	Commercial introduction of plastic milk jug
	Red and White Dairy Cattle Association organized
1965	National Dairy Herd Information Association organized
1967	World Dairy Expo founded and holds first show
1974	Nutrition labeling of fluid milk products begins
1983	INTERBULL developed
	Dairy and Tobacco Adjustment Act created National Dairy Promotion and Research Board and a 15-cent dairy check-off
1989	Animal Model first used for USDA genetic evaluations
1993	Bovine somatotropin, first product of biotechnology for animals, approved
1994	Holstein-Friesian Association officially changes its name to Holstein Association USA, Inc.
1995	Multi-trait Across Country Evaluations (MACE) for bulls implemented by INTERBULL
1998	Dairy Calf and Heifer Association founded
2000	First U.S. commercial robotic milker installed in Wisconsin
	Federal Milk Marketing Orders reformed to reduce the number of orders
2001	National Research Council's Nutrient Requirements of Dairy Cattle most recently updated (7th edition)
2002	North American Intercollegiate Dairy Challenge established
2003	Sexed semen becomes commercially available
2006	Dairy Cattle Reproductive Council founded

2009	Most recent revision of the PDCA Dairy Cow Unified Score Card Genomic predictions of genetic merit officially released by UDSA-AIPL Jersey Youth Academy established
2011	PDCA Showmanship Evaluation Card revised
2013	Council on Dairy Cattle Breeding assumes responsibility for publishing U.S. dairy genetic evaluations

Chapter 2: People and Organizations

ACRONYMS	
ADA	American Dairy Association
ADGA	American Dairy Goat Association
ADSA	American Dairy Science Association
AFBF	American Farm Bureau Federation
AJCA	American Jersey Cattle Association
AMS	Agricultural Marketing Service
AOAC	American Organization of Analytical Chemists
APHIS	Animal and Plant Health Inspection Service
ARS	Agricultural Research Service
CCC	Commodity Credit Corporation
CME	Chicago Mercantile Exchange
CSS	Certified Semen Services
DCHA	Dairy Calf and Heifer Association
DCRC	Dairy Cattle Reproductive Council
DHIA	Dairy Herd Information Association
DHIR	Dairy Herd Information Registry
DRPC	Dairy Records Processing Center
DRINC	Dairy Research, Inc.
EPA	Environmental Protection Agency
FASS	Federation of Animal Science Societies
FCS	Farm Credit Services
FDA	Food and Drug Administration
FSA	Farm Service Agency
FSIS	Food Safety and Inspection Service
IDF	International Dairy Federation
IDFA	International Dairy Foods Association
IMS	Interstate Milk Shippers
NAAB	National Association of Animal Breeders
NADC	National Animal Disease Center
NAIDC	North American Intercollegiate Dairy Challenge
NASS	National Agricultural Statistics Service
NCIMS	National Conference on Interstate Milk Shipments
NDC	National Dairy Council

NDHIA	National Dairy Herd Information Association
NDPRB	National Dairy Promotion and Research Board
NMC	National Mastitis Council
NMPF	National Milk Producers Federation
NRC	National Research Council
NRCS	Natural Resource Conservation Service
PDCA	Purebred Dairy Cattle Association
SWCD	Soil and Water Conservation District
UDIA	United Dairy Industry Association
USDA	United States Department of Agriculture
USDEC	United States Dairy Export Council
YDLI	Young Dairy Leaders Institute

DAIRY INDUSTRY PIONEERS

S. M. Babcock	Developed the butterfat test that was the basis for DHIA testing
Gail Borden	Received the first patent for condensed milk
Dr. Gustaw Delaval	Invented the centrifugal cream separator
W. D. Hoard	Founded *Hoard's Dairyman*, the national dairy farm magazine
Louis Pasteur	Invented pasteurization; considered the first person to discover that bacteria cause food spoilage and disease
Dr. Harvey Thatcher	Invented the milk bottle.

DAIRY INDUSTRY LEADERS

Jim Mulhern	President and CEO, *National Milk Producers Federation*
Corey Geiger	Managing Editor, *Hoard's Dairyman*
Jay Mattison	CEO and Administrator, *National DHIA*
Jim Dickrell	Editor, *Dairy Herd Management*
David Selner	Executive Director, *National Dairy Shrine*

BREED ASSOCIATION LEADERS

Becky Payne	Executive Director, **Ayrshire** Breeders Association
David Wallace	Executive Secretary, **Brown Swiss** Cattle Breeders Association
Douglas Granitz	CEO & Executive Secretary, American **Guernsey** Association
John Meyer	CEO/Executive Secretary, **Holstein** Association USA, Inc.
Neal Smith	Executive Secretary and CEO, American **Jersey** Cattle Association
Junia Isiminger	Executive Secretary, American **Milking Shorthorn** Society
Mandy Sell	Promotions Manager, **Red & White** Dairy Cattle Association

U.S. GOVERNMENT AGRICULTURAL LEADERS

Sonny Purdue	U.S. Secretary of Agriculture
Sen. Pat Roberts (R-KS)	Chair, U.S. Senate Agriculture, Nutrition, & Forestry Committee
Rep. Michael Conaway (R-TX)	Chair, U.S. House Committee on Agriculture

DAIRY RELATED ORGANIZATIONS

The mission of **National All-Jersey, Inc.** is to increase the value of and demand for Jersey milk and to promote equity in milk pricing.

The **Holstein Foundation's** education leadership development and outreach programs serve youth and young adults representing all breeds of dairy cattle.

The **Council on Dairy Cattle Breeding** oversees approval of records systems standards. The council appoints the group to certify performance of DHI's and other herd record providers.

The four **Dairy Records Processing Centers (DRPC's)** in the U.S. are:

- Agritech Analytics
- DHI-Provo
- AgSource Cooperative Services
- Dairy Records Management Systems

Dairy Farmers of America (DFA) is the largest dairy cooperative in the U.S.

Nestlé USA is the largest processor and distributor of milk and dairy products in the U.S.

Nestlé of Switzerland is the top dairy company in the world based on dairy sales.

Danone is the world's largest yogurt maker.

The **New Zealand Dairy Board** is the world's largest private exporter of dairy products.

Items traded at the **Chicago Mercantile Exchange** daily are:

- Block and barrel cheese (cash)
- Butter futures
- Class III and Class IV milk futures and options

Dairy Management, Inc. (DMI) is a nonprofit organization formed by the National Dairy Board and United Dairy Industry Association. It conducts programs in integrated marketing, communications, promotion, and research for U.S. dairy farmers. **Organizations under the DMI umbrella** are:

- American Dairy Association
- National Dairy Council
- U.S. Dairy Export Council

The **American Dairy Science Association** (ADSA) is an international organization of educators, scientists, and industry representatives who are committed to advancing the dairy industry. The ***Journal of Dairy Science*** is the organization's official scientific publication. ADSA has two divisions in its organizational structure – Dairy Foods and Dairy Production.

The **National Dairy Shrine Museum** is located in Fort Atkinson, Wisconsin.

ORGANIZATION HEADQUARTERS	
American Dairy Science Association	Champaign, Illinois
Council on Dairy Cattle Breeding	Bowie, Maryland
Dairy Calf and Heifer Association	Madison, Wisconsin
Hoard's Dairyman	Fort Atkinson, Wisconsin
Milk and Dairy Beef Quality Assurance Center	Stratford, Iowa
National Dairy Shrine	Denmark, Wisconsin
National DHIA	Verona, Wisconsin
National Milk Producers Federation	Arlington, Virginia

EVENT LOCATIONS	
All-American Dairy Show	Harrisburg, Pennsylvania
Eastern States Exposition (The Big E)	West Springfield, Massachusetts
National 4-H Dairy Conference	Madison, Wisconsin
North American International Livestock Exposition	Louisville, Kentucky
World Dairy Expo	Madison, Wisconsin

Chapter 3: Dairy Breeds

Breed	Origin	Arrived in U.S.	Mature Bodyweight	Method of Permanent ID
Ayrshire	County of Ayr, Scotland	1822	1,200 lb.	Photo or sketch
Brown Swiss	Switzerland	1869	1,400 lb.	Ear tattoo
Guernsey	Isle of Guernsey	1831	1,250 lb.	Photo, sketch, ear tattoo
Holstein	Netherlands & Germany	1852	1,400 lb.	Photo or sketch
Jersey	Isle of Jersey	1815	1,000 lb.	Eartag or tattoo
Milking Shorthorn	England	1846	1,400 lb.	Ear tattoo

Breed	Association Name & Headquarters	Magazine
Ayrshire	Ayrshire Breeders Association Columbus, Ohio	*Ayrshire Digest*
Brown Swiss	Brown Swiss Cattle Breeders Association Beloit, Wisconsin	*Brown Swiss Bulletin*
Guernsey	American Guernsey Association Columbus, Ohio	*Guernsey Breeders' Journal*
Holstein	Holstein Association USA, Inc. Brattleboro, Vermont	*Holstein Pulse*
Jersey	American Jersey Cattle Association Reynoldsburg, Ohio	*Jersey Journal*
Milking Shorthorn	American Milking Shorthorn Association Beloit, Wisconsin	*Milking Shorthorn Journal*
Red and White	Red and White Dairy Cattle Association Madison, Wisconsin	*The Red Bloodlines*

MISCELLANEOUS BREED INFORMATION

Brown Swiss cattle were originally used for milk, meat and draft purposes. Today's Brown Swiss cattle are known for:

- High protein to fat ratio
- Sound feet and legs
- Longevity
- Having few health problems

Guernsey milk is known for its golden color.

Holsteins make up about 90% of the U.S. dairy cow population.

The three **colors found in registered Holstein cattle** are black, red, and white.

On average, **Holsteins** produce the most milk per cow.

Jerseys generally produce milk with the highest fat and protein content.

The **Red and White Dairy Cattle Association** has an open herdbook with different levels of registry. The organization allows different breeds in their herdbook, not just red and white Holsteins.

NOTABLE ANIMALS

World production leaders by breed	
Brown Swiss	Lost Elm Prelude Pixy ET (65,430 lb.)
Holstein	Ever-Green-View My Gold-ET (77,480 lb.)
Jersey	Mainstream Barkly Jubilee (55,590 lb.)
World lifetime milk production record holder	Gillette E Smurf
Queen Mother of the Brown Swiss breed	Jane of Vernon
First bull to produce one million units of semen	Fisher-Place Mandingo-TW

DAIRY GOATS

Capriculture is the study of goats and goat husbandry.

Breeds of dairy goats

- Alpine
- La Mancha
- Nigerian Dwarf
- Nubian
- Oberhasli
- Saanen
- Sable
- Toggenburg

The **American Dairy Goat Association** is third in total dairy animals registered annually in the United States, following the Holstein and Jersey organizations.

Chapter 4: Dairy Cattle Judging, Fitting and Showing

PDCA DAIRY COW UNIFIED SCORECARD

Category	Points	Traits in Priority Order	
Frame	15	Rump (5) Front end (5) Back/loin (2)	Stature (2) Breed characteristics (1)
Dairy Strength	25	Ribs (8) Chest (6) Barrel (4) Thighs (2)	Neck (2) Withers (2) Skin (1)
Rear Feet and Legs	20	Movement (5) Rear legs – side view (3) Rear legs – rear view (3) Feet (3)	Thurl position (2) Hocks (2) Bone (1) Pasterns (1)
Udder	40	Udder depth (10) Rear udder (9)* Teat placement (5) Udder cleft (5)	Fore udder (5)* Teats (3) Udder balance and texture (3)

**In Holsteins, fore & rear udder are weighted equally at 7 points each.*

DAIRY HEIFER SCORECARD (Unofficial)

Category	Points
Frame	40
Dairy Strength	20
Feet and Legs	30
Body Capacity	10

FINAL CLASSIFICATION SCORES

Brown Swiss		Holstein		Jersey	
Excellent	90-94	Excellent	90-97	Excellent	90-100
Very Good	85-89	Very Good	85-89	Very Good	80-89
Good Plus	80-84	Good Plus	80-84	Desirable	70-79
Good	75-79	Good	75-79	Acceptable	60-69
Fair	65-74	Fair	65-74	Poor	50-59
Poor	60-64	Poor	50-64		

ANATOMY RELATED TO JUDGING

The **hock** is used as the reference point to determine the height of the udder floor.

The parts of a cow's anatomy that may be twisted to one side and called "**wry**" are the face and tail.

The **main udder supports** are the median suspensory ligament, lateral suspensory ligament, and skin.

The **median suspensory ligament** is the major support of the udder and divides it in half when viewed from the rear.

The **subcutaneous abdominal veins** are also called the milk veins.

SHOWMANSHIP

When **exhibiting a dairy animal**, the parading circle before the judge should move clockwise.

When **showing a dairy heifer**, the rear leg nearest the judge should be placed farther back than the other. When **showing a dairy cow**, the rear leg nearest the judge should be placed farther forward than the other.

One should **lead a dairy animal** from the left side of the animal when viewed from the rear.

SHOW ETHICS

A dairy animal can be **disqualified** from being shown in the show ring for the following reasons:

- Blind quarter
- Freemartin heifer
- Permanent lameness
- Tampering to conceal faults
- Total blindness

Ohio was the first state to make tampering with show cows a crime.

PDCA SHOWMANSHIP EVALUATION CARD

SLIGHT DISCRIMINATIONS

Exhibitor

- Inappropriate halter
- Lead strap tightly looped
- Walks slowly backward into the ring
- Sidesteps when leading calf
- Has stiff outstretched arm
- Has poor posture – either overly stiff or slumped, sloppy
- Improper head carriage, animal's nose is too high
- Calf's head is not turned slightly toward judge when hide is felt
- Stepping on or kicking at the animal's front feet
- Inappropriate size of calf for competitor

Animal

- Minor instances of animal not handled well
- Is not alert
- Muzzle is not wiped clean
- Switch is not brushed and fluffed
- Clipping lines not properly blended

MODERATE DISCRIMINATIONS

Exhibitor

- Not wearing white clothing or show-approved professional attire
- Inappropriate or unprofessional attire that draws attention to the exhibitor
- Wearing clothing with farm or commercial advertising/logos
- Does not know birth date, fresh date, breeding date, due date
- Unable to recognize type faults of the animal
- Halter not fitting or put together properly
- Holding the lead strap too far from the halter
- Has fingers in ring of the halter
- Failure to hold throat when needed
- Improper head carriage, animal's head held too low
- Unable to show animal to best advantage
- Slow response to judge or ring official
- Inattentiveness
- Watching the judge too intently
- Over-showing
- Leading too slowly
- Has elbow or hands up
- Is too far to outside or inside of ring
- Incorrect spacing to the animal in front when on parade
- Failure to switch rear legs when the judge moves around the animal
- Doesn't walk quickly into line
- Crowding or bumping other animals when pulled in line
- Leaving extra space in line
- Failure to maintain a straight lineup
- Moves excessively in line
- Unable to back up animal
- Legs incorrectly posed
- Does not keep animal straight from head to tail
- Chewing gum

Animal

- Legs not clipped
- Dirt/dust in hair coat
- Dirt/wax in ears
- Feet not cleaned
- Excessive use of hair sprays, powder and other fitting products
- Clipping too early; hair appears too long
- Incomplete clipping
- Excessive clipping

SERIOUS DISCRIMINATIONS

Exhibitor

- Lead strap looped & fastened
- Striking the animal
- Positioning animal's rear legs by stepping on rear feet
- Fusses with or moves calf to the extreme
- Minor instances of unsportsmanlike conduct
- Is late to class
- Wearing inappropriate shoes
- Chewing tobacco
- Carries or talks on a cell phone

Animal

- Animal causing disturbances to others

DISQUALIFICATIONS

- Violations of PDCA Show Ring Code of Ethics
- Unsportsmanlike conduct
- Repeated striking of the animal

RECOMMENDATION FOR THE EVALUATION OF THE TOPLINE

Topline is groomed, doesn't distract from the animal's overall appearance, conforms to the guidelines of the PDCA Showring Code of Ethics

HEIFER CLASSES

The individual **heifer classes in a dairy show** are:

- Spring heifer calf
- Winter heifer calf
- Fall heifer calf
- Summer yearling heifer
- Spring yearling heifer
- Winter yearling heifer
- Fall yearling heifer

JUDGING CONTESTS

The **Hoard's Dairyman Cow Judging Contest** consists of 5 picture classes. The contest begins with the January 10 issue each year.

The **National 4-H Dairy Cattle Judging Contest** is held at the World Dairy Expo in Madison, Wisconsin.

There are four animals in a class in a **4-H dairy judging contest**.

The **All-American Invitational Youth Dairy Cattle Judging Contest** is held at the All-American Dairy Show in Harrisburg, Pennsylvania.

The (NAILE) **Invitational Youth Dairy Judging Contest** is held at the North American International Livestock Exposition in Louisville, Kentucky.

Chapter 5: Calf and Heifer Management

ACRONYMS

ADG	Average daily gain
AFC	Age at first calving

ECONOMICS

Heifers account for 15 to 20 percent of total farm expenses on many dairy operations.

Feed costs account for 55 to 60 percent of the total cost of raising dairy replacement heifers.

PROJECT SELECTION

Important **points to consider** when selecting a calf as a project animal include:

- Age
- Breed
- Health
- Pedigree
- Conformation

IDENTIFICATION

Methods commonly used to identify calves include:

- Eartag
- Photo
- Sketch
- Tattoo
- Freeze branding

LIQUID DIET

Liquid diet choices for pre-weaned calves include milk replacer, whole milk, and colostrum.

A **pre-weaned** calf should be fed 10-17 percent of its body weight in milk or milk replacer daily.

When a calf nurses, milk travels through the **esophageal groove** to the omasum and abomasum. It bypasses the rumen and reticulum. In a newborn calf, the reticulum and rumen are not yet fully developed.

COLOSTRUM

Colostrum is milk that is secreted during the first two to three days after calving.

Colostrum contains **antibodies** that provide immunity from disease for calves. It contains a higher level of protein than normal milk.

A **newborn calf** should be fed colostrum for the first three days of life.

If colostrum is **pasteurized**, it should be heated to 140°F for 60 minutes.

The **critical factors** in colostrum management are quantity, quality, timing, and cleanliness.

Storage options for excess colostrum are:

- Add preservative acid
- Fermented
- Frozen
- Refrigerated

Frozen colostrum may be safely stored for a year.

The Brix refractometer and colostrometer are **on-farm tools for estimating colostrum quality**.

Conditions that can result in **poor quality colostrum** include:

- Cows is dry less than 3-4 weeks
- Pre-milking
- Leaking teats
- Dirty udder and teats
- Young cow

MILK REPLACER

Conventional milk replacer should contain 20% crude protein and 20% fat.

Accelerated milk replacer should contain 26-30% crude protein and 15-25% fat.

Recommended protein sources for milk replacers are:

- Casein
- Dried skim milk
- Dried whey
- Dried whey product
- Dried whey protein concentrate
- Modified wheat protein
- Protein modified soy flour
- Soy protein concentrate
- Soy protein isolate

WEANING

Weaning is the act of taking a young animal off of milk as the main source of nutrition.

Grain intake should be the main criterion used for deciding when to wean a calf.

Before weaning a calf should eat at least **2-3 pounds of grain per day for three consecutive days**.

CALF STARTER

Calf starter should contain 18-22% crude protein.

There are several **types of calf starters** available. They are:

- Commercial textured calf starters
- Commercial pelleted starters
- Homemade grind and mix starters

CALF HOUSING

Calf housing should be clean, dry, draft-free and well ventilated.

Warm calf housing is housing in which environmental temperature is controlled.

The temperature in **cold calf housing** varies with the outside temperature.

Systems of calf housing include:

- Calf hutch
- Elevated stalls
- Pens on the floor
- Cold calf housing system
- Counter-slope system

Advantages of calf hutches include:

- They are easily moved
- They provide better ventilation
- They prevent disease from spreading from one calf to another

GROWTH

Calves should at least double their **birth weight** by 8 weeks of age.

Average daily gain (ADG) is a significant factor in monitoring growth rates in dairy heifers.

Body size is the most important factor to consider in determining when to breed a heifer for the first time.

Heifers usually **show heats** at 40% of mature bodyweight. They should start being **bred** at 55% of mature bodyweight and **calve** for the first time at approximately 82% of mature bodyweight.

Compensatory growth is a term used to describe a period of increased growth rate that follows a growth restriction imposed earlier in the heifer's life.

CALF HEALTH

The **leading causes of death in young calves** are scours and pneumonia.

The **major causes of calf scours** include:

- Inadequate colostrum
- Poor quality colostrum
- Unsanitary calving conditions
- Overfeeding
- Poor quality milk replacer
- Overcrowding
- Inadequate ventilation

Physical factors contributing to pneumonia in calves are drafts, chilling, dampness, and poor ventilation.

Places where pathogenic organisms may gain entry into a newborn calf's body are the mouth, navel, and nose.

Signs of illnesses in calves include:

- Poor appetite
- Cough
- Watery manure
- Nasal discharge
- Drooping ears
- Dull eyes
- Lack of energy
- Elevated temperature

A **7% iodine solution** should be painted on the calf's navel soon after birth to seal the entrance from disease causing organisms.

A calf is 2 to 3 weeks old when it begins to **chew its cud**.

Calves should be **dehorned** at about three weeks of age.

Methods of dehorning calves are paste (caustic potash), cut or gouge (Barnes type dehorner), and electric.

Extra teats are also known as supernumerary teats. Between 30 and 40 percent of heifers born have extra teats. They should be surgically removed around 4 months of age.

CUSTOM HEIFER REARING

Custom heifer growing offers several **advantages** to dairy producers who have been raising their own replacements including:

- Decreased labor requirement
- Increased milking herd management
- Increased facility capacity for milking cows
- Herd expansion without capital investment with use of existing facilities
- Increased feed inventory for milking cows
- Potential for better replacement heifers

Major elements associated with a **contract** for raising dairy replacements are:

- Time period
- Billing and payment procedures
- Definition of each party's responsibility
- Amendments, renegotiations, and renewal
- Conditions for termination of agreement

Methods of charging for heifer grower services include:

- Per animal per day
- Per animal
- Per pound of gain
- Feed plus yardage
- Option to purchase

Chapter 6: Nutrition, Feeds and Feeding

ACRONYMS

AA	Amino acid	**FFA**	Free fatty acid
ADF	Acid detergent fiber	**ME**	Metabolizable energy
ADIN	Acid detergent insoluble nitrogen	**MUN**	Milk urea nitrogen
ADP	Adenosine diphosphate	**NDF**	Neutral detergent fiber
AMP	Adenosine monophosphate	**NDIN**	Neutral detergent insoluble nitrogen
ATP	Adenosine triphosphate	**NE**	Net energy
BCS	Body condition score	**NEL**	Net energy for lactation
BHBA	Beta hydroxybutyrate	**NEFA**	Non-esterified fatty acid
BUN	Blood urea nitrogen	**NFC**	Nonfiber carbohydrates
CF	Crude fiber	**NIR**	Near-infrared reflectance
CP	Crude protein	**NPN**	Nonprotein nitrogen
DCAD	Dietary cation-anion difference	**NSC**	Nonstructural carbohydrates
DE	Digestible energy	**PUN**	Plasma urea nitrogen
DM	Dry matter	**RDP**	Rumen-degradable protein
DMI	Dry matter intake	**RFQ**	Relative forage quality

DEFINITIONS

Mastication	Chewing
Cud	Feed that a cow has regurgitated and is being re-chewed
Esophagus	Tube that connects the mouth to the rumen
Saliva	Watery substance formed in the mouths of animals, secreted by the salivary glands
Rumination	Process in ruminants when semi-liquid ingested feed is regurgitated into the esophagus, re-chewed, and re-swallowed for further digestion
Eructation	Belching of gas by ruminant animals as a natural way for releasing gases produced during the fermentation process
Papillae	Tiny, finger-like projections that line the wall of the rumen
Villi	Small projections that line the small intestine wall
Chyme	Feed material found in the small intestine
Nutrient	Any chemical substance that provides nourishment to the body
Digestible energy	The total energy in a feedstuff minus the energy lost in feces
Metabolizable energy	Digestible energy minus the energy lost in urine and gas
Net energy	Actual amount of energy the body can use for growth, lactation, reproduction, and body maintenance
Crude protein	Total protein in a feed

Rumen degradable protein	Protein or nitrogen that is degraded in the rumen by microorganisms and incorporated into microbial protein or freed as ammonia
Rumen undegradable protein	Protein that passes through the rumen and is unchanged by microbes; also called by-pass protein
Amino acids	Building blocks of true proteins
Forage	Vegetative portion of plants in a fresh, dried, or ensiled state that is fed to livestock
Baleage	Wrapped, round bales of silage
Green chop	Forage harvested (cut and chopped) in the field and fed directly to livestock
Hay	Dried forage (grasses, alfalfa, clovers) used for feeding farm animals
Silage (Ensilage)	Green forage that is chopped and put into a silo, where it is packed or compressed to exclude air and undergoes an acid fermentation (lactic and acetic acids) that retards spoilage
Dry matter	Portion of a feed that remains after water has been removed by drying in an oven
Buffer	Any substance that can reduce changes in pH when an acid or alkali is added
Anion	A negatively charged ion or particle
Cation	A positively charged ion or particle
Total mixed ration	A blend of all feedstuffs (forages & concentrates) in one feed
Body condition scoring	A system to evaluate the thinness or fatness of dairy cattle
Palatability	Taste or likability of a feedstuff
Annuals	Plants that are seeded each year and whose growth are completed in one crop year
Perennials	Plants that have a life cycle of more than two years
Negative energy balance	Occurs when the amount of energy taken into the body is less than the amount of energy required by the body
Acid	A substance that has a low pH (below 7.0)
Alkaline	A substance that has a high pH (above 7.0)

SALIVA

Saliva is the major buffer for maintaining optimum rumen pH.

The mature dairy cow produces **50 to 80 quarts** of saliva per day.

The **functions** of saliva are to:

- Moisten food
- Lubricate food
- Act as a buffer
- Provide fluid base for many nutrients
- Provide the proper environment for bacterial growth

RUMINANT

The dairy cow is a **ruminant**, meaning it has a four-compartment stomach.

The **stomach compartments** are the reticulum, rumen, omasum, and abomasum.

RETICULUM

The reticulum is also known as the **honeycomb**.

The reticulum is the stomach compartment located **closest to the heart**.

Hardware disease occurs in the reticulum.

RUMEN

The rumen is also known as the **fermentation vat**.

The rumen is the largest of the cow's stomach compartments. It makes up 25% of the **newborn calf's stomach capacity** and 80% of the **mature cow's stomach capacity**.

Fermentation is the primary process that takes places in the rumen.

Bacteria, fungi, and protozoa are types of **organisms that live in the rumen** and digest feed.

Carbon dioxide and methane are **gases produced in the rumen**.

The **ideal rumen pH** is 5.9 to 6.2. The rumen is acidotic when rumen pH drops below 5.9.

OMASUM

The omasum is also called **manyplies**.

The main **function** of the omasum is the dehydration of partially digested feed.

ABOMASUM

The **abomasum** is the enzyme and acid secreting portion of the ruminant stomach.

The abomasum is also called the **true stomach**.

The **primary acid found in the abomasum** is hydrochloric acid.

SMALL INTESTINE

The **segments of the small intestine** are the duodenum, jejunum and ileum.

Fats are broken down in the small intestine.

The **liver** is the first organ to receive blood from the small intestine.

The **pancreas** secretes digestive enzymes into the small intestine.

LARGE INTESTINE

The **main functions** of the large intestine are water absorption and storage of waste materials.

NUTRIENTS

The **main processes for which a cow uses nutrients** from her feed are maintenance, growth, production and reproduction.

The **nutrients contained in feedstuffs** are carbohydrates, fats, protein, minerals, vitamins, and water.

ENERGY

Major sources of energy for the dairy cow are fats and carbohydrates.

Energy is most likely to be the limiting nutritional requirement for the high producing dairy cow.

A **calorie** is a unit of measure of energy in a feed; it is the amount of energy required to raise 1 gram of water 1°C.

FATS

Fats are the **most concentrated energy source** in dairy cattle rations. They contain **2.25 times the energy value of starch**.

The recommended **maximum level** of fat in a lactating cow's ration is 5 to 7% of ration dry matter.

The **forms of fat** used in dairy cattle rations include animal fats (tallow), protected fats (calcium soaps), and whole oil seeds (whole cottonseeds, whole soybeans)

Fatty acids are the building blocks of fats and lipids.

Saturated fatty acids are completely hydrogenated; each carbon atom is associated with the maximum number of hydrogen atoms. They have no double bonds.

Unsaturated fatty acids are not completely hydrogenated. They have one or more double bonds.

Whole oil seeds contain high levels of unsaturated fatty acids.

CARBOHYDRATES

The **basic elements** contained in carbohydrates are carbon, hydrogen, and oxygen.

Cellulose and hemicellulose are **structural carbohydrates** that the cow can use as a source of energy.

Starch, sugar, and pectin are **nonstructural carbohydrates** that are highly digestible parts of feeds.

VOLATILE FATTY ACIDS

Volatile fatty acids are the main products of carbohydrate digestion by rumen microorganisms.

The **main volatile fatty acids** produced in the rumen are acetic acid (acetate), butyric acid (butyrate), and propionic acid (propionate).

Acetic acid is the primary source of energy and milkfat.

Propionic acid is a precursor for glucose; it is produced from digestion of starch and grain.

PROTEIN

The **basic elements** that are present in all proteins are carbon, hydrogen, oxygen, and nitrogen.

Most proteins contain **16% nitrogen**.

To **determine the crude protein content** of a feed, multiply the nitrogen fraction by 6.25.

If a farmer said he was feeding a **16% dairy feed**, the 16% is referring to crude protein.

Proteins derived from poultry, marine or vegetable sources may be used in ruminant rations.

Proteins derived from ruminant sources may not be used in ruminant rations because of concerns about Mad Cow Disease.

AMINO ACIDS

There are **20 standard amino acids**.

The cow's **sources of amino acids** are rumen undegradable protein and rumen microbes.

Amino acids are classified as essential or nonessential.

Essential amino acids must be provided in the diet. The **ten essential amino acids** for milking cows are:

- Arginine
- Histidine
- Isoleucine
- Leucine
- Lysine
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine

The **most limiting amino acids** in dairy cattle nutrition are lysine and methionine.

Nonessential amino acids are produced by the cow and do not have to be provided in the diet.

MINERALS

Macrominerals are generally required in **relatively large quantities**. Requirements are usually stated as a **percent of ration dry matter**. The macrominerals are:

- Calcium
- Magnesium
- Potassium
- Sulfur
- Chlorine
- Phosphorus
- Sodium

Potassium is the mineral needed by the dairy cow in the largest quantity.

Microminerals (trace minerals) are required in **relatively small quantities**. Requirements are usually stated in **parts per million (ppm)**. The microminerals are:

- Cobalt
- Iodine
- Manganese
- Zinc
- Copper
- Iron
- Selenium

VITAMINS

Vitamins are classified as either fat-soluble or water-soluble.

The **fat-soluble vitamins** are Vitamin A, Vitamin D, Vitamin E, and Vitamin K.

Beta-carotene, found in most legumes and grasses, is a precursor of Vitamin A.

Vitamin E has functions similar to selenium.

Vitamin K plays a role in the coagulation of blood.

The **water-soluble vitamins** are the B complex vitamins and Vitamin C.

The **B Complex vitamins** are:

- Thiamine (B1)
- Niacin (B3)
- Biotin (B7)
- Choline
- Riboflavin (B2)
- Pantothenic Acid (B5)
- Folic Acid (B9)
- B12

Vitamin C is also known as ascorbic acid.

Vitamins are measured in **International Units (IU)**.

WATER

An average dairy cow drinks **30 to 50 gallons** of water each day.

Performance (growth or milk production) will be reduced the quickest through a lack of water as compared to other nutrients.

A dairy cow **excretes or loses water** through breathing, feces, milk, sweat, and urine.

Factors influencing the amount of water consumed by dairy cattle include:

- Body size
- Water quality
- Diet
- Environmental temperature
- Relative humidity
- Milk production
- Water temperature

Peak times for water consumption are as soon as cows leave the milking parlor and when cows consume large amounts of dry matter (at feeding).

Physiological functions of water in the body include:

- A medium to transport nutrients
- Functions as a universal solvent
- Serves as a fluid to lubricate joints
- Serves as a fluid base for milk
- To carry waste products to the point of excretion
- To cool the body at high environmental temperatures
- Serves as a substrate for metabolic reactions

NUTRIENT REQUIREMENTS

Many factors are required to determine **nutrient requirements of a lactating cow** including:

- Body weight
- Age
- Milk production level
- Fat test
- Stage of lactation
- Reproductive status
- Body condition
- Environmental temperature

LEGUMES

Legumes used in dairy rations include:

- Alfalfa
- Bird's Foot Trefoil
- Clover
- Lespedeza
- Peanuts
- Peas
- Soybeans
- Vetch

Nitrogen fixing bacteria are associated with legumes.

Phosphorus is critical for the establishment of legumes.

HAY

Immature hay is more valuable as a feed for dairy cows than mature hay because of:

- Higher nutrient content
- Higher digestibility
- Greater palatability
- Lower fiber

Relative feed value (RFV) combines digestibility and intake estimates into one number for an easy and effective way to identify and market quality hay. RFV is expressed as a percent compared to full bloom alfalfa at 100 percent RFV.

SILAGE

Phases of silage fermentation are aerobic, anaerobic, stable, and feeding.

Types of silage storage facilities include:

- Bunker silo
- Trench silo
- Upright/tower silo
- Plastic bag
- Oxygen limiting silo

The **minimum recommended feeding rate** from an upright silo is 2-4 inches per day in the winter and 4-6 inches per day in the summer. It is at least 6 inches per day for bunker silos.

Plastic is generally considered the best material for covering a bunker silo.

Even distribution of silage within the silo to exclude air is an important part of making good quality silage.

Valuable **nutrients that can be lost in seepage** from a silo are minerals, organic acids, protein, and soluble sugars.

Lactic acid is the most desirable acid produced during ensiling. **Butyric acid** is an undesirable acid.

Heat damage in haylage is indicated by dark color and burnt odor.

CORN SILAGE

Corn silage has the best fermentation and preservation characteristics with minimal seepage when harvested at **35% dry matter**.

The **desired pH** or properly fermented corn silage is 4.0 or less.

Cold flow ammonia may be added to corn silage to increase the crude protein content.

Kernel processing of corn silage increases starch digestibility.

The recommended **theoretical length of cut (TLC)** for corn silage harvested with a conventional harvester is ⅜ inch. If harvested with a harvester fitted with a kernel processor, TLC should be ¾ inch.

Characteristics of corn that have been introduced through **transgenics** include:

- Corn borer resistance
- Herbicide resistance
- High oil content
- Waxy corn

Bt corn hybrids were genetically engineered to provide resistance to the European corn borer.

Brown midrib corn varieties have lower lignin concentrations, which increase fiber digestibility.

FORAGE TESTING

Forage testing is the most reliable way of knowing the nutrient content of forages.

Forage testing **methods** include NIR and wet chemistry.

A **forage analysis report** commonly contains:

- Dry matter
- Crude protein
- Soluble protein
- Total digestible nutrients
- Net energy lactation
- Acid detergent fiber
- Neutral detergent fiber
- Ash (mineral matter)

When **sampling square bales of hay** for forage testing, 20 bales should be sampled.

A **dry matter** determination may be done quickly and easily on a forage sample at home using a microwave oven, gram scale, paper plate and water glass.

FIBER

Fiber is needed in dairy cattle rations to:

- Maximize dry matter and energy intakes
- Maintain normal rumen function
- Maintain normal milkfat percentage
- Protect against post-calving difficulties

Digestibility of plant fiber decreases as the plant increases in age and/or in hot weather.

Acid detergent fiber (ADF) consists of cellulose, lignin, and lignified nitrogen components (heat damaged protein).

The **acid detergent fiber** content of a high producing cow's ration should be 18-21%.

Neutral detergent fiber (NDF) is used to predict feed intake. The compounds that make up neutral detergent fiber (NDF) are cellulose, hemicellulose, and lignin.

FORAGE PARTICLE SEPARATOR

A forage particle separator can be used to:

- Evaluate whether there is enough long fiber in the ration
- Check for over mixing and particle size reduction
- Develop baseline particle size information for comparison
- Check ration uniformity
- Determine optimum mixing order
- Evaluate whether particle size changes with hay quality
- Check for sorting

MINERAL SUPPLEMENTS

Common **mineral supplements** include:

- Dicalcium phosphate
- Limestone
- Magnesium oxide
- Monocalcium phosphate
- Potassium chloride
- White salt

Limestone is an excellent source of calcium.

BUFFERS

Reasons one might add buffers to a dairy cow's ration include:

- Increase fat test
- Aid in adjusting to high-energy ration
- Improve milk quality
- Improve digestibility
- Maintain acid-base balance
- Improve intake

Buffers commonly used in dairy rations include:

- Limestone (calcium carbonate)
- Magnesium oxide
- Sodium bentonite
- Sodium bicarbonate

DIETARY CATION-ANION DIFFERENCE

Dietary Cation-Anion Difference (DCAD) is a helpful tool to prevent milk fever.

The **elements** used to calculate DCAD are Sodium (+), Potassium (+), Chlorine (-), and Sulfur (-).

Ionic salts are used in pre-fresh cow rations to help prepare cows for the sudden demand for blood calcium. Examples are:

- Ammonium chloride
- Ammonium sulfate
- Calcium chloride
- Calcium sulfate
- Magnesium chloride
- Magnesium sulfate

IONOPHORES

Ionophores alter rumen fermentation by boosting the production of propionic acid and reducing the production of acetic acid. Examples are Lasalocid and Monensin. Monensin is approved for use in lactating dairy cattle, but Lasalocid is not.

BY-PRODUCT FEEDS

By-products can be successfully used as feed for dairy cattle. Before including a byproduct in the ration, the following factors should be considered:

- Nutrient composition
- Cost
- Availability
- Palatability
- Storage
- Consistency
- Ability to feed/use

By-product feedstuffs include:

- Cottonseed hulls
- Dried brewers grain
- Soybean hulls
- Cottonseed meal
- Hominy feed
- Soybean meal
- Distillers grains
- Peanut meal
- Wet brewers grain
- Wheat middlings
- Whole cottonseed

TOTAL MIXED RATION

Advantages of feeding a TMR include:

- Eliminate selective feeding
- Consistent ration
- High dry matter intake
- Free-choice mineral not needed
- Higher milk production
- Lower percent fiber needed in ration
- Easier to balance precisely
- Fewer digestive upsets
- Can feed a variety of by-products

GROUPING

When **grouping the milking herd**, several factors may be considered including:

- Body condition
- Lactation number
- Production level
- Reproductive status
- Stage of lactation
- Health

BODY CONDITION SCORING

Body condition scoring, based on a five-point scale, can be used to evaluate nutrition and health. A score of 1 is given to a very thin cow; a score of 5 is given to a very fat cow.

Targets for body condition scores at different stages of lactation are:

At calving 3.0-3.25
Early lactation.....2.5
Mid lactation.....2.75
Late lactation.....3.0
At drying off.....3.0-3.25

GRAZING

The most common **reason that farm owners adopt grazing** is cost reduction. The main **costs cited for reduction** are feed and labor.

Advantages of intensive rotational grazing include:

- Low input costs
- Low labor requirement
- Even manure distribution
- Reduced soil erosion
- Improved weed control

Disadvantages of grazing include:

- Inconsistent quality
- Inconsistent quantity
- Unable to balance ration properly
- Lower forage yield per acre
- Distance from parlor

MISCELLANEOUS

A mature dairy cow has 32 **teeth**, but has no upper front teeth.

Feed is the largest cost in milk production.

Molasses are often added to dairy cattle rations to improve taste (palatability) and reduce dustiness.

Raw soybeans will turn rancid if they are ground.

Peak milk production usually occurs 2-3 weeks before peak feed intake.

Milk urea nitrogen (MUN) shows how well nitrogen and fermentable carbohydrates are balanced in the ration.

Chapter 7: Lactation and Milking Management

ACRONYMS	
BST	Bovine somatotropin
BTMC	Bulk tank milk culture
BTSCC	Bulk tank somatic cell count
CFM	Cubic feet per minute
CIP	Clean in place
CMT	California mastitis test
CNS	Coagulase-negative staphylococci
DMSCC	Direct microscopic somatic cell count
IGF	Insulin-like growth factor
IMI	Intramammary infection
rBST	Recombinant bovine somatotropin
SCC	Somatic cell count
SCS	Somatic cell score
WMT	Wisconsin mastitis test

DEFINITIONS	
Alveoli	Spherical clusters of secretory cells in the mammary gland that are arranged in grape-like structures
Myoepithelium	Contractile tissue that forces milk out of the alveoli upon action of oxytocin
Keratin	Waxy substance produced by cells lining the teat canal that serves as a plug between milkings and aids in reducing penetration by microorganisms
Strutting	Condition in which the teats point out too much
Supernumerary teats	Extra teats
Lactation	Period of time when a cow is in milk
Liner slip	Condition whereby a teat cup slides down the surface of the teat, often accompanied by a squawk
Milkline	Line that carries milk and air during milking and has the dual function of providing milking vacuum and conveying milk to a receiver
Looped milkline	Milkline that forms an enclosed circuit with two full-bore connections to the receiver
Lowline (or low-level) milking system	System in which the milk inlet to the milkline or receiver jar is below the animal standing level
Washline	Line that carries cleaning and sanitizing solutions during the cleaning process from the wash sink, vat or tank to the milking units, milkline or milking vacuum line

Milk meter	Device between the cluster and the milkline for measuring all the milk from an individual animal
Sanitary trap	Vessel between the milk system and the air system to limit movement of liquids and other contaminants between the two systems
Pulsation	The cyclic opening and closing of a teat cup liner
Pulsator	The part of the milking system that causes the alternate vacuum pressure between the teat cup shell and liner
Alternating pulsation	When cyclic movement of the liners of two teat cups within a cluster alternates with the movement of the other two liners
Pulsation rate	The number of times per minute that the pulsator opens and closes
Pulsation ratio	The amount of time a pulsator creates vacuum to open the liner compared with the amount of time it admits air to collapse the liner
Vacuum pump	An air pump that produces vacuum in the milking system
Vacuum gauge	An instrument to indicate the level of vacuum in the system, relative to atmospheric pressure
Vacuum regulator (Vacuum controller)	The part of the milking system that prevents the vacuum level from exceeding a prescribed level
Bulk tank	Large storage tank for cooling and storing milk at a cold temperature until it is transported to a processing plant; usually made of stainless steel
Agitator	Stirs milk in the bulk tank to help with cooling and to provide a uniform product mixture for sampling
Sanitizer	Chemical solution used to kill bacteria on product contact surfaces
Backflushing	System for sanitizing teat cup liners between cow milkings
Clean-in-place (CIP)	Capability to clean and disinfect the milk-contact components of a milking system by circulating appropriate solutions through them without disassembly
Air injector	Device that allows controlled, cyclic admission of air during cleaning and sanitizing to produce slug flow conditions
Milk stone	Milk-mineral deposit on milk handling equipment
Forestripping	Process by which the first few streams of milk are removed from the teat prior to milking to observe for abnormalities and to flush the teat canal
Foremilk	First streams of milk stripped from the udder prior to milking
Milk letdown	Process through which milk is squeezed out of milk-producing tissue by the action of the hormone, oxytocin
Residual milk	Milk remaining in the mammary gland following completion of milking
Mastitis	An inflammation of the udder, most commonly caused by infecting microorganisms
Inflammation	Condition in which the cow's body seeks to eliminate or neutralize invading microorganisms and repair damaged tissue.
Intramammary infection	Infection characterized by the presence of microorganisms growing in the udder
Subclinical mastitis	Mastitis with no detectable change in the udder itself and no observable abnormality of the milk

Clinical mastitis	Mastitis characterized by visible abnormalities in the udder or milk
Acute mastitis	Mastitis characterized by sudden onset, redness, swelling, hardness, pain, grossly abnormal milk, and reduced milk yield
Chronic mastitis	Mastitis that continues over a long period of time, with progressive development of scar tissue and simultaneous reduction in milk yield
Ropy milk	Milk that contains strings of white blood cells
Spontaneous recovery	Ability of a cow to cure itself of an udder infection without the aid of antibiotics or other drugs
Somatic cell count (SCC)	Measurement most commonly used as an indicator of mastitis; an indicator of the extent of subclinical mastitis present in a cow's udder or number of leukocytes present
Involution	Process by which udder tissue goes back to a non-milk-producing state after drying off
Stray voltage	Small electric currents that flow through the electrical grounded-neutral system and that pass through a cow's body, adversely affecting her behavior and performance

HORMONES

Adrenaline (epinephrine) can interfere with milk ejection when a cow becomes frightened or upset.

Oxytocin is the hormone that causes milk letdown. It is produced by the hypothalamus, but secreted from the posterior pituitary. Maximum oxytocin concentration in blood occurs one minute after beginning stimulation.

Prolactin is the pituitary hormone that is critical in the initiation and maintenance of lactation.

Estrogen and progesterone are **ovarian hormones** that are involved in the development of the mammary gland.

MILK PRODUCTION

The **parts of the teat** through which milk passes are the teat cistern, sphincter muscle, and streak canal (teat canal).

Cows milked three times a day will normally produce 8 to 15 percent more milk than cows milked twice a day.

Cows calving in November, December, and January have the highest **305-day milk production**.

MILKING FACILITIES

Types of milking parlors include herringbone, parallel, parabone, rotary, and side opening.

The **herringbone parlor** is the most common type in use today.

Automatic milking systems milk cows without human labor. Other names for automatic milking systems are voluntary milking systems and robotic milking.

MILKING EQUIPMENT

Parts of a milking unit include the claw, teat cup shell, teat cup liner (inflation), milk tube, and short air tube.

Teat cup liners (inflations) should generally be replaced every 1,000 – 1,200 cow milkings.

Specifically, the **teat cup liner (inflation)** is the only part of the milking system that touches the cow.

Signs of a **malfunctioning milking system** include:

- Excessive vacuum fluctuation
- Teat cups fall off
- Squawking teat cups
- Slow milking
- Flooded milk lines
- Uneven milk flow

A **liner slip** may be caused by:

- Improper liner design
- Cluster weight
- Vacuum fluctuations
- Milking wet teats

Vacuum pressure at the teat end at the time of milking should be 12 to 13 inches of mercury.

CLEANING EQUIPMENT

A standard milking **equipment cleaning protocol** consists of four phases:

1. Pre-rinse
2. Chlorinated alkaline cleaning
3. Acid rinse
4. Sanitization

The key factors for **adequate, effective cleaning** of milking systems are contact time, water temperature, and chemical concentration.

Recommended temperature of water for washing the bulk tank, lines, and other equipment is 160°F.

Dirty equipment is most frequently the cause of high bacteria counts in milk.

MILKING PROCEDURES

The **recommended milking procedures** are:

1. Provide a clean, low stress environment for cows.
2. Check foremilk and udder for mastitis.
3. Pre-dip teats in an effective product and provide a 20 to 30-second contact time.
4. Dry teats completely with an individual towel.
5. Attach milking unit within 1 minute after the start of stimulation.
6. Adjust units as necessary for proper alignment.
7. Shut off vacuum before removing unit.
8. Dip teats immediately after unit removal with an effective product.

Consequences of long pre-milking stimulation include:

- Lower production
- Slower milking time
- Higher somatic cell count (mastitis problems)

CLOTH TOWELS

When using **cloth towels** in udder preparation, the following guidelines are recommended:

- Use a separate towel for each cow.
- Wash cloth towels using warm water.
- Do not let damp towels sit between uses because of yeast or mold contamination.
- Dry towels immediately after washing or add bleach when washing.

TEAT DIPS

When using a teat dip as a **pre-dip**, the dip should be left on the teat for at least 20 to 30 seconds before it is wiped off.

The main **reason for teat dipping after each milking** (post-dipping) is to reduce the rate of new infection in the udder.

Solutions commonly used as teat dips include:

- Bronopol
- Chlorhexidine
- Chlorine
- DDBSA
- Hydrogen peroxide
- Iodine
- Quaternary ammonia

MASTITIS

The **major factors** involved in bovine mastitis are the cow, microorganisms, and environment.

Mastitis is the most costly disease in dairy cattle. **Economic losses** due to mastitis are estimated to be about $200 per cow per year.

Mastitis-related costs include:

- Reduced milk production (64%)
- Discarded milk (14%)
- Early cow replacement cost (8%)
- Reduced cow sale value (5%)
- Drugs (5%)
- Veterinarian (3%)
- Labor (1%)
- Lost milk premiums (variable)

The **main types of mastitis** are subclinical mastitis, clinical mastitis, acute mastitis, and chronic mastitis.

Symptoms of clinical mastitis include:

- Flakes
- Clots
- Stringy milk
- Watery milk
- Hot quarter
- Swollen quarter
- Presence of blood

The California Mastitis Test, conductivity, and strip cup are **on-farm screening tests** to detect mastitis.

Potential causes of mastitis include:

- Failure to teat dip
- Faulty milking equipment
- Improper dry cow management
- Poor housing/environment
- Poor milking practices
- Poor sanitation
- Stray voltage

Steps in a **good mastitis control program** are:

- Use functionally adequate milking equipment in the correct manner.
- Dip teats after milking with an effective product.
- Treat clinical cases immediately with recommended dosages.
- Treat every quarter of every cow at dry off with an effective dry cow product.
- Cull chronic cows.

The most effective **measures to prevent new mastitis infections** are teat dipping and dry cow antibiotic treatment.

The **streak canal (teat canal)** is the cow's first line of defense against mastitis infections; **leukocytes** are the second natural line of defense.

SOMATIC CELLS

High numbers of **somatic cells** in milk are generally an indicator of infection (mastitis).

Somatic cells include two **types of cells**:

- White blood cells (leukocytes) that move into the udder during inflammation
- Epithelial cells from milk producing tissues

Normal milk generally has a SCC less than 200,000 cells/milliliter.

The legal limit for **somatic cell counts in raw milk** in the United States is 750,000 cells/ml. The limit in the European Community is 400,000 cells/ml.

U.S. milk and milk products exported to European Union member countries must have a rolling average somatic cell count less than 400,000 cells/ml.

MASTITIS-CAUSING PATHOGENS

Culturing milk samples (on-farm or in a lab) can provide information for mastitis prevention, treatment and control by identifying the mastitis-causing pathogen.

Contagious mastitis-causing pathogens are those growing in the udder that are spread from cow to cow. Examples include:

- *Staphylococcus aureus (Staph. aureus)*
- *Mycoplasma* species
- *Streptococcus agalactiae (Strep. ag.)*

Environmental mastitis-causing pathogens grow in the cow's environment and contact the udder and teats causing infection. They include bacteria classified as coliforms or environmental Streptococci.

Coliforms include:

- Escherichia coli (E. coli)
- Enterobacter species
- Klebsiella species

Environmental Streptococci include:

- Streptococcus dysgalactiae
- Streptococcus uberis

Many **other pathogens** may cause mastitis including other bacteria, fungi, and yeast.

ENVIRONMENT

Factors affecting the dairy cow's environment are:

- Climate
- Herd size
- Frequency and duration of confinement housing
- Season of year
- Housing type
- Management of cows and facilities

Sources of environmental bacteria in dairy herds are:

- Soil
- Bedding
- Mud
- Water
- Feedstuffs
- Feces

MILK QUALITY AND COMPOSITION

The legal limit for **bacteria counts in raw milk** in the U.S. is 100,000 cfu/ml.

Sources of **on-farm milk contamination** include:

- Air (dust)
- Dirt (outside of the cow)
- Feed
- Interior of udder
- Antibiotics
- Equipment
- Insects
- Water

Factors that can **influence milk composition** include:

- Age of cow
- Somatic cell count
- Milking procedures
- Environmental temperature
- Breed
- Season
- Genetics
- Estrus
- Stage of lactation
- Nutrition

Conditions that will cause a **decrease in fat test** include:

- Finely chopped feeds
- Extremely hot weather
- Estrus
- Low fiber content in ration
- Illness

Mastitis has an effect on **milk composition**.

Components that decrease in concentration in mastitic milk are:

- Lactose
- Solids not fat
- Calcium
- Total proteins
- Total solids
- Phosphorus
- Casein
- Fat
- Potassium

Components that increase in concentration in mastitic milk are:

- Lipase
- Chloride
- Leukocytes
- Sodium
- Immunoglobulins
- Trace Minerals

DRY PERIOD

The traditionally **recommended length of the dry period** for dairy cows is 45 to 60 days.

The most **effective time to treat mastitis infections** is at drying off.

The **purposes of dry cow antibiotic treatment** are to remove existing infections and prevent new infections.

Reasons to **treat every quarter of every cow** at drying off are:

- Higher concentration of antibiotics (than lactating products)
- Antibiotics remain longer
- No discarding of saleable milk
- Prevent new infections

Chapter 8: Dairy Products and Milk Marketing

ACRONYMS	
ADV	Acid degree value
CFU	Colony forming units
CLA	Conjugated linoleic acid
COOL	Country of Origin Labeling
CWT	Cooperatives Working Together
DIPP	Dairy Indemnity Payment Program
GATT	General Agreement on Tariffs and Trade
HACCP	Hazard Analysis and Critical Control Points
HTST	High temperature, short time
MPP-Dairy	Margin Protection Program for Dairy
NAFTA	North American Free Trade Agreement
NFDM	Non fat dry milk
NOP	National Organic Program
PI	Preliminary incubation
PMO	Pasteurized Milk Ordinance
RDA	Recommended Daily Allowance
SNF	Solids not fat
SPC	Standard plate count
TS	Total solids
UF	Ultrafiltration
UHT	Ultra high temperature

DEFINITIONS	
Raw milk	Milk as it comes from the cow prior to processing
Casein	The primary protein found in milk
Lactose	Milk sugar that gives milk its sweet flavor
Lactase	Enzyme needed by humans to digest lactose
Lactose intolerance	Condition when a person cannot break down milk sugar
Acid degree value	Test that detects rancidity in milk
Cryoscope	Instrument used to test the freezing point of milk to determine if water has been added
Standard place count	Test that measures bacterial content of raw milk to monitor milk quality
Phosphatase test	Test used to determine if raw milk has mixed with pasteurized milk
Lipase	Enzyme that breaks down butterfat, leading to rancidity
Clarification	Process that removes solid impurities from milk prior to pasteurization

Separation	Process of dividing milk into skim milk and cream
Standardization	Process that assures that milk and dairy products will be uniform in protein and fat content
Pasteurization	Process that destroys any disease-producing bacteria that might be present in raw milk
Fortification	Process by which vitamins are added to milk
Hazard Analysis and Critical Control Points	System of quality control that identifies where mistakes often occur
Churning	Process that turns cream into butter
Rennet	Substance containing many enzymes that is obtained from the lining of a calf's stomach
Rennin	Enzyme found in rennet that is used to coagulate protein (casein) when making cheese
Whey	Fluid by-product of cheese making.
Cream	High fat milk product separated from milk
Cultured dairy products	Dairy foods that have been fermented with lactic acid bacteria
Milk class	Describes how milk is used by the processor or in a marketing area
Fluid milk	Packaged dairy products used as beverage milks
Fluid products	Term traditionally used to define products including beverage milks, fluid cream items, and yogurts
Fluid utilization	Proportion of Grade A milk in a market used to produce fluid (Class I) milk
Manufacturing milk	Grade B milk or the Grade A milk used in the production of manufactured dairy products
Manufacturers	Producers of cheese, butter, nonfat dry milk, and other storable dairy products
Processors	Firms that process raw Grade A milk into fluid products.
Mailbox milk price	Price for milk of average composition and is a weighted average for the market; accounts for all **payments** received for milk including performance bonuses and premiums; also accounts for all **deductions** such as promotion, hauling, capital retains, and cooperative dues

MILK

Milk is nature's most nearly perfect food.

Milk is **96-98% digestible**.

Animals other than the cow are also used to produce **milk for human consumption** throughout the world. These animals include the goat, sheep, camel, water buffalo, reindeer, horse, and yak.

Cow's milk consists of 87.4% water and 12.6% milk solids.

Milk solids can be divided into solids-not-fat (8.9%) and fat (3.7%).

Components of the **solids-not-fat** part of milk are protein (3.4%), lactose (4.8%), and minerals (0.7%).

The **minimum total solids-not-fat content** in the legal definition of milk is 8.25%.

PROTEIN

Milk contains **casein** and **whey proteins**.

Milk taste improves as the protein level in milk increases.

LACTOSE

Lactose is the major solids component of milk.

The **simple sugars** that make up lactose are glucose and galactose.

VITAMINS AND MINERALS

Vitamin D is added to milk at processing time to prevent rickets. It is essential for efficient use of calcium and phosphorus in bone growth.

Reduced fat (2% fat), lowfat (1% fat), and skim milk must be **fortified with Vitamin A** to be nutritionally similar to whole milk.

The **minerals** found in milk that are **important in bone growth** are calcium and phosphorus.

CONJUGATED LINOLEIC ACID

Conjugated linoleic acid (CLA) is an 18-carbon fatty acid present in milk, particularly from cows grazing pasture, which has been found to have cancer prevention effects.

CLA content is greater in higher fat products.

MILK QUALITY

The **expiration date** on a milk carton is a customer's assurance of a fresh dairy product.

The **"Real Seal"** assures the customer that the product they are purchasing is a genuine dairy product.

Advantages of high quality milk from a processor's point of view include:

- Improved flavor
- Long shelf life
- Increased cheese yield
- Reduced hauling and handling costs due to low quality milk not having to be diverted to an alternative use

Advantages of high quality milk from a dairy producer's point of view include:

- Greater profitability
- Increased milk yield
- Low culling rates
- Low treatment costs
- Reduced labor and labor cost
- Larger milk checks due to improved milk per cow and premiums

ON-FARM MILK STORAGE

A **bulk tank** should be washed and sanitized every time it is emptied.

Grade A raw milk must be cooled to **45°F or less** within two hours after milking.

After the first milking, the temperature of milk in a bulk tank should not reach higher than **50°F** at any time.

Milk temperature should be kept under **40°F** to maintain the best quality.

MILK QUALITY TESTS

Raw milk quality tests used by milk plants include:

- Acid degree value
- Antibiotic test
- Flavor
- Freezing point
- Leukocyte (somatic cell) count
- Preliminary incubation (PI) count
- Sediment test
- Standard plate count

OFF-FLAVORS

Common off-flavors in milk are:

- Acid
- Bitter
- Cooked
- Feed
- Fermented
- Foreign
- Fruity
- Lacks freshness
- Oxidized
- Rancid
- Salty
- Sour

Off-flavors in milk are most commonly found in the **butterfat** component.

An **oxidized flavor** can result from exposing milk to:

- Sunlight or fluorescent lighting (Light-oxidized)
- Copper bearing surfaces (Metal-oxidized)

Pigmented milk cartons are used to prevent an oxidized flavor.

A **sour** flavor occurs when there are large numbers of bacteria present in milk.

ANTIBIOTIC RESIDUES

Antibiotic residues are not allowed in milk for human consumption. Reasons for this regulation include:

- Some people are allergic to antibiotics. (Main reason)
- Milk that contains antibiotic residues is not good for cheese making.
- Bacteria may become resistant to antibiotics.
- Antibiotics are not a natural part of milk.

PASTEURIZATION

Pasteurization increases the shelf life of milk by substantially reducing the total bacteria population.

Pasteurization destroys lipase and other natural milk enzymes, which might cause off-flavor in milk during refrigerated storage.

The **batch or holding method** of pasteurization heats milk to 145°F for not less than 30 minutes.

The **high temperature, short time method** of pasteurization heats milks to 161°F for 15 seconds.

BEVERAGE MILKS

Milk is **labeled** according to the following standards:

Label	Other Names	Grams of fat per cup	Calories per cup
Fat free	Nonfat, skim	0	80
Lowfat	1% fat	2.5	100
Reduced fat	2% fat	5	120
Whole		8	150

Titanium dioxide is often added to fat free milk to whiten the milk.

BUTTER

It takes **21.2 pounds of whole milk** to make a pound of butter.

Butter must contain a minimum of **80% fat**.

U.S. Grade AA is the highest grade of butter sold in the U.S.

One stick of butter = 1/2 cup = 1/4 pound = 8 tablespoons

CHEESE

It takes **10 pounds of whole milk** to make a **pound of cheese**.

The **protein content** of milk most affects the amount of cheese one can get from a unit of milk.

The major **components** of dried whey are lactose, minerals, and protein.

Cheese is **classified according to its consistency**. The classes are soft, semi-soft, hard, and very hard.

Mozzarella cheese is the most popular variety of cheese in the United States. **Cheddar** is second most popular.

Feta and Roquefort are cheeses made from the milk of animals other than the dairy cow.

CREAM

Cream must contain at least 18% milk fat.

Cream varieties include:

- Half & half
- Light cream
- Cream in aerosol cans
- Reduced-fat sour cream
- Sour half & half
- Light whipping cream
- Sour cream
- Acidified sour half & half
- Heavy cream
- Acidified sour cream

FROZEN DAIRY PRODUCTS

Frozen dairy products include ice cream, frozen custard, sherbet, and frozen yogurt.
It takes **12 pounds of whole milk** to make a **gallon of ice cream**.

Federal standards require ice cream to contain a **minimum of 10% milk fat** and **20% total milk solids** by weight.

Some **premium ice creams** contain 16% milk fat.

CULTURED DAIRY PRODUCTS

Cultured dairy product examples include:

- Acidophilus milk
- Kefir
- Buttermilk
- Sour cream
- Crème fraîche
- Yogurt

Yogurt is a mixture of milk (whole, reduced-fat, lowfat, or nonfat) and cream fermented by a culture of lactic acid-producing bacteria. Yogurt contains at least 3.25% milk fat and 8.25% solids-not-fat.

Authentic **Greek yogurt** is made by straining yogurt using muslin or cheesecloth to remove whey from the yogurt to make it creamy and thick. It takes four pounds of milk to make one pound of authentic Greek yogurt.

FEDERAL MILK MARKETING ORDERS

The **Agricultural Marketing Agreement Act of 1937** provided for **Federal Milk Marketing Orders**.

The **Secretary of Agriculture** regulates Federal Milk Marketing Orders.

The **federal orders** specify minimum prices and conditions under which regulated milk handlers must operate when selling fluid milk products within a specified geographic area.

There are **ten** Federal Milk Marketing Orders in the Unites States. **Component pricing** is used in **six** of the orders.

The **current Federal Milk Marketing Orders** are:

- Appalachian
- Arizona
- Central
- Florida
- Mideast
- Northeast
- Pacific Northwest
- Southeast
- Southwest
- Upper Midwest

MILK CLASSES

Federal Milk Marketing Orders have four **milk classes** based on how milk is used by the processor or in a marketing area.

Class I	Beverage milks
Class II	Fluid cream products, yogurt, and manufactured products (ice cream, cottage cheese)
Class III	Cream cheese and hard manufactured cheese
Class IV	Butter and milk in dried form

MILK GRADES

Fluid grade (Grade A) milk is milk produced under sanitary conditions that qualify it for fluid consumption. Only Grade A milk is regulated under Federal Milk Marketing Orders.

The **Pasteurized Milk Ordinance (PMO)** is the document that establishes the standards for Grade A milk.

Manufacturing grade (Grade B) milk is milk not meeting the fluid grade standards. Less strict standards generally apply.

MILK COOPERATIVES

The **top five milk producing cooperatives** in the U.S. based on member milk volume in 2015 were:

1. Dairy Farmers of America
2. California Dairies, Inc.
3. Land O'Lakes, Inc.
4. FarmFirst Dairy Cooperative
5. Northwest Dairy Association

The **top 50 cooperatives** accounted for 80 percent of the milk produced in the U.S. in 2015.

COOPERATIVES WORKING TOGETHER

Cooperatives Working Together (CWT) is a dairy farmer-funded self-help program to address supply and demand imbalances that can depress milk prices. The CWT program focuses on providing export assistance.

CWT is operated within the structure of the **National Milk Producers Federation**.

CWT's **funding** comes from farmers who invest 4 cents per hundredweight of milk sold.

ORGANIC DAIRY PRODUCTION

Organic dairy production is a method of production that uses:

- No hormones to promote growth
- No antibiotics
- No mammalian or poultry by-products in feed
- 100% organic feed

California ranks first among the states for the number of **organic dairy cows**.

USDA's **National Organic Program (NOP)** regulates the standards for any farm, wild crop harvesting, or handling operation that wants to sell an agricultural product as organically produced.

NOP standards for organic livestock production require access to pasture throughout the grazing season and a diet consisting of at least 30% dry matter intake from pasture grazed during the grazing season, totaling at least 120 days.

DAIRY PROMOTION

Fifteen cents per hundredweight of milk sold are deducted from every dairy producer's milk check to pay for promotion and research through the **dairy checkoff**.

Started in 1937, **June Dairy Month** was originally called National Milk Month. The American Dairy Association is the national leader for June Dairy Month.

National Grilled Cheese Month is observed in April.

National Ice Cream Month is observed in July.

The **dairy case** is usually placed at the rear of the store because it causes shoppers to walk past many other products in order to get to the dairy case, which increases impulse buying.

The **"Got Milk?"** campaign was first used by California milk processors in 1993. It was retired by MilkPEP in 2014 and was replaced by the **"Milk Life"** tagline.

DAIRY PRODUCT CONSUMPTION

As a person's age increases, his/her **milk consumption** tends to decrease.

McDonald's is the fast food chain that uses the most milk in the U.S.

Milk is the victory drink at the Indianapolis 500 each year.

DIETARY GUIDELINES

According to the *2015 Dietary Guidelines for Americans*, the following amounts of dairy are recommended in the Healthy U.S.-Style Pattern:

For children ages 2 to 3 years: 2 cup-equivalents per day

For children ages 4 to 8 years: 2 ½ cup-equivalents per day

For adolescents ages 9 to 18 years and adults: 3 cup-equivalents per day

MyPlate is an illustration of the five food groups in a place setting based on the *2010 Dietary Guidelines for Americans*; it is designed to help consumers make healthier food choices.

Chapter 9: Miscellaneous

ACRONYMS

CTAP	Current Test Day Analysis Program
DCR	Data collection rating
DIM	Days in milk
ECM	Energy corrected milk
ERPA	Estimated relative producing ability
FCM	Fat corrected milk
ME	Mature equivalent
PCDART	Personal Computer Direct Access to Records by Telephone
RIP	Record in progress
SMV	Slow moving vehicle
TQM	Total quality management

WEIGHTS AND MEASURES

Item	Weight
A gallon of milk	8.6 pounds
A quart of milk	2.15 pounds
A bushel of corn	56 pounds
A bushel of wheat	60 pounds
A bushel of barley	48 pounds
A bushel of oats	32 pounds
A bushel of soybeans	60 pounds
A hundredweight (cwt)	100 pounds
A kilogram	2.2 pounds

U.S. DAIRY INDUSTRY AT A GLANCE IN 2016

Number of licensed dairy farms	41,809
Number of dairy cows*	9.3 million
Milk per cow per year	22,774 pounds
Milk production	212.4 billion pounds

*The number of dairy cows reached its peak in 1945.

STATE RANKINGS FOR DAIRY PRODUCTION IN 2016

Total milk production	1) California 2) Wisconsin 3) New York 4) Idaho 5) Michigan
Number of dairy cows	1) California 2) Wisconsin 3) New York 4) Idaho 5) Pennsylvania
Milk per cow	1) Colorado 2) Michigan 3) Idaho 4) New Mexico 5) Arizona
Cows per herd	1) New Mexico 2) Arizona 3) Nevada 4) Colorado 5) California

STATE RANKINGS FOR FORAGE PRODUCTION IN 2016

Corn silage production	1) Wisconsin 2) Minnesota 3) California 4) New York 5) Iowa
Alfalfa production	1) Wisconsin 2) California 3) Idaho 4) Minnesota 5) South Dakota

DHIA

The **standard length of a DHIA record** is 305 days.

The meaning of "**305-2X-ME**" on dairy records is that the lactation record was adjusted to a 305-day lactation, twice a day milking, mature equivalent.

If one sees "**3X**" in a dairy animal's production records, it means the cow was milked three times a day.

A DHIA record may be **terminated** if a cow has dried off, aborted or died.

A **lactation record** is generally adjusted for lactation length, mature equivalent, and 2 times a day milking.

Lactation records in progress can be used in calculation of USDA-AIPL Sire Summaries if they have at least one test and are a minimum of 40 days in length.

A **Data Collection Rating (DCR)** is an indicator of the amount of information included in a production record and the resulting accuracy level when compared to production records with either less or more information.

National DHIA and Quality Certification Services offer **20 DHI test plans** to participating producers.

Laboratory tests available through DHI include:

- Butterfat percentage
- Protein percentage
- Solids-not-fat percentage (SNF)
- Milk urea nitrogen (MUN)
- Somatic cell count (SCC)
- Johne's disease

CULLING

Reasons for culling a dairy cow from the herd include:

- Low production
- Mastitis
- Reproduction
- Udder
- Feet and legs
- Disease
- Injury
- Disposition

Dairy cattle can be sold privately on farm or in auction sales. **Types of auction sales** are consignment, dispersal, and reduction.

FARM BUSINESS MANAGEMENT

The **necessary economic inputs** for a dairy operation are land, labor, capital, and management.

A **cooperative** is a firm that is owned by its farmer members, is operated for their benefit, and distributes earnings on the basis of patronage.

PRECISION DAIRY FARMING

Precision dairy farming is the use of technologies to measure physiological, behavioral, and production indicators on individual animals to improve management strategies and farm performance.

Examples of precision dairy farming include:

- Daily milk yield monitoring
- Milk component monitoring
- Pedometers
- Accelerometers
- Automatic temperature recording devices
- Milk conductivity indicators
- Automatic estrous detection monitors
- Daily body weight measurements

Benefits of precision dairy farming include:

- Improved animal health and well-being
- Increased efficiency
- Reduced costs
- Improved product quality
- Minimized adverse environmental impacts
- Risk analysis and management
- More objective (less observer bias and influence)

FARM BILL

Every five years, the U.S. Congress passes a bundle of legislation called the **Farm Bill**; it sets national policy for agriculture, nutrition, conservation, and forestry.

The **Agricultural Act of 2014** is the name of the 2014 Farm Bill.

LABOR MANAGEMENT

The **minimum wage** in the U.S. is $7.25 per hour, effective July 24, 2009.

Selection tools that a dairy manager can use when hiring a new employee include:

- Application forms
- Interviews
- Reference checks
- Work tests
- Trial periods

The **Worker Protection Standard** is an Environmental Protection Agency (EPA) program designed to protect the nation's agricultural workers from pesticides.

PHOTOPERIOD

Long-day photoperiod, providing 16 to 18 hours of light per day, may stimulate lactating cows to produce 5 pounds more milk per day on average.

Melatonin is the hormone released by the pineal gland in response to longer day length.

Short-day photoperiod exposes cows to 8 hours of light followed by 16 hours of darkness. **Dry cows** exposed to a short-day photoperiod produce more milk in the next lactation than similar cows exposed to long day photoperiod or natural light conditions.

ANIMAL WELL-BEING

According to the American Veterinary Medical Association, **animal welfare** is the ethical responsibility of ensuring animal well-being.

Animal well-being is the condition in which animals experience good health, are able to effectively cope with their environment, and are able to express a diversity of species-typical behaviors.

The **National Dairy Animal Well-Being Initiative** is a producer-led effort to build consumer trust and confidence in the dairy industry's commitment to animal well-being.

An **animal rights activist** is a person who believes that an animal's life has the same value as a human's life and has the goal of eliminating all systems that involve the use of animals by humans.

FREESTALLS

The main reason that dairy cows refuse to use **freestalls** is improper size.

The **parts of a freestall** include:

- Support post
- Stall partition
- Neck rail
- Brisket board (tube)
- Stall surface (bedding, mattress)
- Rear curb

Chapter 10: Reproduction

ACRONYMS

AI	Artificial insemination
CIDR	Controlled internal drug release
CL	Corpus luteum
CR	Conception rate
ET	Embryo transfer
FSH	Follicle stimulating hormone
GnRH	Gonadotropin releasing hormone
IVF	In vitro fertilization
LH	Luteinizing hormone
MOET	Multiple ovulation and embryo transfer
PGF2α	Prostaglandin F2α
PR	Pregnancy rate
SCR	Sire conception rate
TAI	Timed artificial insemination

COW'S REPRODUCTIVE TRACT

The **parts of the cow's reproductive tract** are:

- Vulva
- Vagina
- Cervix
- Uterus
- Oviduct
- Ovary

The **broad ligament** is the structure that holds the uterus and ovaries in their proper position.

The **site of semen deposition** in natural service (bull) is in the vagina next to the cervix; in artificial insemination it is normally in the body of the uterus.

OVARIES

The main **functions of the ovary** are production of ova and secretion of hormones essential for reproduction.

One hundred percent (100%) of the **ova** in a mature cow's ovaries were present at birth.

Ovulation is the process of releasing an ovum from the follicle on the ovary.

The **fertile life of an ovum** after its release from the follicle is 6 to 12 hours.

The **corpus luteum** is a temporary gland that forms on the ovary after the ovum is released. It is also called yellow body.

FEMALE REPRODUCTIVE HORMONES

Gonadotropin Releasing Hormone (GnRH)	▪ Secreted by the hypothalamus; ▪ Controls the secretion of pituitary hormones (FSH and LH)
Follicle Stimulating Hormone (FSH)	▪ Secreted by the anterior pituitary gland; ▪ Stimulates growth of follicles
Luteinizing Hormone (LH)	▪ Secreted by the anterior pituitary gland ▪ Causes the follicle to rupture and then causes the corpus luteum to replace the follicle; ▪ Increases dramatically in concentration 24 hours prior to ovulation soon after the onset of estrus
Estrogen (E2)	▪ Produced by the follicle; ▪ Necessary for behavioral estrus and peaks at the onset of standing estrus
Progesterone (P4)	▪ Produced by the corpus luteum; ▪ Necessary for the maintenance of pregnancy; ▪ Inhibits the release of GnRH from the hypothalamus
Prostaglandin (PGF)	▪ Produced by the uterus (endometrium); ▪ Causes destruction or regression of the corpus luteum

ESTROUS CYCLE

The **normal range in length** of the estrous cycle is 18 to 24 days.

On average, there are **21 days between heat periods** in dairy cows.

The **phases of the estrous cycle** are:

- Follicular (active follicles are present)
- Luteal (corpus luteum is the dominant ovarian structure)

The **stages of the estrous cycle** are:

1. Estrus: heat period
2. Metestrus: transition
3. Diestrus: corpus luteum present
4. Proestrus: prior to estrus

Follicles develop in a wave-like pattern known as the **follicular wave**. There are five phases of a follicular wave:

- Recruitment
- Selection
- Growth
- Dominance
- Regression

There are normally 2 or 3 **follicular waves** during an estrous cycle in cattle.

ESTRUS

Estrus is the period of heat in dairy cattle.

Duration of standing heat is usually 2 to 12 hours with an average of 7 hours.

Pregnancy is the most common cause of a cow not coming back into heat. It is estimated that 3 to 5% of pregnant cows exhibit estrus.

Milk **progesterone** levels are low during estrus.

A **silent heat** is the condition where the physical signs of heat are difficult to detect.

Anestrus is the failure to have an estrous cycle. Poor nutrition and uterine infections are the leading causes.

Signs of estrus in dairy cattle include:

- Restlessness
- Following and smelling another cow
- Standing to be mounted
- Vulva becomes red and swollen
- Bellowing
- Mounting other cow
- Clear mucus discharge from vulva

Standing to be mounted is the most reliable sign of estrus.

Estrus synchronization programs include:

- CIDR
- Ovsynch
- Pre-Synch
- Co-Synch
- Heat-synch

Heat detection aids used on dairy farms include:

- Heat expectancy charts
- Pedometers
- Pressure sensors
- Detector animals
- Tail chalk
- Accelerometers
- Electronic heat detection systems

ARTIFICIAL INSEMINATION

Artificial insemination (AI) is the process of freezing semen from a bull and thawing it later to fertilize ova.

Advantages of using artificial insemination over natural service include:

- Safety
- Better disease control
- Easier to prove bulls
- Genetic improvement
- Better record keeping
- Less expensive than keeping a bull

A cow should be **artificially inseminated** 5 to 15 hours after the onset of standing heat.

A **French straw** is a thin cylinder in which frozen semen is preserved.

Liquid nitrogen is used to freeze and store semen. The **temperature of liquid nitrogen** is 320°F.

Frozen semen should be thawed in a warm water bath (90 to 95°F) for a minimum of 40 seconds to maximize the number of motile sperm.

FERTILIZATION

Fertilization is the process of joining an ovum and a sperm. It takes place in the **oviduct**.

A **zygote** is a fertilized ovum.

The fetus develops in the **uterus** after the ovum is fertilized.

EMBRYO TRANSFER

Embryo transfer is the process of removing a fertilized ovum from a donor cow and transferring it to another cow or heifer.

Most **embryo transfers** are conducted on day 7 or 8 after breeding.

A **recipient** is an animal that received a fertilized ovum from a donor.

Superovulation is the process that involves treating a cow with a hormone (FSH) to increase the number of ova produced.

Transvaginal aspiration uses ultrasonography to view the ovary while removing oocytes through the vagina using a needle. Harvested oocytes are matured and fertilized in vitro.

CONCEPTION RATE

Conception rate is the percent of services (breedings) that result in a pregnancy. Factors affecting a dairy herd's conception rate include:

- Heat detection accuracy
- Semen (bull) fertility
- Herd (cow) fertility
- Technician competency

Reasons cows don't become pregnant when the herd is bred by artificial insemination include:

- Failure to ovulate
- Hormone imbalance
- Failure to inseminate
- Heat detection errors
- Fertilization failure
- Poor quality semen
- Improper insemination technique

PREGNANCY RATE

Pregnancy rate is the percent of cows that become pregnant out of those cows eligible to become pregnant in a given period of time, usually 21 days. It is the combined effect of heat detection rate and conception rate.

Pregnancy rate is usually calculated every 21 days because that is the average length of the dairy cow's estrous cycle.

Pregnancy rate can be calculated for AI bred herds, bull bred herds, or a combination of both.

PLACENTA

The **placenta** is the structure through which the fetus receives all of its nutrients.

The placenta is attached to the uterus in dairy cattle by maternal **caruncles** and fetal **cotyledons** (placentones).

A **retained placenta** is the condition when the fetal membranes remain attached to the maternal caruncles within the uterus for an extended period of time after calving (greater than 24 hours).

Retained placenta incidence is highest in summer.

GESTATION

Gestation is the period of pregnancy; it begins at fertilization and ends at birth.

Average gestation length varies from 276 to 292 days.

Gestation length can vary due to many factors including:

- Age of the cow
- Sex of the calf
- Season of the year
- Breed of the cow
- Number of calves carried

Brown Swiss cattle have the longest gestation period.

PARTURITION

Parturition is the act of giving birth.

Cortisol is the hormone the calf triggers in response to stress to initiate parturition.

Relaxin is the hormone released prior to calving that enables the cervix to soften and stretch in preparation for expelling the calf.

Signs that a cow is near calving include:

- Udder full
- Vulva enlarged
- Mucus discharge
- Restlessness
- Relaxation of ligaments at tail head

The **normal birth position** of a calf is front feet first with the head between the legs.

TIME TERMS

Voluntary Waiting Period (VWP) is the time period after calving when the dairy producer chooses not to breed a cow. The most common VWP is 60 days.

Days to first service is the days from calving until first breeding date.

Days open is the days from calving until conception or successful breeding date.

Calving interval is the period of time from one calving to the next calving, usually measured in months. A herd's average calving interval is influenced by several factors including:

- Voluntary waiting period
- Conception rate
- Estrus (heat) detection
- Reproductive culling

MALE REPRODUCTIVE SYSTEM

The **main functions of the testes** are to produce sperm and produce the male sex hormones.

Cryptorchidism is the condition when one or both testes fail to descend from the abdomen into the scrotum, often affecting fertility.

Mature sperm are stored in the **epididymus**.

Sperm live 24 to 30 hours after being deposited in the cow's reproductive tract. It takes sperm 6 hours to become **capacitated** (i.e., to develop the ability to fertilize the ovum).

Sperm produce **lactic acid** during metabolism.

Fructose is the primary sugar found in semen.

The **male reproductive hormones** include:

- **Follicle stimulating hormone (FSH)** – stimulates sperm production
- **Luteinizing hormone (LH)** – stimulates sperm production
- **Testosterone** – responsible for the male sex drive (libido)

SIRE CONCEPTION RATE

Sire Conception Rate (SCR) is an evaluation of artificial insemination (AI) service-sire fertility computed by the Council on Dairy Cattle Breeding; it is calculated for Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn bulls.

ULTRASOUND

Ultrasound can be used in a reproductive management program in several ways including:

- Pregnancy determination
- Determine if twins are being carried
- Determine sex of embryo
- Determine embryonic losses
- Monitor cystic ovaries

REPRODUCTIVE HEALTH

Reproductive failure is the number one reason for culling in U.S. dairy herds.

Involution is the process where the uterus returns to normal size after calving. It usually takes 30 to 45 days after calving for a cow's reproductive tract to return to normal.

Metritis is an infection of the uterus. **Endometritis** is an inflammation of the uterine lining. Incidence is highest in summer.

Sterility describes the animal that cannot reproduce. **Infertility** describes the animal that is neither normally fertile nor totally sterile.

Abortion is the premature expulsion of a fetus. **Diseases that cause abortions** in dairy cattle include:

- Brucellosis
- Chlamydia
- Leptospirosis
- Neospora
- Campylobacteriosis (Vibriosis)
- IBR
- Listeriosis
- Trichomoniasis

Cystic ovaries are found in 12-14% of problem breeders. They develop in 10-40% of dairy cows during their lifetime.

Types of **cystic ovaries** are follicular cysts, luteal cysts, and cystic corpus lutea.

Follicular cysts are thin-walled, anovulatory (not ovulating) cysts. They secrete variable amounts of estrogen.

Luteal cysts are thick-walled cysts. They secrete low levels of progesterone.

Cystic corpus lutea have characteristics similar to normal corpora lutea.

Twinning in dairy cattle has several disadvantages including:

- Reduced milk production during the lactation
- Calving difficulties are more frequent
- Abortion rates are higher
- Twins are often weak at birth
- Potential for a freemartin heifer

A **freemartin** is a sterile heifer born twin to a bull. Ninety percent (90%) of heifers born twin to a bull are sterile.

Chapter 11: Genetics

ACRONYMS	
AGIL	Animal Genetics and Improvement Laboratory
AIP	Animal Improvement Program
BAA	Breed Age Average
BLAD	Bovine Leukocyte Adhesion Deficiency
BLUP	Best Linear Unbiased Predictor
CCR	Cow Conception Rate
CE	Calving Ease
CM$	Cheese Merit
CVM	Complex Vertebral Malformation
DBH	Difficult Birth in Heifers
DCE	Daughter Calving Ease
DNA	Deoxyribonucleic Acid
DPR	Daughter Pregnancy Rate
DUMPS	Deficiency of Monophosphate Synthase
EBV	Estimated Breeding Value
ETA	Estimated Transmitting Ability
FAIR	Farm Animal Identification and Records
FM$	Fluid Merit
FTI	Functional Trait Index
FUI	Functional Udder Index
GM$	Grazing Merit
GMD	Gold Medal Dam
gPTA	Genomic Predicted Transmitting Ability
HCD	Haplotype for Cholesterol Deficiency
HCR	Heifer Conception Rate
JPI	Jersey Performance Index
MACE	Multiple-trait Across Country Evaluations
mRNA	Messenger Ribonucleic Acid
NM$	Lifetime Net Merit
PA	Parent Average
PCR	Polymerase Chain Reaction
PL	Productive Life
PPR	Progressive Performance Rating
PTA	Predicted Transmitting Ability

PTI	Production-Type Index
RFID	Radio Frequency Identification
RNA	Ribonucleic Acid
rRNA	Ribosomal Ribonucleic Acid
RT	Recessive Tested
RVC	Rectovaginal Constriction
SB	Stillbirth
SCE	Service Sire Calving Ease
SDM	Spinal Dysmyelination
SMA	Spinal Muscular Atrophy
SNP	Single Nucleotide Polymorphism
STA	Standardized Transmitting Ability
TPI	Total Performance Index
tRNA	Transfer Ribonucleic Acid

ANIMAL IDENTIFICATION

Identification is the first step in a herd improvement program.

American ID numbers for dairy cattle consist of a three letter country code followed by a twelve digit animal number and will be used by DHI organizations, breed associations, and state animal health departments. The **country code for the U.S.** is 840.

Visibility is the most important feature when selecting tags or brands for identification.

NAAB CODE FOR SIRES

The **NAAB code for a sire** has three parts.

- The number before the letter indicates the **stud** from which the bull's semen can be purchased. It is referred to as the **stud code**.

  1 = Genex/CRI 7 = Select Sires 11 = Alta Genetics
  14 = Accelerated Genetics 29 = ABS Global 200 = Semex

- The letters indicate the **breed**.

  AY = Ayrshire BS = Brown Swiss GU = Guernsey
  HO = Holstein JE = Jersey MS = Milking Shorthorn
  RW = Red and White

- The number following the letters is an **individual bull identification number**.

Example: 7HO00543 is the NAAB Code for CARLIN-M IVANHOE BELL.

BASIC GENETICS

A **gene** is the basic unit of inheritance.

A **chromosome** is a threadlike linear strand of DNA and associated proteins found in the nucleus of animal and plant cells that carries the genes and functions in the transmission of hereditary information. Dairy cattle have 30 **pairs of chromosomes**.

A **locus** is the position that a given gene occupies on a chromosome.

An **allele** is any of the alternative forms of a gene that may occur at a given locus.

Genotype is the genetic make-up of an individual.

Phenotype is the observed trait of an individual resulting from the effects of the genotype, the environment, and their interaction.

Heritability (h^2) is the measure of the percent of phenotypic differences between animals for a single trait that can be transmitted to offspring.

Predicted Transmitting Ability (PTA) is a measurement of average superiority or inferiority that will be transmitted to an offspring.

The **genetic make up of a population** can be changed by migration, selection, mutation, and chance.

GENOMICS

The total genetic content of an organism is known as its **genome**.

Genomics is the study of genes or gene products in an organism.

Proteomics is the study of all of the proteins that genes create.

Gene mapping is the process of determining where genes are located on individual chromosomes.

RELATIONSHIPS

A **pedigree** is a record of ancestry.

A **purebred** is a dairy animal whose sire and dam of the same breed are registered or who are eligible to be registered in a herdbook.

A **registration paper or certificate** accompanies a purebred animal and certifies its parentage.

The **sire** determines the sex of a calf.

The technical term used to describe brothers and sisters is **siblings**.

ANIMAL MODEL

The **Animal Model** is the genetic method for evaluating bulls and cows currently used.

When making its evaluation, the Animal Model uses **information** from:

- Parents (pedigree)
- Individual performance
- Progeny (offspring)

GENETIC EVALUATIONS

The **Council on Dairy Cattle Breeding** publishes U.S. genetic evaluations.

Official evaluations in 2017 will be released in April, August and December. **Genomic evaluations** will be released monthly.

A minimum of ten (10) daughters is required for a bull to have a **bull proof** published.

The **genetic base** for genetic evaluations is updated every five years. It was most recently updated in December 2014 and is the average PTA of animals born in 2010. The next base change is scheduled for 2020.

INTERBULL is the name of the International Bull Evaluation Service based in Uppsala, Sweden.

Reliability is an indicator of the accuracy of genetic evaluations.

GENETIC INDEXES

Lifetime Net Merit (NM$) is a genetic index. It combines the following traits for **Holsteins** and **Brown Swiss**:

- Milk
- Fat
- Protein
- Somatic cell score
- Productive life
- Feet and legs composite
- Udder composite
- Body weight composite
- Daughter pregnancy rate
- Heifer conception rate
- Cow conception rate
- Calving ability*
- Cow livability

NM$ for **other breeds does not include calving ability.*

Total Performance Index (TPI) is a genetic index used by the Holstein breed that is determined by placing emphasis on production and type. The traits included are:

- Protein
- Fat
- Feed Efficiency
- Type
- Dairy Form
- Udder Composite
- Feet and Leg Composite
- Productive Life
- Somatic Cell Score
- Fertility Index
- Daughter Calving Ease
- Daughter Stillbirth

Traits used in the **Udder Composite Index** for Holsteins are:

- Fore udder attachment
- Rear udder height
- Rear udder width
- Udder depth
- Udder cleft
- Front teat placement

Traits used in the **Body Size Composite Index** for Holsteins are stature, strength, body depth, and thurl width.

The **Feet and Legs Composite Index** for Holsteins is calculated using the traits of rear legs – side view, rear legs – rear view, and foot angle combined with the feet and legs score.

Traits used in the **Dairy Capacity Composite Index** for Holsteins are dairy form and strength.

The **Jersey Performance Index (JPI)** is a genetic index used by the Jersey breed that is determined by placing emphasis on production and type. The traits included are:

- PTA Protein
- PTA Fat
- CFP Milk
- Productive Life
- Livability
- Somatic Cell Score
- Daughter Pregnancy Rate
- Cow Conception Rate
- Heifer Conception Rate
- Functional Trait Index*

*There are 14 linear traits used for calculating the **Functional Trait Index** for Jerseys.

The **Jersey Udder Index** serves an indicator of mastitis resistance in Jerseys; it uses the following traits:

- Fore udder
- Rear udder height
- Rear udder width
- Udder cleft
- Udder depth
- Front teat placement
- Front teat length

CALVING EASE

Farm employees should assign **calving ease scores** at the time of calving to describe the event. The scoring system is:

1 = No problem or unobserved
2 = Slight problem
3 = Needed assistance
4 = Considerable force
5 = Extremely difficult

The Council on Dairy Cattle Breeding calculates two **Calving Ease Summaries** for the National Association of Animal Breeders (NAAB):

- **Service Sire Calving Ease** measures a bull's tendency to sire calves that are born easily.
- **Daughter Calving Ease** measures the influence of the sire of the cow on calving ease.

STILLBIRTH

It is recommended that farm employees record **stillbirth scores** to provide accurate calf mortality information. The scoring system is:

1 = the calf was born alive and was alive 48 hours postpartum

2 = the calf was born dead

3 = the calf was born alive but died within 48 hours postpartum

Daughter Stillbirth measures the ability of a particular cow (daughter) to produce live calves.

Service Sire Stillbirth measures the tendency of calves from a particular service sire to be stillborn more or less often.

Stillbirth evaluations are expressed as percent stillbirths in heifers (%SBH), where stillborn calves are those scored as dead at birth or born alive but died within 48 hours of birth.

INBREEDING

Inbreeding can decrease mature equivalent (ME) milk production by 60 to 80 pounds per lactation for each percent increase in inbreeding.

Consequences of inbreeding include:

- Decreased general vigor
- Decreased reproductive performance
- Increasing similarity between animals
- More recessive genes exposed
- Decreased production
- Increased calf mortality
- Smaller mature size
- Slower growth rate

UNDESIRABLE RECESSIVE TRAITS

Undesirable recessive traits in **Brown Swiss** cattle are:

- Weaver
- Spinal Dysmyelination
- Spiderleg
- Spinal Muscular Atrophy

Undesirable recessive traits in **Holsteins** include:

- Bovine Leukocyte Adhesion Deficiency
- Bulldog
- DUMPS
- Hairless
- Imperfect Skin
- Pink Tooth (Porphyria)
- Brachyspina
- Complex Vertebral Malformations
- Dwarfism
- Haplotype for Cholesterol Deficiency
- Mule-Foot (Syndactylism)
- Prolonged Gestation

Undesirable recessive traits found in **Jerseys** are:

- Limber Legs
- Rectovaginal Constriction

Undesirable recessive traits have **not been documented** for the Ayrshire, Guernsey, or Milking Shorthorn breeds.

Chapter 12: Animal Health

ACRONYMS

BLV	Bovine Leukosis Virus
BRSV	Bovine Respiratory Syncytial Virus
BSE	Bovine Spongiform Encephalopathy
BVD	Bovine Virus Diarrhea
DA	Displaced Abomasum
ELISA	Enzyme-Linked Immunosorbent Assay
FARAD	Food Animal Residue Avoidance Databank
IBR	Infectious Bovine Rhinotracheitis
Ig	Immunoglobulin
IM	Intramuscular
IV	Intravenous
MLV	Modified Live Virus
NAHMS	National Animal Health Monitoring System
PCR	Polymerase chain reaction
VFD	Veterinary Feed Directive

NORMAL STATS FOR DAIRY ANIMALS

Temperature

Calf: 102.5°F

Adult dairy cow: 101.5°F

Pulse rate (cow): 60 – 70 heart beats per minute

Respiratory rate (cow): 30 breaths per minute

ANATOMY AND PHYSIOLOGY

Physiology is the branch of biology that deals with the process, activities, and phenomena of life and living organisms.

The **basic tissues** that make up a cow's body are connective, epithelium, muscle, and nerve.

The **organ systems** found in the body are:

- Circulatory
- Respiratory
- Integumentary (skin)
- Nervous
- Digestive
- Endocrine
- Reproductive
- Skeletal
- Muscular

An **enzyme** is a protein that acts as a catalyst in starting or speeding up specific chemical reactions.

Insulin is a hormone produced by the pancreas that promotes cell growth and division.

The **parathyroid gland** is responsible for mobilizing calcium from the bone.

Phagocytosis is the process by which white blood cells engulf microorganisms.

Ligaments connect one bone to another bone; **tendons** connect a muscle to a bone.

The **mitochondrion** is known as the powerhouse of the cell because all energy is produced in this cell part.

BLOOD

Approximately **400 pounds of blood** are pumped through the udder to produce one pound of milk.

The **external pudic artery** is the major artery supplying blood to the udder.

Erythrocytes are more commonly known as red blood cells. They are the only cells that have no nucleus.

DISEASE

A **disease** is a change in the normal state of the body, or one or more of its organs, which disturbs the proper performance of body functions.

A **pathogen** is any microorganism that causes disease.

Antibodies (immunoglobulins) are proteins synthesized by organs of the cow's immune system that aid in the elimination of foreign substances such as microorganisms.

The main **immunoglobulin isotypes** are IgA, IgE, IgG, and IgM.

A **carrier** is an animal that is infected with a disease but has no clinical symptoms.

A **toxin** is a poison produced by microorganisms that kills cells.

Diseases can be classified on the basis of their **primary cause**:

- Environmental
- Genetic
- Infectious
- Metabolic

Infectious diseases of cattle result from the interplay between three factors.

- The **animal** and its ability to resist disease (immunity)
- An **infectious agent** (bacteria, viruses, and parasites)
- The **environment**

Diseases in dairy cattle that are caused by a **virus** include:

- Blue tongue
- BLV
- BRSV
- BVD
- Cow pox
- IBR
- PI-3
- Warts

Diseases caused by a **clostridial organism** include:

- Blackleg
- Malignant edema
- Overeating disease
- Tetanus

Examples of **metabolic diseases** are:

- Displaced abomasum
- Ketosis
- Laminitis
- Milk fever
- Retained placenta

Diseases with a **color in their name** include:

- Blackleg
- Blue tongue
- Pinkeye
- Red nose
- Red water
- White heifer disease
- White muscle disease

Zoonoses are diseases and infections that are transmitted between vertebrate animals and human beings. Zoonoses that may be **transmitted from cattle to humans** include:

- Brucellosis
- Cowpox
- Cryptospirosis
- Leptospirosis
- Listeriosis
- Q-fever
- Rabies
- Ringworm
- Salmonellosis
- Tuberculosis

Biosecurity describes management practices that protect the herd from the entry of new diseases and minimize the spread and/or adverse effects of diseases in the herd.

PROPER AND COMMON DISEASE NAMES

Proper Name	Common Name
Acetonemia	Ketosis
Bovine spongiform encephalopathy	Mad cow disease
Brucellosis	Bang's disease
Displaced abomasum	Twisted stomach
Dystocia	Calving difficulty
Fibropapellomatosis	Warts
Hypocalcemia	Milk fever
Infectious bovine keratoconjunctivitis	Pinkeye
Infectious bovine rhinotraceitis	Red nose
Laminitis	Founder
Listeriosis	Circling disease
Papillamatous digital dermatitis	Hairy heel warts
Paratuberculosis	Johne's disease
Parturient paresis	Milk fever
Pneumonic pasteurellosis	Shipping fever
Pododermatitis	Foot rot
Traumatic gastritis	Hardware disease

ACIDOSIS

Acidosis is a metabolic disorder that often occurs when a dairy cow eats too much grain.

BLACKLEG

Blackleg is an acute, fever producing disease of cattle and sheep.

The **bacterium *Clostridium chauvoei*** causes the disease.

Blackleg most often occurs in **pastured cattle** during the spring or fall.

BLOAT

Bloat is the condition when a cow cannot belch.

Cows **grazing rapidly growing legumes** are susceptible to bloat.

Gases associated with bloat are carbon dioxide and methane.

Poloxolene may be administered to prevent or correct bloat.

Simple **laundry detergent** can be used to alleviate bloat in cattle.

A **trocar** is an instrument used to puncture the rumen in cases of bloat.

BOVINE LEUKOSIS VIRUS

Bovine Leukosis Virus (BLV) is a retrovirus that infects lymphoid tissue.

The virus is **transmitted** to cattle mainly by direct exposure with infected blood, saliva, semen, and milk.

Signs of BLV infection include:

- Tumors in lymphoid tissues
- Weight loss
- Fever
- Rear limb weakness or paralysis
- Gastrointestinal obstructions
- Enlarged lymph nodes
- Decreased milk production
- Loss of appetite
- Protruding eyeballs
- Increased blood lymphocytes counts

BRUCELLOSIS

Brucellosis (Bang's disease) is caused by a bacterium of the genus *Brucella*. Infections may cause:

- Abortions
- Stillborn or weak calves
- Retained placentas
- Weight loss
- Reduced milk yield

The **milk ring test** is used to identify Brucellosis in cattle.

Undulant fever is the human equivalent of brucellosis. Drinking raw milk contaminated with *Brucella* bacteria is the means of contracting the disease.

COCCIDIOSIS

Coccidiosis is a disease in calves that is also very common in poultry and is characterized by chronic diarrhea.

Signs of coccidia in calves include:

- Watery scours with flakes of blood
- Mucus in the feces
- Weight loss
- Dull listlessness
- Dehydration

Methods to control coccidiosis include:

- Accurate diagnosis and monitoring
- Limit stress
- Maintain sanitation
- Medicate

There are two classes of **anti-coccidial drugs**.

- **Coccidiocides** kill coccidia as they migrate through the intestine, interrupting the organism's life cycle.
- **Coccidiostats** inhibit the coccidia's growth and development, preventing them from reproducing.

CRYPTOSPIROSIS

Cryptosporidium parvum is a protozoan parasite that has been recognized as a common cause of diarrhea in calves and other animals, including humans.

Management practices that can reduce cryptosporidiosis in newborns include:

- Provide clean, dry areas for cows to calve
- Feed colostrum using a clean bottle and sanitized nipple
- Provide clean, dry pens for calves
- Allow pens to thoroughly dry between calves
- Feed and care for sick calves last

DISPLACED ABOMASUM

A **displaced abomasum** is the condition where the abomasum moves positions inside the body cavity and twists, causing severe digestive problems.

Most displaced abomasums are **left-sided** (80-90%).

Predisposing factors for a cow's displaced abomasum include:

- Acidotic rations
- Advanced pregnancy
- High milk production
- Hypocalcemia
- Lack of exercise
- Lead feeding
- Selenium deficiency
- Stress of calving

FAT COW SYNDROME

Fat cow syndrome is a disease when a cow gains too much weight during late lactation or the dry period.

The disease is almost always **associated with other problems** at calving including:

- Displaced abomasum
- Fatty liver syndrome
- Mastitis
- Metritis
- Milk fever
- Retained placenta

GRASS TETANY

Grass tetany is a metabolic disorder associated with a magnesium deficiency.

The disorder occurs most often in adult cows milking heavily and grazing lush green pastures.

HARDWARE DISEASE

Hardware disease is the general term used to describe a situation where a piece of metal has been swallowed and then collects in and/or pierces the reticulum.

A **magnet** is often given to an animal to prevent hardware disease.

HEAT STRESS

The **ideal environmental temperature range** for dairy cattle is 25 to 65°F.

A dairy cow can lose **body heat** through convection, conduction, radiation, and evaporation.

Methods used to cool cows during **heat stress** include:

- Shade
- Air exchange
- Air movement
- Access to water
- Sprinkle

JOHNE'S DISEASE

Johne's disease is caused by the bacterium *Mycobacterium paratuberculosis*, which infects the small intestine of ruminant animals, especially cattle, sheep, and goats.

Cattle with Johne's disease are usually **infected** soon after birth, but the first **symptoms** do not appear until 2 to 4 years of age.

Clinical symptoms of Johne's disease:

- Diarrhea
- Soft swelling in the jaw
- Weight loss
- Death
- General unthriftiness
- Substantial drops in milk production
- Susceptibility to other problems such as infertility

Types of tests for Johne's disease commonly used today are:

- Tests that **measure antibodies** in blood serum
- Tests that **find the organism** in manure by fecal culture or polymerase chain reaction (PCR)

No effective treatment can be recommended for Johne's disease. Therefore, producers must concentrate on preventing new infections. **Strategies for preventing** new Johne's disease infections include:

- Prevent highly susceptible newborn calves and young animals from ingesting manure from adults, whether from the dam, the environment, or feed and water.
- Calving areas should be dry, free of manure, and well bedded.
- Remove the calf from the dam immediately after birth.
- Do not use the same equipment to clean up manure and to load feed.
- Do not walk in feed bunks.
- Identify and remove infected animals and their manure.
- Investigate all animals considered for purchase, and buy only from test-negative herds with no history of Johne's disease.
- Do not allow test-positive cows to calve.
- Sell at birth all calves from positive cows.

KETOSIS

Ketosis (Acetonemia) is a condition when there is an accumulation of ketones in the body.

The first **signs** of ketosis are:

- Cow goes off feed
- Ketone (acetone) smell on the cow's breath

Propylene glycol is fed or administered to cows to treat ketosis.

Niacin may be added to feeds to aid in the prevention of ketosis.

LAMENESS

A cow may experience **lameness** for many reasons including:

- Abscess
- Foot rot
- Infection
- Injury
- Soft sole syndrome
- Trimming too close

The most important **practices for the reduction of foot problems** are hoof trimming and footbaths.

The **purposes of a footbath** are:

- Remove irritants from the foot and between the toes
- Disinfect and cleanse the foot
- Dry and toughen the foot

Substances commonly used in a footbath include copper sulfate, zinc sulfate, and formalin.

The most common walk-through **treatment for foot rot** is a 5% solution of copper sulfate.

MAD COW DISEASE

Mad Cow Disease (Bovine Spongiform Encephalopathy) is a fatal brain disease of cattle; it affects the brain and spinal cord.

The disease originated in the **United Kingdom**.

MILK FEVER

Milk fever is caused by a deficiency of blood calcium related to an imbalance of calcium, phosphorus, and Vitamin D.

Most cases of milk fever **occur** within 72 hours after calving.

About **6 percent of dairy cows** are affected by milk fever each year.

Groups of cows that are at greater risk of having milk fever are older cows, fatty liver cows, and Jerseys.

Symptoms of milk fever include:

- Cow goes down
- Dilated eyes
- Rapid heart rate
- Below normal body temperature

Calcium glutamate is an intravenous injection for immediate and temporary treatment of milk fever.

MYCOTOXINS

A **mycotoxin** is a toxin produced by a fungus, especially a mold.

Members of the **mycotoxin** family that affect animals include:

- Aflatoxin
- Fumonisin
- Trichothecenes
- Ochratoxins
- Zearalenone
- Ergot alkaloid

Clinical symptoms of mycotoxins in dairy cattle include:

- Abortions
- Gastrointestinal upsets
- Poor response to therapy
- Weight loss
- Cystic ovaries
- Infertility
- Silent heats
- Rise in metabolic disease due to liver malfunction
- Feed refusal
- No milk
- Unthriftiness

NEOSPOROSIS

Neosporosis is a disease that causes abortions and occasionally causes birth of weak “dummy” calves that have serious brain infections.

A **protozoan**, *Neospora caninum*, causes the disease.

Dogs are classified as a definitive host for the causative organism.

PARASITES

External parasites in dairy cattle include flies, lice, mites, mosquitoes, and ticks.

Lice are most troublesome during winter and spring.

Types of flies commonly found around the dairy farm are:

- House fly
- Horn fly
- Stable fly
- Heel fly
- Face fly
- Deer fly

The **face fly** spreads pinkeye.

The **heel fly** is associated with grubs or warbles in cattle.

House and stable flies need heat, moisture, and a suitable breeding medium to survive and reproduce.

The **phases of a fly’s life cycle** are:

- Egg
- Larvae
- Pupa
- Adult

Sanitation is the most effective management tool to control flies on a dairy farm.

Internal parasites in dairy cattle include:

- Lung worms
- Round worms
- Stomach worms
- Liver flukes
- Coccidia

The **brown stomach worm** is the most economically detrimental parasite of cattle.

Anthelminthics are a class of chemicals used to kill internal parasites.

PINKEYE

Pinkeye is a highly contagious disease characterized by an infection of the cornea or membrane lining of the eye; it is most prevalent during the summer. The primary infectious agent is *Moraxella Bovis*, a bacterium.

Measures for preventing pinkeye include:

- Fly control
- Vaccination
- Clipping pastures to prevent seed-head development

PNEUMONIA

Predisposing causes of pneumonia in calves include:

- Poor ventilation
- Dirty pens
- Overcrowding
- Drastic temperature changes
- High humidity
- Poor nutrition
- Wide range of ages in one pen

Types of organisms that can cause pneumonia are:

- Bacteria
- Molds
- Parasites
- Viruses
- Yeasts

Pneumonia-causing bacteria include:

- *Pasteurella multocida*
- *Haemophilus somnus*
- *Mannheimia* (Pasteurella) *haemolytica*
- *Mycoplasma* species

Pneumonia-causing viruses include:

- Infectious bovine rhinotracheitis virus (IBR)
- Bovine viral diarrhea virus (BVDV)
- Parainfluenza-3 virus (PI3)
- Bovine respiratory syncytial virus (BRSV)

RABIES

Rabies is a deadly viral infection that is mainly spread by infected animals.

Suspected cases of **rabies** are confirmed by:

- Fluorescent antibody test of brain
- By injecting brain tissue into mice and observing

Non-domestic animals that can cause an infection of cattle with rabies include:

- Bat
- Fox
- Bobcat
- Raccoon
- Coyote
- Skunk

RINGWORM

Ringworm is a contagious disease caused by a fungus that can be easily spread to other animals. The fungus infection invades the hair follicles and the outer layer of skin.

Tincture of iodine may be used to control ringworm.

SCOURS

Scours is a disease in calves characterized by diarrhea, dehydration, and unthriftiness. It is easily transferred from one animal to another through the manure of an infected animal.

Bacteria that commonly cause scours among calves include *Escherichia coli, Salmonella, and Clostridium perfringens*.

Viruses that commonly cause scours among calves include *Rotavirus* and *Coronavirus*.

Protozoa that commonly cause scours among calves include coccidia and *Cryptosporidium*.

SHIPPING FEVER

Shipping fever is a respiratory disease that cattle often develop after being transported by truck or rail.

UDDER EDEMA

Udder edema is a condition that exists when an excessive amount of lymph accumulates between the skin and secretory tissue of the udder.

WARTS

Warts are caused by a virus and are contagious to other calves.

WHITE MUSCLE DISEASE

White muscle disease is caused by a deficiency of Vitamin E and/or selenium.

The best way to **prevent** the disease is to supplement Vitamin E and selenium.

MORBIDITY VS. MORTALITY

Morbidity rate is the number of sick animals during a specified period of time.

Mortality rate is the number of dead animals during a specified period of time.

VACCINATIONS

Calfhood vaccinations should be considered for the following diseases:

- Blackleg
- Brucellosis
- BVD
- Clostridia
- IBR
- Leptospirosis
- Malignant edema
- PI-3
- Scours

The major **types of vaccines** are killed and modified live.

ANTIBIOTICS

Antibiotics are chemical agents given to animals that kill or stop growth of bacteria.

A cow may be given antibiotics in numerous ways including:

- Intramuscular injection
- Intravenous injection
- Intraperitoneal injection
- Intramammary infusion
- Intrauterine infusion
- In the ration

The **jugular vein** is the ideal location for most intravenous injections.

MEDICINE CHEST

Suitable items for a **medicine chest** for the average herd include:

- Alcohol
- Bloat remedy
- Scissors
- Petroleum jelly
- Syringe and needles
- General use disinfectant
- Teat and udder ointments
- Soap
- Sterile bandaging material
- Iodine solution
- Adhesive tape
- Trocar and canula
- Wash basin

A **balling gun** is an instrument used to give an animal a pill.

Chapter 13: Nutrient Management

ACRONYMS

BMP	Best management practices
CAFO	Concentrated animal feeding operation
CNMP	Comprehensive nutrient management plan
EQIP	Environmental Quality Incentive Program
IPM	Integrated pest management
NPS	Non-point source

WATER

Groundwater is water in the soil. It may resurface in a brook, stream, or pond. Water in drinking water wells is from groundwater.

Surface water is water in any exposed body of water including streams, rivers, ponds, lakes, and oceans.

The **leading environmental issues** facing farmers are phosphorus (P) and nitrogen (N) contamination of ground and surface water.

Runoff is the movement of nutrients across the surface of soils to surface water (streams, rivers, ponds).

Leaching is the movement of nitrate (a nitrogen containing compound) through soils to groundwater.

Well-managed **alternative water sources** usually provide animals cleaner water and help prevent exposure to certain diseases.

MANURE

Manure storage allows manure to be applied according to crop needs rather than on a daily basis.

Types of storage facilities for manure are:

- **Solid** manure storage – dry stack barn
- **Slurry** manure storage – anaerobic pit, earthen structure, or above ground tank
- **Liquid** manure storage – lagoon

Slurry manure storage is the most common type of manure storage on dairy farms.

General categories of **odor-controlling chemicals** for manure management are:

- Masking agents
- Odor counteractants
- Enzymatic products

Manure testing (measuring nutrient content) may reduce fertilizer purchases and/or prevent application of nutrients in excess of crop requirements.

Factors that affect the **nutritive value of manure** are:

- Amount of added feed, bedding and water
- Crop
- Method of collection
- Soil characteristics
- Type of feed ration
- Climate
- Method of application
- Method of storage
- Time of application

NON-POINT SOURCE POLLUTION

Non-point source usually refers to pollution (nutrients, chemicals, toxins or pathogens) that contaminate ground or surface water.

Non-point source pollution originates from multiple and diffuse sources which are not readily identified.

Examples of **nonpoint sources of nutrient pollution** include most farms, agricultural cropland, and suburban lawns receiving fertilizer.

BEST MANAGEMENT PRACTICES

Best management practices (BMP's) are practices that protect water quality while improving profitability of the farm.

The **Soil and Water Conservation District (SWCD)** is a local board that defines priority watersheds, approves conservation plans, and distributes cost share funds to farmers for implementation of BMP's.

Cost-share is a financial incentive from the state or federal government to the farmer to help pay for equipment or practices that reduce pollution.

Best management practices for livestock farms include:

- Fencing animals out of bodies of surface water
- Installation of an alternative water source
- Installation of stream crossings
- Installation of buffer strips between cropland and surface water
- Shoreline or creek bank stabilization and protection
- Animal travel lane stabilization
- Rotational loafing lot management system
- Installation of a storm water retention pond
- Planting small grain cover crops
- Installation of a manure storage facility
- Manure testing
- Controlling surface water runoff
- Implementation of a nutrient management plan

Buffer strips are areas of grassland installed between cropland or feedlots and waterways to take up nutrients and prevent nutrients from running off into water.

Benefits of small grain cover crops include:

- Increase use of land applied nutrients
- Stabilize cropland
- Prevent erosion in wintertime

The **rotational loafing lot management system** consists of vegetated exercise and rest areas installed to replace dirt exercise lots. Its benefits are:

- Runoff is reduced because grass growing on lots uses nutrients
- Soil erosion is reduced because grass growing on lots stabilizes soil
- Cows stay cleaner

Methods of **reducing soil erosion** include:

- Contour cropping
- Cover crop
- Grass waterways
- Reduced tillage
- Soil seeding
- Strip cropping
- Terracing
- Wind breaks

BEDDING MATERIALS

Common dairy cattle **bedding materials** include:

- Newspaper
- Sand
- Shavings
- Recycled manure solids
- Sawdust (green or kiln-dried)
- Straw

NUTRIENT MANAGEMENT

A **nutrient management plan** is a plan for the land application of manure and fertilizer to meet crop needs.

Animal density impacts nutrient management on farms and is usually measured as animal units per acre. An **animal unit** is 1000 pounds of live weight of any animal.

Areas that contribute waste that must be handled are:

- Feeding area
- Housing or loafing area
- Holding pen area
- Milking parlor
- Runoff area

WASTE MANAGEMENT SYSTEMS

The following factors should be considered when planning a **waste management system**:

- **Environmental** (Rainfall, stream location, prevailing winds, evaporation, temperature, topography, soil type, surface drainage, water table depth)
- **Operational** (Herd size, cropping & feeding practices, land area, cropland for waste application, existing buildings & machinery)
- **Economic** (Availability of capital and labor, future expansion plans)
- **Social** (Neighbors, zoning)
- **Legal Requirements** (EPA General Permit, State and local permits)

COMPOSTING

Composting requires air, moisture, nutrients, and carbon.

Composting is an acceptable way of disposing of dead calves and cows. Two to six months are required for composting depending on the size of the animal and the rate of the compost reaction.

Advantages of composting manure include:

- Reduces volume
- Reduces potential for nutrient runoff
- More uniform than manure
- Excellent soil conditioner
- Doesn't attract flies and insects
- Weeds and pathogens destroyed
- Reduces fertilizer needs

FERTILIZER

Fertilizer labels have three important numbers.

- The first number is the amount of **nitrogen (N).**
- The second number is the amount of **phosphate (P_2O_5).**
- The third number is the amount of **potash (K_2O).**

These three numbers represent the **primary nutrients**: nitrogen (N), phosphorus (P), and potassium (K).

A bag of 15-10-5 fertilizer contains 15 percent nitrogen, 10 percent phosphate, and 5 percent potash.

Appendix: Suggested Reading

Hutjens, M. F. 2008. *Feeding Guide*. W. D. Hoard & Sons Company, Fort Atkinson, WI.

Knowlton, K. F., and J. M. Nelson. 2003. *World of Dairy Cattle Nutrition*. Holstein Foundation, Inc., Brattleboro, VT.

Purebred Dairy Cattle Association. 2009. *Dairy Cattle Unified Scorecard*. Purebred Dairy Cattle Association, Madison, WI.

Purebred Dairy Cattle Association. 2004. *Showring Code of Ethics*. Purebred Dairy Cattle Association, Madison, WI.

Purebred Dairy Cattle Association. 2011. *PDCA Showmanship Evaluation Card*. Purebred Dairy Cattle Association, Madison, WI.