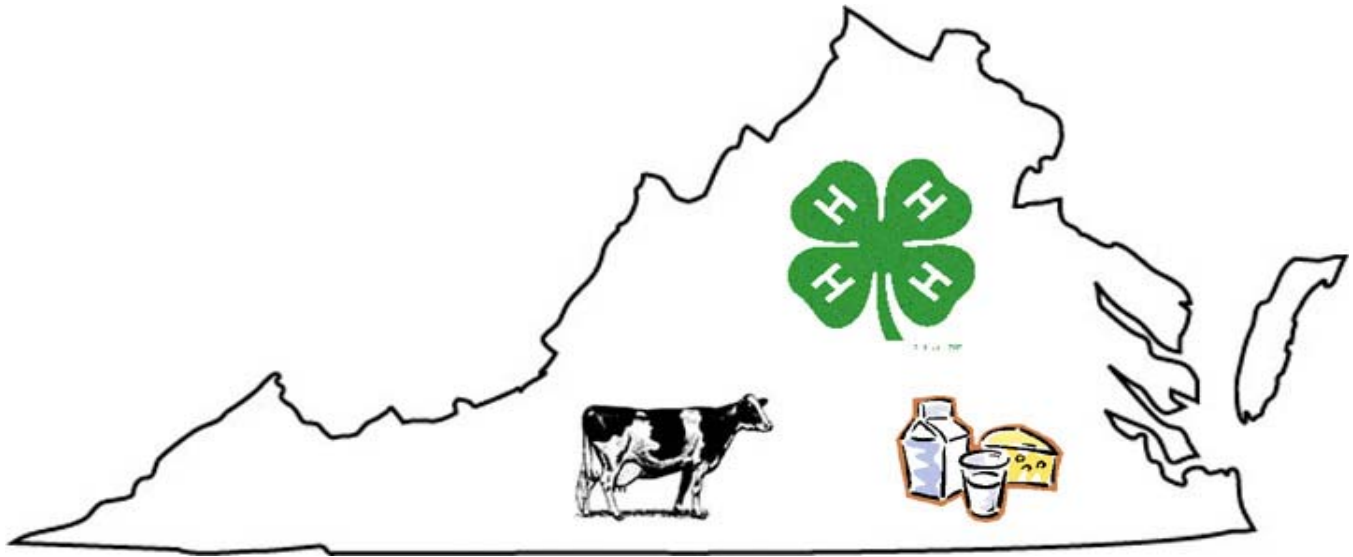


2011 Virginia 4-H Dairy Quiz Bowl Materials



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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.

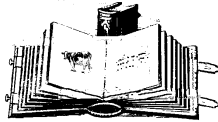
Disclaimer

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

2011 Virginia 4-H Dairy Quiz Bowl Study Materials



1600's

- 1611** First cows arrived at the **Jamestown Colony**
- 1624** First cows arrived at the **Plymouth Colony**



1801-1860

- 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**
- 1856** First **commercial butter factory** established in New York
- 1857** First successful **condensory** built by Gail Borden in Burrville, Connecticut

1861-1880

- 1865** **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

1881-1900

- 1884** **Milk bottle** invented
- 1885** ***Hoard's Dairyman*** magazine first published
- 1885** **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



1901-1915

- 1905** First **cow testing association** in the U.S. organized in Michigan
- 1906** **American Dairy Science Association** founded
- 1906** First **National Dairy Show** held in Chicago
- 1906** **Brown Swiss** cattle recognized as an official dairy breed in the United States
- 1906** **National Dairy Council** organized
- 1914** **Smith Lever Act** signed establishing the Cooperative Extension Service

1916-1930

- 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 Improvement** testing program started
- 1930** **Hoard's Dairyman cow judging contest** begun

1931-1937

- 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
- 1937** **Federal Agricultural Marketing Act** which provides basis for federal milk marketing orders passed

1938-1940

- 1938** **Artificial insemination** began in the U.S.
- 1938** First **A.I. cooperative in the U.S.** was organized in New Jersey by E. J. Perry
- 1938** First **bulk tanks** used on farms
- 1940** **American Dairy Association** founded
- 1940** **Purebred Dairy Cattle Association** formed

1941-1950

- 1942** **National Association of Animal Breeders** organized
- 1943** The **PDCA Dairy Cow Unified Score Card** was first copyrighted
- 1945** First edition of the National Research Council's ***Nutrient Requirements of Dairy Cattle*** was published
- 1949** **National Dairy Shrine** founded

1951-1960

- 1951** **Computer** first used to calculate DHIA records in Utah
- 1951** First U.S. **young sire sampling program** established
- 1951** First **successful embryo transfer** in dairy cattle
- 1951** First **commercial milk replacer** for calves introduced
- 1953** Frosty, the first U.S. **calf resulting from frozen semen** born
- 1955** **Flavor control equipment** introduced commercially
- 1960** **National Mastitis Council** founded

1961-1980

- 1964** Commercial introduction of **plastic milk jug**
- 1964** **Red and White Dairy Cattle Association** organized
- 1965** **National Dairy Herd Improvement Association** organized
- 1967** **World Dairy Expo** founded and holds first show
- 1974** **Nutrition labeling** of fluid milk products begins

1981-1990

- 1983** **INTERBULL** developed
- 1983** **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

1991-2000

- 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
- 2000** **Federal Milk Marketing Orders** reformed to reduce the number of orders

2001-present

- 2001** National Research Council's **Nutrient Requirements of Dairy Cattle** most recently updated (7th revised ed.)
- 2002** **North American Intercollegiate Dairy Challenge** established
- 2003** **Sexed semen** becomes commercially available
- 2009** Most recent revision of the **PDCA Dairy Cow Unified Score Card**
- 2009** **Genomic predictions of genetic merit** officially released by USDA-AIPL

Chapter 2: People and Organizations

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

ADA	American Dairy Association
ADSA	American Dairy Science Association
AFACT	American Farmers for the Advancement and Conservation of Technology
AFBF	American Farm Bureau Federation
AJCA	American Jersey Cattle Association
AMS	Agricultural Marketing Service (USDA)
AOAC	American Organization of Analytical Chemists
APHIS	Animal and Plant Health Inspection Service (USDA)
ARS	Agricultural Research Service (USDA)
CCC	Commodity Credit Corporation

Acronyms

CME	Chicago Mercantile Exchange
CSS	Certified Semen Services
DCHA	Dairy Calf and Heifer Association
DCRC	Dairy Cattle Reproductive Council
DHIA	Dairy Herd Improvement Association
DHIR	Dairy Herd Improvement Registry
DRPC	Dairy Records Processing Center
DRINC	Dairy Research, Inc.
EPA	Environmental Protection Agency
FASS	Federation of Animal Science Societies

Acronyms

FCS	Farm Credit Services
FDA	Food and Drug Administration
FSA	Farm Service Agency (USDA)
FSIS	Food Safety Inspection Service (USDA)
IDF	International Dairy Federation
IDFA	International Dairy Foods Association
IMS	Interstate Milk Shippers
NAAB	National Association of Animal Breeders
NADC	National Animal Disease Center
NASS	National Agricultural Statistics Service (USDA)

Acronyms

NCIMS	National Conference of Interstate Milk Shipments
NDC	National Dairy Council
NDHIA	National Dairy Herd Improvement 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 (USDA)
PDCA	Purebred Dairy Cattle Association
PETA	People for the Ethical Treatment of Animals

Acronyms

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 <i>Hoard's Dairyman</i> , the national dairy farm magazine.
Louis Pasteur	Invented pasteurization. He is considered the first person to discover that bacteria cause food spoilage and disease.
Dr. Harvey Thatcher	Invented the milk bottle.

U.S. Government Agricultural Leaders

Tom Vilsack	U.S. Secretary of Agriculture
Sen. Debbie Stabenow (D-MI)	Chair of the U.S. Senate Agriculture, Nutrition, and Forestry Committee
Rep. Frank Lucas (R-OK)	Chair of the U.S. House Committee on Agriculture

Breed association leaders

Becky Payne	Executive Secretary Ayrshire Breeders Association
David Wallace	Executive Secretary Brown Swiss Cattle Breeders Association
Seth Johnson	Executive Secretary-Treasurer American Guernsey Cattle Association
John Meyer	Executive Secretary Holstein Association USA, Inc.
Neal Smith	Executive Secretary and CEO American Jersey Cattle Association

Breed association leaders

David Kendall	Executive Secretary American Milking Shorthorn Society
Nicole Stout	Executive Secretary-Treasurer Red & White Dairy Cattle Association

Dairy industry leaders

Mark Clarke	General Manager World Dairy Expo
Jerry Kozak	President and CEO National Milk Producers Federation
Steve Larson	Managing Editor Hoard's Dairyman
Thomas Quaife	Editor Dairy Herd Management

Organization headquarters

American Dairy Science Association	Champaign, Illinois
Dairy Calf and Heifer Association	Chesterfield, Missouri
Hoard's Dairyman	Fort Atkinson, Wisconsin
Milk & Dairy Beef Quality Assurance Center	Stratford, Iowa
National Dairy Shrine	Fort Atkinson, 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

Dairy-related organizations

All-Jersey Sales Corporation is involved with cattle marketing.

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.

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

- ① Block and barrel cheese (cash)
- ② Class III and Class IV milk futures and options
- ③ Butter futures

Dairy-related organizations

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.

There are four **Dairy Records Processing Centers** (DRPC's) in the United States. They are:

- ① Agri Tech Analytics
- ② Ag Source Cooperative
- ③ DHI-Provo
- ④ Dairy Records Management Systems

Dairy-related organizations

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

Dean Foods is the largest processor and distributor of milk and other dairy products in the U.S.

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

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

Dairy Management, Inc. (DMI)

DMI is a nonprofit organization formed by the National Dairy Board and Unified Dairy Industry Association.

It conducts programs in integrated **marketing, communications, promotion, and research** for U.S. dairy farmers.

Organizations under the DMI umbrella are:

- ① American Dairy Association
- ② National Dairy Council
- ③ U.S. Dairy Export Council

Federation of Animal Science Societies (FASS)

FASS was formed by mutual consent and for the mutual benefit of its founding Member Societies:

- ① American Dairy Science Association (ADSA)
- ② American Society of Animal Science (ASAS)
- ③ Poultry Science Association (PSA)

Chapter 3: Dairy Breeds

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Ayrshire

Origin

County of Ayr, Scotland

Arrived in U.S.

1822

Mature bodyweight

1,200 pounds

Method of permanent ID

Photographs or sketches

Association name

Ayrshire Breeders Association

Association headquarters

Columbus, Ohio

Magazine

Ayrshire Digest



Brown Swiss

Origin

Switzerland

Arrived in U.S.

1869

Mature bodyweight

1,400 pounds

Method of permanent ID

Ear tattoo

Association name

Brown Swiss Cattle Breeders Association

Association headquarters

Beloit, Wisconsin

Magazine

Brown Swiss Bulletin



Guernsey

Origin

Isle of Guernsey

Arrived in U.S.

1831

Mature bodyweight

1,250 pounds

Method of permanent ID

Photographs or sketches

Association name

American Guernsey Association

Association headquarters

Columbus, Ohio

Magazine

Guernsey Breeders' Journal



Holstein

Origin

Netherlands and Germany

Arrived in U.S.

1852

Mature bodyweight

1,400 pounds

Method of permanent ID

Photographs or sketches

Association name

Holstein Association USA, Inc.

Association headquarters

Brattleboro, Vermont

Magazine

Holstein Pulse



Jersey

Origin

Isle of Jersey

Arrived in U.S.

1815

Mature bodyweight

1,000 pounds

Method of permanent ID

Eartag or tattoo

Association name

American Jersey Cattle Association

Association headquarters

Reynoldsburg, Ohio

Magazine

Jersey Journal



Milking Shorthorn

Origin

England

Arrived in U.S.

1846

Mature bodyweight

1,400 pounds

Method of permanent ID

Ear tattoo

Association name

American Milking Shorthorn Association

Association headquarters

Beloit, Wisconsin

Magazine

Milking Shorthorn Journal



Red and White

Association name

Red and White Dairy Cattle Association

Association headquarters

Clinton, Wisconsin

Magazine

The Red Bloodlines

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.

Miscellaneous breed information

Brown Swiss were originally used for **milk**, **meat** and **draft** purposes.

Today's Swiss are known for:

- ① High protein to fat ratio
- ② Sound feet and legs
- ③ Longevity
- ④ Having few health problems

Holsteins make up about 90% of the US 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.

Guernsey milk is known for its golden color.

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

Notable animals

World production leaders by breed

Brown Swiss: Lost Elm Prelude Pixy ET (58,826 lb.)

Holstein: Ever-Green-View My 1326-ET (72,170 lb.)

Jersey: Mainstream Barkly Jubilee (55,590 lb.)

The Queen Mother of the Brown Swiss breed is **Jane of Vernon**.

The first bull to produce one million units of semen was **Fisher-Place Mandingo**.

Dairy goats

Capriculture is the study of goats and goat husbandry.

Breeds of dairy goats

- ① Alpine
- ② La Mancha
- ③ Nubian
- ④ Oberhasli
- ⑤ Saanen
- ⑥ Toggenburg



Chapter 4: Dairy Cattle Judging, Fitting, and Showing

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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 pts. each.*

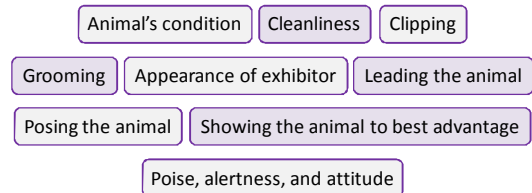
Dairy Heifer Scorecard

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

PDCA Fitting and Showing Scorecard

Category	Points
Appearance of animal	30
Appearance of exhibitor	10
Presentation of animal	60

Items that a judge looks for when judging a fitting and showmanship contest include:



Showing guidelines

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.

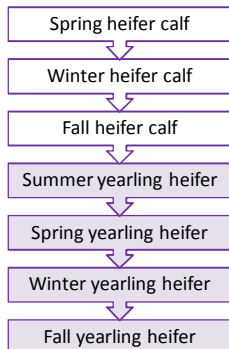
Show ethics

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

- ① Blind quarter
- ② Freemartin heifer
- ③ Permanent lameness
- ④ Tampering to conceal faults
- ⑤ Total blindness

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

Heifer classes in a dairy show



Anatomy related to judging

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

The **main udder supports** are:

- ① Skin
- ② Median suspensory ligament
- ③ Lateral suspensory ligament

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

- ① Face
- ② Tail

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.

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.



Chapter 5: Calf and Heifer Management

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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

There are several important **points to consider** when selecting a calf as a project animal. They include:

- ① Age
- ② Breed
- ③ Health
- ④ Pedigree
- ⑤ Conformation



Identification

Methods commonly used to identify calves include:



Eartags



Freeze branding



Photos



Sketch



Tattoo

Liquid diet

Liquid diet choices for pre-weaned calves include:

- ① Milk replacer
- ② Whole milk
- ③ Colostrum

A pre-weaned calf should have **8 to 10 percent** of its body weight in milk or milk replacer daily.

Colostrum

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

It 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**.

Colostrum management

Critical factors in colostrum management:

- ① Quantity
- ② Quality
- ③ Timing
- ④ Cleanliness

Storage options for excess colostrum:

- ① Add preservative acid
- ② Ferment
- ③ Freeze (may be safely stored frozen for a year)
- ④ Refrigerate

Colostrum quality

A **colostrometer** is a device used to measure the antibodies in colostrum.

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

- ① Cow dry less than 3-4 weeks
- ② Pre-milking
- ③ Young cow
- ④ Leaking teats
- ⑤ Dirty udder and teats

Milk replacer

Recommended nutritional content of milk replacer

<u>Program</u>	<u>Crude Protein</u>	<u>Fat</u>
Conventional	20%	20%
Accelerated	26-30%	15-25%

Recommended protein sources for milk replacers

- | | |
|----------------------|----------------------------------|
| ① Casein | ⑤ Dried whey protein concentrate |
| ② Dried skim milk | ⑥ Modified wheat protein |
| ③ Dried whey | ⑦ Protein modified soy flour |
| ④ Dried whey product | ⑧ Soy protein concentrate |
| | ⑨ Soy protein isolate |

Miscellaneous

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.

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

The common names for the **stages of a female dairy animal's life** from birth to weaning are:

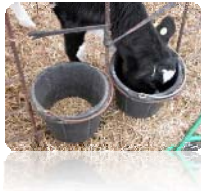
- ① Calf
- ② Heifer
- ③ Cow

Weaning

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

The main criterion for deciding when to wean a calf should be **grain intake**.

A calf should consume a minimum of **1.5 pounds** of grain per day for three consecutive days before weaning.



Calf starter

The recommended **crude protein** content for calf starter is **18-22%**.

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

- ① Commercial textured calf starters
- ② Commercial pelleted starters
- ③ Home-made grind and mix starters



Growth

Average Daily Gain (ADG) is a significant factor in monitoring growth rates in dairy heifers.

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

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

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



Calf housing

Calf housing should be:

- ① Clean
- ② Dry
- ③ Draft-free
- ④ 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

- ① Calf hutch
- ② Elevated stalls
- ③ Pens on the floor
- ④ Cold calf housing system
- ⑤ Counter-slope system

Advantages of calf hutches

- ① Easily moved
- ② Prevent disease from spreading from one calf to another
- ③ Better ventilation

Health

Scours and **pneumonia** are the leading causes of death in young calves.

Major causes of calf scours

- ① Inadequate colostrum
- ② Poor quality milk replacer
- ③ Unsanitary calving conditions
- ④ Overfeeding
- ⑤ Poor quality colostrum
- ⑥ Overcrowding
- ⑦ Inadequate ventilation

Physical factors contributing to pneumonia in calves

- ① Drafts
- ② Chilling
- ③ Dampness
- ④ Poor ventilation

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

Signs of illnesses in calves

- ① Poor appetite
- ② Cough
- ③ Watery manure
- ④ Nasal discharge
- ⑤ Drooping ears
- ⑥ Dull eyes
- ⑦ Lack of energy
- ⑧ Elevated temperature



Preventative measures

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

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

Methods of dehorning calves:

- ① Paste (caustic potash)
- ② Electric
- ③ Cut or gouge (Barnes type dehorner)

Extra teats are also known as **supernumerary teats**.

Between **30 and 40 percent** of heifers born have extra teats.

They should be removed as soon as they can be told apart from the four main teats, or at dehorning time.

Custom dairy heifer rearing

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

- ① Decreased labor requirement
- ② Increased milking herd management
- ③ Increased facility capacity for milking cows
- ④ Herd expansion without capital investment with use of existing facilities
- ⑤ Increased feed inventory for milking cows
- ⑥ Potential for better replacement heifers

Custom dairy heifer rearing

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

- ① Time period
- ② Billing and payment procedures
- ③ Definition of each party's responsibility
- ④ Amendments, renegotiations, and renewal
- ⑤ Conditions for termination of agreement

Methods of charging for heifer grower services include:

- ① Per animal per day
- ② Per animal
- ③ Per pound of gain
- ④ Feed plus yardage
- ⑤ Option to purchase

Chapter 6: Nutrition, Feeds, and Feeding

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

AA	<i>amino acid</i>
ADF	<i>acid detergent fiber</i>
ADIN	<i>acid detergent insoluble nitrogen</i>
ADP	<i>adenosine diphosphate</i>
AMP	<i>adenosine monophosphate</i>
ATP	<i>adenosine triphosphate</i>
BCS	<i>body condition score</i>
BHBA	<i>beta hydroxybutyrate</i>
BUN	<i>blood urea nitrogen</i>
CF	<i>crude fiber</i>

Acronyms

CP	<i>crude protein</i>
DCAD	<i>dietary cation-anion difference</i>
DE	<i>digestible energy</i>
DM	<i>dry matter</i>
DMI	<i>dry matter intake</i>
FFA	<i>free fatty acid</i>
ME	<i>metabolizable energy</i>
MUN	<i>milk urea nitrogen</i>
NDF	<i>neutral detergent fiber</i>
NDIN	<i>neutral detergent insoluble nitrogen</i>

Acronyms

NE_g	<i>net energy for growth</i>
NE_l	<i>net energy for lactation</i>
NE_m	<i>net energy for maintenance</i>
NEFA	<i>non-esterified fatty acid</i>
NFC	<i>nonfiber carbohydrates</i>
NIR	<i>near-infrared reflectance</i>
NPN	<i>nonprotein nitrogen</i>
NSC	<i>nonstructural carbohydrates</i>
PUN	<i>plasma urea nitrogen</i>
RDP	<i>rumen-degradable protein</i>

Acronyms

RFQ	<i>relative forage quality</i>
RFV	<i>relative feed value</i>
RUP	<i>rumen-undegradable protein</i>
TDN	<i>total digestible nutrients</i>
TMR	<i>total mixed ration</i>
VFA	<i>volatile fatty acid</i>

A mouthful...

A mature dairy cow has **32 teeth**, but has **no upper front teeth**.
Chewing is also known as **mastication**.

Cud is feed that a cow has regurgitated and is being re-chewed.

Eructation is belching of gas by ruminant animals as a natural way for releasing gases produced during the fermentation process.

Rumination is the process in ruminants when semi-liquid ingesta is regurgitated into the esophagus, re-chewed, and re-swallowed for further digestion.

The **esophagus** is the tube that connects the mouth to the rumen.



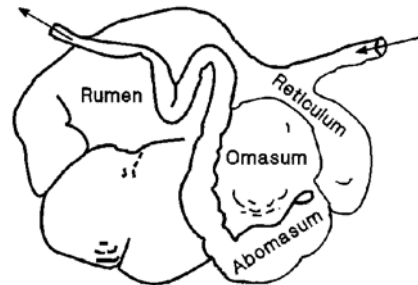
Saliva

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 include:

- ① Moistens food
- ② Lubricates food
- ③ Acts as a buffer
- ④ Provides fluid base for many nutrients
- ⑤ Provides the proper environment for bacterial growth

The dairy cow's four compartment stomach



Rumen = "fermentation vat" **Omasum** = "manyplies"
Reticulum = "honeycomb" **Abomasum** = "true stomach"

Rumen

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**.

The primary process that takes place in the rumen is **fermentation**.

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

The tiny, finger-like projections that line the wall of the rumen are called **papillae**.

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

The **reticulum** is the stomach compartment located closest to the heart. Hardware disease occurs in the reticulum.

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

The **abomasum** is the enzyme and acid secreting portion of the ruminant stomach. The primary acid found in the abomasum is **hydrochloric acid**.

Small Intestine

The segments of the small intestine are the:

- ① **Duodenum**
- ② **Jejunum**
- ③ **Ileum**

Villi are the small projections that line the small intestine wall.

The feed material found in the small intestine is called **chyme**.

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:

- ① Water absorption; and
- ② Storage of waste materials.

Nutrients

A **nutrient** is any chemical substance that provides nourishment to the body.

The **main processes** for which a cow uses nutrients from her feed are:

- ① Growth
- ② Maintenance
- ③ Production
- ④ Reproduction

The **major nutrients** contained in feedstuffs are:

- ① Energy
- ② Protein
- ③ Vitamins
- ④ Minerals
- ⑤ Water

Energy is most likely to be the limiting nutrient for the high producing dairy cow. **Fats** and **carbohydrates** are major sources of energy for the dairy cow.

Amino Acids

Amino acids are the building blocks of true proteins.

There are **20** standard amino acids.

The cow's two **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. Nonessential amino acids are produced by the cow and do not have to be provided in the diet.

Ten essential amino acids for milking cows

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

* Most limiting amino acids in dairy cattle nutrition.

Vitamins

Fat Soluble

Vitamin A

Vitamin D

Vitamin E

Vitamin K

Water Soluble

B Complex

Vitamin C

B Complex vitamins include: **Thiamine** (B1), **Riboflavin** (B2), **Niacin**, **Pantothenic Acid**, **Biotin**, **Folic Acid**, **Choline**, and **B12**.

Vitamins

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

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

Vitamin C is also known as **ascorbic acid**.

Vitamin E has functions similar to selenium.

Vitamin K plays a role in the coagulation of blood.

Minerals

Macrominerals are generally required by the body in relatively **large quantities**. Requirements are usually stated as a **percent of ration dry matter**.

Calcium

Chlorine

Magnesium

Phosphorus

Potassium*

Sodium

Sulfur

* Needed by the dairy cow in the largest quantity

Microminerals (also known as **trace minerals**) are required by the body in relatively **small quantities**. Requirements are usually stated in **parts per million (ppm)**.

Cobalt

Copper

Iodine

Iron

Manganese

Selenium

Zinc

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.

Factors influencing the amount of water consumed by dairy cattle

- ① Body size
- ② Environmental temperature
- ③ Water temperature
- ④ Water quality
- ⑤ Relative humidity
- ⑥ Diet
- ⑦ Milk production



Peak times for water consumption

- ① As soon as cows leave the milking parlor
- ② When cows consume large amounts of dry matter (at feeding)

Water

Physiological functions of water in the body include:

- ① A medium to transport nutrients
- ② To carry waste products to the point of excretion
- ③ To cool the body at high environmental temperatures
- ④ Functions as a universal solvent
- ⑤ Serves as a fluid to lubricate joints
- ⑥ Serves as a fluid base for milk
- ⑦ Serves as a substrate for metabolic reactions

A dairy cow **excretes or loses water** through:

- ① Breathing
- ② Feces
- ③ Milk
- ④ Sweat
- ⑤ Urine

Forage analysis or testing

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

Forage testing methods include:

- ① NIR
- ② Wet chemistry

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

Ash is the mineral matter present in feed.

Dry matter

Dry matter is the portion of a feed that remains after water has been removed by drying in an oven.

Items needed to do a quick and easy dry matter determination on a forage at home:



①
Microwave
oven



②
Gram
scale



③
Paper
plate



④
Water
glass

Measures of energy

Calorie = unit of measure of energy in a feed; the amount of energy required to raise 1 gram of water 1°C.

Digestible energy = 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 = the actual amount of energy the body can use for growth, lactation, reproduction, and body maintenance.

Fiber

Fiber is needed in dairy cattle rations to:

- ① Maximize dry matter and energy intakes
- ② Maintain normal rumen function
- ③ Maintain normal milkfat percentage
- ④ Protect against postcalving difficulties



The **digestibility** of plant fiber decreases as the plant increases in age or in hot weather.

Acid Detergent Fiber (ADF) consists of **cellulose**, **lignin**, and **lignified nitrogen components** (heat damaged protein). The acid detergent fiber (ADF) 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**.

By-product feeds

By-products can be successfully used as feed for dairy cattle.

Nutrient composition, **cost**, **availability**, **palatability**, **storage**, **consistency**, and **ability to feed** (use) are factors that should be considered before including a by-product in the ration.

By-product feedstuff examples

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

Protein sources

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

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

Common mineral supplements

Dicalcium phosphate

Limestone*

Magnesium oxide

Monocalcium phosphate

Potassium chloride

White salt

*Excellent source of calcium

Buffers

A **buffer** is any substance that can reduce changes in pH when an acid or alkali is added.

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

- ① Increase fat test
- ② Aid in adjusting to high energy ration
- ③ Improve milk quality
- ④ Improve digestibility
- ⑤ Maintain acid-base balance
- ⑥ Improve intake

Buffers **commonly used** in dairy rations include:

- | | |
|---------------------------------|----------------------|
| ① Limestone (calcium carbonate) | ③ Magnesium oxide |
| ② Sodium bentonite | ④ Sodium bicarbonate |

Ionophores

Ionophores alter rumen fermentation by boosting the production of propionic acid and reducing the production of acetic acid. Examples are:

- ① **Lasalocid** (not approved for use in lactating dairy cattle)
- ② **Monensin** (approved for use in lactating dairy cattle)

Nutrient requirements

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

- ① Body weight
- ② Age
- ③ Milk production level
- ④ Fat test
- ⑤ Stage of lactation
- ⑥ Reproductive status
- ⑦ Body condition
- ⑧ Environmental temperature



Total mixed ration (TMR)

A **TMR** is a blend of all feedstuffs (forages & grains) in one feed.

Advantages of feeding a total mixed ration include:

Eliminate selective eating

Consistent ration

Higher dry matter intake

Free-choice mineral not needed

Higher milk production

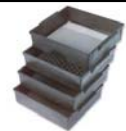
Lower percent fiber needed in ration

Easier to balance precisely

Fewer digestive upsets

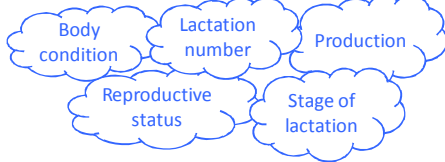
Can feed a variety of by-products

Uses for a forage particle separator



- ① Evaluate whether there is enough long fiber in the ration
- ② Check for overmixing and particle size reduction
- ③ Develop baseline particle size information for comparison
- ④ Check ration uniformity
- ⑤ Determine optimum mixing order
- ⑥ Evaluate whether particle size changes with hay quality
- ⑦ Check for sorting

Factors that may be considered when grouping the milking herd



Dietary Cation-Anion Difference (DCAD)

DCAD is a helpful tool in **milk fever prevention**.

An **anion** is a **negatively** charged ion or particle.

A **cation** is a **positively** charged ion or particle.

The **elements** used to calculate DCAD are:

- ① Sodium (+)
- ② Potassium (+)
- ③ Chlorine (-)
- ④ Sulfur (-)

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

- | | |
|---------------------|----------------------|
| ① Ammonium chloride | ④ Calcium sulfate |
| ② Ammonium sulfate | ⑤ Magnesium chloride |
| ③ Calcium chloride | ⑥ Magnesium sulfate |

pH

An **acid** is a substance that has a low pH (below 7.0).

An **alkaline** is a substance that has a high pH (above 7.0).

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

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

Forages

Forage = the vegetative portion of plants in a fresh, dried, or ensiled state that is fed to livestock.

Baleage = wrapped, round bales of silage.

Green chop = forages 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 into a silo, where it is packed or compressed to exclude air and undergoes an acid fermentation (lactic and acetic acids) that retards spoilage.

Legumes

Legumes used in dairy rations include:

- | | |
|-----------------------|------------|
| ① Alfalfa | ⑤ Peanuts |
| ② Bird's Foot Trefoil | ⑥ Peas |
| ③ Clover | ⑦ Soybeans |
| ④ Lespedeza | ⑧ Vetch |



Nitrogen fixing bacteria are associated with legumes.

Phosphorus is critical for the establishment of legumes.

Grazing

Surveys indicate that the most common reason that farm owners adopted grazing was to **reduce costs**.

The main **costs cited for reduction** were:

- ① Feed
- ② Labor

Disadvantages of grazing:

- ① Distance from parlor
- ② Inconsistent quality
- ③ Inconsistent quantity
- ④ Unable to balance ration properly
- ⑤ Lower forage production per acre



Hay

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

- ① Higher nutrient content
- ② Higher digestibility
- ③ Greater voluntary intake (more palatable)
- ④ 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:

- ① Aerobic phase
- ② Anaerobic phase
- ③ Stable phase
- ④ Feeding phase

Types of silage storage facilities include:

- ① Bunker silo
- ② Trench silo
- ③ Upright/tower silo
- ④ Plastic bag
- ⑤ 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.

Silage

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

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

Valuable nutrients that can be lost in **seepage** from a silo are:

- ① Minerals
- ② Organic acids
- ③ Protein
- ④ Soluble sugars

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**.

Cold flow ammonia is often added to corn silage to increase the crude protein content.

Kernel processing of corn silage is used to increase starch digestibility.

The **theoretical length of cut** (TLC) for corn silage harvested with a conventional harvester is recommended to be **3/8 inch**. If harvested with a harvester fitted with a kernel processor, the TLC should be **3/4 inch**.

Corn varieties

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

- ① Corn borer resistance
- ② Herbicide resistance
- ③ High oil content
- ④ 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 raise fiber digestibility.

Miscellaneous

Feed is the largest cost in milk production.

Palatability is the taste or likability of a feedstuff.

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

Annuals are plants that are seeded each year and whose growth are completed in one crop year.

Perennials are plants that have a life cycle of more than two years.

Raw soybeans will turn rancid if they are ground.

Miscellaneous

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

Positive energy balance occurs when the amount of energy taken into the body is greater than the amount of energy required by the body.

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

Chapter 7: Lactation and Milking Management

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

bST	<i>bovine somatotropin</i>
BTMC	<i>bulk tank milk culture</i>
BTSCC	<i>bulk tank somatic cell count</i>
CFM	<i>cubic feet per minute</i>
CIP	<i>clean in place</i>
CMT	<i>California mastitis test</i>
CNS	<i>coagulase-negative staphylococcus</i>
DMSCC	<i>direct microscopic somatic cell count</i>
IGF	<i>insulin-like growth factor</i>
IMI	<i>intramammary infection</i>

Acronyms

SCC	<i>somatic cell count</i>
SCS	<i>somatic cell score</i>
WMT	<i>Wisconsin mastitis test</i>

Udder anatomy

Alveoli are spherical clusters of secretory cells in the mammary gland that are arranged in grape-like structures.

Myoepithelium is contractile tissue that forces milk out of the alveoli upon action of oxytocin.

The **parts of the teat through which milk passes** are:

- ① Teat cistern
- ② Sphincter muscle
- ③ Streak canal or teat canal (opening in the end of the teat)

Keratin is the waxy substance produced by cells lining the teat canal that serves as a plug between milkings and aids in reducing penetration by microorganisms.

Strutting is the condition in which the teats point out too much.

Supernumerary teats are extra teats.

Milk production

Lactation is the period of time when a cow is in milk.

Cows will normally produce **8 to 15 percent more** milk when milked **three times a day** as compared to those milked twice a day.

Three hundred and five day milk production is highest for cows calving in **November, December, and January**.

Hormones

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

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

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

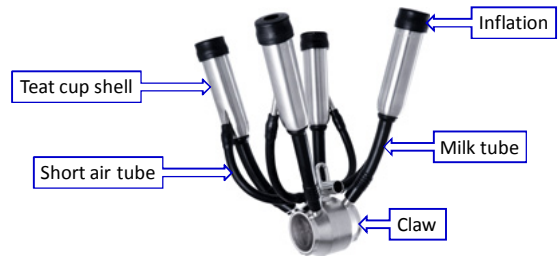
Estrogen and **progesterone** are ovarian hormones that are involved in the development of the mammary gland.

Types of milking parlors



- ① Herringbone (most common type in use today)
- ② Parabone
- ③ Parallel
- ④ Rotary
- ⑤ Side opening

Parts of a milking unit



Teat cup liners (inflations) should be replaced every 1,000 – 1,200 cow milkings. Specifically, the only part of the milking system that touches the cow is the teat cup liner or inflation.

Parts of a milking system

A **milkline** is a line that carries milk and air during milking and has the dual function of providing milking vacuum and conveying milk to a receiver.

A **looped milkline** is a milkline that forms an enclosed circuit with two full-bore connections to the receiver.

A **lowline (or low-level) milking system** is a system in which the milk inlet to the milkline or receiver jar is below the animal standing level.

A **washline** is a 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.

A **milk meter** is a device between the cluster and the milkline for measuring all the milk from an individual animal.

Pulsation

Pulsation is the cyclic opening and closing of a teat cup liner.



The **pulsator** is the part of the milking system that causes the alternate vacuum pressure between the teat cup shell and liner.

Alternating pulsation is when cyclic movement of the liners of two teat cups within a cluster alternates with the movement of the other two liners.

The **pulsation rate** is number of times per minute that the pulsator opens and closes.

The **pulsation ratio** is 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

A **vacuum pump** is an air pump that produces vacuum in the system.

A **vacuum gauge** is an instrument to indicate the level of vacuum in the system, relative to atmospheric pressure.

A **vacuum regulator (vacuum controller)** is the part of the milking system that prevents the vacuum level from exceeding a prescribed level.

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

A **sanitary trap** is a vessel between the milk system and the air system to limit movement of liquids and other contaminants between the two systems.

Bulk tank

A **bulk tank** is a large storage tank for cooling and storing milk at a cold temperature until it is transported to a processing plant. It is usually made of stainless steel.



An **agitator** is a mechanical or pneumatic means, provided with the bulk milk tank, for stirring the milk to facilitate cooling and to provide a uniform product mixture for sampling.

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 **requirements for adequate, effective cleaning** of milking systems are:

- ① Time
- ② Temperature
- ③ Concentration

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

A **sanitizer** is a chemical solution used to kill bacteria on product contact surfaces.

Cleaning equipment

Backflushing is a system for sanitizing teat cup liners between cow milkings.

Clean-in-place (CIP) is the capability to clean and disinfect the milk-contact components of a milking system by circulating appropriate solutions through them without disassembly.

An **air injector** is a device that allows the controlled, cyclic admission of air during cleaning and sanitizing to produce slug flow conditions.

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

Milk stone is a milk-mineral deposit on milk handling equipment.

Signs of a malfunctioning milking system

- ① Excessive vacuum fluctuation
- ② Flooded milk lines
- ③ Slow milking
- ④ Squawking teat cups*
- ⑤ Teat cups fall off
- ⑥ Uneven milk flow

*A **liner slip** is a condition whereby a teat cup slides down the surface of the teat, often accompanied by a squawk, caused by improper liner design, cluster weight, vacuum fluctuations, or milking wet teats.

Milking-related definitions

Forestripping is a 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.

The first streams of milk stripped from the udder prior to milking are called **foremilk**.

The process through which milk is squeezed out of milk-producing tissue by the action of the hormone, oxytocin, is called **let-down**.

Residual milk is milk remaining in the mammary gland following completion of milking.

Stray voltage, small electric currents that flow through the electrical grounded-neutral system and which pass through a cow's body, adversely affects her behavior and performance.

Recommended milking procedures

- ① Provide a clean, low stress environment for cows.
- ② Check foremilk and udder for mastitis.
- ③ Predip 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

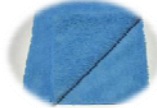
- ① Lower production
- ② Slower milking time
- ③ Higher somatic cell count (mastitis problems)



Cloth towels

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

- ① Use a separate towel for each cow.
- ② Wash cloth towels using warm water.
- ③ Do not let damp towels sit between uses because of yeast or mold contamination.
- ④ Dry towels immediately after washing or add bleach when washing.



Mastitis

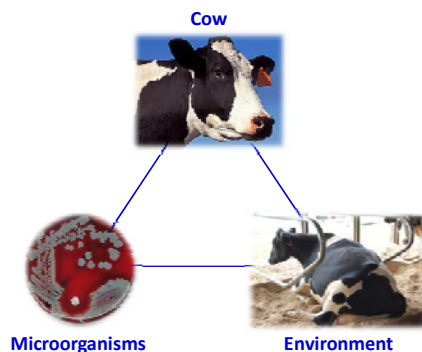
Mastitis is the most costly disease in dairy cattle.

Mastitis-related costs include:

- ① Reduced milk production (64%)
- ② Discarded milk (14%)
- ③ Early cow replacement cost (8%)
- ④ Reduced cow sale value (5%)
- ⑤ Drugs (5%)
- ⑥ Veterinarian (3%)
- ⑦ Labor (1%)
- ⑧ Lost milk premiums (variable)



Major factors involved in bovine mastitis



Mastitis definitions

Mastitis is an inflammation of the udder, most commonly caused by infecting microorganisms.

Inflammation is a condition in which the cow's body seeks to eliminate or neutralize invading microorganisms and repair damaged tissue.

Intramammary infection is characterized by the presence of microorganisms growing in the udder.

Ropy milk is milk that contains strings of white blood cells.

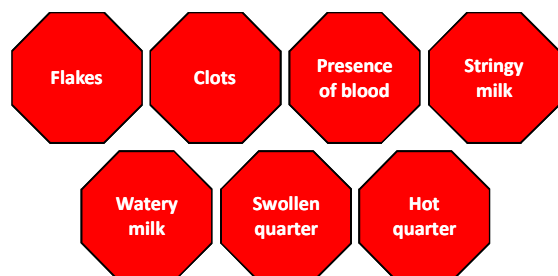
Spontaneous recovery is the ability of a cow to cure herself of an udder infection without the aid of antibiotics or other drugs.

Types of mastitis

The main types of mastitis are described below.

- ① **Subclinical mastitis** is mastitis with no detectable change in the udder itself and no observable abnormality of the milk.
- ② **Clinical mastitis** is characterized by visible abnormalities in the udder or milk.
- ③ **Acute mastitis** is characterized by sudden onset, redness, swelling, hardness, pain, grossly abnormal milk, and reduced milk yield.
- ④ **Chronic mastitis** continues over a long period of time, with progressive development of scar tissue and simultaneous reduction in milk yield.

Symptoms of clinical mastitis



On-farm screening tests to detect mastitis



California Mastitis Test (CMT)



Conductivity



Strip Cup

Somatic cells

High numbers of **somatic cells** in milk are generally an indicator of infection, or mastitis.

Somatic cells include two types of cells:

- ① White blood cells (**leukocytes**) that move into the udder during inflammation and
- ② **Epithelial cells** from milk producing tissues.

A **somatic cell count** (SCC) is a measurement most commonly used as an indicator of mastitis. It is an indicator of the extent of subclinical mastitis present in a cow's udder or number of leukocytes present.

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

Causes of mastitis infections

- ① Failure to teat dip
- ② Faulty milking equipment
- ③ Improper dry cow management
- ④ Poor housing/environment
- ⑤ Poor milking practices
- ⑥ Poor sanitation
- ⑦ Stray voltage

Mastitis-causing pathogens

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

- ① *Staphylococcus aureus* (Staph. aureus)
- ② *Streptococcus agalactiae* (Strep. ag.)
- ③ *Mycoplasma* species

Environmental mastitis-causing pathogens are those growing in the cow's environment that contact the udder and teats causing infection. Examples include:

- ① *Escherichia coli* (E. coli)
- ② *Enterobacter* species
- ③ *Klebsiella* species
- ④ *Streptococcus dysgalactiae* (Strep. dysgalactiae)
- ⑤ *Streptococcus uberis* (Strep. uberis)

Coliforms

Environmental Streps

Other mastitis-causing pathogens

Arcanobacterium pyogenes

Bacillus cereus

Coagulase-positive staphylococci

Corynebacterium bovis

Fungi

Nocardia species

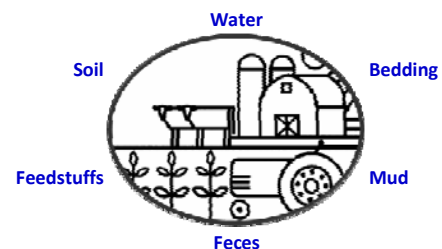
Prototheca

Pseudomonas aeruginosa

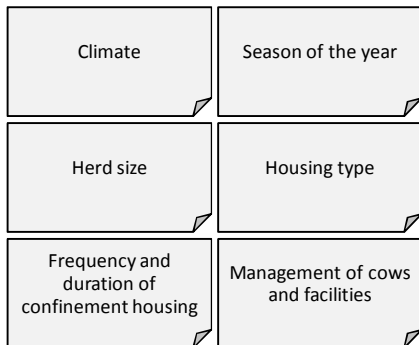
Serratia

Yeast

Sources of environmental bacteria in dairy herds



Factors affecting the dairy cow's environment



Five steps in a good mastitis control program

- ① Use functionally adequate milking equipment in the correct manner.
- ② Dip teats after milking with an effective product.
- ③ Treat clinical cases immediately with recommended dosages.
- ④ Treat every quarter of every cow at dry off with an effective dry cow product.
- ⑤ Cull chronic cows.

Mastitis prevention

The **most effective measures** to prevent new mastitis infections are:

- ① Teat dipping
- ② Dry cow antibiotic treatment

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

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:

- ① Iodine
- ② Chlorhexidine
- ③ Bronopol
- ④ Quaternary ammonia
- ⑤ DDBSA
- ⑥ Chlorine



Milk quality

The legal limits for **somatic cell counts** in raw milk are:

United States = 750,000 cells/ml

European Community = 400,000 cells/ml

Legal limit for **bacteria counts** in raw milk (U.S.) = 100,000 cfu/ml

Sources of on-farm milk contamination include:

- | | |
|----------------------------------|---------------------|
| ① Air (dust) | ⑤ Feed |
| ② Antibiotics | ⑥ Insects |
| ③ Dirt (from outside of the cow) | ⑦ Interior of udder |
| ④ Equipment | ⑧ Water |

Factors that can influence milk composition

- | | |
|-----------------------------|----------------------|
| ① Age of cow | ⑥ Breed |
| ② Environmental temperature | ⑦ Estrus |
| ③ Genetics | ⑧ Milking procedures |
| ④ Nutrition | ⑨ Season |
| ⑤ Somatic cell count | ⑩ Stage of lactation |



Conditions that will cause a decrease in fat test

- | | |
|-------------------------|-------------------------------|
| ① Cow is in heat | ④ Illness |
| ② Extremely hot weather | ⑤ Low fiber content in ration |
| ③ Finely chopped feeds | |

Mastitis effects on milk composition

Components that **decrease** in concentration in mastitic milk

- ① Lactose
- ② Total proteins
- ③ Casein
- ④ Solids not fat
- ⑤ Total solids
- ⑥ Fat
- ⑦ Calcium
- ⑧ Phosphorus
- ⑨ Potassium

Components that **increase** in concentration in mastitic milk

- ① Lipase
- ② Sodium
- ③ Chloride
- ④ Immunoglobulins
- ⑤ Leukocytes
- ⑥ Trace Minerals

Dry period

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

Involution is the process by which udder tissue reverts to a non-milk-producing state after drying off.

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

The **purposes of dry cow antibiotic treatment** are:

- ① To remove existing infection
- ② To prevent new infection

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

- ① Higher concentration of antibiotics (than lactating products)
- ② Antibiotics remain longer
- ③ No discarding of saleable milk
- ④ Prevents new infections

Chapter 8: Dairy Products and Milk Marketing

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

ADV	<i>acid degree value</i>
CFU	<i>colony forming units</i>
CLA	<i>conjugated linoleic acid</i>
COOL	<i>country of origin labeling</i>
CWT	<i>Cooperatives Working Together</i>
DEIP	<i>Dairy Export Incentive Program</i>
DIPP	<i>Dairy Indemnity Payment Program</i>
GATT	<i>General Agreement on Tariffs and Trade</i>
HACCP	<i>hazard analysis critical control points</i>
HTST	<i>high temperature, short time</i>
MILC	<i>Milk Income Loss Contract</i>

Acronyms

NAFTA	<i>North American Free Trade Agreement</i>
NDM	<i>nonfat dry milk</i>
NOP	<i>National Organic Program</i>
PI	<i>preliminary incubation</i>
PMO	<i>Pasteurized Milk Ordinance</i>
RDA	<i>Recommended Daily Allowance</i>
SNF	<i>solids not fat</i>
SPC	<i>standard plate count</i>
TS	<i>total solids</i>
UF	<i>ultrafiltration</i>
UHT	<i>ultra high temperature</i>

Milk

Milk is nature's most nearly perfect food.

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

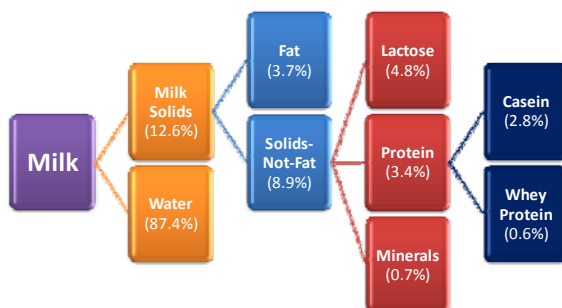
Raw milk is milk as it comes from the cow prior to processing.

Animals other than the cow are used to produce milk for human consumption throughout the world. These animals include:

- ① Goat
- ② Sheep
- ③ Camel
- ④ Water buffalo
- ⑤ Reindeer
- ⑥ Horse
- ⑦ Yak



Cow's milk composition



Milk composition

The components of the **solids-not-fat** portion of milk are:

- ① Protein
- ② Lactose
- ③ Minerals

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

The primary **protein** found in milk is **casein**.

As the protein level in milk increases, milk taste improves.

Lactose

Lactose is the major solids component of milk. It is the **milk sugar** that gives milk its sweet flavor.

The two **simple sugars** that make up lactose are:

- ① Glucose
- ② Galactose

Lactase is the enzyme needed by humans to digest lactose.

Lactose intolerance is the condition when a person cannot metabolize (break down) milk sugar.

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.

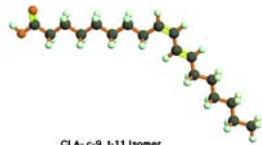
The **minerals** found in milk that are important in bone growth are:

- ① Calcium
- ② Phosphorus

Conjugated linoleic acid (CLA)

Conjugated linoleic acid (CLA) is an 18-carbon fatty acid present in milk, particularly from cows grazing pastures, that has been found to have anticarcinogenic 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.

There is a direct relationship between the quality of milk produced on the farm and that sold off the store shelf.

Advantages of high quality milk

Processor's point of view

- ① Improved flavor
- ② Long shelf life
- ③ Increased cheese yield
- ④ Reduced hauling and handling costs due to low quality milk not having to be diverted to an alternative use

Dairy producer's point of view

- ① Greater profitability
- ② Increased milk yield
- ③ Larger milk checks due to improved milk per cow and premiums
- ④ Reduced labor and labor cost
- ⑤ Low culling rates
- ⑥ Low treatment costs

Milk quality tests

Tests that milk plants use to determine **quality of raw milk** include:

- ① Acid degree value
- ② Antibiotic test
- ③ Flavor
- ④ Freezing point
- ⑤ Leukocyte (somatic cell) count
- ⑥ Preliminary incubation (PI) count
- ⑦ Sediment test
- ⑧ Standard plate count

Milk quality tests

Acid degree value detects rancidity.

The ***Bacillus stearothermophilus* disc assay** is the official test for antibiotic residues.

The **cryoscope** is the instrument used to test the freezing point of milk to determine if water has been added.

The **standard plate count** is a test that measures bacterial content of raw milk to monitor milk quality.

The **phosphatase test** is used to determine if raw milk has been added to pasteurized milk.

Off-flavors in milk

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

Exposing milk to sunlight or copper bearing surfaces will result in an **oxidized** flavor. Pigmented milk cartons are used to prevent an oxidized flavor.

Lipase, an enzyme, breaks down butterfat, leading to **rancidity**.

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

Common off-flavors

- ① Bitter
- ② Fermented
- ③ Fruity
- ④ High acid
- ⑤ Lacks freshness
- ⑥ Oxidized
- ⑦ Rancid
- ⑧ Sour

Antibiotics

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

- ① Some people are allergic to antibiotics. (Main reason)
- ② Milk that contains antibiotic residues is not suitable for cheese making.
- ③ Bacteria may become resistant to antibiotics.
- ④ Antibiotics are not a natural part of milk.

Milk processing

The main purpose of **clarification** is to remove impurities from milk.

Separation is the process of dividing milk into skim milk and cream.

Standardization assures that milk and dairy products will be uniform in protein and fat content.

Pasteurization destroys any disease-producing bacteria that might be present in raw milk.

Fortification is the process in which vitamins are added to milk.

More on pasteurization

Pasteurization destroys any disease-producing bacteria that might be present in raw milk.

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

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

Pasteurization methods

- ① **High temperature, short-time method**
161°F for 15 seconds
- ② **Batch or holding method**
145°F for not less than 30 minutes

Milk labeling

Milk label	Other names	Grams of fat per cup	Calories per cup
Fat free	Fat free, nonfat, or 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

Churning is the process that turns cream into butter.

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

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

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

Butter equivalency

1 stick = 1/2 cup = 1/4 pound = 8 tablespoons



Cheese

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

The amount of cheese one can get from a pound of milk is most affected by the protein content of the milk.

Rennin is the enzyme obtained from the lining of a calf's stomach that is used to coagulate casein protein when making cheese.

Rennet is an enzyme used to coagulate milk when making cheese.

Whey is the fluid by-product of cheese making. The three major components of dried whey are **lactose**, **minerals**, and **protein**.

Cheese

Cheese is classified according to its consistency. The classes are:

- ① Soft
- ② Semi-soft
- ③ Hard
- ④ Very hard



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

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

Cream

Cream is the high fat milk product separated from milk. It must contain at least **18%** milk fat.

Cream varieties

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

Frozen dairy products

Frozen dairy products include:

- ① Ice cream
- ② Frozen custard
- ③ Sherbet
- ④ 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

Examples of **cultured dairy products** include:

- ① Yogurt
- ② Buttermilk
- ③ Acidophilus milk

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.



Danone is the world's largest yogurt maker.

Federal Milk Marketing Orders

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

Federal Milk Marketing Orders are regulated by the **Secretary of Agriculture**.

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

There are **10** Federal Milk Marketing Orders in the United States. **Component pricing** is used in **6** of the orders.

FMMO Names:

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

Milk Classes

Milk class describes **how milk is used** by the processor or in a marketing area.

Class I Beverage milks

Class II Fluid cream products
Yogurts
Perishable manufactured products (ice cream, cottage cheese, and others)

Class III Cream cheese
Hard manufactured cheese

Class IV Butter
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.

Other milk marketing definitions

Fluid milk refers to packaged dairy products used as beverage milks.

Fluid products is the term traditionally used to define products including beverage milks, fluid cream items, and yogurts.

Fluid utilization is the proportion of Grade A milk in a market used to produce fluid (Class I) milk.

Manufacturing milk is Grade B milk or the Grade A milk used in the production of manufactured dairy products.

Manufacturers generally refers to the producers of cheese, butter, nonfat dry milk, and other storable dairy products.

Processors generally refers to firms that process raw Grade A milk into fluid products.

Organic dairy production

Organic dairy production is a method of production using cattle cared with:

- ① No hormones to promote growth
- ② No antibiotics
- ③ 100% organic feed
- ④ No mammalian or poultry by-products in feed

National Organic Program (NOP)

USDA's **National Organic Program** 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:

- ① Access to pasture throughout the grazing season
- ② Diet consisting of at least 30% dry matter intake from pasture grazed during the grazing season, totaling at least 120 days

Mailbox milk price

The **mailbox milk price** is the price for milk of average composition and is a weighted average for the market.

It accounts for all **payments** received for milk including performance bonuses and premiums, and all **deductions** such as promotion, hauling, capital retains, and cooperative dues.

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.

Top milk producing cooperatives

The **top five milk producing cooperatives** in the U.S. based on member milk volume in 2009 were:

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

The top 50 cooperatives accounted for **79.6%** of the milk produced in the U.S. in 2009.

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.

April is **National Grilled Cheese Month**.

July is **National Ice Cream Month**.

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.

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.

According to Dairy Management, Inc., one out of every four pounds of cheese is eaten as part of a sandwich.

Government programs

The **Dairy Export Incentive Program** (DEIP) is a program that provides cash bonuses (subsidies) to exporters of U.S. dairy products to sell certain dairy products in targeted overseas markets.

The **Milk Income Loss Contract** (MILC) program financially compensates dairy producers when domestic milk prices fall below a specified level. MILC is based on the milk price in **Boston**. The program is administered by the **Farm Service Agency** (FSA).

Cooperatives Working Together (CWT)

CWT is a dairy farmer-funded self-help program to address supply and demand imbalances that can depress milk prices.

CWT programs include:

- ① Export assistance
- ② Herd retirement



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

CWT's funding comes from farmers who invest **10 cents per hundredweight** of milk sold.

Chapter 9: Miscellaneous

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

CTAP	<i>Current Testday Analysis Program</i>
DCR	<i>data collection rating</i>
DIM	<i>days in milk</i>
ECM	<i>energy corrected milk</i>
ERPA	<i>estimated relative producing ability</i>
FCM	<i>fat corrected milk</i>
ME	<i>mature equivalent</i>
PCDART	<i>Personal Computer Direct Access to Records by Telephone</i>

Acronyms

RIP	<i>record in progress</i>
SMV	<i>slow moving vehicle</i>
TQM	<i>total quality management</i>

Weights and measures

Item	Weights
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 - 2009



Number of licensed dairy farms	54,947
Number of dairy cows*	9,201,000
Milk per cow per year	20,576 pounds
Milk production	189 billion pounds

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

State rankings – milk production (2009)

Total milk production	Milk per cow
① California	① New Mexico
② Wisconsin	② Washington
③ New York	③ Colorado
④ Idaho	④ Arizona
⑤ Pennsylvania	⑤ Michigan
Number of dairy cows	Milk per person
① California	① Idaho
② Wisconsin	② Wisconsin
③ New York	③ Vermont
④ Idaho	④ New Mexico
⑤ Pennsylvania	⑤ South Dakota

State rankings – forage production (2009)

Alfalfa production

- ① Wisconsin
- ② California
- ③ South Dakota
- ④ Idaho
- ⑤ Minnesota



Corn silage production

- ① Wisconsin
- ② California
- ③ New York
- ④ Pennsylvania
- ⑤ Minnesota



DHIA records

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 stands for milked three times a day.

A DHIA record may be terminated if a cow has:

- ① Dried off;
- ② Aborted; or
- ③ Died

DHIA records

A **lactation record** is generally adjusted for the following:

- ① Lactation length
- ② Mature equivalent
- ③ 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. It was developed by USDA-AIPL.

DHI services

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

Laboratory tests available through DHI include:

- ① Butterfat percentage
- ② Protein percentage
- ③ Solids-not-fat percentage (SNF)
- ④ Milk urea nitrogen (MUN)
- ⑤ Somatic cell count (SCC)

Culling

Reasons for culling a dairy cow from the herd include:

- | | |
|------------------|-----------------|
| ① Low production | ⑤ Feet and legs |
| ② Mastitis | ⑥ Disease |
| ③ Reproduction | ⑦ Injury |
| ④ Udder | |

Dairy cattle can be sold privately on the farm or in auction sales. **Types of auction sales** are:

- ① Consignment
- ② Dispersal
- ③ Reduction

2008 Farm Bill

The name of the 2008 Farm Bill is **The Food, Conservation and Energy Act of 2008**.

The bill made a fundamental change in the milk support purchase program by specifying the support prices of purchased manufactured products, not the price of milk.



Farm business management

The necessary **economic inputs for a dairy operation** are:

- ① Land
- ② Labor
- ③ Capital
- ④ Management

Benchmarking is pinpointing those areas in your business which are going great and those areas where improvements are needed.

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.

Dairy-L is an electronic dairy discussion group on the Internet.

Hazard Analysis of Critical Control Points (HACCP) is a system of quality control that identifies where mistakes often occur.

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:

- ① Application forms
- ② Interviews
- ③ Reference checks
- ④ Work tests
- ⑤ Trial periods

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

Anatomy and physiology

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

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.

Anatomy and physiology

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.

The **basic tissues** that make up a cow's body are:

- ① Connective
- ② Epithelium
- ③ Muscle
- ④ Nerve



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

- ① Circulatory
- ② Respiratory
- ③ Integumentary (skin)
- ④ Nervous
- ⑤ Digestive
- ⑥ Endocrine
- ⑦ Reproductive
- ⑧ Skeletal
- ⑨ Muscular

Blood

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

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

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

Heat stress

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

A dairy can **lose body heat** through:

- ① Convection
- ② Conduction
- ③ Radiation
- ④ Evaporation

The principles used to **cool cows** during heat stress include:

- ① Shade
- ② Air exchange
- ③ Air movement
- ④ Access to water
- ⑤ Sprinkle



Photoperiod manipulation

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

Dry cows exposed to a **short-day photoperiod** (SDPP) produce more milk in the subsequent lactation than similar cows exposed to LDPP or natural light conditions.

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



Animal well-being

According to the AVMA, **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:

- ① Support post
- ② Stall partition
- ③ Neck rail
- ④ Brisket board (tube)
- ⑤ Stall surface (bedding, mattress)
- ⑥ Rear curb





Chapter 10: Reproduction

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

AI	<i>artificial insemination</i>
CIDR	<i>controlled internal drug release</i>
CL	<i>corpus luteum</i>
ET	<i>embryo transfer</i>
FSH	<i>follicle stimulating hormone</i>
GnRH	<i>gonadotropin releasing hormone</i>
LH	<i>luteinizing hormone</i>
MOET	<i>multiple ovulations, embryo transfer</i>
PGF_{2α}	<i>prostaglandin F_{2α}</i>
SCR	<i>sire conception rate</i>

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:

- | | |
|----------------------------|---------------------------|
| ① Voluntary waiting period | ② Estrus (heat) detection |
| ③ Conception rate | ④ Reproductive culling |

Time terms

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:

- ① Age of the cow
- ② Breed of the cow
- ③ Sex of the calf
- ④ Number of calves carried
- ⑤ Season of the year

Brown Swiss have the longest gestation period.

The cow's reproductive tract

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

- ① Vulva
- ② Vagina
- ③ Cervix
- ④ Uterus
- ⑤ Oviduct
- ⑥ Ovary

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

Ovaries

The **main functions of the ovary** are:

- ① Production of ova
- ② Secretion of hormones essential for reproduction

100% of the ova that a mature cow has in her ovaries are present at birth.

The **fertile life of an ovum** after its release from the follicle on an ovary 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

- ① **Gonadotropin Releasing Hormone (GnRH)** is secreted by the hypothalamus. It controls the secretion of pituitary hormones (FSH and LH).
- ② **Follicle stimulating hormone (FSH)** is secreted by the anterior pituitary gland. It stimulates growth of follicles.
- ③ **Luteinizing hormone (LH)** is secreted by the anterior pituitary gland. It causes the follicle to rupture and then causes the corpus luteum to replace the follicle. It increases dramatically in concentration 24 hours prior to ovulation soon after the onset of estrus.

Female reproductive hormones

- ④ **Estrogen (E2)** is produced by the follicle. It is necessary for behavioral estrus and peaks at the onset of standing estrus.
- ⑤ **Progesterone (P4)** is produced by the corpus luteum. It is necessary for the maintenance of pregnancy. It inhibits the release of GnRH from the hypothalamus.
- ⑥ **Prostaglandin (PGF)** is produced by the uterus (endometrium). It causes destruction or regression of the corpus luteum. Estrumate® and Lutalyse® are commercial prostaglandin products commonly used in dairy cattle reproductive management.

Estrous cycle

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

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

The estrous cycle contains two **phases**:

- ① **Follicular** – active follicles are present
- ② **Luteal** – CL is the dominant ovarian structure

The estrous cycle consists of four **stages**:

- ① **Estrus** – heat period
- ② **Metestrus** – transition
- ③ **Diestrus** – CL
- ④ **Proestrus** – prior to estrus

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.

The most common cause of a cow not coming back into heat is **pregnancy**. 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

- ① Restlessness
- ② Bellowing
- ③ Following and smelling another cow
- ④ Mounting other cows
- ⑤ Standing to be mounted*
- ⑥ Discharge of clear mucus from the vulva
- ⑦ Vulva becomes red and swollen

* The **most reliable sign** of estrus is **standing to be mounted**.

Heat detection aids

- ① Heat expectancy charts
- ② Tail chalk
- ③ Pedometers
- ④ Pressure sensors
- ⑤ Electronic heat detection systems
- ⑥ Detector animals

Estrus synchronization programs

- ① CIDR
- ② Ovsynch
- ③ Pre-Synch
- ④ Co-Synch
- ⑤ Heat-synch

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:

- ① Safety
- ② Genetic improvement
- ③ Better disease control
- ④ Better record keeping
- ⑤ Easier to prove bulls
- ⑥ Less expensive than keeping a bull

Artificial insemination

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

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

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.

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.

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

Fertilization is the process of joining an ovum and a sperm. Fertilization of an ovum occurs in the **oviduct**. A fertilized ovum is called a **zygote**. The **fetus** develops in the uterus after the ovum is fertilized.

Conception rate

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

- ① Heat detection accuracy
- ② Herd (cow) fertility
- ③ Semen (bull) fertility
- ④ Technician competency

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

- ① Failure to ovulate
- ② Fertilization failure
- ③ Hormone imbalance
- ④ Poor quality semen
- ⑤ Failure to inseminate
- ⑥ Improper insemination technique
- ⑦ Heat detection errors

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- ⑦ Heat detection errors

Pregnancy rate

The reproductive performance of a dairy herd is primarily affected by **conception rate** and **heat detection efficiency**.

Pregnancy rate determines how fast cows become pregnant following the voluntary waiting period (**VWP**). 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. It 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). Incidence is highest in summer.

Parturition (calving)

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:

- ① Udder full
- ② Vulva enlarged
- ③ Mucus discharge
- ④ Relaxation of ligaments at tail head
- ⑤ Restlessness

Parturition (calving)

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

It usually takes **30 to 45 days** after calving for a cow's reproductive tract to return to normal.

Involution is the process where the uterus returns to normal size after calving.



Male reproduction

The **main functions of the testes** are to:

- ① Produce sperm
- ② Produce the male sex hormones

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

The **male reproductive hormones** include:

- ① **Follicle stimulating hormone** (FSH) stimulates sperm production.
- ② **Luteinizing hormone** (LH) stimulates sperm production.
- ③ **Testosterone** is responsible for the male sex drive (libido).

Spermatozoa

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.

The primary sugar found in semen is **fructose**.

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.

Sire Conception Rate

Sire Conception Rate (SCR) is an evaluation of artificial-insemination (AI) service-sire fertility. It replaced **Estimated Relative Conception Rate (ERCR)**.

SCR is calculated for Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn bulls.

It is computed by **USDA-AIPL**.

Ultrasound

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

- ① Pregnancy determination
- ② Determine embryonic losses
- ③ Monitor cystic ovaries
- ④ Determine sex of embryo

Reproductive problems

The number one reason for **culling** in U.S. dairy herds is **reproductive failure**.

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

An **abortion** is the premature expulsion of a fetus.

Diseases that cause abortions in dairy cattle include:

- ① Brucellosis
- ② Campylobacteriosis (Vibriosis)
- ③ Chlamydia
- ④ IBR
- ⑤ Leptospirosis
- ⑥ Listeriosis
- ⑦ Neospora
- ⑧ Trichomoniasis

Cystic ovaries

12 to 14% of problem breeders have cystic ovaries.

10 to 40% of dairy cows develop cystic ovaries during their lifetime.

Types of cystic ovaries

- ① **Follicular cysts** are thin-walled, anovulatory (not ovulating) cysts; secrete variable amounts of estrogen.
- ② **Luteal cysts** are thick-walled cysts; secrete low levels of progesterone.
- ③ **Cystic corpus lutea** have characteristics similar to normal corpora lutea.

Twinning

Disadvantages of twinning in dairy cattle include:

- ① Reduced milk production during the lactation
- ② Calving difficulties are more frequent
- ③ Abortion rates are higher
- ④ Twins are often weak at birth
- ⑤ Potential for a freemartin heifer

A **freemartin** is a sterile heifer born twin to a bull.

Ninety percent of heifers born twin to a bull are sterile.



Chapter 11: Genetics

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

AIPL	<i>Animal Improvement Programs Laboratory</i>
BAA	<i>Breed Age Average</i>
BLAD	<i>Bovine Leukocyte Adhesion Deficiency</i>
BLUP	<i>Best Linear Unbiased Predictor</i>
CE	<i>Calving Ease</i>
CM\$	<i>Cheese Merit</i>
CVM	<i>Complex Vertebral Malformation</i>
DBH	<i>Difficult Birth in Heifers</i>
DCE	<i>Daughter Calving Ease</i>
DNA	<i>Deoxyribonucleic Acid</i>

Acronyms

DPR	<i>Daughter Pregnancy Rate</i>
DUMPS	<i>Deficiency of Monophosphate Synthase</i>
EBV	<i>Estimated Breeding Value</i>
ETA	<i>Estimated Transmitting Ability</i>
FAIR	<i>Farm Animal Identification and Records</i>
FM\$	<i>Fluid Merit</i>
FTI	<i>Functional Trait Index (Jersey)</i>
FUI	<i>Functional Udder Index (Jersey)</i>
GMD	<i>Gold Medal Dam (Holstein)</i>
gPTA	<i>Genomic Predicted Transmitting Ability</i>

Acronyms

JPI	<i>Jersey Performance Index</i>
MACE	<i>Multiple-trait Across Country Evaluations</i>
mRNA	<i>Messenger Ribonucleic Acid</i>
NM\$	<i>Lifetime Net Merit</i>
PA	<i>Parent Average</i>
PCR	<i>Polymerase Chain Reaction</i>
PL	<i>Productive Life</i>
PPR	<i>Progressive Performance Rating (Brown Swiss)</i>
PTA	<i>Predicted Transmitting Ability</i>
PTI	<i>Production-Type Index (Ayrshire, Guernsey)</i>

Acronyms

RFID	<i>Radio Frequency Identification</i>
RNA	<i>Ribonucleic Acid</i>
rRNA	<i>Ribosomal Ribonucleic Acid</i>
RT	<i>Recessive Tested</i>
RVC	<i>Retrovaginal Constriction (Jersey)</i>
SB	<i>Stillbirth</i>
SCE	<i>Service Sire Calving Ease</i>
SDM	<i>Spinal Dysmyelination (Brown Swiss)</i>
SMA	<i>Spinal Muscular Atrophy (Brown Swiss)</i>
SNP	<i>Single Nucleotide Polymorphism</i>
TPI	<i>Total Performance Index (Holstein)</i>

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**.

The most important feature when selecting tags or brands for identification is **visibility**.



NAAB Code

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. The letters indicate the breed. The number following the letters is an individual bull identification number.

Bull Stud	Stud Code	Breed	Letters
Genex/CRI	1	Ayrshire	AY
Select Sires	7	Brown Swiss	BS
Alta Genetics	11	Guernsey	GU
Accelerated Genetics	14	Holstein	HO
ABS Global, Inc.	29	Jersey	JE
		Milking Shorthorn	MS
		Red & White	WW

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.

More basic genetics

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:

- ① Migration ③ Selection
- ② Mutation ④ 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.



Siblings is the technical term used to describe brothers and sisters.

Animal Model

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

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

- ① Parents (pedigree)
- ② Individual performance
- ③ Progeny (offspring)



Genetic evaluations

USDA-AIPL publishes genetic evaluations. **Official evaluations** in 2011 will be released in April, August and December. **Genomic evaluations** in 2011 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 USDA-AIPL genetic evaluations is updated every five years. It was updated in January 2010 and will be the average PTA of the animals born in 2005.

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

Reliability is an indicator of the accuracy of genetic evaluations.

Lifetime Net Merit (NM\$)

NM\$ is a genetic index. It combines the following traits for **Holsteins** and **Brown Swiss**:

- | | |
|---------------------------|---------------------------|
| ① Fat | ⑥ Udder composite |
| ② Protein | ⑦ Body size composite |
| ③ Somatic cell score | ⑧ Daughter pregnancy rate |
| ④ Productive life | ⑨ Calving ability* |
| ⑤ Feet and legs composite | |

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

Total Performance Index (TPI)

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 | Productive Life |
| Fat | Somatic Cell Score |
| Type | Daughter Pregnancy Rate |
| Dairy Form | Daughter Calving Ease |
| Udder Composite | Daughter Stillbirth |
| Feet and Leg Composite | |



Holstein composite indexes

Composite Index	Traits Included	
Udder	Fore udder attachment	Udder depth
	Rear udder height	Udder cleft
	Rear udder width	Front teat placement
Body Size	Stature	Body depth
	Strength	Thurl width
Feet & Legs	Rear legs – side view	Foot angle
	Rear legs – rear view	Feet & legs score
Dairy Capacity	Dairy form	Dairy strength

Jersey Performance Index (JPI)

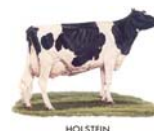
JPI is a genetic index used by the **Jersey** breed that is determined by placing emphasis on production and type. The traits included are:

- | | |
|--------------------------|---------------------------|
| ① PTA Protein | ④ Productive Life |
| ② PTA Fat | ⑤ PTA Somatic Cell Score |
| ③ Functional Trait Index | ⑥ Functional Udder Index* |

*The **Functional Udder Index** serves an indicator of mastitis resistance. It weights the following traits:

- | | |
|---------------------|------------------------|
| ① Fore udder | ④ Udder depth |
| ② Rear udder height | ⑤ Front teat placement |
| ③ Udder cleft | ⑥ Front teat length |

Final classification scores



HOLSTEIN



JERSEY

Excellent	90 to 97
Very Good	85 to 89
Good Plus	80 to 84
Good	75 to 79
Fair	65 to 74
Poor	50 to 64

Excellent	90 to 100
Very Good	80 to 89
Desirable	70 to 79
Acceptable	60 to 69
Poor	50 to 59

Calving ease

Calving Ease Summaries are calculated by USDA-AIPL for the National Association of Animal Breeders (NAAB). Two summaries are now calculated:

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.

Calving ease scores

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

Stillbirth (SB)

Stillbirth scores

- 1 = the calf was born alive and was alive 48 h postpartum
- 2 = the calf was born dead
- 3 = the calf was born alive but died within 48 h postpartum

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

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

The **SB 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:

- ① Decreased general vigor
- ② Decreased production
- ③ Decreased reproductive performance
- ④ Increased calf mortality
- ⑤ Increasing similarity between animals
- ⑥ Mature size is smaller
- ⑦ More recessive genes exposed
- ⑧ Slower growth rate

Undesirable recessive traits



BROWN SWISS

Weaver
Spiderleg

Spinal Dysmyelination (SDM)
Spinal Muscular Atrophy (SMA)



JERSEY

Limber Legs
Retrovaginal Constriction

Undesirable recessive traits



HOLSTEIN

- ① Bovine Leukocyte Adhesion Deficiency (BLAD)
- ② Bulldog
- ③ Complex Vertebral Malformations (CVM)
- ④ DUMPS
- ⑤ Dwarfism
- ⑥ Hairless
- ⑦ Imperfect Skin
- ⑧ Mule-Foot (Syndactylism)
- ⑨ Pink Tooth (Porphyria)
- ⑩ Prolonged Gestation

Undesirable recessive traits have not been documented for Ayrshires, Guernseys, or Milking Shorthorn.

Chapter 12: Health

2011 Virginia 4-H Dairy Quiz Bowl Study Materials

Acronyms

BLV	<i>Bovine Leukosis Virus</i>
BRSV	<i>Bovine Respiratory Syncytial Virus</i>
BSE	<i>Bovine Spongiform Encephalopathy</i>
BVD	<i>Bovine Virus Diarrhea</i>
DA	<i>Displaced Abomasum</i>
ELISA	<i>Enzyme-Linked Immunosorbent Assay</i>
FARAD	<i>Food Animal Residue Avoidance Databank</i>
IBR	<i>Infectious Bovine Rhinotracheitis</i>
Ig	<i>Immunoglobulin</i>
IM	<i>Intramuscular</i>

Acronyms

IV	<i>Intravenous</i>
MLV	<i>Modified Live Virus</i>
NAHMS	<i>National Animal Health Monitoring System</i>
PI-3	<i>Parainfluenza-3</i>

Normal stats for dairy animals

Temperatures

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



Disease basics

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.

An animal that is infected with a disease but has no clinical symptoms is called a **carrier**.

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

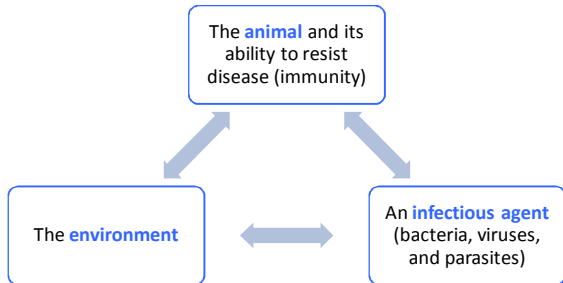
Disease classification

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

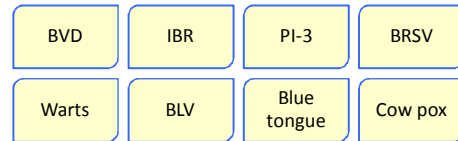


Infectious diseases

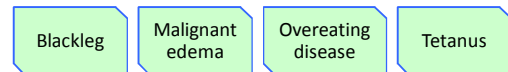
Infectious diseases of cattle result from the interplay between three factors.



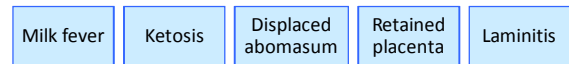
Diseases in dairy cattle that are caused by a virus



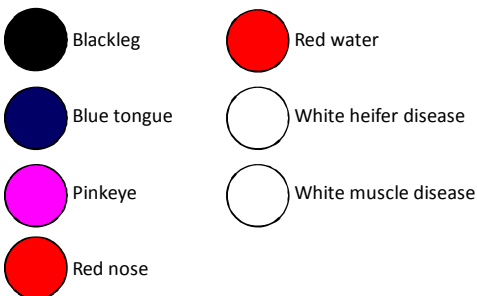
Diseases caused by a clostridial organism



Metabolic diseases



Diseases with a color in their name



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
Infectious bovine rhinotracheitis	Red nose
Keratoconjunctivitis	Pinkeye

Proper and common disease names

Proper Name	Common Name
Laminitis	Founder
Listeriosis	Circling disease
Papillomatous digital dermatitis	Hairy heel warts
Paratuberculosis	Johne's disease
Parturient paresis	Milk fever
Pneumonic pasteurellosis	Shipping fever
Traumatic gastritis	Hardware disease

Bloat

Bloat is the condition when a cow cannot belch.

It may occur in cows grazing rapidly growing legumes.

Carbon dioxide and **methane** are two gases associated with the condition of bloat.

Poloxolene may be administered to prevent or correct bloat.

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



Bovine Leukosis Virus

Bovine Leukosis Virus (BLV) is a retrovirus that infects dairy and beef cattle's lymphoid tissue.

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

Signs of infection may include:

- | | |
|------------------------------|--------------------------------------|
| ① Tumors in lymphoid tissues | ⑦ Rear limb weakness or paralysis |
| ② Enlarged lymph nodes | ⑧ Protruding eyeballs |
| ③ Weight loss | ⑨ Gastrointestinal obstructions |
| ④ Decreased milk production | ⑩ Increased blood lymphocytes counts |
| ⑤ Fever | |
| ⑥ Loss of appetite | |

Brucellosis

Brucellosis (Bang's disease) is caused by a bacteria of the genus *Brucella*.

Infections may cause:

- ① Abortions
- ② Stillborn or weak calves
- ③ Retained placentas
- ④ Weight loss
- ⑤ Reduced milk yield

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

Undulant fever is the human equivalent of brucellosis. It can be contracted by drinking raw milk contaminated by brucellosis.

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:

- ① Watery scours with flakes of blood
- ② Dull listlessness
- ③ Mucus in the feces
- ④ Dehydration
- ⑤ Weight loss

Methods to control coccidiosis:

- ① Accurate diagnosis and monitoring
- ② Maintain sanitation
- ③ Limit stress
- ④ 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 living organism's growth and development, preventing them from reproducing.

Cryptosporidium

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 diarrhea in newborns due to cryptosporidium, as well as other pathogens include:

- ① Provide clean, dry areas for cows to calve
- ② Feed colostrum using a clean bottle and sanitized nipple
- ③ Provide clean, dry pens for calves
- ④ Allow pens to thoroughly dry between calves
- ⑤ 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.

80 to 90 % of displaced abomasums are left-sided.

Predisposing factors for a cow's displaced abomasum include:

- ① Stress of calving or high milk production
- ② Lead feeding
- ③ Acidotic rations
- ④ Hypocalcemia
- ⑤ Selenium deficiency
- ⑥ Lack of exercise
- ⑦ Advanced pregnancy

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:

- ① Milk fever
- ② Displaced abomasum
- ③ Retained placenta
- ④ Metritis
- ⑤ Mastitis
- ⑥ Fatty liver syndrome

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:

- ① Diarrhea
- ② General unthriftiness
- ③ Soft swelling in the jaw
- ④ Substantial drops in milk production
- ⑤ Susceptibility to other problems such as infertility
- ⑥ Weight loss
- ⑦ Death



Testing for Johne's disease

There are two **types of tests for Johne's disease** commonly used today:

- ① **Tests that measure antibodies** in blood serum
- ② **Tests that find the organism** causing Johne's disease, *Mycobacterium paratuberculosis*, in manure by fecal culture or 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

- ① Prevent highly susceptible newborn calves and young animals from ingesting manure from adults, whether from the dam, the environment, or feed and water.
- ② Calving areas should be dry, free of manure, and well bedded.
- ③ Remove the calf from the dam immediately after birth.
- ④ Do not use the same equipment to clean up manure and to load feed.
- ⑤ Do not walk in feed bunks.
- ⑥ Identify and remove infected animals and their manure.
- ⑦ Investigate all animals considered for purchase, and buy only from test-negative herds with no history of Johne's.
- ⑧ Do not allow test-positive cows to calve.
- ⑨ Sell at birth all calves from positive cows.

Ketosis

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

The **first signs** of ketosis are:

- ① Cow goes off feed
- ② Ketone (acetone) smell on the cow's breath

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

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

Lameness

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

- ① Abscess
- ② Foot rot
- ③ Infection
- ④ Injury
- ⑤ Soft sole syndrome
- ⑥ Trimming too close



The **most important practices** for the reduction of foot problems are:

- ① Hoof trimming
- ② Foot baths

Foot baths

The **purposes** of a foot bath are:

- ① Remove irritants from the foot and between the toes
- ② Disinfect and cleanse the foot
- ③ Dry and toughen the foot

Substances commonly used in a foot bath include:

- ① Copper sulfate
- ② Zinc sulfate
- ③ Formalin

Milk fever

Milk fever is also referred to as **hypocalcemia**.

A deficiency of blood calcium related to an imbalance of calcium, phosphorus, and Vitamin D is the **cause** of milk fever.

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

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

Milk fever

Groups of cows that are at **greater risk** of having milk fever are:

- ① Older cows
- ② Fatty liver cows
- ③ Jerseys

Symptoms of milk fever include:

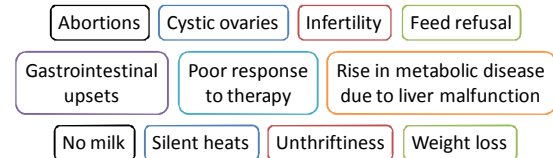
- ① Cow goes down
- ② Rapid heart rate
- ③ Dilated eyes
- ④ Below normal body temperature

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

Mycotoxins

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

Clinical symptoms of mycotoxins in dairy cattle include:



External parasites

External parasites in dairy cattle include:

- ① Flies
- ② Lice
- ③ Mites
- ④ Mosquitoes
- ⑤ Ticks



Lice are most troublesome during **winter** and **spring**.

Flies

Types of flies commonly found around the dairy farm:

- ① House fly
- ② Stable fly
- ③ Face fly
- ④ Horn fly
- ⑤ Heel fly
- ⑥ 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.

Phases of a fly's life cycle

- ① Egg
- ② Larvae
- ③ Pupa
- ④ Adult



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

Internal parasites

Internal parasites in dairy cattle include:

- ① Lung worms
- ② Round worms
- ③ Stomach worms (The brown stomach worm is the most economically detrimental parasite of cattle.)
- ④ Liver Flukes
- ⑤ Coccidia

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

Pneumonia

Predisposing causes of pneumonia in calves:

- ① Poor ventilation
- ② High humidity
- ③ Dirty pens
- ④ Drastic temperature changes
- ⑤ Poor nutrition
- ⑥ Overcrowding
- ⑦ Wide range of ages in one pen



Types of organisms that can cause pneumonia:

- ① Bacteria
- ② Molds
- ③ Parasites
- ④ Viruses
- ⑤ Yeasts

Pneumonia-causing organisms

Pneumonia-causing bacteria

- ① *Pasteurella multocida*
- ② *Mannheimia (Pasteurella) haemolytica*
- ③ *Haemophilus somnus*
- ④ *Mycoplasma*

Pneumonia-causing viruses

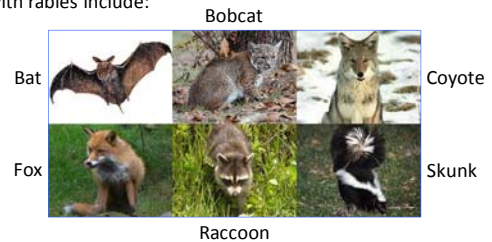
- ① Infectious bovine rhinotracheitis virus (IBR)
- ② Parainfluenza-3 virus (PI3)
- ③ Bovine viral diarrhea virus (BVDV)
- ④ Bovine respiratory syncytial virus (BRSV)

Rabies

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

- ① Fluorescent antibody test of brain
- ② By injecting brain tissue into mice and observing

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



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.

Organisms that commonly cause scours among calves

- | | |
|-----------------|--|
| Bacteria | <ol style="list-style-type: none"> ① <i>Escherichia coli</i> ② <i>Salmonella</i> ③ <i>Clostridium perfringens</i> |
| Viruses | <ol style="list-style-type: none"> ① Rotavirus ② Coronavirus |
| Protozoa | <ol style="list-style-type: none"> ① <i>Coccidia</i> ② <i>Cryptosporidium</i> |

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

Blackleg is an acute, fever producing disease of cattle and sheep. It is caused by the bacterium *Clostridium chauvoei*. It most often occurs in pastured cattle during the spring or fall.

Foot rot is also known as **pododermatitis**. A 5% solution of **copper sulfate** is the most common walk-through treatment.

Grass tetany is a metabolic disorder associated with a **magnesium deficiency**. It occurs most often in adult cows milking heavily and grazing lush green pastures.

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.

Mad Cow Disease (Bovine Spongiform Encephalopathy) affects the nervous system. It originated in Great Britain.

Neosporosis is a disease that causes abortions and occasionally causes birth of weak "dummy" calves that have serious brain infections. It is **caused by a protozoa**, *Neospora caninum*. Dogs are classified as a definitive host for the causative organism.

Pinkeye (Keratoconjunctivitis) is most prevalent during the summer. Incidence may be reduced by ensuring that proper levels of **Vitamin A** are in the diet.

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.

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

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

An **umbilical hernia** is a condition when a loop of intestine protrudes from the navel.

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

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

Morbidity versus mortality

Morbidity rate is the number of sick animals.



Mortality rate is the number of dead animals.



Vaccinations

Calfhood vaccinations should be considered for the following diseases:

- | | |
|---------------|-------------------|
| ① IBR | ⑥ Leptospirosis |
| ② BVD | ⑦ Clostridia |
| ③ PI-3 | ⑧ Malignant edema |
| ④ Brucellosis | ⑨ Scours |
| ⑤ Blackleg | |

The major **types of vaccines** are:

- ① Killed
- ② Modified live

Antibiotics

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

A cow can be given antibiotics in numerous **ways** including:

- ① Intramuscular injection (most common)
- ② Intravenous injection
- ③ Intraperitoneal injection
- ④ Intramammary infusion
- ⑤ Intrauterine infusion
- ⑥ In the ration

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

Antibodies

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

The four main immunoglobulin **isotypes** are:

- ① IgA
- ② IgE
- ③ IgG
- ④ IgM

Medicine chest

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



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



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



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



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

Miscellaneous

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.

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

- | | |
|-------------------|-----------------|
| ① Brucellosis | ⑥ Q-fever |
| ② Cowpox | ⑦ Rabies |
| ③ Cryptosporiosis | ⑧ Ringworm |
| ④ Leptospirosis | ⑨ Salmonellosis |
| ⑤ Listeriosis | ⑩ Tuberculosis |

Chapter 13: Nutrient Management

2011 Virginia 4-H Dairy Quiz Bowl Study Materials



Acronyms

BMP	<i>Best Management Practice</i>
CAFO	<i>Concentrated Animal Feeding Operation</i>
CNMP	<i>Comprehensive Nutrient Management Plan</i>
EQIP	<i>Environmental Quality Incentive Program</i>
IPM	<i>Integrated Pest Management</i>
NPS	<i>Non-point Source</i>

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.

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

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.

Non-point source

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.

Most farms, agricultural cropland, and suburban lawns receiving fertilizer are all examples of nonpoint sources of nutrient pollution.

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.

BMP's for livestock farms

- ① Fencing animals out of bodies of surface water
- ② Installation of an alternative water source
- ③ Installation of stream crossings
- ④ Installation of buffer strips between cropland and surface water
- ⑤ Shoreline or creek bank stabilization and protection
- ⑥ Animal travel lane stabilization
- ⑦ Rotational loafing lot management system



BMP's for livestock farms

- ⑧ Installation of a storm water retention pond
- ⑨ Planting small grain cover crops
- ⑩ Installation of a manure storage facility
- ⑪ Manure testing
- ⑫ Controlling surface water runoff
- ⑬ Implementation of a nutrient management plan

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

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.

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

- ① Runoff and soil erosion are reduced because the grass growing on the lots uses nutrients and stabilizes soil.
- ② Cows stay cleaner.

Benefits of **small grain cover crops** include:

- ① Increase use of land applied nutrients
- ② Stabilize cropland
- ③ Prevent erosion in wintertime

Methods of reducing soil erosion

- ① Wind breaks
- ② Cover crop
- ③ Strip cropping
- ④ Contour cropping
- ⑤ Terracing
- ⑥ Grass waterways
- ⑦ Reduced tillage
- ⑧ Soil seeding



Common dairy cattle bedding materials

- ① Newspaper
- ② Recycled manure solids
- ③ Sand
- ④ Sawdust (green or kiln-dried)
- ⑤ Shavings
- ⑥ 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 lb of live weight of any animal.

Areas that contribute waste that must be handled are:

- ① Feeding area
- ② Housing or loafing area
- ③ Holding pen area
- ④ Milking parlor
- ⑤ Runoff area



Manure testing

Benefits of manure testing (measuring nutrient content) include:

- ① May reduce fertilizer purchases.
- ② May prevent application of nutrients in excess of crop requirements.

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

- ① Type of feed ration
- ② Method of storage
- ③ Method of application
- ④ Crop
- ⑤ Amount of added feed, bedding, and water
- ⑥ Method of collection
- ⑦ Time of application
- ⑧ Soil characteristics
- ⑨ Climate

Manure storage

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

Types of storage facilities

- ① **Solid** manure storage – dry stack barn
- ② **Slurry** manure storage – anaerobic pit, earthen structure, or above ground tank (most common on dairy farms)
- ③ **Liquid** manure storage – lagoon

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

- ① Masking agents
- ② Odor counteractants
- ③ Enzymatic products

Planning a waste management system

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

- ① **Environmental** (Rainfall, stream location, prevailing winds, evaporation, temperature, topography, soil type, surface drainage, water table depth)
- ② **Operational** (Herd size, cropping & feeding practices, land area, cropland for waste application, existing buildings & machinery)
- ③ **Economic** (Availability of capital and labor, future expansion plans)
- ④ **Social** (Neighbors, zoning)
- ⑤ **Legal Requirements** (EPA General Permit, State and local permits)

Composting

Composting requires:

- ① Air
- ② Moisture
- ③ Nutrients
- ④ 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:

- ① Reduces volume
- ② Doesn't attract flies and insects
- ③ Reduces potential for nutrient runoff
- ④ Weeds and pathogens destroyed
- ⑤ More uniform than manure
- ⑥ Reduces fertilizer needs
- ⑦ Excellent soil conditioner

Fertilizer

Fertilizer labels have three important numbers.

- ① The first number is the amount of **nitrogen** (N).
- ② The second number is the amount of **phosphate** (P_2O_5).
- ③ 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.

