

Troop 1292 # 18A

MERIT BADGE SERIES



ANIMAL SCIENCE



BOY SCOUTS OF AMERICA

HOW TO USE THIS PAMPHLET

The secret to successfully earning a merit badge is for you to use both the pamphlet and the suggestions of your counselor.

Your counselor can be as important to you as a coach is to an athlete. Use all of the resources your counselor can make available to you. This may be the best chance you will have to learn about this particular subject. Make it count.

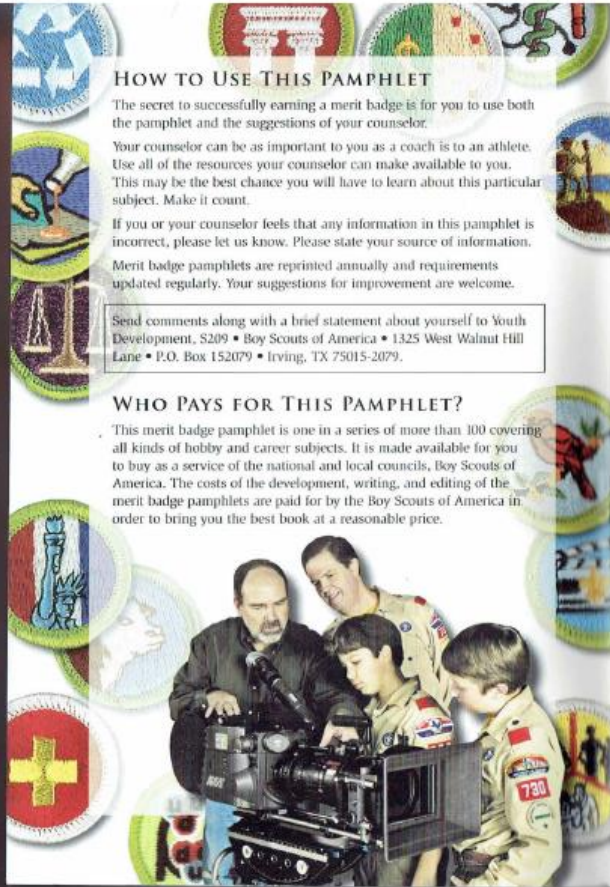
If you or your counselor feels that any information in this pamphlet is incorrect, please let us know. Please state your source of information.

Merit badge pamphlets are reprinted annually and requirements updated regularly. Your suggestions for improvement are welcome.

Send comments along with a brief statement about yourself to Youth Development, S209 • Boy Scouts of America • 1325 West Walnut Hill Lane • P.O. Box 152079 • Irving, TX 75015-2079.

WHO PAYS FOR THIS PAMPHLET?

This merit badge pamphlet is one in a series of more than 100 covering all kinds of hobby and career subjects. It is made available for you to buy as a service of the national and local councils, Boy Scouts of America. The costs of the development, writing, and editing of the merit badge pamphlets are paid for by the Boy Scouts of America in order to bring you the best book at a reasonable price.



BOY SCOUTS OF AMERICA
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Requirements



1. Name four breeds of livestock in each of the following classifications: horses, dairy cattle, beef cattle, sheep, hogs. Tell their principal uses and merits. Tell where the breeds originated.
2. List five diseases that afflict the animals in each of the classifications in requirement 1. Also list five diseases of poultry. Describe the symptoms of each disease and explain how each is contracted and how it could be prevented.
3. Explain the major differences in the digestive systems of ruminants, horses, pigs, and poultry. Explain how the differences in structure and function among these four types of digestive tracts affect the nutritional management of these species.
4. Select one type of animal—beef cow, dairy cow, horse, sheep, goat, or hog, or a poultry flock—and tell how you would properly manage it. Include in your discussion nutritional (feeding) concerns, housing, disease prevention, waste control/removal, and breeding programs if appropriate.
5. Explain the importance of setting clear goals for any animal breeding program. Tell how purebred lines of animals are produced. Explain the practice of crossbreeding and the value of this practice.

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6. Complete ONE of the following options:

Beef Cattle Option

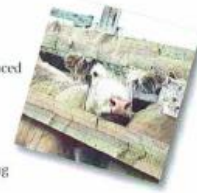
- a. Visit a farm or ranch where beef cattle are produced under any of these systems:
 - (1) Feeding market cattle for harvest
 - (2) Cow/calf operation, producing cattle for sale to commercial feeders
 - (3) Producing purebred cattle for sale as breeding stock to others

Talk with the operator to learn how the cattle were handled, fed, weighed, and shipped. Describe what you saw and explain what you learned. If you cannot visit a cattle ranch or farm, view a video from a breed association, or research the Internet (with your parent's permission) for information on beef cattle production. Tell about your findings.

- b. Sketch a plan of a feedlot to include its forage and grain storage facilities, and loading chute for 30 or more fattening steers; or sketch a corral plan with cutting and loading chutes for handling 50 or more beef cows and their calves at one time.
- c. Make a sketch showing the principal wholesale and retail cuts of beef. Tell about the U.S. Department of Agriculture (USDA) dual grading system of beef. Tell the basis of each grade in each system.
- d. Define the following terms: bull, steer, bullock, cow, heifer, freemartin, heiferette, calf.

Dairying Option

- a. Tell how a cow or a goat converts forage and grain into milk. Explain the differences in feeds typically used for dairy cows versus those fed to beef cows.
- b. Make a chart showing the components in cow's milk or goat's milk. Chart the amount of each component.
- c. Explain the requirements for producing grade A milk. Tell how and why milk is pasteurized.



- d. Tell about the kinds of equipment used for milking and the sanitation standards that must be met on dairy farms.
- e. Define the following terms: bull, cow, steer, heifer, springer; buck, doe, kid.
- f. Visit a dairy farm or a milk processing plant. Describe what you saw and explain what you learned. If you cannot visit a dairy farm or processing plant, view a video from a breed or dairy association, or research the Internet (with your parent's permission) for information on dairying. Tell about your findings.

Horse Option

- a. Make a sketch of a useful saddle horse barn and exercise yard.
- b. Tell about the history of the horse and the benefits it has brought to people. Using the four breeds of horses you chose in requirement 1, discuss the different special uses of each breed.
- c. Define the following terms: mare, stallion, gelding, foal, colt, filly; mustang, quarter horse, draft horse, pacer, trotter; pinto, calico, palomino, man, overo, tobiano.
- d. Visit a horse farm. Describe what you saw and explain what you learned. If you cannot visit a horse farm, view a video from a breed association, or research the Internet (with your parent's permission) for information on horses. Tell about your findings.
- e. Outline the proper feeding of a horse doing light work. Explain why the amount and kind of feed will change according to the kind of horse and the work it does. Describe what colic is, what can cause it, and its symptoms.



Sheep Option

- a. Make a sketch of a live lamb. Show the location of the various wholesale and retail cuts.
- b. Discuss how wools are sorted and graded.



- c. Do ONE of the following:
 - (1) Raise a lamb from weaning to market weight. Keep records of feed intake, weight gains, medication, vaccination, and mortality. Present your records for review by your counselor.
 - (2) Visit a farm or ranch where sheep are raised. Describe what you saw and explain what you learned. If you cannot visit a sheep farm or ranch, view a video from a breed association, or research the Internet (with your parent's permission) for information on sheep. Tell about your findings.
- d. Describe some differences between the production of purebred and commercial lambs. Then select two breeds that would be appropriate for the production of crossbred market lambs in your region. Identify which breed the ram should be.
- e. Define the following terms: wether, ewe, ram, lamb.

Hog Option

- a. Make a sketch showing the principal wholesale and retail cuts of pork. Tell about the recommended USDA grades of pork. Tell the basis for each grade.
- b. Outline in writing the proper feeding programs used from the breeding of a gilt or sow through the weaning of the litter. Discuss the feeding programs for the growth and finishing periods.
- c. Do ONE of the following:
 - (1) Raise a feeder pig from weaning to market weight. Keep records of feed intake, weight gains, medication, vaccination, and mortality. Present your records for review by your counselor.
 - (2) Visit a farm where hogs are produced, or visit a packing plant handling hogs. Describe what you saw and explain what you learned. If you cannot visit a hog production unit or packing plant, view a video from a packer or processor, or research the Internet (with your parent's permission) for information on hogs. Tell about your findings.
- d. Define the following terms: gilt, sow, barrow, boar.



Avian Option

- a. Make a sketch of a layer house or broiler house showing nests, roosts, feeders, waterers, and means of ventilation. Explain how insulation, ventilation, temperature controls, automatic lights, and other environmental controls are used to protect birds from heat, cold, and bad weather.
 - b. Explain why overcrowding is dangerous for poultry flocks.
 - c. Tell about the grading of eggs. Tell how broilers (fryers) are graded. Describe the classes of chicken meat.
 - d. Do ONE of the following:
 - (1) Manage an egg-producing flock for five months. Keep records of feed purchased, eggs sold, medication, vaccination, and mortality. Present your records for review by your counselor.
 - (2) Raise 20 chicks from hatching. Keep records of feed intake, weight gains, medication, vaccination, and mortality. Present your records for review by your counselor.
 - (3) Visit a commercial avian production facility. Describe what you saw and explain what you learned. If you cannot visit a commercial facility, view a video from a poultry association, or research the Internet (with your parent's permission) for information on poultry production. Tell about your findings.
 - e. Define the following terms; hen, rooster, chick, capon; tom, poult.
7. Find out about three career opportunities in animal science. Pick one and find out the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.



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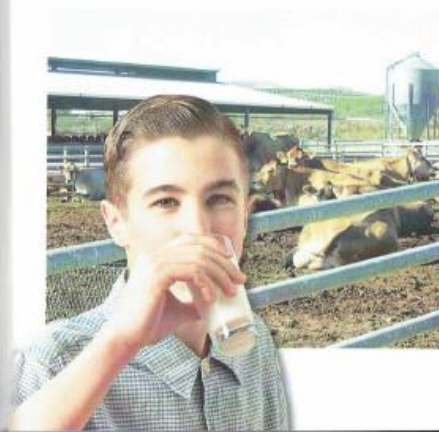
Animals of Farms and Ranches

Cattle, horses, sheep, goats, hogs, poultry, and other domesticated animals are important to people for many reasons. They supply us with food and clothing, we use them for recreational purposes, they work with and for us.

Farm animals provide us with meat, a basic part of the diet in human cultures the world over. They also supply milk, eggs, wool, and hides, and many valuable by-products ranging from medicines to glue, candles, soap, brushes, fertilizers, and other chemicals. Some animals are used for transportation and work as draft animals. Others are trained for sporting events or kept simply because we enjoy them.



This pamphlet will help you learn about the many kinds of useful animals raised by farmers and will introduce you to principles of livestock selection, breeding, nutrition, health care, and management.





Livestock Breeding and Breeds

A Thoroughbred and a draft horse are bred for different purposes—one for speed, the other for strength. A cow may be a milk cow or a beef animal. A beef cow's purpose is to produce calves that will be raised for meat, a milk cow's purpose is to produce a lot of milk with a fairly low butterfat content, or less milk with a high butterfat content.

Butterfat is the natural fat of milk.



Even within a single breed, great differences may exist between animals. For example, a Holstein cow will give more milk on average than a Jersey. But a healthy, well-tended Jersey of superior lineage might produce more milk than a poorly managed Holstein whose parents had inferior genetics.

The same principle of *breed differences* holds true for other livestock. A livestock producer needs to know the advantages and drawbacks of various breeds. The choice of stock to raise will depend on the producer's preference, the breed's characteristics, the area of the country in which the stock will be raised, and the strength of the market for that breed.

Livestock producers constantly try to upgrade their herds or flocks by breeding or buying animals that will improve the herd. They pay close attention to the health, condition, environment, and proper feeding of their stock. These measures—good breeding and good management—are essential for success in livestock production.



Livestock Breeding

Distinct animal breeds are the result of many generations of selective breeding of individuals with specific traits. Animal breeders maintain these breeds by continually selecting individuals that look or perform well, according to the "breed standard."

In many cases, breed standards are kept by *breed associations*, or groups of people who agree on what the characteristics of the breed should include, and who help other breeders and producers to meet the standards.

By definition, animals within a breed are more related than animals of different breeds. They have common ancestors and therefore share more genetic similarity and, thus, more similarity in appearance and performance.

Some livestock producers are interested in using *purebred* animals, or animals of a specific breed. But many producers will produce *crossbred* animals by mating two animals of different breeds, to get the best characteristics of the two breeds. For example, a beef cattle producer interested in the good milk production of an Angus cow and the size of a larger animal like a Simmental would mate an Angus to a Simmental to produce crossbred offspring that have some characteristics from both breeds.



Think of the cattle producer who uses an Angus-Simmental cross. Both breeds are good choices if the producer wants a large animal with good quality meat. If the cattle lived in a hot, desert environment, a Brahman cross might be better because of its heartiness and ability to withstand harsh conditions. This is a case of the environment *interacting* with genetics, an essential consideration for livestock producers.

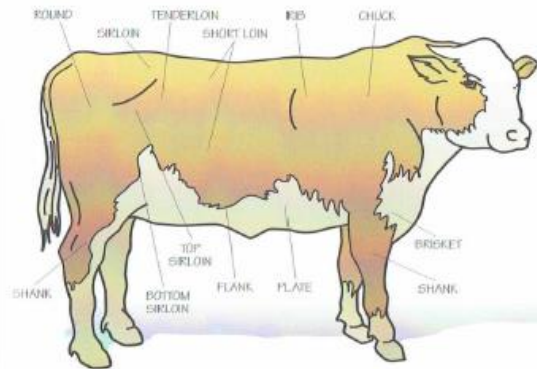
The most important thing in livestock breeding is for the breeder to establish goals, depending on what the production environment might include.

Breeds of Livestock

This section describes the principal breeds of beef cattle, dairy cattle, horses, sheep, dairy goats, hogs, and chickens raised in the United States. To learn more about a breed, check the resources listed at the end of the pamphlet, or ask your merit badge counselor or county agent where you can get more information.

Beef Cattle

People do not eat grass or hay or other such roughages (coarse vegetation). Cattle, however, can convert roughages into meat, milk, and usable by-products. Cattle are the most efficient and economical way for people to get food from lands that are wooded, mountainous, or otherwise unsuited for growing crops but that will produce good supplies of grass and forages.



Terms to Describe Beef and Dairy Cattle

Bull—a sexually intact (uncastrated) adult male.
Bullock—a young bull.
Steer—a male castrated before reaching sexual maturity.
Cow—a mature female.
Calf—a young animal of either sex. Cattle are called *calves* until one year of age; from one to two, they are *yearlings*.
Heifer—a young cow that has not produced a calf.
Heiferette—a young cow that has not had more than one calf.
Springer—a heifer or cow that is nearly ready to calve and will, therefore, begin producing milk; the *lactating* period begins as soon as the calf is born.
Freemartin—a female calf that is born as a twin with a male and is sterile.

Major Breeds of Cattle

Beef cattle:

European breeds: Angus, Devon, Hereford, Red Angus, Shorthorn

Indian breeds: Brahma

U.S.-developed breeds: Beefmaster, Brangus, Polled Hereford, Santa Gertrudis

Exotic breeds: Blonde d'Aquitaine, Charolais, Chianina, Galloway, Gelbvieh, Highland, Limousin, Maine-Anjou, Murray Grey, Piedmontese, Polled Shorthorn, Simmental, White Park

Dairy cattle: Ayrshire, Brown Swiss, Dutch Belted, Guernsey, Holstein, Jersey, Kerry

Dual-purpose cattle (used for both beef and dairy): Milking Shorthorn, Normande, Pinzgauer, Red Poll, Tarentaise



Beef Breeds

Beef cattle are raised throughout the United States in all kinds of climates. Certain breeds are better adapted than others to the local weather and feed supplies and make better choices for certain parts of the country. Ranchers choose a breed based on personal preference and the breed's characteristics such as its adaptability, body size, longevity, ability to efficiently reproduce, mothering and milking abilities, ability to gain weight, and other traits that match the producer's production environment and goals.

Angus. The Angus breed was developed from the native cattle of Scotland and came to the United States in 1873. They tolerate cold climates well. Angus steers average 1,200 pounds at harvest. They are noted for their ability to produce high-quality beef. The breed is popular in the central, southern, and western United States.

Hereford. The Hereford is an old English breed that, until the mid-1700s, was bred mainly as draft animals. The first Herefords in the United States arrived in 1817. Gradually, breeders began improving the Hereford for beef, changing the body structure toward more smoothness and less weight. Herefords are especially popular in the West and Southwest for their ability to graze over a vast range. They take good care of their offspring, making the breed popular under range conditions where good mothering may be vital for the calf's survival.

Polled Hereford. The Polled Hereford developed directly from the American Hereford. In 1898, a young Hereford breeder from Iowa saw some hornless cattle being exhibited at the Trans-Mississippi World Fair in Omaha, Nebraska. By 1901, he established the Polled Hereford breed with naturally hornless whiteface cattle he had obtained. The two breeds look much alike, except the Polled Hereford has no horns.



Angus, which are polled (hornless) and solid black in color, often are used in crossbreeding programs with Herefords to produce the "black baldy," a black animal with a white face, popular with cattle producers.



The Hereford has a red coat with a white face, crest, brisket, belly, and switch (tail) and usually has white below the knees. Its horns curve downward and slightly forward.

Midwesterners discovered in 1870 that hornless cattle sometimes appeared in horned Shorthorn herds. Thus, Polled Shorthorns were developed. Both Shorthorns and Polled Shorthorns will adapt to a wide range of climates, from the heat of the southern states to colder mountain weather.



Shorthorn cattle are combinations of red, white, and roan (a mixture of red and white hairs).



The Brahman has a large hump above the shoulders and long, narrow, droopy ears. Coat color varies from shades of gray to black, to red and speckled coats, with dark skin coloring, particularly around the eyes, for protection from the sun.

Shorthorn. The Shorthorn originated on England's northeastern coast. By 1783, these cattle were found in America. Shorthorns were valued by America's early settlers for their meat and as draft animals for pulling wagons and plows. The cattle are noted for their adaptability, nurturing ability, reproductive performance, good disposition, good feed conversion (pounds of feed needed per pound of weight gain), and longevity.

Brahman. The American Brahman was developed from cattle imported from India and Brazil. The first Brahman-type stock arrived in the United States in the late 1800s. The Brahman has a genetic resistance to diseases such as tick fever and pink-eye. These cattle are well-adapted to hot climates and tolerate parasites better than some breeds. Brahman cattle are particularly popular in the hot and humid southern states. The breed does not stand extreme cold as well as the breeds that originated in cooler climates.

Santa Gertrudis. The Santa Gertrudis was developed in the early 1900s in South Texas on the King Ranch. Shorthorn cows bred to Brahman bulls produced cattle that could do well in the hot, humid South and also have good-quality carcasses. Mature bulls weigh up to 2,600 pounds; cows average 1,200 to 1,400 pounds. Market weight is about 1,300 pounds. This breed tolerates hot weather as well as colder climates.



The Santa Gertrudis are dark red. Most have horns, but some are polled.

Brangus. Crossbreeding work between Angus and Brahman cattle started in 1912. By 1949, a cross was stabilized at five-eighths Angus and three-eighths Brahman, and the new breed was named the Brangus. Now found in nearly every state in the United States and in Canada, Australia, Mexico, Central America, South America, and Africa, the cattle tolerate hot weather very well.



The Brangus combines the best of the Brahman and the Angus. These cattle are solid black and polled.

Charolais. The Charolais was developed in central France. The King Ranch of Texas is given credit for importing the first Charolais bulls to the United States in 1936. The cattle are noted for their ability to grow rapidly and produce lean, tender beef that is fine-textured and of excellent quality. Bulls weigh as much as 2,600 pounds, and mature cows may weigh 1,700 pounds. The breed is marketed at 1,250 to 1,350 pounds.



The Charolais is large, long-bodied, and heavily muscled. Its coat is white or a light straw color. Charolais generally have horns, but some are polled.



Chianina cattle are off-white in color, with black on the tongue, nose, and switch and around the eyes.



Limousin cattle are horned and red-gold with a light buckskin color on the underside, legs, and muzzle. Through crossbreeding, there are also polled Limousin and black Limousin.



In Europe, purebred Simmental cattle vary in color from light to dark red, with distinct areas of white. The horns, legs, and tail generally are white, and there may be white patches on the flanks and behind the shoulders.

Chianina. One of the world's oldest breeds, the Chianina comes from Italy. Bred as draft and beef animals, the Chianina was introduced in the United States in 1971 and is frequently used in crossbreeding programs. Mature bulls weigh up to 3,500 pounds; females up to 2,400 pounds. These animals grow rapidly and are marketed at 1,350 pounds. The Chianina is a good beef breed, well-muscled with a thin layer of fat.

Limousin. The Limousin breed, developed in France, was introduced into North America in 1968 when a bull arrived in Canada. The first Limousin bulls imported permanently into the United States did not arrive until the fall of 1971. The breed is noted for the extra thickness and muscling typical of the cattle. Mature bulls average 2,400 pounds; cows are about 1,350 pounds.

Simmental. The Simmental has long been a popular breed in Europe. The first purebred Simmental bull arrived in the United States in 1971. Breeders here kept the Simmental's basic color pattern when crossing it with the Hereford. U.S. beef producers have also crossed Simmentals with the Angus and Charolais, and the resulting cattle include red and black individuals. Mature Simmental bulls weigh 2,400 to 2,800 pounds; cows weigh from 1,300 to 1,800 pounds.

Registered Herd or Commercial?

Registered purebred cattle herds usually are smaller than commercial operations. For the breeder to be successful, a market must exist for the animals produced. The advantage of a purebred program is that the breeder can produce a generally superior and more uniform animal that will bring a premium price. A purebred herd can be the best way to get the greatest income from a small acreage.



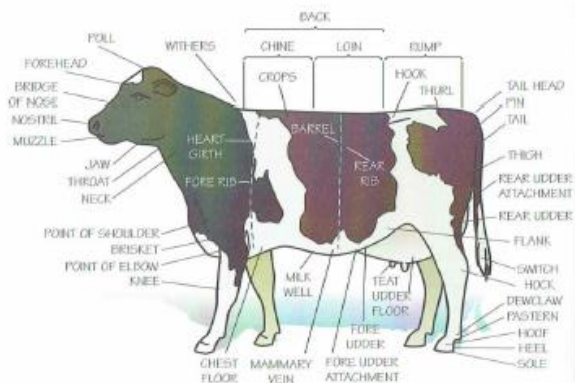
Managing a registered herd takes effort, however. The registration procedures, the paperwork involved in keeping breeding records, and the certification of animals demand careful attention to detail and a large investment of time.

A commercial cattle herd made up of crossbred beef cattle may have recognizable bloodlines—for instance, white-face cattle that are mostly Hereford and black cattle that are mostly Angus—but the animals are not pedigreed. The modern commercial beef herd usually has crossbred cattle for increased productivity and adaptability to various market and production conditions. The herd may be confined on improved pasture or allowed to run on open range. One cow on well-managed, improved pasture may get all of the nutrients she needs for herself and her calf on as few as one to three acres. In areas of low rainfall and poor plant growth, she may need to graze 100 acres or more.

Ask ranchers and breeders in your area about the most common and popular beef breeds there. Ask about the advantages and disadvantages of breeding purebred animals versus raising a commercial crossbred herd.

Dairy Cattle

Milk is a source of high-quality protein, minerals, and vitamins. All 50 states produce and process milk; California, Wisconsin, New York, Pennsylvania, Minnesota, and Idaho lead the way in milk production. Fluid milk, half-and-half, whipping cream, yogurt, butter, cheese, and ice cream are a few of the products we enjoy thanks to the dairy industry.



Dairy Breeds

Holsteins are the dominant breed, especially in fluid milk markets.

In the United States are six commonly recognized dairy breeds: Ayrshire, Brown Swiss, Guernsey, Holstein, Jersey, and Milking Shorthorn. Holstein and Brown Swiss produce greater amounts of milk; Jersey and Guernsey give milk with a higher butterfat percentage. More butterfat in milk gives a richer taste.

A dairy farmer should pick the breed that best fits local conditions and markets. In some areas, nearly all of the milk produced is used as fluid milk. In other areas, most of the milk goes to make cheese and other dairy products.

Ayrshire. The Ayrshire originated in Scotland. Today it is found throughout the United States but mostly in the Northeast and Midwest. Ayrshires are well-built, of medium size, strong, and rugged, with symmetrical udders that are well-attached to the body. Almost all Ayrshires are dehorned as calves because their long, curved horns are impractical in dairy operations. Mature cows weigh about 1,200 pounds.



Ayrshires usually are light to deep reddish-brown or mahogany, or a combination of red and white, with distinctive markings.

Brown Swiss. The Brown Swiss, one of the world's oldest dairy breeds, was developed on the mountain slopes and valleys of Switzerland. Brown Swiss are known for their calm dispositions. The first Brown Swiss to be introduced into America came to Massachusetts in 1869 and 1870. Mature cows weigh about 1,500 pounds.



Brown Swiss are solid brown, varying from very light to dark.

Guernsey. This breed originated on the Isle of Guernsey off the northern coast of France. Guernseys are found throughout the United States, mostly in the central states. They are medium-sized cattle, gentle and easily handled. A mature cow in milk weighs about 1,150 pounds. Heifers mature early. The milk of these cattle is especially yellow.



Guernseys are fawn-colored with white markings. Skin color is golden yellow or pinkish.



Most Holsteins are black and white; some are red and white.



The Jersey is medium-brown to fawn in color.

All breeds of dairy cattle have the genes for growing horns, but in U.S. dairy herds nearly all are dehorned soon after birth. Why? Because horns can cause injury to other animals and to those who work with the cattle.

Dual-Purpose Breeds

Cattle originally filled three roles for people: They provided milk, meat, and labor. Eventually, horses and then machinery replaced cattle for labor, so they were often developed for the single purpose of providing either meat or milk. Some breeds, however, still serve a dual purpose and can be raised as either beef or dairy cattle.

Milking Shorthorn. The Milking Shorthorn was an important dual-purpose breed for the pioneers in America, who depended on it for both milk and meat. In early American history, the breed was often called the Durham cow. Modern Milking Shorthorns are raised mainly to produce milk. They are red or white, or a combination (roan), with no black markings. Mature cows weigh about 1,400 pounds.

Holstein. Holsteins descended from cattle developed in the northern part of the Netherlands, especially the province of Friesland, and northern Germany. This is the most popular dairy breed in the United States and is found in all states in great numbers. It is also the largest breed, with mature cows weighing about 1,500 pounds. Holsteins are noted for producing large volumes of milk with low butterfat.

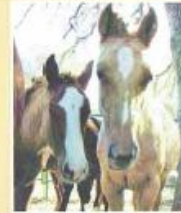
Jersey. The Jersey came from the Isle of Jersey, in the English Channel between Great Britain and France. Jerseys—the smallest of the major U.S. dairy breeds—often were kept aboard sailing ships to supply milk during long sea voyages, and probably came to America with early colonists. The breed's first recorded arrival in America was in 1850. The cows produce a rich milk, high in butterfat and protein. Mature cows weigh 900 to 1,300 pounds. Heifers mature early, calving for the first time at 20 to 24 months of age.

Horses

In 1920, 27 million horses lived in the United States. Today there are only a little more than 4 million. The big drop was caused by the internal combustion engine. With the invention of the truck, tractor, and automobile, horses were no longer needed for heavy farm work and transportation.

In recent times, however, the horse has made a comeback as millions of people have discovered the fun of owning a horse for sport and recreation. Most horses today are kept for riding and racing, but some are still workhorses.

Terms used to describe the markings on a horse's face or legs include *baldface* (a mostly white face), *blaze* (a large white patch on the face), *star* (any small white patch on the forehead), *snip* (any small white patch near the muzzle), and *sock* (a white patch above the foot).

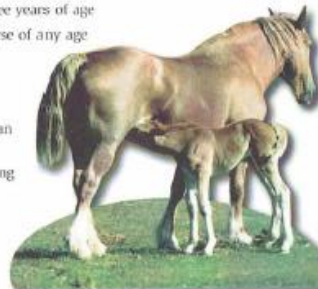


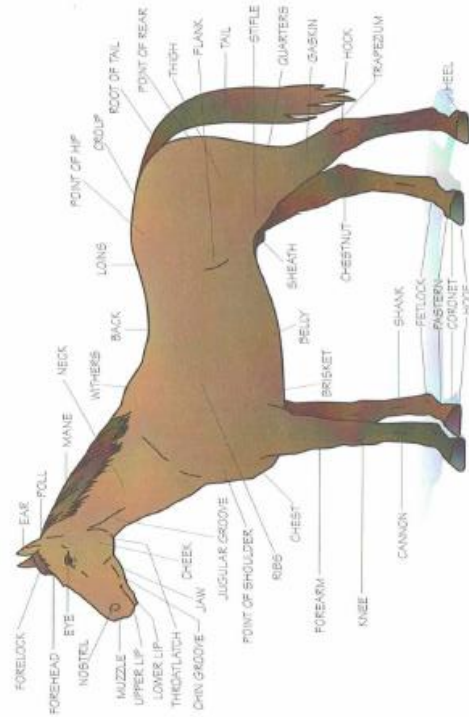
The cow horse is one working horse that is still on the job. A good cow horse is still needed to work cattle in many cattle operations.

Descriptive Terms

Horse enthusiasts use several terms to describe the sex, age, or condition of a horse:

- **Stallion**—a sexually intact male horse more than three years of age
- **Stud**—a stallion used for breeding
- **Colt**—an intact male up to three years of age
- **Gelding**—a castrated male horse of any age
- **Mare**—a mature female
- **Filly**—a female horse age three years or younger
- **Foal**—a male or female less than one year old
- **Weanling**—a just-weaned young horse of either sex





Parts of a horse

Horses may be various shades of black, brown, *chestnut* (reddish-brown), *dun* (yellowish-gray), gold, gray, *sorrel* (yellowish-brown), and white. *Bay* horses have a brown coat and black *points* (legs, mane, and tail). Chestnut horses may have *flaxen* (pale yellow) or sorrel manes and tails, but not black points. Many gray horses are born a dark color and turn a lighter shade with age. Some gray horses turn white by the time they are fully grown. *Rouan* horses are yellowish-brown or reddish-brown and sprinkled with white or gray hairs. *Calicos* are predominantly white with red and black patches.

Palominos have a golden coat and a light blond or silvery mane and tail. Most have no white except on the face and on the legs below the hocks and knees. Almost every horse breed except the Thoroughbred has palominos. The color type was developed by breeders in the United States and Mexico.

Major Breeds of Horses

Light horses: American Saddlebred, Appaloosa, Arabian, Hackney, Morgan, Paint, Quarter Horse, Standardbred, Tennessee Walking Horse, Thoroughbred
Heavy horses: American Cream, Belgian, Clydesdale, Percheron, Shire, Suffolk
Ponies: Connemara, Hackney, Pony of the Americas, Shetland, Welsh

Horse Breeds

This country has more breeds and varieties of horses than anywhere else in the world. Some breeds came from other countries; others were developed here for specific uses.





The Saddlebred may be chestnut, bay, gray, black, or golden in color.



The Appaloosa is noted for the colorful spots on its rear quarters.



The Arabian is known for speed, stamina, beauty, and alertness.



The Morgan has a proud carriage, upright graceful neck, and distinctive head.

American Saddlebred. The American Saddlebred was developed during colonial days in Virginia, West Virginia, Kentucky, and Tennessee. Recognized as a distinct breed around 1900, the original stock included Thoroughbreds, Canadian pacers, Morgans, and Standardbreds. It is popular today for its easy, comfortable ride. Most American Saddlebreds are used for recreational riding and are popular in the show ring.

Appaloosa. Appaloosas probably came to this continent with Spanish explorers. In the 19th century, most of these horses were owned by the Nez Percé Indians of the Northwest. Later, the breed became widely scattered. Today, Appaloosas are mostly stock and recreation horses.

Arabian. As the name implies, the Arabian was developed in Arabia. It has been bred in the United States since the Colonial period. George Washington rode a gray Arabian charger. Noted as an "easy keeper," the Arabian can be maintained on less-than-ideal pasture or grain rations, making it an economical horse to own.

Morgan. The Morgan was founded by a single outstanding horse. A bay stallion named Justin Morgan, born in 1789, was renowned for his strength, speed, and stamina. He also had the remarkable ability to pass on his likeness and his strengths to his offspring. His descendants, in turn, passed these traits to their offspring. Morgans are popular as saddle horses, trotting racers, carriage horses, and show horses. Some are used as cow horses on cattle ranches.

Paint. From early human cave paintings, Egyptian wall murals, and statues found in ancient Chinese burial mounds, we know the striking paint horse has been around for a long time. Spanish conquistadors brought paints and other horses to the Americas in the 16th century. By the 1800s, paints (also called pintos) were favorite mounts of American Indians and cowboys. Today, paints are popular saddle, show, and stock horses. They are deep-chested, well-muscled, powerful animals that perform well under saddle. A calm disposition and quiet intelligence make the paint a good recreation horse.

Paint horses have two-toned coat markings of white and a darker color. Its two major color patterns are called tobiano (usually red or sorrel on the sides, with white extending over the back), and overo (white on the sides with the color over the back).



The quarter horse gained a reputation in Colonial America as a short-distance runner. Its usual race distance was a quarter mile; hence its name.

Quarter Horse. The quarter horse was the first horse breed established and developed in the Americas. Stallions of Arab, Barb, and Turk breeds shipped to the Americas by Spanish explorers and traders were crossed with a band of mares that arrived from England in 1611. The result was a compact, heavily muscled horse that could run short distances faster than any horse before it.

As settlers moved west and cattle ranches began stretching across the plains, the quarter horse became famous for its "cow sense," which made it invaluable for working cattle on the open ranges of the West. Today, the quarter horse is still used in ranch work and is the most common breed in rodeo events.



Riders find the quarter horse surefooted and intelligent, and a sturdy, dependable mount for weekend trail rides.

Mustangs are descended from horses that Spanish explorers brought to North America in the 1500s. Some of their horses escaped and ran wild. By the mid-1800s, bands of mustangs roamed wide areas of the West. These small, fleet-footed horses make excellent "cow ponies." They have great stamina and seem to sense what a cow might do next. Today, the quick, agile quarter horse has replaced the mustang as the cowboy's favorite mount.



Shetlands come in almost all horse colors.

Shetland. The Shetland pony was developed in the Shetland Islands about 100 miles north of Scotland. Small and rugged, it originally was used in coal mines to pull heavy loads in tight spaces. This pony is widely used today as a child's mount and show pony.



Standardbreds are known for great stamina and the ability to trot or pace rapidly without breaking into a running gallop.

Standardbred. A Thoroughbred stallion named Messenger bred in the 18th century to native mares that were natural trotters or pacers produced the Standardbred. Used mostly in harness racing, the breed has been popular here since the early 1800s.

There are two kinds of harness horses—trotters and pacers. A *trotter* moves the front leg on one side of its body and the hind leg on the other side at the same time. A *pacer* moves the legs on the same side of its body together. Most of the harness-racing horses in the United States are pacers. The two types do not usually race together because pacers generally go faster than trotters.

Tennessee Walking Horse. The smooth and easy gait of the Tennessee walking horse, a breed founded in middle Tennessee, makes this horse a favored mount of park rangers, mounted police officers, field trial enthusiasts, hunters, endurance riders, competitive trail riders, show-ring performers, and riders of all ages and skill levels.



The famous running walk of the Tennessee walking horse is an inherited, natural gait unique to this breed, known for its calm, easy temperament.

Thoroughbred. The Thoroughbred, developed in England for racing, arrived here in the 18th century. Known for its great heart and tremendous speed and stamina in flat racing and jumping, nearly all Thoroughbreds are bred for racing. Some are used as saddle horses and polo mounts. They tend to be somewhat nervous and excitable.



Coat colors in Thoroughbreds may be bay, chestnut, black, or gray; roans are seen rarely.

Draft Horse. The draft horse is a type of horse that includes several breeds that may weigh 2,200 pounds or more. The most popular breeds are the Clydesdale, Belgian, Percheron, Shire, and Suffolk. The tractor and truck of the 19th century and before, few draft horses are work animals today; some are kept for show.



The powerful Belgian (above) and Clydesdale (left) are favorites for pulling wagons in parades.



Sheep

Sheep are good foragers and can be produced economically on land that is virtually useless for crops. Millions of acres in the United States that cannot be used profitably by other livestock are grazed by sheep. Of the 200 or more sheep breeds scattered throughout the world, more than 35 are found in the United States. Most are of British or European origin.

Sheep breeds have tremendous genetic diversity. Some have fine wool; others have hair. Some breeds at maturity weigh as little as 100 pounds; others may weigh four times as much. Some breeds average one lamb per ewe (mature female); others commonly produce three or more lambs at each lambing (birth). Various breeds differ in their herding or flocking instincts. Some tend to herd or flock together better than others, making them better adapted to the open range.



Only about 10 sheep breeds are commercially important today, but the great genetic diversity of sheep allows breeders to make changes rapidly to meet changes in economic conditions and the demands of the market. For successful sheep breeders, the market is an important factor in breed selection. There are three major markets for sheep: raising lambs for meat, producing wool, and raising show lambs.

Other important considerations when choosing a sheep breed include the breed's

- Adaptability to the local environment, taking into account climate and the availability of forage
- Reproductive efficiency, such as number of lambs born and raised per lambing season or year
- Growth rate and carcass quality (faster growth and more lean meat with less fat in the carcass are most economical)
- Wool production

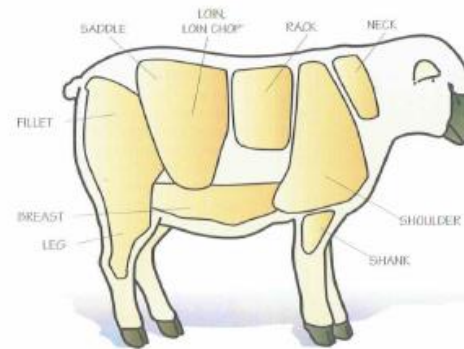
Major Breeds of Sheep

Ewe breeds (fine wool): Debouillet, Finnsheep, Merino, Rambouillet, Romanov

Ram breeds (meat-type): Cheviot, Columbia, Cotswold, Dorset, Hampshire, Leicester, Lincoln, Oxford, Romney, Shropshire, Southdown, Suffolk

Dual-purpose breeds: Cheviot, Columbia, Corriedale, Dorset, Romeldale, Polwarth, Targhee

Meat cuts of a sheep



Terms to Describe Sheep

Ewes—mature females

Rams—mature, sexually intact males

Wethers—male sheep castrated before sexual maturity

Lambs—young sheep

Sheep breeds are classified according to their role in crossbreeding and commercial use. *Ewe breeds* are generally the white-faced breeds of fine-wool type. *Ram breeds* are meat-type sheep used mainly as sires for market lamb production. *Dual-purpose breeds* are used as either ewe or ram breeds depending on the production situation.

Ewe Breeds

Ewe breeds developed mainly from crosses of fine-wool and long-wool types and highly fertile breeds such as the Finnsheep, Booroola Merino, and Romanov. All the fine-wool breeds in the United States trace their ancestry to the Spanish Merino.



Delaine Merinos produce the best-quality wool in the United States.



Rambouillets are noted for their high-quality wool, ability to adapt to tough range conditions, and size (they are the largest of the fine-wool breeds).

Merino. The Merino was first imported into the United States in the 18th century. Its three types—types A and B of the American Merino, and type C, the Delaine Merino—differ chiefly in the degree of skin folds or wrinkles. The Delaine Merino has the smoothest skin. Merinos are strong, hardy, and herd well. Mature Delaine rams weigh from 150 to 200 pounds; ewes weigh from 110 to 150 pounds. Most rams are horned.

Rambouillet. The Rambouillet is a good wool producer and also offers acceptable meat. These sheep herd well and are popular in range country. Rams weigh 225 to 275 pounds and ewes 140 to 200 pounds. Most rams have large, spiral horns, but some are polled. The breed was developed from Merino stock imported from Spain into France about 1786, and came to the United States in the 19th century.

Ram Breeds

The ram breeds are selected on the basis of size, growth rate, carcass quality, and ease of lambing. The principal ram breeds in the United States are the Suffolk and Hampshire. The Columbia, Shropshire, Oxford, Southdown, Dorset, and others are used as ram breeds to a lesser extent.



The Suffolk is hornless and has a black face, ears, and legs.

Suffolk. The Suffolk was developed in England and brought to America in the late 1880s. This large, hardy breed tolerates heat well and adapts well to range conditions of the western states. The ewes are excellent mothers. Lambs mature rapidly.



The Hampshire's ears and face are dark and relatively free of wool, as are the legs below the knee and hock.

Hampshire. Originally from southern England, the Hampshire is a large and active breed, with mature rams weighing 275 pounds or more and mature ewes 200 pounds or more in breeding condition. The Hampshire is well-muscled, hornless, and noted for its vigor, strength, and mild disposition. These sheep do well on the range. Ewes lamb easily and have heavy, vigorous lambs.

Columbia. The Columbia originated in Wyoming and Idaho from the crossing of Lincoln rams (a long-wool breed) and Rambouillet ewes. It adapts well to range conditions. Mature Columbia rams weigh 225 to 275 pounds; ewes weigh 125 to 190 pounds. The breed produces a high-quality fleece. Ewes produce a wool clip (the wool shorn at shearing) of 12 pounds or more annually.



The Columbia has a white, open-faced, polled head.



Shropshire rams and ewes are polled.



Both sexes of the Oxford are polled.



Southdown rams and ewes are polled. This breed is a popular choice for 4-H and National FFA Organization market lamb and sheep projects.

Shropshire. The Shropshire, developed in England, first appeared in the United States about 1855. In size, it ranks between the Hampshire and the Southdown. It is a good meat animal, grows rapidly, and shearing yields about 8 to 12 pounds of wool annually.

Oxford. Developed in south central England, the Oxford arrived in this country in 1846. Rams weigh 200 to 275 pounds; ewes weigh 150 to 225 pounds. The Oxford shears heavier than many others used as ram breeds, producing 10 to 12 pounds of wool a year.

Southdown. Native to southeastern England, the Southdown had arrived in the United States by the 17th century. An excellent meat breed, the Southdown also produces fine-quality wool but in small amounts. It matures early and is smaller than other ram breeds, with deep, firm flesh. Rams weigh 190 to 230 pounds; ewes weigh 140 to 180 pounds.



Dorset. The Dorset originated in England and is now found in nearly all parts of the United States except the mountain states and the extreme southeast. Multiple births and out-of-season lambs are common, giving these sheep the nickname "the mother breed." The Dorset is a medium-sized sheep, with good body length and muscling and good carcass quality. Rams weigh 225 to 275 pounds; ewes weigh 150 to 200 pounds.

Dual-Purpose Breeds

The breeds classified as dual purpose usually are crossed with the ewe breeds to produce crossbred females for market lamb production. Breeds in this category include the Columbia, Dorset, Corriedale, and Cheviot.

Corriedale. The Corriedale was developed in New Zealand from Lincoln rams crossed with Merino ewes. The breed was imported into Wyoming in 1914. These sheep may shear 10 to 12 pounds of wool a year. Mature rams weigh 185 to 225 pounds, and ewes range from 125 to 185 pounds. Both sexes are polled.

Cheviot. Cheviots originated in the border country between Scotland and England and arrived in the United States in 1838. The breed is noted for its vigor, good milking and nurturing ability, quality meat, and ability to adapt to rugged grazing conditions. Mature rams weigh 160 to 200 pounds; ewes weigh 120 to 160 pounds. Fleece weight usually is light, about 5 to 7 pounds annually. The face and legs have no wool. Both sexes are polled.



The Dorset breed is noted for mothering ability and milking ability.



Corriedales produce good meat and dense fleece of good quality.



The Cheviot is a small, hardy sheep with excellent meat.

Dairy Goats

Goats are grazing animals that can eat a wide variety of plants. Some ranchers use them to clear brush and other unwanted plants from pastures. Goats actively hunt for food and can cover a wide area in search of scarce forage. They thrive in harsh environments such as rocky and mountainous areas and dry or semitropical climates.



Domestic goats produce milk, meat, leather, and wool. Rabies, the elderly, and people with stomach ailments may find goat's milk easier to digest than cow's milk. People who are allergic to the protein in cow's milk may be able to drink goat's milk safely. However, those who cannot digest the lactose in cow's milk can't drink goat's milk either, because the milk sugar is the same in both kinds of milk.

In the United States and Canada, the most popular milk-producing goat is the Anglo-Nubian, or Nubian. It was developed by breeding British dairy goats with goats imported from Africa and India. Other major breeds of dairy goats are the Saanen, Toggenburg, and Alpine, all developed in Switzerland.

Goat's milk cheeses have a creamy texture and a wide range of flavors. Popular goat's milk cheeses include blue, chèvre, feta, and ricotta.

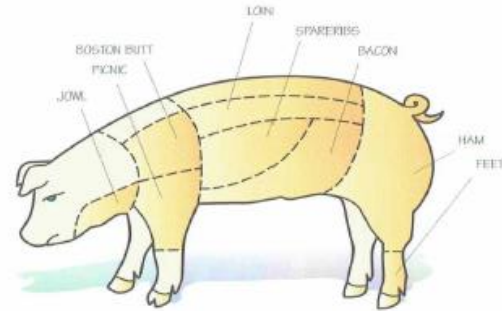
In its composition, goat's milk differs slightly from cow's milk. Both are about 87 percent water, 3 to 4 percent protein, 3 to 5 percent fat (depending on the breed), and 5 percent lactose (milk sugar). Both provide similar amounts of calcium and phosphorus. Goat's milk, however, contains more vitamin A than cow's milk but smaller amounts of certain B vitamins including vitamin B₁₂.

An adult male goat is called a *buck* or a *billy goat* . An adult female is a *doe* or a *nanny goat* . A goat less than a year old is a *kid* . The mature weight of modern dairy breeds is between 130 and 200 pounds.

Hogs

Hogs breed rapidly, require little space, and reach market size relatively quickly. These qualities make them a natural choice for small farmers who want to turn home-raised grain into a marketable meat product quickly. Intensive commercial production, however, is rapidly replacing the small pig farmer. Small farmers may typically raise pigs for market from fewer than 50 to 100 sows (adult female swine), but intensive commercial producers often have from 500 to 10,000 sows.

Hogs have been in America since explorer Hernando de Soto brought some, and lost them to the wilds, in the early 1500s. Pioneers brought hogs to Jamestown in 1609. Settlers moving westward spread them throughout the United States. By 1840, the center of production had shifted to the Midwest, where it remains today, although swine make important contributions to every state's economy.



Meat cuts of a hog

Swine producers today breed for a meat-type hog with a good yield of the lean cuts—ham, loin, picnic shoulder, and Boston butt. Quality hogs are well-muscled and lean.

Swine Breeds

As is true for other livestock, there is no "best" breed of swine. A hog producer must base breed selection on the growth rate of the breed, the number of pigs in an average litter, and the desirability of the meat, as well as suitability to the producer's goals.

Major Breeds of Hogs

British breeds: Berkshire, Yorkshire, Tamworth

U.S.-developed breeds: American Landrace, Chester White, Duroc, Hampshire, Poland China, Spotted Swine



The American Landrace is white.



Berkshires are black with white on the face, tail, and all four feet.



The Chester White originated in Chester County, Pennsylvania.

American Landrace. The American Landrace was developed from Landrace stock from Denmark and other European countries. Mature boars (adult, sexually intact male swine) weigh 700 to 900 pounds, and sows weigh 550 to 750 pounds. The Landrace has a long body and is known for its large litter size.

Berkshire. An English breed, the Berkshire is the oldest improved swine breed. It first came to the United States in 1823. A mature Berkshire is of medium size, with boars weighing 700 to 900 pounds and sows 600 to 750 pounds. The breed is long-bodied and produces fine quality meat.

Chester White. Because of their mothering ability, large litters, durability, and soundness, Chester Whites are popular with pork producers. Chesters mature early and can be marketed at a lighter weight than some breeds. Chester White carcasses are noted for large hams.

Duroc. The Duroc originated in New Jersey and New York in the mid-1800s. A popular and hardy breed, it is noted for an excellent rate of weight gain and feed efficiency (that is, the number of pounds of feed needed to produce one pound of weight gain). Sows have large litters and are good nurturers. Durocs mature early.



The Duroc is all red, the shade varying from light to dark.

Hampshire. The Hampshire was developed from English breeds in Boone County, Kentucky, during the 19th century. Hampshires are noted for leanness, durability, carcass quality, and efficiency. They are large-framed and deep-bodied.



The Hampshire has a black body with a white belt running over the shoulders and front legs.

Poland China. The name of the Poland China is misleading because no swine from Poland or China contributed to its development. It originated in Ohio and was named by a Polish farmer. The breed is known for producing a heavy ham carcass.



The Poland China is black with white feet, snout, and tip of tail.

Spotted Swine. The Spotted swine has changed drastically from the short, fat hog in the early 1900s to a long-sided, fast-growing, large, and hardy breed with excellent carcass quality. The Spot is noted for its mothering ability, litter size, and muscling.



Spotted swine are known as highly productive hogs.

Besides the pure breeds of swine, many *hybrids* (crossbred animals) have been developed to produce pigs that excel in certain characteristics, such as carcass leanness, growth rate, feed efficiency, and reproductive rate. The white breeds have been used extensively as sows for mating to boars of the colored breeds such as the Berkshire, Hampshire, and Poland China.



Poultry

Chickens produce meat and eggs, two of the world's major sources of food. In the United States, many poultry farms are in Georgia, Arkansas, North Carolina, Alabama, Mississippi, Texas, California, Virginia, Pennsylvania, Minnesota, Iowa, and Ohio.

Poultry kept for human use includes turkeys, geese, ducks, guinea fowl, and chickens. People also raise game birds such as chukar partridge, quail, and pheasant. This pamphlet will mention only chickens. To learn more about the others, visit your local library or a poultry producer.



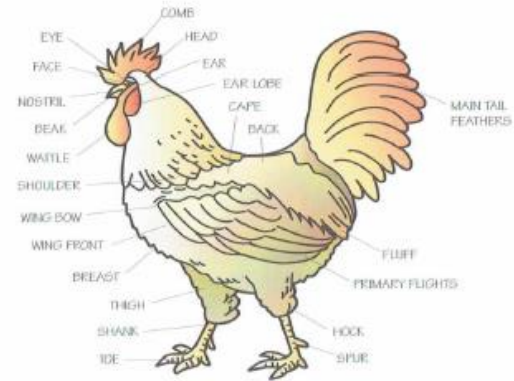
White Leghorn pullets.
A *pullet* is a young hen.



Barred Plymouth Rock male

Major Chicken Varieties in the United States

The major chicken varieties include the White Leghorn, White Plymouth Rock, Barred Plymouth Rock, Rhode Island Red, New Hampshire, and Dark Cornish. Most chickens in the United States are hybrids. The high-quality, high-producing birds of commercial egg farms and broiler farms are the results of careful selection and crossbreeding.



Major external parts of a chicken

Broilers. Commercial poultry farms normally buy chicks from companies that specialize in chick production for either meat or egg production. For *broiler* (meat) production, *straight-run* (unsexed) chicks usually are ordered.

Layers. Brown eggs are popular in some areas, but most commercial egg farms use hens that produce white eggs from the White Leghorn breed or from strains of the breed. Commercial producers use high-producing laying hens that have been bred for egg production.



Animals need fresh, clean water available to them at all times.

Management Practices

Livestock animals have certain physical needs that must be met if they are to grow and develop normally, stay healthy, and be productive.



Cattle, horses, sheep, goats, hogs, and poultry have the same basic needs, but the way their needs are met varies. This section will cover these needs in general terms. For more detailed information, talk with your merit badge counselor, county agent, or a livestock producer.

Feeding and Watering

The nutritional needs of different animals vary, but all require the following.

Water. Fresh, clean water is a must at all times for every animal. A cow, for instance, will drink about 12 gallons of water a day—more in hot weather than in cold. She can live for weeks without food but only a few days without water, which she needs to regulate body temperature, dissolve and carry nutrients, and eliminate wastes.

Carbohydrates. Sugars, starches, and cellulose are carbohydrates that the body “burns” (oxidizes) to provide the energy used for growth, fattening, and reproduction.

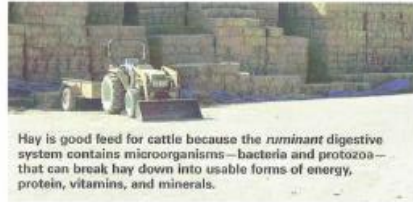
Fats. This class of nutrients mainly provides high amounts of energy but also supplies the small amounts of *fatty acids* required for proper growth.

Proteins. These complex compounds provide the *amino acids* essential for an animal’s normal growth and functioning. The body uses amino acids mainly to build soft tissues such as muscles.

Without a balanced diet of all these nutrients, animals will not flourish. They will be less productive than healthy specimens, or become infected with disease, and their offspring may be weak or deformed.

Vitamins. These complex substances are vital to normal growth and health. Vitamins are required in small amounts and play specific roles in the body.

Minerals. Normal body functioning requires elements such as iron, copper, phosphorus, potassium, selenium, calcium, and iodine. More than a dozen minerals are known to be essential in an animal's diet.



Hay is good feed for cattle because the ruminant digestive system contains microorganisms—bacteria and protozoa—that can break hay down into usable forms of energy, protein, vitamins, and minerals.

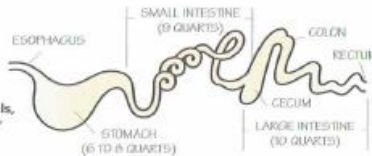
The main difference between ruminant and nonruminant animals is that the ruminant's "stomach" has four compartments, while the nonruminant's has only one. As a result, the types of feed they can use are quite different.

Digestive Systems of Livestock

Feed is the most important factor in the growth, health, and productivity of all kinds of livestock. For most types of livestock, feed is the producer's biggest expense. Livestock producers must feed their animals well, but they must keep costs down to make a profit. Producers can achieve both good nutrition and good economy if they understand how animals use feed and convert it into profitable meat, milk, eggs, wool, or offspring.

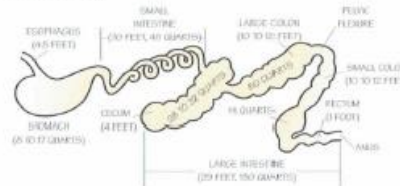
The digestive systems of farm animals are of two kinds. *Ruminants* are cud-chewing, cloven-hoofed animals, including cattle, sheep, and goats. (Deer, bison, antelope, camels, giraffes, and llamas also are ruminants.) All other livestock, including horses, swine, and poultry, are *nonruminants*.

The digestive process of simple-stomached animals, such as the pig, is similar to that of humans.



DIGESTION IN NONRUMINANTS

Let's follow the digestive process of a familiar nonruminant—the horse. The process starts in the mouth, as the horse chews the feed and moistens it with saliva. Chewing causes some physical breakdown of the feed, and saliva eases the feed's passage down the *esophagus* (the tube linking the mouth with the stomach).

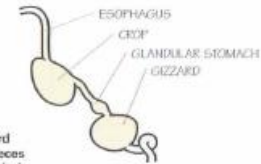


The horse's cecum is relatively large, as this drawing of a horse's digestive system shows. Therefore, the horse can use large amounts of forage. Because the cecum of swine and poultry (and people) has a limited capacity, these animals cannot use forage well.

Once in the horse's stomach, the feed mixes with gastric juices that break down fats and proteins. In the *small intestine*, which is around 70 feet long, enzymes continue to break down proteins, fats, and sugars into simpler substances that can be absorbed into the bloodstream and used by the body.

Digestion and absorption of nutrients continue as food passes through the *caecum* and *colon* (the large intestine). The cecum houses microbes (bacteria and protozoa) that help to break down forages such as hay and grass into nutrients that can be absorbed. Undigested fiber and wastes are expelled through the rectum.

The digestive tract of a chicken, a nonruminant animal, has a pouch, or *crop*, that stores food and slowly passes it to the stomach. After the food has mixed with digestive juices in the stomach, it enters the *gizzard*. This organ's strong muscles grind food. Birds have no teeth to crush their food, so the grinding in the gizzard replaces chewing. The gizzard holds small pieces of gravel that the bird has swallowed, which help to break up and grind the food for better digestion.



For its size, a horse has a small stomach. This means it must eat relatively small amounts over a long period instead of large amounts quickly. If a horse is not fed, its stomach will be empty within 24 hours.

DIGESTION IN RUMINANTS

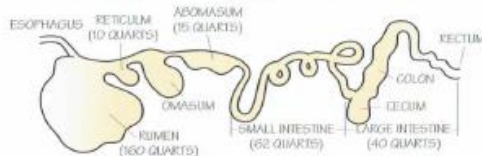
A cow's rumen
may have
200 billion
microorganisms
per teaspoon.

A cow eats by wrapping its tongue around grass and twisting it off. The animal chews its food very little before swallowing it, but does mix the grass with saliva in the mouth to lubricate it and make swallowing easier.

The feed travels down the esophagus to the *rumen*, also called the paunch or fermentation vat. The rumen may hold as much as 50 gallons. This large vat contains microorganisms—bacteria and protozoa—that actively break down the forage the cow eats. These tiny organisms digest the roughage to survive and, in the process, make substances such as fatty acids, B vitamins, and amino acids that the cow needs. When the organisms die, the cow digests them and absorbs the nutrients they release.

Only microbes produce the enzymes that digest forage; the animal itself does not. A calf is not born with the microorganisms needed to digest forages. It must *inoculate* its digestive system by eating or drinking with more mature animals to pick up the necessary microorganisms. Calves start ruminating when they are about three months old; they digest only small amounts of roughage at that age. By weaning, a calf's digestive system is functioning completely.

The rumen of a mature cow acts as a storage vat. After feeding, the cow *regurgitates* (casts up) a cud of partially chewed feed and fluid. Forcing the cud up the esophagus from the rumen to the mouth, the cow chews it more thoroughly and then reswallows it. Digestion by the microbes continues until the particles of feed are small enough to flow down the digestive tract through the small opening of the rumen and *reticulum*.



A cow's digestive system has a "stomach" with four compartments: rumen, reticulum, omasum, and abomasum. A limited amount of microbial digestion continues in its cecum.

Next comes the *omasum*, which removes most of the water. Most microbial digestion is completed by the time the food reaches the next stop, the *abomasum*. Often called the *true stomach* because it performs much like the simple stomach of the horse and pig, the abomasum uses digestive juices to break down food into its nutrient building blocks, which are then absorbed through the wall of the small intestine. Undigested material moves through the cecum and large intestine and is expelled as manure through the rectum.

Ruminants can go for longer periods without food than nonruminants, provided they have adequate rations when they are fed. They can also use more roughages such as grass and hay, which are more difficult to digest than feeds such as grains.

A ruminant's
stomach takes
72 hours to empty.

**Feeding Cattle**

The rations fed to cattle depend on the intended goal—fattening a steer for market, feeding dairy cows to increase milk production, feeding show animals, or wintering cattle, for instance. Rations often are prepared with computers and complicated nutritional data, but you can use some general guidelines to plan basic rations.

- Any sign of *unthriftiness* (lack of vigor or health) in cattle should prompt a change in the ration if parasites and disease can be ruled out as the cause of the problem.