The Normal Animal

The proverbial "contented cow" reflects good health.

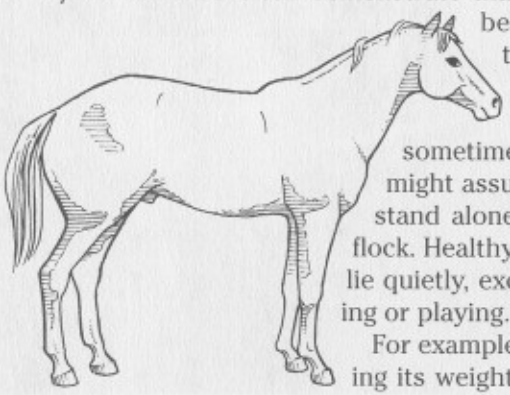
When you are sick or injured, you can tell the doctor what hurts, where it hurts, and how much it hurts. Animals can't do this.

But they *can* communicate pain or distress—although they don't do it on purpose to inform humans. A veterinarian, farmer, or pet owner learns to "read" an animal's condition by comparing its appearance and voice with the normal or healthy condition of another animal of the same breed.

That's why it is important to know what the normal, healthy animal looks and sounds like. Naturally, this will vary a great deal depending on the kind of animal you are observing, and it will vary within the same breed, or even the same family.

Study the animals you are observing while they are resting, playing, and working. Compare them with other members of their breed. You might see differences in normal behavior. For example, one puppy in a litter might be more active and aggressive than the others even though all are normal, healthy pups.

When you know the normal posture and action of the animals you are observing, you will quickly notice when they act abnormally. Sick or injured animals often demonstrate that something is wrong by behaving differently than the owner expects. Ill dogs and cats tend to refuse food, do not play, and sometimes hide. Sick farm animals might assume a different posture or stand alone, away from the herd or flock. Healthy animals usually stand or lie quietly, except when they are working or playing.



For example, a horse that keeps shifting its weight from one leg to another might have an inflamed joint. If it arches its back, the horse might have a mild abdominal pain. If the horse arches its back and spreads its legs like a sawhorse, the animal probably has a severe abdominal pain.

In cold weather, a healthy bird will fluff out its feathers and crouch to keep warm. If it does this during summer or in a warm room, the bird might be ill.

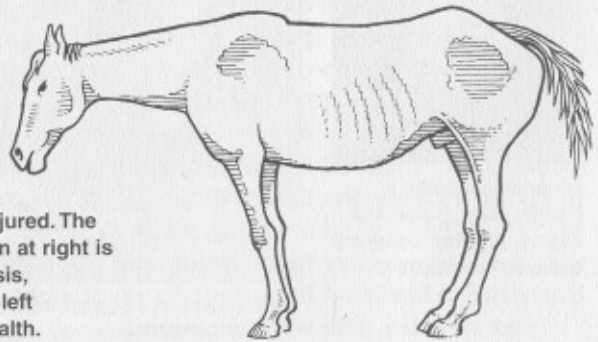
Abnormal posture will help a veterinarian diagnose a disease. A horse that has gorged itself can develop a disease called laminitis, or founder. Although the problem is in the horse's digestive tract, the ailment shows itself in the feet, causing sore feet and even lameness.

Another disease that affects an animal's posture is tetanus or lockjaw. The first sign of tetanus, which is caused by an infection in a wound, is stiffness. Within twenty-four hours, the animal will be very stiff. Its back may be arched, ears upright, and tail extended and quite rigid. Most animals—and man—can get tetanus.

Abnormal movements or actions by an animal might also indicate disease or injury. Watch for signs such as frequent shaking of the head, constant licking, repeated kicking or pawing, squinting or blinking, or constant scratching and biting of its skin. These signs might mean nothing—or they might mean trouble.

If you make a habit of watching animals and comparing them with others of their breed, you can usually tell if they need a veterinarian.

An animal's voice also will tell a careful observer something about its feelings and condition. Horses have various sounds to communicate distress, pleasure, and alarm. So do dogs, pigs, sheep, goats, and most other domestic animals.



Learning how a healthy animal looks and sounds can help you determine when the animal is sick or injured. The horse in the illustration at right is infected with ehrlichiosis, while the horse on the left demonstrates good health.

Measuring an Animal's Health

An animal's posture and movements can help you judge its well-being, but they do not tell the whole story. Much more useful are measurements of body temperature, pulse rate, and respiration (breathing rate).

These three measurements serve as valuable clues to an animal's health. They should be used together for an accurate picture. In some diseases, the temperature of an animal might be normal, but the pulse might be very rapid. If you checked only the temperature and found it normal, the animal might suffer needlessly, because a check of its pulse rate or respiration might have shown the presence of trouble.

Be careful when examining an animal that might be ill or in pain. Such animals might bite, scratch, kick, or otherwise try to defend themselves when examined. It is important to know how to properly restrain a sick or injured animal to keep it—and you—safe.

Measuring Temperature

An animal's body temperature, pulse rate, and respiration serve as clues to its health.

Veterinarians take an animal's temperature by inserting a rectal thermometer in the animal's rectum and leaving it there for two or three minutes before reading it. If you own or care for animals, you should get a thermometer and learn how to use it, because temperature is a valuable guide for detection of disease. Use a thermometer that is of heavier construction than the one your family uses. *Before using a thermometer to check your animal's temperature, consult a veterinarian on the proper way to hold the animal and insert the thermometer in its rectum.* Taking an animal's temperature can be easy to learn, but it is important to do it right so that the animal won't be injured.

You probably know that the normal body temperature of a person is 98.6° Fahrenheit. It isn't possible to be that exact in determining an animal's "normal" temperature. The temperature of a healthy animal might vary one to two degrees up or down from the temperatures shown in the table on page 7.

The animal's temperature can be affected by the weather, excitement, its age, and several other factors. The time of day can also make a difference, so it's best to take an animal's temperature at the same time each day.

Temperature Table

(Approximate rectal temperatures; can vary one to two degrees up or down)

Horse	100.5°	Sheep	102.3°
Cow (low)	101.5°	Dog	101.5°
Pig	102.0°	Cat	101.5°
Dairy goat	104.0°	Rabbit	102.5°

Measuring Pulse Rate

The pulse is the wave of blood in an artery caused by the contractions of the heart. No doubt your pulse has been taken many times by doctors or school nurses. They do this by placing their fingers on the artery on the inside of your wrist and timing the pulse rate.

A veterinarian does the same thing for an animal, but finds the pulse at different points, depending on the kind of animal it is. A horse's pulse, for example, can be found on the lower margin of the jaw, inside the elbow of a front leg, and under the tail. A cow's pulse is taken on the outside of the jaw, just above its lower border.

This Scout is learning to take the pulse rate of a horse by finding its pulse on the lower margin of the jaw.

The pulse of a sheep, dog, or cat is taken on the inside of the thigh, on the femoral artery. Because the pulse of animals such as pigs or birds is hard to find, the veterinarian feels the heartbeat or listens to it with a stethoscope.

Many animals have very rapid heartbeats, so it is hard to count the pulse rate for a full minute. The veterinarian will count the pulse rate for perhaps fifteen seconds two or three times, then average the counts and multiply the average by four to get the pulse rate for one minute.

In checking a pulse rate, it's important to know *how* the pulse feels as well as the number of beats.

Generally, small animals have faster pulses than large animals. For example, a mouse will have a pulse rate of about 600 beats a minute; a guinea pig, 280 beats; and an elephant, 30. The same rule applies even within the same species of animal. A small dog such as the Chihuahua might have a pulse rate of 120, while a German shepherd might average only 80 beats per minute.

Veterinarians want to know *how* the pulse feels, as well as the number of beats. The force and fullness of the pulse beat are important. A beat might be quick, short, and hard, or long, slow, and soft. At other times it might be fast, thin feeling, and irregular. The pulse of a healthy horse or cow usually has a steady rhythm, but a healthy dog often will have an uneven rhythm.

The pulse rates shown below are averages. If your animal differs a few counts either way, it's probably normal as long as the rhythm of the pulse is even.

Pulse Rates per minute

Horse	30–45	Sheep	70–80
Cow	60–70	Dog	80–140
Dairy goat	70–80	Cat	140–200
Pig	60–80		

Measuring Respiration

The respiration rate is the number of times per minute an animal inhales and exhales. In most animals this can be seen by observing the in-and-out motion of the ribs.

The easiest way to count respiration rate, however, is to place your hand on the animal's ribs or flank and count the number of times the chest rises and falls in one minute.

Like the body temperature and pulse rate, several factors can affect the respiration rate, including the animal's age, if it is excited, the outside temperature, and exercise. Injury or disease can also influence the respiration rate.

The rates shown in the following table are averages. Your animal's respiration rate can vary a little in either direction even though your animal is healthy and unhurt.

Respiration Rates per minute

Horse	8–16	Sheep	12–20
Cow	10–30	Dog	10–30
Dairy goat	12–20	Cat	20–30
Pig	8–18		

An Animal's Body Systems

To treat illnesses and injuries, a veterinarian must know how the organs of an animal's body work together in systems. There are about a dozen systems in animals. Each system performs a particular function.

For example, the muscular system allows an animal to move parts of its body. The nervous system receives sensations from the animal's various organs and responds to these sensations. The endocrine or glandular system helps to coordinate the animal's body functions.

For requirement 3, you must learn something about these four important systems: respiratory, digestive, skeletal, and circulatory. Naturally, the way these systems work varies from animal to animal. But their purposes are the same in all animals.

You may want to learn about the functions of the four systems and make your schematic drawings of just one kind of animal. The illustrations on the following pages show systems of several animals. For other drawings and explanations, check your school and public libraries. Your merit badge counselor may have suggestions for resources, too.

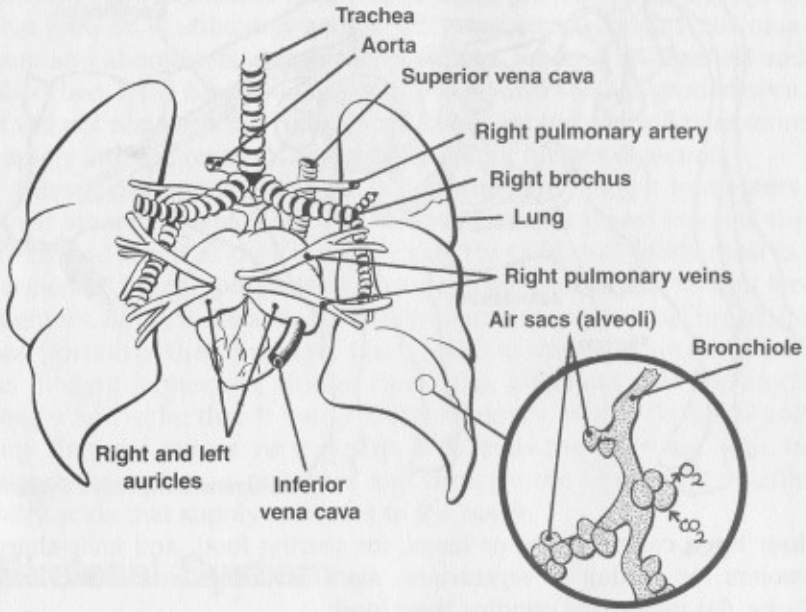
Respiratory System

The function of the respiratory system is to bring life-giving oxygen into the lungs and to carry off carbon dioxide and other waste materials. Without oxygen, animals (and people) cannot survive.

The respiratory system in most animals consists of a nasal cavity, pharynx, larynx, trachea, bronchi, and lungs. The lungs are where oxygen is absorbed and waste (carbon dioxide) is eliminated. The airways (trachea, bronchi) clean and adjust the temperature of the air entering the lungs. The diaphragm, which is a sheet of muscles and tendons, makes breathing possible.

In most animals, the nasal cavity is the passageway from the nostrils. The pharynx is the throat cavity, which connects the nasal cavity to the larynx and trachea. The animal's vocal cords are in the

Respiratory System

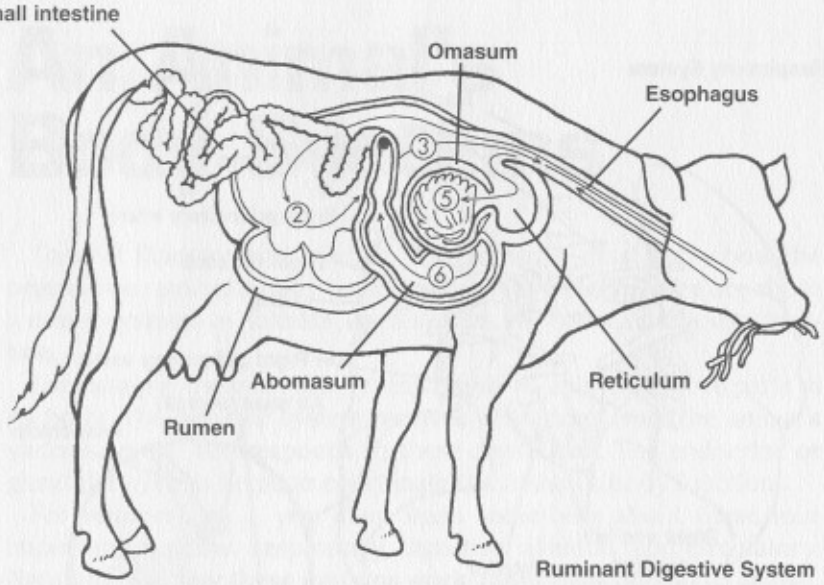


larynx, or voice box. These cords are folds of tissue that vibrate when air passes over them, thereby producing sounds. The trachea is a tubular structure that conducts air from the larynx to the bronchi and lungs. The bronchi are the two main branches of the trachea that lead to the lungs. The bronchi continue to branch in smaller and smaller tubes, ending in the lungs in small air sacs. It is within these sacs that oxygen from the incoming air is exchanged with carbon dioxide from the blood.

Digestive System

The digestive system breaks down the animal's food and permits food to be absorbed by the body. The digestive system includes the teeth, stomach, intestines, liver, and many other organs. Digestive systems among animals are quite different.

Teeth are used to break down the food into smaller bits. Teeth can vary in size and shape depending upon the type of food the animal consumes. Flesh-eating animals, such as the dog, wolf, and lion, have



Ruminant Digestive System

four large canine teeth, or fangs, for tearing food, and knife-sharp molars for cutting it. Vegetarians, such as horses and cows, have large, flat molars for grinding their food.

There are variations in digestive systems. The three main types of digestive systems include *simple monogastrics, foregut fermenters,* and *hindgut fermenters.* Most mammals have stomachs much like ours. The food enters through the esophagus after being chewed and mixed with enzymes in the mouth. Enzymes are substances that help to break down the food. The food is stored in the stomach while digestion continues through a churning action and the work of enzymes. The food then passes into the small intestine, where it is absorbed into the body. Waste products continue through the large intestine and leave the body through the rectum.

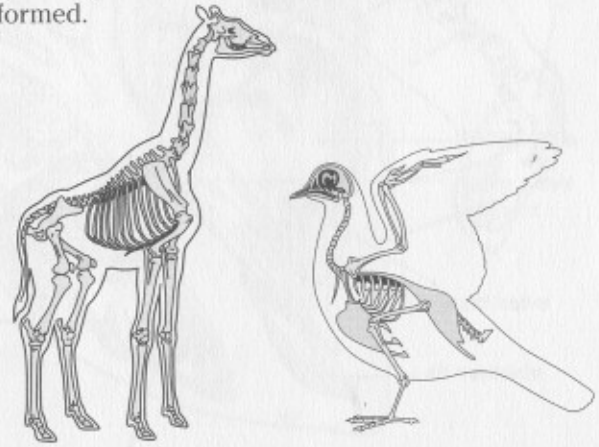
Simple monogastrics (for example, dogs and cats) have digestive tracts much like people. Cattle, deer, sheep, and goats are foregut fermenters (ruminants), and have very different stomachs. Their stomachs have four separate compartments. Two of those compartments—the rumen and the reticulum—serve as holding vats for the food. Ruminant animals fill these compartments with fibrous food (such as straw or grass), which is digested or fermented by bacteria and other microorganisms that live there. The ruminants also will regurgitate this food and chew and swallow it again to aid in this process. The fermented food (called cud), plus the microorganisms that grew on it, ultimately goes to the other compartments, the omasum and abomasum, and to the intestines, where it is digested and absorbed. If the food is an easily digested meal such as ground corn, it will not remain in the rumen for as long, but instead will pass more rapidly into the omasum and abomasum for further digestion.

Horses (and guinea pigs, for that matter) are hindgut fermenters. Their stomachs, which are a lot like ours, cannot digest much of the straw and hay that they normally eat. These fibrous foods must be fermented by microorganisms, just as in the process for foregut fermenters. But in these animals, the fermentation process occurs in the *last* portion of the alimentary tract, which is why they are described as hindgut fermenters. Horses have large intestines that are much longer and wider than is found in other animals, so that the straw and hay they eat moves very slowly. This gives the microbes time to digest these fibrous materials and produce the important, volatile fatty acids that supply nutrients to the horse.

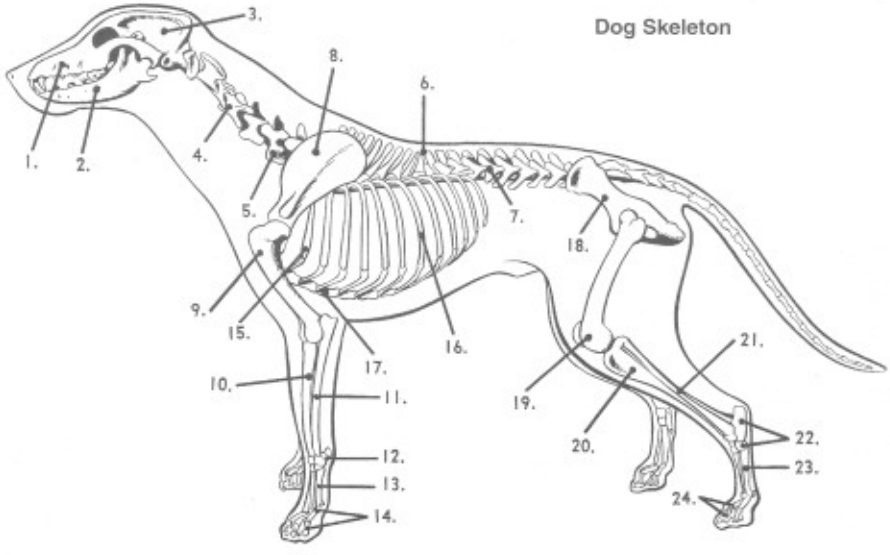
Skeletal System

The skeletal system is made up of bones and joints that support and protect the rest of the body. Tissues called ligaments hold the bones and joints in their proper place.

The skeleton also contains bone marrow, which is where the different types of blood cells (such as red blood cells, white blood cells, and platelets) are formed.



While all four-footed animals have similar skeletons, you can see that many differences exist between the skeletal systems of birds and mammals.



1. maxilla—maxilla
2. mandibula—mandible
3. os parietale—parietal bone
4. vertebra cervicalis IV—fourth cervical vertebra
5. vertebra cervicalis VI—sixth cervical vertebra
6. vertebra thoracica X—tenth thoracic vertebra
7. vertebra lumbalis III—third lumbar vertebra
8. scapula—scapula
9. humerus—humerus
10. radius—radius
11. ulna—ulna
12. ossa carpi—carpal bones
13. ossa metacorpalia—metacarpal bones
14. ossa digitorum (manus)—digital bones (manus)
15. costa II—second rib
16. costa VIII—eighth rib
17. sternum—sternum
18. os coxae—os coxae
19. femur—femur
20. tibia—tibia
21. fibula—fibula
22. ossa tarsi—tarsal bones
23. ossa metatarsalia—metatarsal bones
24. ossa digitorum (pedis)—digital bones (pes)

All four-footed animals have similar skeletons. Their skeletons differ in size, of course, but the function is the same for all kinds of animals. For instance, the mouse and the giraffe share the same number of bones in their necks, even though the giraffe's neck is much longer than the mouse's in proportion to the rest of its body.

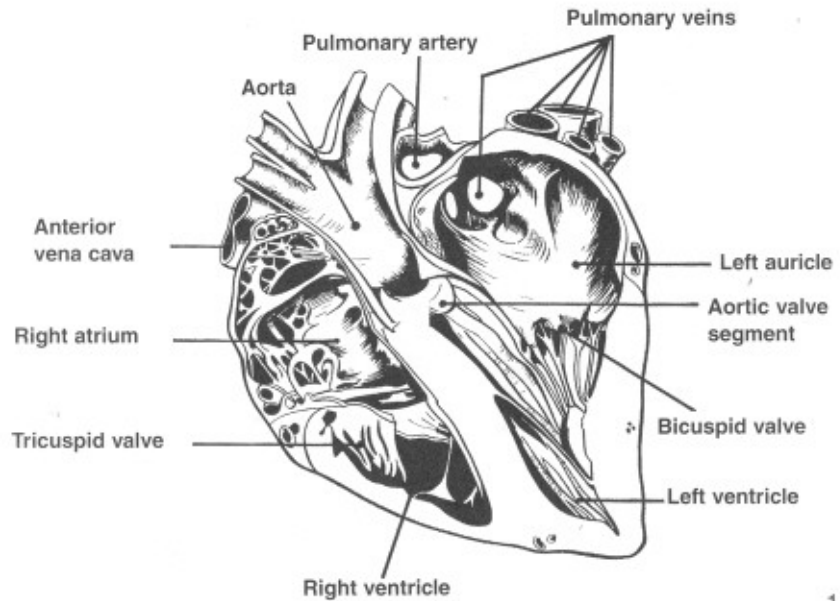
Find a drawing of the skeletal system of your animal and study it. Learn the names of the major parts and what they do to support the body or protect the animal's vital organs.

Circulatory System

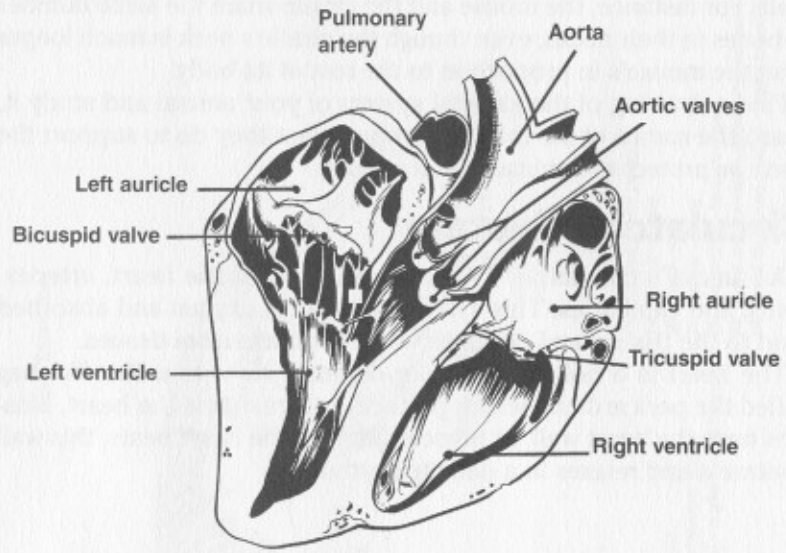
An animal's circulatory system is made up of the heart, arteries, veins, and capillaries. This system transports oxygen and absorbed food to the tissues and removes waste products from tissues.

The heart is a hollow, muscular organ. It rests in a fiberlike bag called the pericardium, which protects and cushions the heart. Muscles form the heart wall, or myocardium. As the heart beats, this wall contracts and relaxes in a definite rhythm.

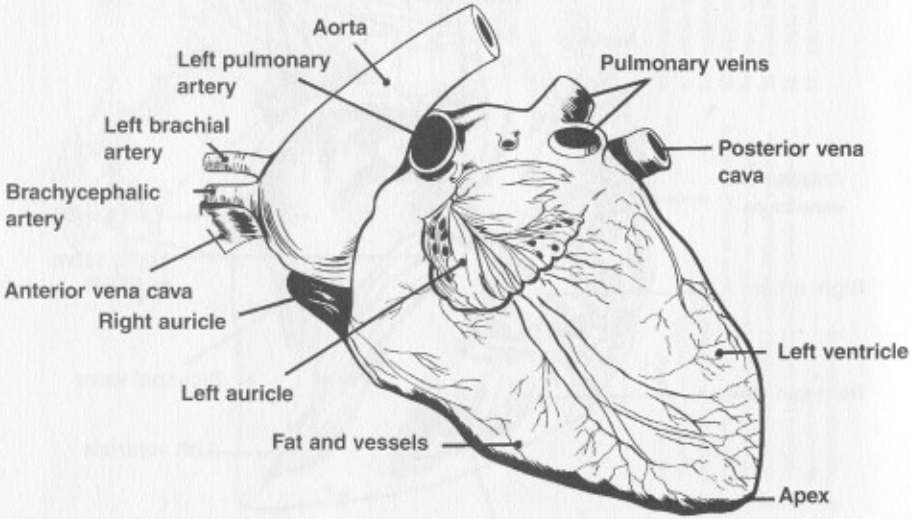
Section of Horse Heart



Section of Horse Heart



Left View of Dog's Heart



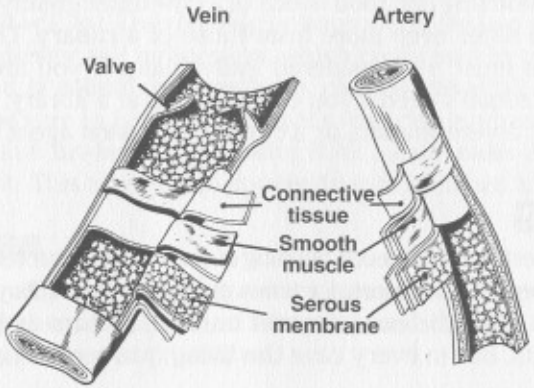
The heart is divided into right and left sides by an inner wall called the septum. Each side of the heart is divided into a thin-walled upper chamber called the atrium, and a thick-walled lower chamber called the ventricle. Between the atria (plural of atrium) and ventricles are small, flaplike valves that open only in one direction. Another set of valves lies at the base of both of the arteries that lead from the heart.

Each of the four heart chambers connects with a large blood vessel. Two large veins, the venae cavae, enter the right atrium, bringing blood from most of the body. Pulmonary veins enter the left atrium from the lungs. Thus, atria act as receiving chambers for the heart and receive their blood through veins.

Two great arteries carry blood from the ventricles, or pumping chambers. Blood from the right ventricle travels to the lungs through the pulmonary artery. The aorta carries blood from the left ventricle to all other parts of the body.

The heart acts as a double pump and circulates blood in a figure-eight pattern. The heart's right side receives blood from the body and pumps it to the lungs. The left side receives blood from the lungs and pumps it to other parts of the body.

Arteries carry blood *away* from the heart; veins carry blood *toward* the heart. Capillaries carry blood through the tissues. A capillary is a tube made up of a thin, single layer of cells containing the flowing blood. Through these thin walls, the blood delivers vital substances to the tissues and picks up waste products. Arteries and veins get the blood to and from these vital exchange centers.



Keeping Animals Healthy

Livestock inspectors are animal experts who help to keep livestock healthy by inspecting and regulating how they are housed and fed.

A health maintenance program is a plan for providing the best care for your animals. The program should cover housing, feeding, watering, and regular grooming (for some kinds of animals) and exercise.

Animal health maintenance helps reduce the chances of disease and injury. Veterinarians believe that at least three-fourths of the losses from death in all animals (and lowered production in farm animals) could be prevented if good animal health practices were followed.

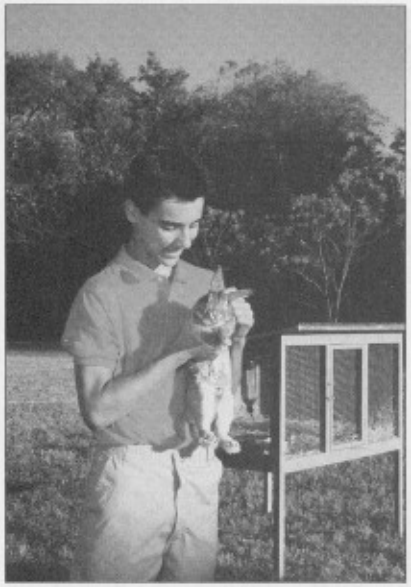
The greatest losses result from diseases transmitted from one animal to another. Think of this in terms not of one isolated animal, herd, or flock, but in terms of thousands of animals being shipped all over the country and the world. If one of these animals carries a disease, it can be passed on to many others.

A program of animal health maintenance will differ for each kind of animal. The housing and food needs of a cow differ greatly from those of a cat, and differ even more from those of a canary. The needs of each species must be considered individually. If you are uncertain about your animal's needs, you can find help at a library, from breed associations, a veterinarian, or a county extension agent.

Housing

Every domestic animal needs housing of some sort for protection against severe weather and predators, for times of illness, and for its young.

The needs of each breed depend on such factors as its size and feeding habits. But in every case the living quarters should be clean and dry, free of drafts, and with no sharp edges or nails that might injure the animal.



The farm home should be on higher ground than farm animal buildings, and far enough away to avoid the flow of barnyard wastes. All waste material should be removed regularly and spread on unused animal pastures, where it will be dried by the sun. This procedure kills many disease-producing organisms.

Also be sure to properly dispose of waste from your companion animals. Failure to do so can cause serious public health problems, especially in urban areas.

Feeding and Watering

No animal will stay healthy for long if it does not have a balanced diet. For good health, the animal needs certain nutrients in its food, and one of the most important things you can do for your animal is to make sure it gets proper nutrition.

Some diseases are caused by a lack of vitamins and minerals. The better the animal's diet, the better it will be able to resist most diseases.

Providing a good, balanced diet does *not* mean feeding your animal everything it will eat. Overfeeding or improperly feeding your animals can cause obesity and indigestion, which could lead to poor health.

Every kind of animal requires fresh, clean water at all times. In the outdoors, be sure to keep your animal's watering equipment or water dish clean and dirt-free by scrubbing it on a daily basis and exposing it to sunlight. This advice also applies to eating dishes and troughs.

Exercise

Daily exercise is necessary to every animal at all times of the year. Even during the coldest part of winter, animals should be exercised or turned out for part of the day.

Exercise tones up flabby muscles, gets the blood circulating, and energizes animals. It also helps prevent them from putting on unhealthy weight. Exercise also is important for companionship, socialization, and training.

Even if it means extra work for you, your animal's health calls for daily exercise.

Animals, like people, need regular exercise in order to stay healthy. Make sure your animals get exercise every day to keep them in good condition.

Grooming

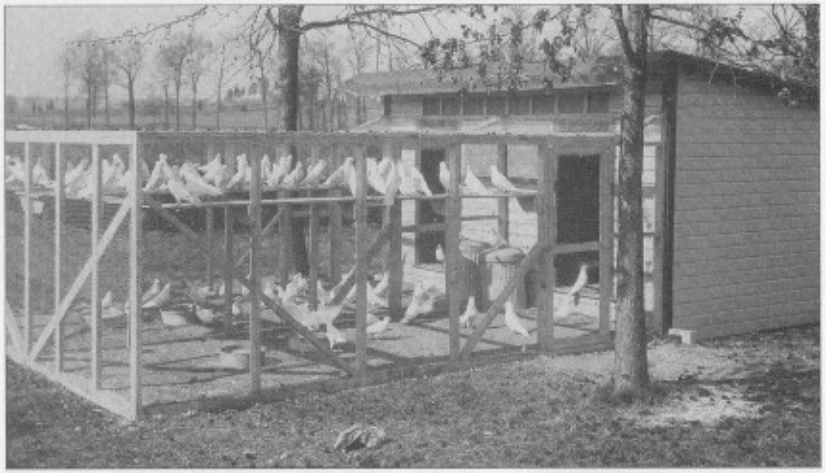
Most domestic animals will benefit from regular grooming. Clean animals are more comfortable and less likely to spread infection or parasites to other animals. As you groom the animal, look for cuts, bruises, hair matting, skin parasites, or any other unusual condition that might require attention.

Grooming cleans the coat and skin of dirt and dandruff. It stimulates blood circulation and reduces the chance of skin diseases. Grooming the animal gives you a chance to check for cuts and bruises that might need care.

Regular grooming serves as an important part of your animal's care.

Immunization or Vaccination

Many infectious diseases can be prevented by immunizing or vaccinating animals. In general, these diseases are either dangerous to the animal (such as canine parvovirus or bovine blackleg), dangerous to people (rabies), or can cause the farmer to lose money due to the animal's illness or failure to reproduce (for example, leptospirosis). Each animal has specific diseases that it should be vaccinated against, and each vaccination has specific requirements for how many inoculations are needed and the best time to administer the inoculations.



Good nutrition and the proper shelter are essential for the well-being of your pets and farm animals. Check with your veterinarian to make sure your animals are receiving a balanced diet. Clean out kennels, pens, and other animal enclosures regularly for the animal's health, and to prevent the spread of infection and parasites.

The Importance of Good Nutrition

Digestion is the process of breaking food down into nutrients such as fats, carbohydrates, and proteins that can be absorbed by the intestines and used by the body for growth, maintenance, and repair. The correct nutrients are necessary to maintain an animals's health, and different animals have different nutritional requirements. You can help keep an animal healthy by giving it a diet that meets its needs.

Nutrients

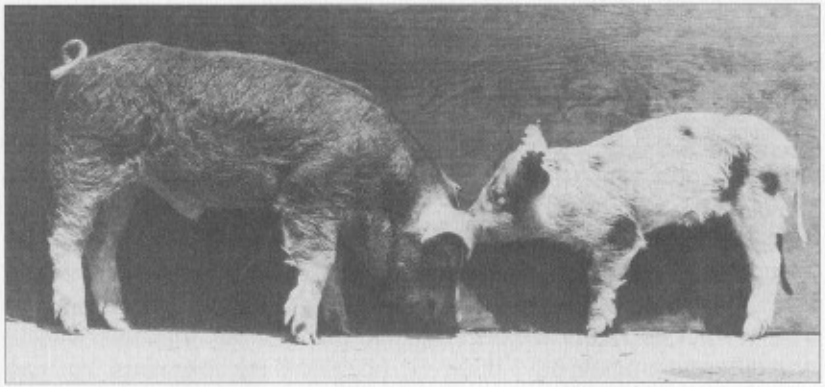
Lipids (fats) are made of glycerol and fatty acids. Lipids have the most calories or energy per gram of any nutrient, and provide energy when the amount of food intake is limited. Some are called "essential fatty acids," which the body must have and which can only be absorbed through the diet.

Proteins are made up of amino acids that contain carbon, hydrogen, oxygen, and nitrogen. Some amino acids are called "essential" because the body must have them and can only get them from the diet. Protein is necessary to repair tissues, but it also provides energy to the body if the diet lacks carbohydrates and fats.

Vitamins A, B-complex, C, D, E, and K are vital for health and life. They are found in most foods, although some foods have more of certain types of vitamins than other foods.

Principal mineral elements include calcium, phosphorus, sodium, chlorine, iron, copper, cobalt, iodine, potassium, sulfur, manganese, magnesium, and zinc. Other trace minerals may be required for health.

Water contains hydrogen and oxygen. Water is essential for all body functions, and makes up most of the animal's weight.

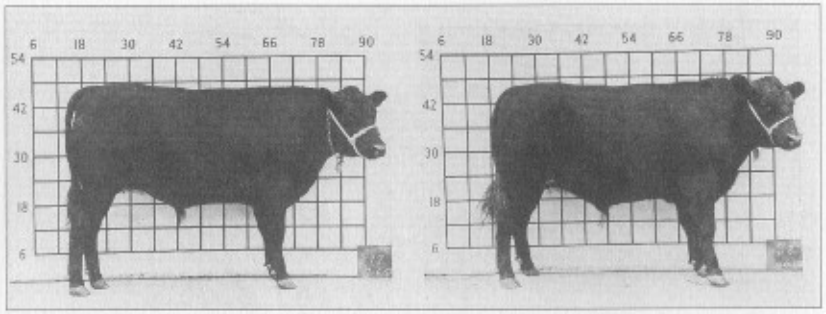


Dietary supplements are vital to an animal's health. While these pigs are littermates, the much smaller pig on the right lacks thiamin in its diet.

Without a properly balanced diet, animals are more susceptible to many diseases. Dogs and cats eating poor or severely imbalanced diets can suffer from skeletal deformities, seborrhea (a skin disorder), poor hair coats, fatty infiltration of the liver, blindness, degeneration of the heart muscle, extreme muscular weakness, inflammation of the pancreas, and various other problems. Horses can give birth to weak or deformed foals and suffer from founder or laminitis (an inflammation of the tissue in the hoof) and many forms of lameness. Swine develop anemia, ulcers, and scours (diarrhea), or can produce dead or weak litters.

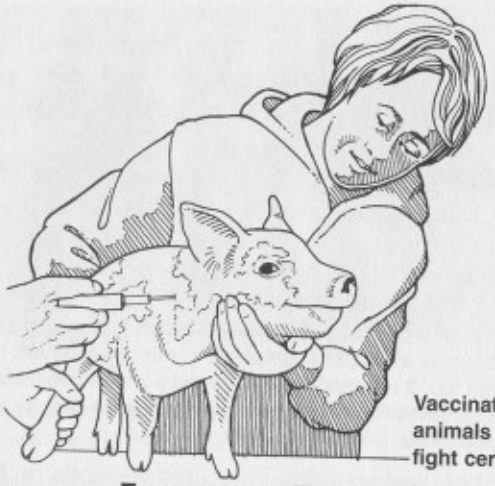
Different kinds of animals have different nutrition needs.

Cattle with poor diets can get milk fever, ketosis, indigestion, white muscle disease, grass tetany, rickets, or night blindness. Poultry suffer from a drop in egg production and lay eggs that won't hatch.



A full-feed diet is essential for good growth. These twin steers each weighed one thousand pounds when photographed, but the steer at left had been continuously well fed. It reached one thousand pounds two months earlier than its twin on the right, which had been on a maintenance diet for six months and was then returned to full feed.

The amount of food an animal requires depends on its age, weight, and level of activity. Larger animals and those that are growing or are active generally need more food than smaller animals or animals that are not active and are not growing. Illness also changes the nutritional needs of an animal. Sick animals often need more energy and protein in order to heal. Some diseases make it necessary to add or eliminate certain types of nutrients from the diet. For advice on good nutrition, talk with your veterinarian, county extension agent, and livestock or poultry dealer, or get one or more of the publications on animal nutrition published by the U.S. Department of Agriculture.



Vaccinating animals helps them fight certain diseases.

Bacterias, Viruses, and Parasites

We have seen that a poor diet can lead to some animal diseases. Other diseases can be caused by chemical poisons, shock, heat or cold, insects, and protozoa (one-celled animals).

However, many diseases are caused by various types of microorganisms, especially when the patient has been previously weakened by poor diet, poor environmental or living conditions, and/or genetic defects. The microorganisms we will discuss briefly are bacterias, viruses, rickettsias, protozoa, fungi, and helminths.

Bacterias

Bacterias are one-celled organisms. There are thousands of types and they live everywhere. To see one bacteria, you must use a microscope, because bacteria are about 1/25,400 of an inch long.

Although almost every species of bacteria can cause disease if the host is susceptible, most bacterias rarely cause harm to otherwise healthy people and animals. In fact, many are useful. For example, some types of bacterias are needed to make buttermilk and cheese

by fermenting milk, and others are necessary for soil to be fertile. But some kinds of bacterias can cause diseases such as colibacillosis in piglets, endocarditis (infection of the heart), pyelonephritis (infection of the kidney), tuberculosis, mastitis (inflammation of the mammary glands), blackleg, and leptospirosis.

Bovine mastitis, one common form of a bacterial disease, is an inflammation of a cow's udder caused by bacteria that get into the udder through the teat openings. There, the bacteria multiply and can produce an acute infection, and the cow's milk cannot be consumed. Sometimes the disease becomes chronic (long lasting). Bovine mastitis is a major problem in our nation's dairy industry today.

Blackleg is a deadly disease of cattle. It can also occur in sheep, goats, and deer. It is caused by bacteria that live in the soil and enter the animal through its feed. Once in the animal's bloodstream, the bacteria attack tissues in various parts of the body. The animal soon develops pain, fever, and swelling of muscles of the thigh, shoulder, or other parts of the body. Death occurs in twelve to thirty-six hours.

Few animals stricken by blackleg survive. But good management and vaccination of all calves against this disease can prevent a bad outbreak of blackleg.

Leptospirosis affects cattle, pigs, sheep, goats, horses, dogs, and humans. Signs of the disease can include difficulty breathing, pale mucous membranes, fever, and blood in urine. However, some animals that show no outward signs become unable to bear young. In its severe form, the infection can cause death in two to ten days. In a milder form, the animal recovers in two to four days.

Leptospirosis is caused by bacteria that enter the body through skin abrasions, the genitalia, or by being inhaled through vapor from the urine of infected animals. Once in the animal's body, the bacteria infect the kidneys and liver.

Cow's Udder

Gland destroyed

Severe mastitis

Mild mastitis

Bacteria enter teat canal

Antibiotics can kill bacteria or prevent them from multiplying, and serve as valuable tools in treating both human and animal infections. Antibiotics are chemical compounds formed by bacterial or fungal microorganisms that inhibit or kill other microorganisms. A particular antibiotic only kills a specific group of bacteria; therefore, it is important to choose the correct antibiotic for a particular infection. Since both humans and animals can become resistant to antibiotics that are improperly or overly prescribed, care should be taken when considering the use of antibiotics to treat an infection or suspected infection. Inappropriate use of antibiotics not only wastes time and money, but can cause the patient serious problems.

Viruses

A virus is a tiny organism that can survive only in living tissue. (Bacteria, on the other hand, thrive in either living or nonliving tissue.) A virus is much smaller than a bacteria, and can be seen only with an electron microscope.

Once in the body of a susceptible animal, a virus can multiply, eventually destroying cells and organs. Most viruses only attack specific types of cells (for example, neurons, epithelial cells, intestinal cells, etc.).

Viruses cannot be killed by antibiotics; this makes control of any virus difficult after the disease has begun. However, vaccines can be effective against viral diseases such as canine and feline distemper, infectious canine hepatitis, and rabies.

Other viral diseases can be controlled by understanding how the disease is spread, and then preventing transmission. For example,

Blackleg is a deadly disease in cattle, and can kill the infected animal within hours. A widespread outbreak can be prevented through good management and by vaccinating all calves.

Vaccines can be effective against some viral diseases. Chick embryos, inoculated with virus, are being harvested here for production of a live virus vaccine.

feline leukemia virus is shed in saliva and is spread from cat to cat as the cats share the same water bowls. Feline immunodeficiency virus is spread when an infected cat bites a noninfected cat. Upper respiratory viruses (feline viral rhinotracheitis, which causes runny eyes and nose) spread to other cats when the infected cat sneezes and contaminates the air or surrounding food and water dishes.

Some diseases can be controlled by destroying the insects that carry the disease.

Animal diseases caused by viruses include encephalomyelitis and infectious anemia of horses, cutaneous papillomatosis and infectious rhinotracheitis of cattle, distemper and parvovirus diarrhea of dogs, distemper and infectious peritonitis of cats, cholera and pseudorabies of pigs, and rabies and certain tumors in various other species.

Other Infectious Organisms

Many other types of organisms can cause disease. *Rickettsias* are single-celled organisms that are larger than viruses, but must live in cells. These organisms cause important diseases such as ehrlichiosis and Rocky Mountain spotted fever in dogs, as well as Q fever in various animals and in people.

Mycoplasmas are similar to bacteria and cause diseases such as pneumonia. *Protozoa* are larger than bacteria. Examples of protozoal diseases are giardiasis (a disease of the intestines), toxoplasmosis, and bovine anaplasmosis.

Fungi are similar to the molds you have probably seen on old bread. They can cause a variety of diseases, such as ringworm (also called dermatophytosis) and aspergillosis (which affects dogs and chickens). Yeasts are a different growth phase of some fungi, and are responsible for diseases such as blastomycosis, histoplasmosis, and coccidioidomycosis (which affects dogs, cats, and people).

Parasites

A parasite is a form of animal life that lives on or in the body of a larger animal. Those that live on the outside of the animal are called external parasites. This group includes many species of ticks, mites, flies, lice, and fleas. Parasites living within an animal's body are called internal parasites. These include about three hundred types of worms that damage domestic animals.

Some parasites infest only one type of animal, while others will attack any warm-blooded animal. Some prefer certain parts of the animal's body for food and shelter, while others can be found throughout the body.

External parasites affect animals in these ways:

- By damaging and irritating the skin (lice, mites, and mosquitoes)
- By invading tissues (maggots or larvae of screwworms, grub worms, and botflies)
- By activating an allergy or sensitization to a substance caused by insect poisons (fleas on a dog)
- By injuring the eyes and ears with secretions
- By secreting substances that prevent normal function of organs (for example, paralysis that results from the bite of certain ticks)
- By transmitting rickettsias, protozoa, and bacterias that can cause disease
- By sucking blood from the animal and making it anemic and susceptible to other diseases (fleas, ticks, lice)

External parasites often carry bacterias or viruses in their bodies that can be deposited in the animal's body while the parasite is feeding or sucking blood. An example is Texas cattle fever, which is transmitted by ticks. Another example is canine heartworm disease, which is transmitted by mosquitoes.

External parasites also carry disease organisms on the feet, in the mouth, or the wings. As the parasites move from animal to animal, the organisms are brushed off. A cattle disease called anaplasmosis is transmitted in this way.

Internal parasites live at least part of their lives within the body of a "host" animal. They harm animals in these ways:

- By damaging tissues and organs as their larvae migrate through the animal's body (ascarids and lungworms). The afflicted tissues are more susceptible to infection.
- By pressuring or obstructing the animal's organs (botflies and ascarids). If the obstruction occurs in the stomach or intestines, the result is gastritis or chronic colic.
- By sucking so much blood from the host animal that it becomes anemic and more susceptible to other diseases (hookworms and strongyles).
- By piercing blood vessels (strongyles) or intestines (nodular worms). Piercing of intestines causes nodules to form on intestinal walls and peritonitis to develop from bacteria, fungi, or viruses.
- By secreting toxins or enzymes that destroy tissues.
- By transmitting bacterias, rickettsias, or viruses.

Life Cycles of Parasites

To properly treat animals for parasites, a veterinarian must know the life cycles of the parasites. Most external parasites have four stages of life—egg, larva, nymph, and adult. (Some, like the louse, have only three stages—egg, nymph, and adult.)

Insecticides are most often effective against the adult external parasite, so they are most commonly used for control. Recent research has discovered groups of chemicals that are effective against the egg and larva stages of certain parasites, especially fleas, and these have greatly improved our control of these parasites.

The best-known internal parasites are helminths (worms), such as roundworms, hookworms, whipworms, and lungworms, although other types of internal parasites exist (e.g., protozoa, such as giardia). Some helminths have complex life cycles in which they must live in one or two other animals before they live in the final host, such as a cow, horse, pig, or dog. When possible, internal parasites are best controlled by preventing infection. This can be important when large numbers of food-producing animals are being raised and the producer must try to avoid having to buy the expensive drugs required for treatment of established infections.

Life Cycle of Ticks

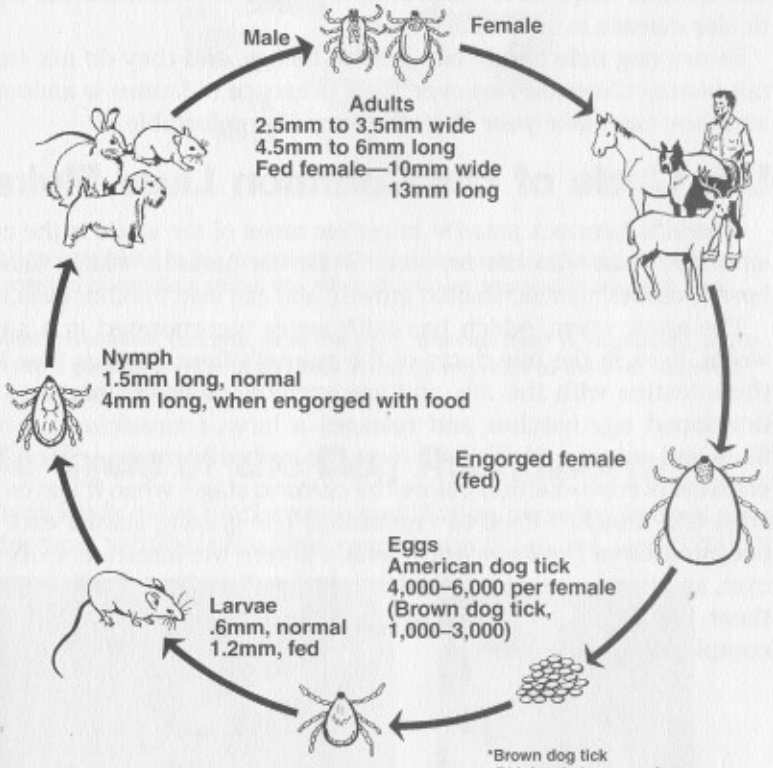
Ticks infest all kinds of warm-blooded animals and some cold-blooded animals, such as snakes and turtles. They transmit diseases and can cause considerable damage to tissues where they are feeding. These areas are then susceptible to bacteria.

Life cycles vary with the species of tick. In general, these parasites all go through the egg, larva, nymph, and adult stages. Some ticks require a full meal of animal blood and a rest period between stages of their life cycle. The rest period can occur either on or off the host animal.

Some kinds of ticks lay their eggs on the host animal, while others lay them on the ground. All ticks are very hardy and can go without food for a long time. This often makes control difficult, and treatment with insecticides often must be repeated. It also is important to clean and spray the environment, since eggs and larvae have probably infested the area.

Life Cycle of American Dog Tick*

The American dog tick, *Dermacentor variablis*, is commonly called the "wood tick." Dogs are the preferred host of adult ticks; however, human beings, horses, and other animals could also serve as a source of blood meals. Immature ticks feed almost exclusively on small rodents, especially meadow mice.



*Brown dog tick
Rhipicephalus sanguineus
(All stages feed on dog)
Its life cycle is similar to that of the American dog tick.

Unlike the American dog tick, which is quite common outdoors during the spring and early summer, brown dog ticks are a household pest and can survive only indoors in the northern United States during cool months. They cannot breed in the open country or woods. Therefore, if there are ticks in your home, especially during the late summer, fall, or winter, they are probably brown dog ticks.

Medical importance: The American dog tick is the principal vector, or transmitter, of Rocky Mountain spotted fever in the southeastern United States. Ticks also transmit Borreliosis (Lyme disease), canine ehrlichiosis, and bovine anaplasmosis. While the tick can transmit any number of diseases, most of the time there is one specific tick that is the principal vector, or transmitter, of a particular disease in a particular area.

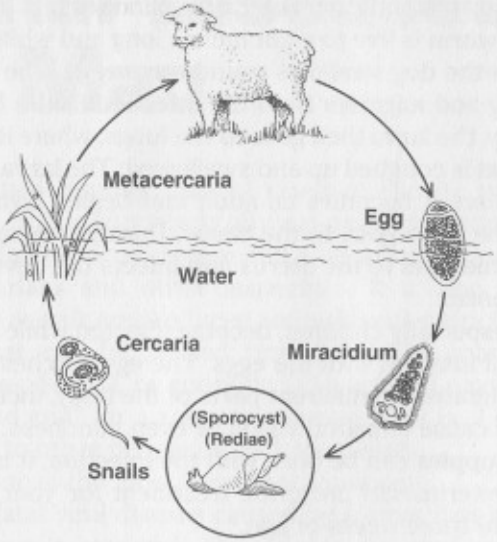
Brown dog ticks rarely bite human beings, and they do not transmit human diseases. However, their presence in homes is annoying, and they can make your dog's life very uncomfortable.

Life Cycle of the Common Liver Fluke

A serious livestock parasite in certain areas of the world is the common liver fluke, *Fasciola hepatica.* While the parasite seldom kills its host, it causes anemia, stunted growth, and can lead to other diseases.

The adult worm, which has both sexes incorporated in a single worm, lives in the bile ducts of the animal's liver. Its eggs flow into the intestine with the bile and are excreted in feces. In water, the developed egg hatches and releases a larva *(miradicium),* which finds and enters a snail's foot. Here the larva undergoes several generations of reproduction before the *cercaria* stage, when it leaves the snail and attaches itself to vegetation. The grazing animal eats the encysted larva *(metacercaria),* which enters the intestine, exits the cyst, and burrows through the intestinal wall and into the liver. From there, it wanders for several weeks before entering the bile duct and completing the life cycle.

Life Cycle of the Common Liver Fluke

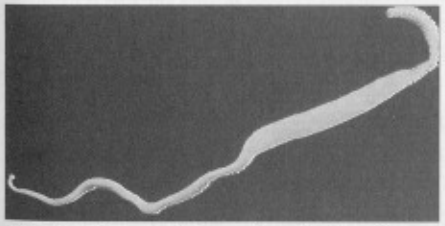


Eggs are eliminated in the droppings of infested animals. In water, the egg develops into the *miracidium* stage; the miracidium then migrates to a snail's foot.

Another generation, *cercaria,* exits the snail, attaches itself to vegetation, and is eaten by a grazing animal. In the host animal, it migrates to the liver, matures, and completes the life cycle.

Life Cycle of the Dog Roundworm

Many kinds of helminths, or worms, live as parasites in dogs. One of the most serious is the large roundworm, *Toxocara canis.* While it



The roundworms (shown) are internal parasites that were found in the intestine of a hog. Another internal parasite is the fringed tapeworm (shown), which attacks sheep.

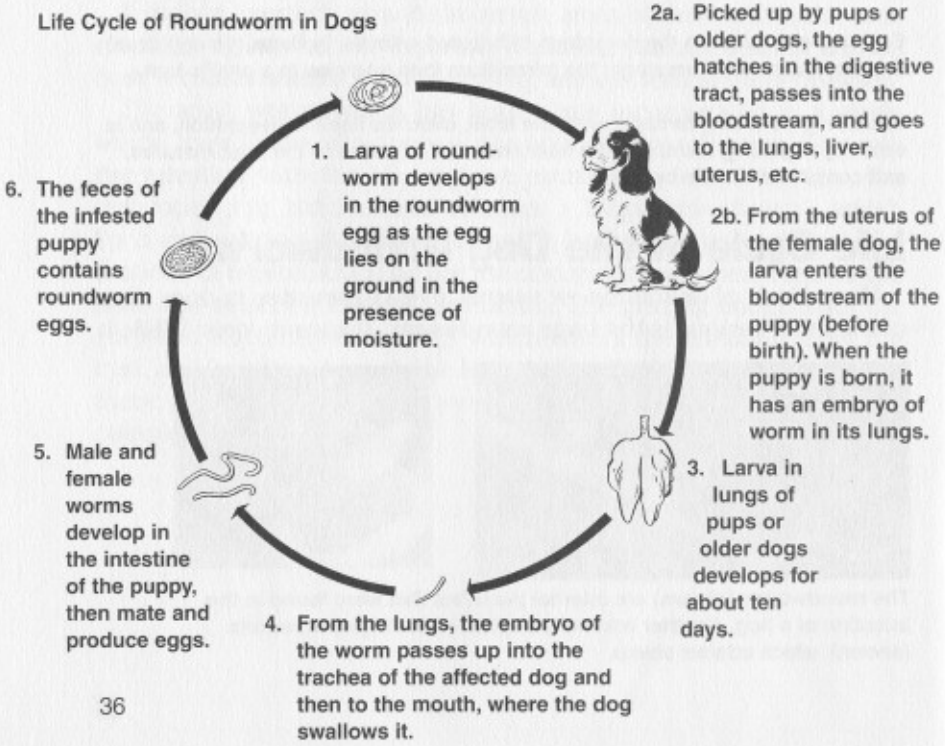
can occasionally be fatal to puppies, more importantly, it can cause disease in humans and can even cause blindness.

The adult worm is five to eight inches long and white. Its life cycle begins when the dog swallows roundworm eggs. The larva hatches from the egg and migrates from the intestine to the liver. In a very young puppy, the larva then goes to the lungs, where it enters the air passages, and is coughed up and swallowed. The larva returns to the intestine, where it becomes an adult and begins laying eggs. In an adult dog, the larva goes to the tissue. During pregnancy, the larva from the tissue goes to the uterus and infects the developing puppy before it is born.

Humans, especially children, become infected while playing in and ingesting soil infected with the eggs. The egg hatches and the larva begins its migration to different parts of the body, including the eye, where it can cause impaired vision or even blindness.

Because puppies can be born with the infection, it is important to have your veterinarian prescribe treatment for your puppy beginning at two to three weeks of age.

Life Cycle of Roundworm in Dogs



Animal Diseases and Man

More than two hundred animal diseases can be passed on to human beings. This is why nearly all meat-producing animal and poultry are carefully inspected before and after slaughtering by government veterinarians and other inspectors. It is also why animal products such as milk are produced and sold under strict regulations.

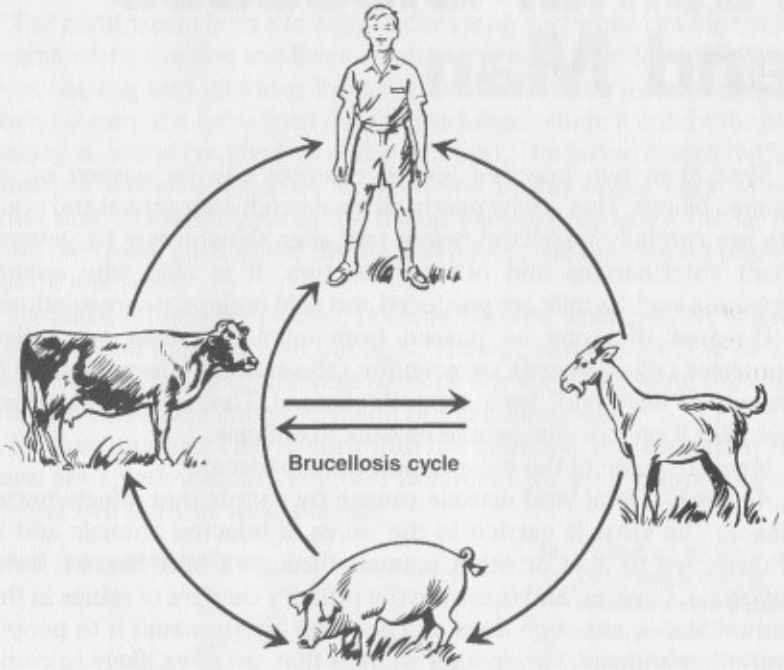
Diseases that can be passed from animal to man are called zoonoses (zō-a-nō-sees), or zoonotic (zō-a-not-ick) diseases. Man is usually a "dead end" for a zoonotic disease. That is, a person does not pass it on to other people or back to animals.

Here are some of the most important zoonoses:

Rabies is a fatal viral disease caused by a virus that infects nerve tissue. The virus is carried in the saliva of infected animals and is transmitted to man or other animals through a bite. Skunks, bats, raccoons, coyotes, and foxes are the primary carriers of rabies in the United States, although dogs and cats can also transmit it to people and other animals. Vaccinating animals that are most likely to come into contact with people helps prevent infection.

Toxoplasmosis, a disease caused by a protozoa, can cause birth defects as well as infections of the eyes, brain, liver, and other organs in humans. Infection can happen when a person ingests the protozoa cysts, which are shed in the feces of cats. Eating infected meat that has not been properly cooked, or drinking unpasteurized goat's milk, can cause infection. Avoid infection by cooking meat well instead of eating it rare, and by washing hands well after handling cats or working in dirt that might be contaminated with cat feces.

Cryptosporidiosis is also caused by a protozoa. The disease causes diarrhea, and can be extremely dangerous to people with a weakened immune system. It is readily spread from animals to humans through infective cysts that are shed in the feces by cattle and other farm animals. Contaminated water supplies can expose many people at once. Proper sanitation is the best way to avoid the disease and prevent it from spreading.



E. coli 157:H7 is a bacteria found primarily in cattle, and can produce severe hemorrhage diarrhea. Eating beef that is infected with E. coli bacteria is a major form of infection. This is an extremely infective organism; exposure to just a few bacteria can result in severe disease. The best way to avoid this infection is by cooking beef well instead of eating it rare.

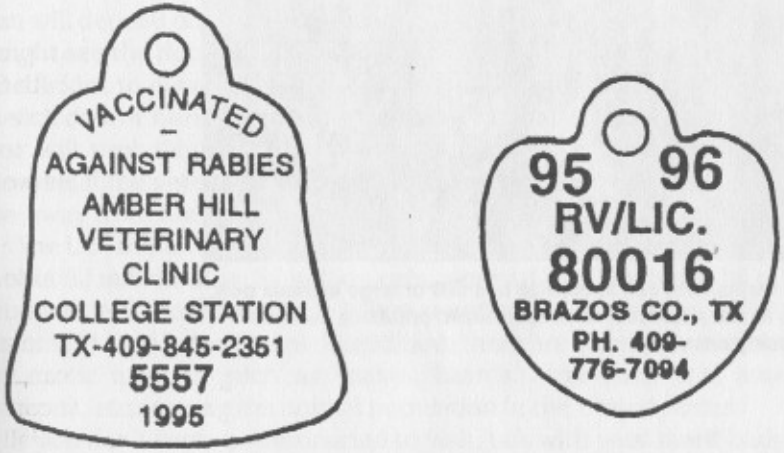
Bubonic plague, a disease caused by a bacteria, is also known as the "black death." Throughout history, the bubonic plague has killed millions of people. The disease occurs in certain areas of the southwestern and south central United States. Cats are infected by fleas that jump off of infected rodents and bite the cats. People can be infected by working with infected cats or from fleas that have come from infected rodents. It is important to recognize potentially infected cats and rodents, to prevent exposure to fleas from these animals, and to avoid handling potentially infected animals.

Animal bites are relatively common, and are responsible for about 1 percent of all people who must visit hospital emergency rooms. Beyond the physical trauma an animal bite can cause, dogs and cats have many types of bacterias in their mouths, and some types are potentially dangerous to humans.

Visceral larval migrans is caused by the *larvae* of certain types of roundworms commonly found in dogs. The immature worms will burrow in various areas of the human body and can cause blindness, heart disease, and/or brain dysfunction. (See "Life Cycle of the Dog Roundworm.") Treating the infected animal and proper sanitation can help halt the spread of this disease.

Sporotrichosis is a fungal infection that is easily transmitted to people, especially from cats (though dogs can carry the disease), and can cause severe skin sores. These sores can take weeks of treatment to cure. It is important to recognize the infection in the cat, because it is usually spread from cat to people by direct contact.

Brucellosis primarily infects people when they ingest infected milk or cheese, usually from goats. It is also possible to become infected by handling contaminated foods, then handling and eating other foods without washing your hands in between contacts. People can also be infected if they contact uterine secretions from an infected animal.



Humans can help break the cycle of rabies by making sure that their animals are properly vaccinated.

Encephalitis means "inflammation of the brain." It is a serious problem and can be fatal. Encephalitis can be caused by several viruses, including the equine encephalitis viruses (Venezuelan, eastern, and western), which can be transmitted to people by mosquitoes.

Other important zoonotic diseases are dermatophytosis (ringworm), echinococcosis (a type of tapeworm), Q fever, Rocky Mountain spotted fever, and tularemia (rabbit fever).

Veterinarians can specialize in small or large animals only, in mixed practices, or in specialized practices such as racing animals.

A Veterinarian's Work

A veterinarian is a professional person who works in some branch of veterinary medicine—the treatment and prevention of illness in animals. Veterinary training requires at least two or three years of college education and four more years of training in a college of veterinary medicine to become a doctor of veterinary medicine (D.V.M. or V.M.D.).

There are approximately 58,000 veterinarians in the United States in three general types of practices. About 13,000 veterinarians have a "mixed practice," and treat both large domestic animals such as horses and cattle, and also household pets such as dogs, cats, and birds. Another 24,000 treat only small animals, while about 5,000 veterinarians limit their practice to large animals only, mainly horses and food-producing species.

There is also a sports medicine group. These veterinarians treat racing horses and racing greyhounds, which have very special needs and diseases.

So what you will see when you spend some time with a veterinarian will depend on that person's practice. If it is a mixed practice, you might see the doctor give distemper shots, treat injuries, administer medicines to pets in the office, and then take a trip to a farm to treat a sick cow or horse. If the practice is only on small animals, the doctor will probably spend the entire workday in the clinic. And, of course, if the veterinarian treats only large animals, this doctor may be away from the office most of the day.

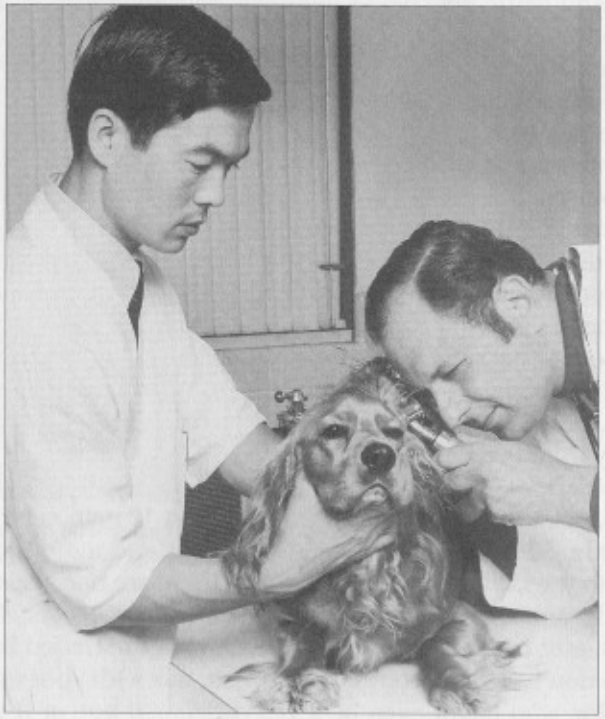
The U.S. Department of Agriculture estimated in 1992 that there are about 52 million dogs, 57 million cats, almost 12 million birds, 96 million cattle, 57 million pigs, 5 billion poultry, and more than 300,000 horses in the United States. In addition, there are uncertain numbers of exotic animals, such as snakes, lizards, large cats, fish, small rodents, etc., among the animal population in the United States.

If you don't know a veterinarian to visit, talk with your merit badge counselor, who might even be a veterinarian. If not, or if your merit badge counselor can't give you any time for a visit, ask your counselor to suggest a veterinarian who can.

Other Opportunities for Veterinarians

Veterinary medicine is a very broad field. It offers fascinating opportunities in health services and science, as well as in direct treatment of animals.

Nearly a third of all veterinarians work in nonpracticing fields, which include the following:



A career in veterinary medicine offers fascinating opportunities in health services and science as well as in direct treatment of animals.

- Teachers in colleges of veterinary medicine and agriculture and who conduct extension work in the community.
- Researchers who work on the prevention and treatment of both human and animal health problems. Laboratory care of research animals is a new and important area of practice for veterinarians.
- Industrial veterinarians who guide and direct research for both human and veterinary products.
- Public health and government regulatory service inspectors, who inspect meat and meat products, poultry and poultry products, creameries, dairies, water plants, and animals coming into this country from abroad. These officials also supervise the movement of animals from state to state; regulate the manufacture of drugs, serums, and vaccines; conduct tests for such diseases as tuberculosis and brucellosis; and take part in campaigns to eliminate animal diseases.
- Public health teams that discover new treatments for preventing *human* diseases through the study of animals.
- Public health veterinary officials of the armed forces who work in medical and space research.
- Food animal consultants, who help prevent problems in animals before they occur through good nutrition. Today, the successful food animal consultant might carry a portable computer, a cellular phone, and a modem to maintain contact with the office from the field, evaluate prior records from a particular farm, compare current findings to records of what has happened previously at this farm, and then make recommendations to the farmer or rancher about changes in diet, supplementation, medication, immunization, and/or which animals to keep or cull.

If you think you might want to consider a career in veterinary medicine, you should begin to prepare in high school. Your high school studies should include courses in English, mathematics, general science, biology, physics, and chemistry.

If you want to find out more about this important field, write to the American Veterinary Medical Association, 1931 North Meacham Road, Suite 100, Schaumburg, IL 60173-4360. Enclose a business-size, stamped, self-addressed envelope.