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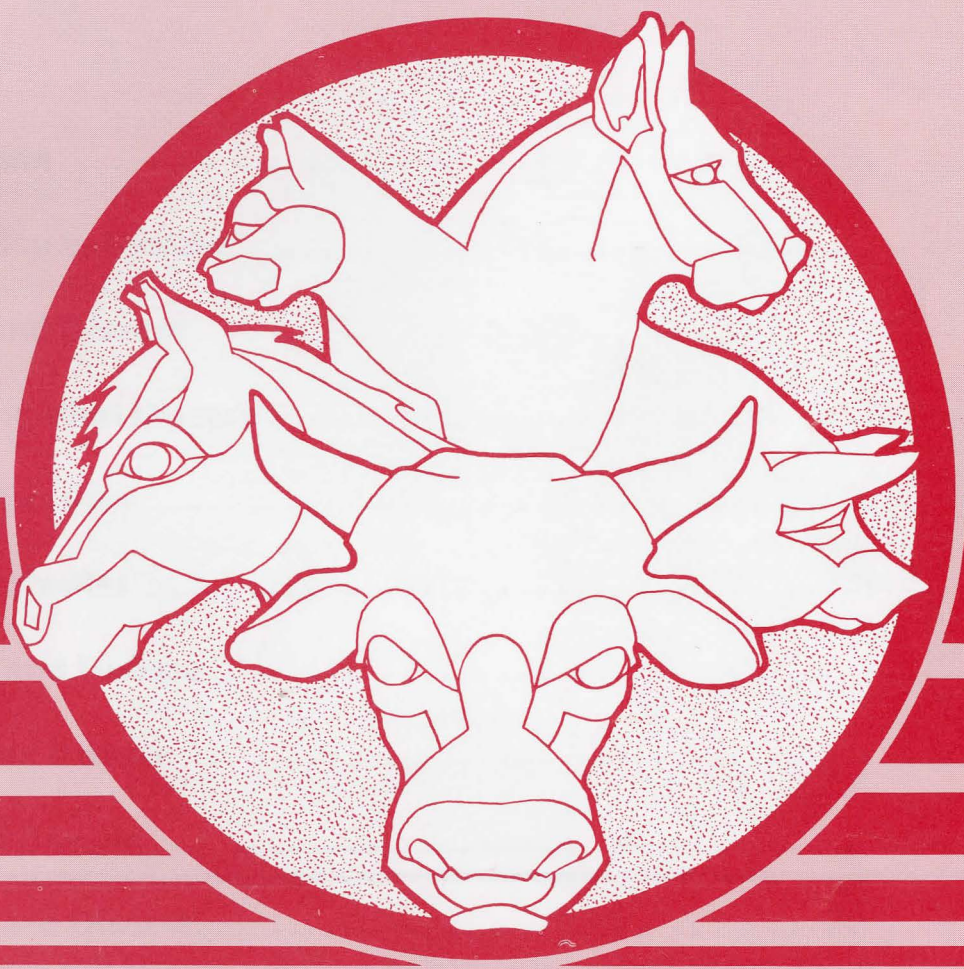
Nebraska Cooperative Extension Service 4-H 48

UNIT II

ANIMAL DISEASE
4-H
VETERINARY SCIENCE



Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Leo E. Lucas, Director of Cooperative Extension Service, University of Nebraska, Institute of Agriculture and Natural Resources.

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This educational material for 4-H use is a revision of the literature developed by the National 4-H Veterinary Science Program Development Committee. Special acknowledgment is extended to Norden Laboratories, Lincoln, Nebraska for funding assistance in development of this revision.

Acknowledgment for the development of the original unrevised material is extended to State and Federal Extension Service representatives, the American Veterinary Medical Association, the National 4-H Committee and the Upjohn Company.

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4-H VETERINARY SCIENCE

UNIT II - ANIMAL DISEASE

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INTRODUCTION

4-H Veterinary Science Program
Unit II
Animal Disease

The 4-H Veterinary Science program has three units to help in learning new information in proper order. Unit I, **The Normal Animal,** introduced you to the conditions of an animal that are considered normal or free from disease and healthy. It explained the need for recognizing normal attitude and behavior of the animals in your care. The appearance of the skin, temperature, pulse and respiration rate, and several other characteristics are all important indicators concerning the health of the animal. Unit I also provided an understanding of cells, tissues, organs, and systems as the basis for proper decisions on handling the animal when it becomes sick. Unit II, **Animal Disease,** will build on the knowledge gained in Unit I. A review of **The Normal Animal** manual will help you recall some veterinary science terms as you progress in Unit II. In Unit III the elimination of disease will be introduced.

In the study of **Animal Disease,** you will be introduced to new words and information about how the body reacts to disease problems. Remember that the principles which govern the response in an animal are very similar to that of a human body.

Your study of veterinary science is much more than just animal health. Biology and the related life sciences are all a part of the study of animal disease. Observing animals you are interested in makes the study more interesting and exciting.

At the beginning of each lesson is a list of *Words to Know.* At first the new words may appear very difficult, but further reading, study and discussion with other people will help provide meaning and greater understanding. Do not be discouraged if the words seem more than you can handle. Do your best and learn as much as you can.

Following the Words to Know section is a list of questions you should be able to answer when you have completed the lesson. Study them carefully and find the answers in the lesson or in the discussion at the 4-H meetings. What you learn in one lesson will be the basis for learning in the lessons which follow.

Unit II, Lesson I

INTRODUCTION TO DISEASE

Words to Know

Disease: an alteration of the body function at the cellular level causing malfunction of systems or organs

Pathogen: disease-producing agent

Infection: to enter or invade another organism and disturb the normal body functioning of the invaded organism

Contamination: to be covered or soiled by infectious, toxic or foreign agents

Lesion: damage or injury to body tissue that may or may not cause malfunction

Toxins: poisonous substances

Endotoxins: non-living poisons derived from bacterial intracellular material that cause injury to animal tissue

Exotoxins: toxin formed by some bacterial cells, certain plants and animals

Antitoxins: antibodies formed within the animal to neutralize (stop) toxins

Antigen: disease-causing agent, toxins or foreign material that stimulates immune response; for example: the actual disease or a vaccine

Inflammation: the body's response to an irritant or injury

Contagious: Infectious agent spread by contact of a susceptible with the sick

After reading this section you should be able to answer the following questions:

- What is a disease? How is disease different from an injury? How is it similar?
- How do animals become infected by disease causing agents? How is disease spread?
- How does the animal's body defend itself against disease?
- How does the way we handle and manage our animals help them to stay healthy?

You should know what a healthy animal is after completing Unit I of the 4-H Veterinary Science Project. The physical appearance, attitude and behavior all tell when an animal feels well. A disease problem creates a disturbance in the body or organs and causes the animal to behave abnormally, thus exhibiting a **sign.** You should always be alert to notice these warnings and know your animals well enough to detect behavior change. However, it is not necessarily true that a healthy-looking animal is healthy. An internal examination of digestion, respiration or other functions must sometimes be made to determine the condition of an animal. Animals may be abnormal internally, possibly in the beginning stages of a disease, and show little or no noticeable signs. Other animals show definite signs of ill health. Disease, then, can be illness with or without visible signs.

Disease may be simply defined as an alteration of the body function at the cellular level causing malfunction of systems or organs. Although some diseases are not evident until in their more terminal stages, many show signs that can be seen by closely observing the animal.

Closely associated to disease is **inflammation,** the body's response to an irritant or injury. Although inflammation is present in some diseases, there are others where it is absent.

Before **disease** in an animal will develop there must be a **susceptibility** or a lack of resistance to that disease. Animal susceptibility varies for many reasons. There may be a species resistance, natural immunity, or a rapid immune response that may protect the animal by developing a high resistance to the invader. If there is a lack of resistance, there must be causes that injure or kill the living cells for disease to start. The result is disease development.

Disease may occur in any part of the body and can occur from different causes, either living or non-living. Disease may also occur from deficiencies (too little), or excesses (too much), of certain nutrients or other agents that contact or are ingested (taken in) by the animal. Examples of living agents may include bacteria, viruses, parasites, insects or protozoa. Some non-living agents include shock, heat, cold, chemical poisons or certain essential food nutrients. Iodine and vitamin A, for example, may cause disease either when fed in excess or deficient amounts.

Non-Living Agents

Wounds, burns, freezing or injuries from any cause may damage body tissues, create pain and impair function, increasing the possibility of disease development. When tissues are injured due to physical force or bruising, that is called **trauma.** Cuts, tears, bruises, sprains and punctures are examples of trauma or traumatic injury.

Faulty nutrition or dietary diseases may cause metabolic disorders. Too much or a lack of necessary vitamins, minerals or forage itself, can cause these nutritional disorders.

Poisonous substances (**toxins**) may originate from living or non-living sources and can cause cellular and tissue damage, either by ingestion or skin contact.

Most bacteria, although alive, contain non-living toxins (substances that can be poisonous) that injure animal tissues. These are called **endotoxins.** This type

of bacteria retain their toxins within (endo) their own cell wall. The toxin is released when the bacterial cell dies and breaks down. Certain plants, animals and other bacteria can secrete their toxins into the surrounding (exo) area. Some of these toxins can be deadly. These substances are called **exotoxins.** The animal's body does have a defense against exotoxins. When exotoxins are released into the body of an animal, they have the ability to stimulate that animal to produce **antitoxins.** These anti (against) toxins (poison) neutralize the toxins produced by the invading microorganism or other sources of toxin. Pathogens (disease producing organisms) that do not necessarily form potent toxins still have the ability to invade and infect the body. Once in the tissues, they multiply and spread at an alarming rate. Because endotoxins of bacteria do not stimulate the production of antibodies, they are not considered **true toxins.**

Exotoxins, however, are considered true toxins. They are grouped into three main categories according to the type of organism which produced them:

1. **Bacterial toxins** are produced by bacteria and cause diseases such as tetanus* and botulism**.

2. **Zootoxins** are produced by animals such as snakes, spiders and bees. Victims of these bites can have serious problems, including death, due to the zootoxin.

3. **Phytotoxins** are produced by plants such as the castor bean plant, the poisonous fungi of certain toadstools, and the braken fern. When toxic plants are eaten by animals (or humans), death or serious illness can occur.

Toxic substances are also found in certain chemicals, however; these do not stimulate antibody production.

Living Agents

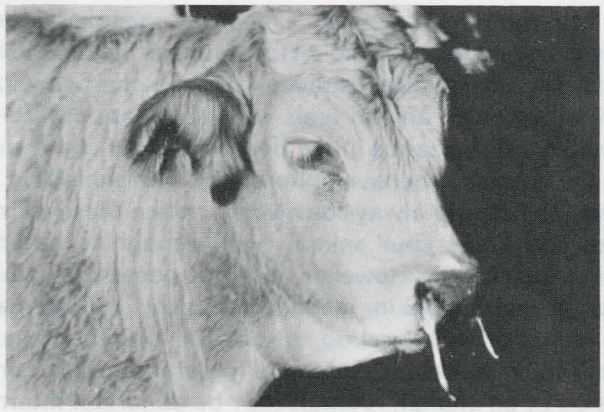
When living agents enter an animal's body and disturb the normal functioning to any degree, **infection** has occurred. An infectious disease, therefore, is one caused by the presence in, or on, an animal body of a foreign, living organism which produces abnormal signs by its presence.

Some examples of living agents which cause disease are **bacteria,** responsible for tonsillitis in humans or blackleg in cattle; **fungi,** which causes ringworm in animals and man; **viruses** which cause rabies, sleeping sickness, and canine distemper; and **protozoa,** responsible for coccidiosis in poultry, cattle and swine. **Internal parasites** (tapeworms, hookworms and many others) and **external parasites** (lice, ticks and fleas) are other types of living agents that cause disease. More information is provided about living agents in the lessons that follow.

The Spread of Disease

Most infections due to living agents come from infected animals of the same species. Others are passed from one species to another. A disease that is shared by both animals and man is called a **zoonosis.** Exposure plus susceptibility are necessary for disease to develop. Ways in which disease may be spread in-

- Direct contact with a diseased animal. This involves actual contact between animals. For example, if a healthy, susceptible animal rubs against one infected with ringworm, the disease can be contracted by the non-infected animal. It is called contagious if the disease spreads to the susceptible.
- Indirect disease transmission occurs upon contact with contaminated nonliving objects, such as stalls or feed boxes. This results in transfer of the disease agent to the new host.
- Contact with a healthy disease carrier. A disease carrier is an animal or human recovered from a disease but still harboring the disease-causing organisms in it's own body. It then passes them on to others and spreads the disease.
- Infection from **contaminated** soil. Certain soil organisms start infection if they enter an open wound. Blackleg of cattle, tetanus and gas gangrene are that type of infection.
- Infection from contaminated food and water, such as sewage drainage or poor preservation of foods. Salmonellosis and botulism are food poisonings.
- Air-borne infections spread rapidly when animals or people are crowded closely together. These organisms do not spread very far, but may be widely dispersed by coughing or sneezing. In confined areas such as feedlots with many animals present, respiratory disease sometimes spreads rapidly from infected secretions of sick animals.

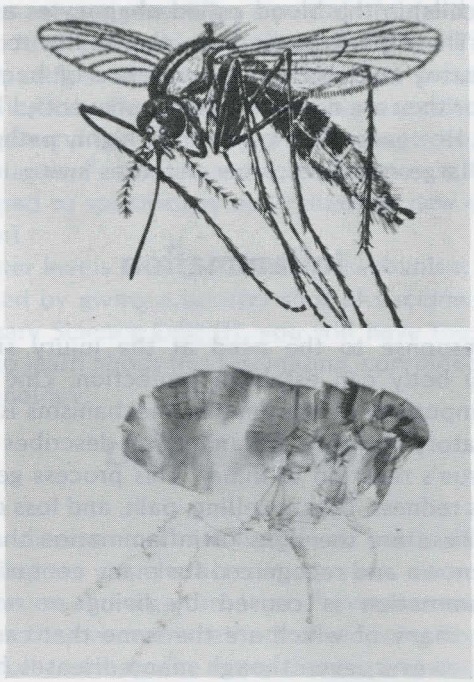


1.1 Secretions from sick animals create sources of exposure to healthy animals.

*Tetanus (lock-jaw) - a disease caused by the bacteria *Clostridium tetani,* usually associated with puncture wounds.

**Botulism - a disease caused by bacterial toxin of *Clostridium botulinum,* usually associated with poor canning (preservation techniques) of certain meats and vegetables.

• Infections are transmitted by blood-sucking insects, such as flies, fleas, mosquitoes, lice or ticks. These are called vectors (carry pathogenic agents). Diseases such as sleeping sickness in horses, or heartworm in dogs, are examples of vector-borne disease.



1.2 The mosquito and the flea are examples of disease and parasite vectors (carriers).

• Infections from resident organisms normally found in an animal's body, but become disease-causing, when the animal's resistance is weakened. The virus that causes cold sores in humans is an example of this infection.

Most infectious organisms which reach the animal's tissues and body fluids, are destroyed by antibodies or other defense mechanisms. But in some cases, the body defenses are ineffective. When an animal's resistance to infection is weakened by stress, deficiency or illness, the infective agents can multiply and grow. If this happens, the animal must regain its strength, build immunity and neutralize the invading organisms or it may die.

If the infection hangs on and gradually wears down the animal's resistance, the infection is called **chronic.** If the animal's resistance is poor, leading to the rapid growth of infectious organisms, it is called an **acute** disease.

Elimination of the Organism

Elimination of the infectious organism is necessary to protect the health of the animal. This usually occurs; however, in some cases, the infected animal (host) and disease organism are able to live together without serious injury to either. This situation is not voluntary on the animal's part. It is a case of the host's inability to eliminate the organism and the organism's inability to lower the resistance of the host. Sometimes this situation lasts the lifetime of the animal. During this time the animal may show intermittent signs of disease. Or the animal may appear normal and may or may not shed disease organisms. If the organism, for example, becomes isolated (held in check, subdued or encapsulated) by the body defenses, the infection is said to be **arrested.** This does not mean that the animal is entirely cured.

In both man and animal, some disease organisms continue to live in the body after the disease apparently has run its course. These infectious organisms may be eliminated in body excretions and may cause infection in others that are susceptible, if they come in contact with these secretions. When animals are actually going through the disease, most are shedding infectious organisms at that time, but when recovery is complete there are usually very few carriers or shedders. Animals that recover from the disease, but have and shed the disease-carrying organisms from their bodies, are called **shedders** or **carriers.** The carrier is certainly a problem affecting disease control. An obviously diseased animal has many signs while a carrier may have none, making it very difficult to detect which animal is the carrier.

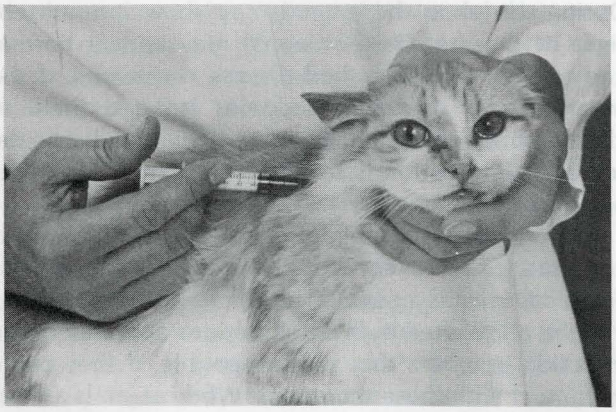
Other animals, insects or objects which have picked up organisms from contact with a diseased animal are called **contact carriers** or **vectors.** These cause definite problems in the control and elimination of disease.

Protection Against Disease

No matter how thorough your management program, how clean your feeding utensils or how regularly you vaccinate, your animal will be exposed to pathogenic organisms. So your animal's body defenses wage a constant battle against invading pathogens. Fortunately, the animal wins most of these battles and usually shows no sign of disease. This constant protective mechanism is why your animal remains healthy.

The ability of an animal to remain free of disease is known as **resistance.** Resistance depends on physical (body ability), metabolic (body chemistry), and inherent (inherited or inborn) factors. The animal species' natural immunity, its health and inherited traits are examples. Lack of resistance is called **susceptibility.** When disease resistance is developed by exposure to the pathogen through artificial or natural means, the animal develops **immunity.**

Normal, healthy animals have internal (inner) and external (outer) body defenses which help keep their resistance high. An animal's **first line** of defense, the skin and mucous membranes, slow the entrance of the organisms into the animal's body. Secondary defense mechanisms combat the infectious agents if the first line fails to stop entry into the body tissues.



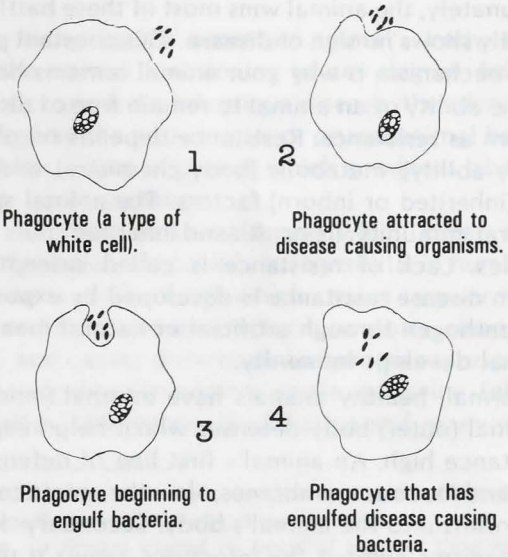
1.3 Vaccination is a method to aid in developing a resistance (immunity) to a disease.

The First Line of Defense

The first line of defense against pathogens are the tough protective skin and mucous membranes. In 4-H Veterinary Science, Unit I, you learned that the mucous membrane is the epithelial tissue that internally lines the body openings that are exposed to the environment, such as the digestive tract and nasal cavities. This tissue acts as a barrier to the invading organisms. Mucous membranes contain cells that can excrete fluids that dilute or wash away organisms and create a barrier to reduce the chance of disease.

If the first line of defense is injured by cuts, bruises, burns, etc., infection may result. **Note that infection and disease are not the same.** Infection shows that the organism is in the body. However, disease may or may not develop. Potential pathogens can be present at any given time without any sign of disease.

When injury occurs, a chain of events begins which determines whether disease will result or not. First, there is bleeding which tends to wash out any organisms that may have entered the wound. At the same time specialized leucocytes (disease-fighting white blood cells) in the blood called **phagocytes** are activated. These phagocytes have the ability to engulf and destroy bacteria. If the presence of bacteria is small, or they are **non-pathogenic,** uneventful healing occurs. However, if the organism is highly **pathogenic,** and in large numbers, other defenses swing into action.



1.4 Illustration of phagocyte (a type of white blood cell) engulfing disease-causing bacteria. Diagrams are hundreds of times actual size.

Inflammation

In response to the need at the injury site, the healthy body can establish protection. One of the most important of the defense mechanisms is the inflammatory response. **Inflammation** describes the living tissue's reaction to injury. This process generally creates redness, heat, swelling, pain, and loss of function. These are the signs of inflammation that have been known and recognized for many centuries.

Inflammation is caused by living or nonliving agents, many of which are the same that cause disease. However, even though many diseases have inflammation, there are many non-inflammatory diseases. **Any inflammatory "lesion" (damage or trauma to body tissue) carries the suffix "itis."** This is quite specific; for example, tonsillitis indicates inflammation of the tonsils and appendicitis indicates inflammation of the appendix. If a lesion is not inflammatory, it is not an "itis."

The purpose of the inflammatory process is to reduce the effect of an irritant to injured tissue. The main response to injury is the accumulation of fluids and leucocytes (white blood cells) in the injured area. These fluids and cells tend to dilute, localize, destroy and remove the irritant. Additionally, replacement of any injured tissue is part of the process. The process is complex and involves many chemical and physical reactions.

The Secondary Defense

If a pathogen passes the first line defenses, the secondary defenses must go into action. When a toxin, bacteria or virus creates generalized disorder in the blood and tissues it is called a toxemia, bacteremia or viremia, depending upon the organism involved. When a generalized disorder occurs, disease-causing agents are carried and spread to various parts of the body where serious damage can occur in sites such as the kidney, lung or brain. To combat this fast spread, the body has mechanisms in the blood and tissues in addition to phagocytes. These other defenses are antitoxins and antibodies that neutralize toxins or inhibit organism multiplication.

These defense mechanisms are developed in response to an introduction of an antigen (an agent that stimulates immune response) into the animal system. For example, a toxin, an invading organism, or even vaccines are antigens. Over a period of time the body can produce antitoxin or antibodies that will neutralize the antigen and cause a recovery or prevent disease or toxicity. Once an antibody is present it will act only against a specific antigen. If new antigens come into an animal's body, a completely new antibody is developed to specifically neutralize the new invader (antigen).

Greater levels of this protective mechanism can be produced by giving a booster shot of vaccine. In 4-H Veterinary Science Unit III, you will have the opportunity to learn about this fascinating, complex subject - Immunology.

Disease Control

Each disease is controlled in a particular way, depending on its characteristics, such as mode of transmission and organism type. Prevention and treatment are the two main methods of reducing disease. It is difficult to memorize every disease and its characteristics, but you may find it helpful to be familiar with the most common. Early, accurate diagnosis by a veterinarian is necessary for effective disease control. Vague signs of disease, and signs of other diseases that are similar, are major factors that slow accurate diagnosis.

Prevention is the key to success in disease control and to accomplish this, you must know the characteristics of each disorder. This takes years of study because of the complexities of each disease.

Introduction to Disease

Member Activity: Complete the following questions about animal diseases.

1. Explain what a disease is.

2. Give some signs that might indicate to you that your project animal is diseased.

3. Describe the difference between exotoxins, endotoxins and antitoxins.

4. Describe the following terms:

   a. living agents

   b. nonliving agents

   c. chronic

   d. acute

   e. carrier

5. Look up the different forms of immunity and explain how each is developed.

6. List the preventive measures you take with your project animal to keep it free of disease.

7. Pick one disease. Investigate it thoroughly. Write it's causes, symptoms, effects, treatment and any possible preventive measures.

Unit II, Lesson II

BACTERIA AND DISEASE

Words to Know

Bacteria: single-celled organisms capable of carrying on life functions; there are both beneficial and harmful bacteria

Classify: to break into basically similar groups according to structure and function

Dormancy: a relatively inactive or resting condition in which bacterial processes are slowed down, suspended, or latent but capable of being activated

Flagella: whip-like structures found on protozoa and some bacteria that assist motion

Pathogen: any agent which can produce disease

Spore: a resistant form of some bacteria which protects the organism from unfavorable environmental conditions

After reading this section you should be able to answer the following questions:

- What are bacteria?
- How are bacteria classified?
- What structures can be found in bacteria?
- What conditions are required for growth?
- How do some bacteria protect themselves from unfavorable environmental conditions?

Bacteria and Disease

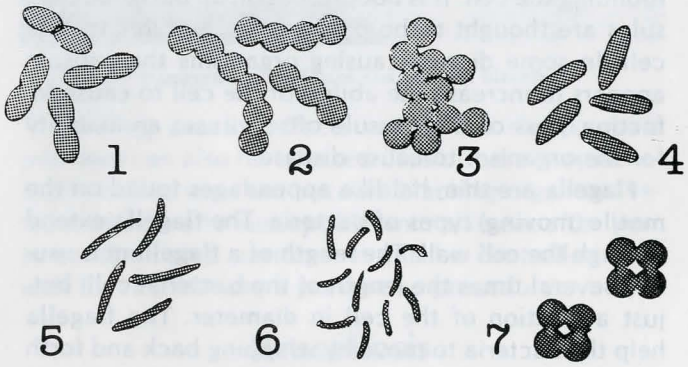
Bacteria were among the first life forms on earth, long before plants and animals evolved into forms we recognize today. A bacterium is a single-celled microscopic life form. It is capable of living and multiplying on its own if conditions are favorable. The first bacteria probably developed using energy from inorganic elements or compounds. As green plants appeared on the earth, some bacteria species used them as food. They have developed over the years into many varieties, both helpful and harmful.

Bacteria are the most abundant form of life today. They live everywhere, thrive in certain conditions and affect animal, plant and human life in many ways. Many bacteria help humans and animals. These **beneficial** bacteria can improve soil fertility, aid in food manufacture and are necessary for digestion in some animals. Other types of bacteria are called pathogens and produce disease. These **harmful** bacteria include those which cause disease, food spoilage and destroy or contaminate other products.

General Characteristics

There are thousands of different species of bacteria, in equally as many sizes. However, they can be classified into three groups according to shape. These groups are: (1) coccus or spherical; (2) bacillus or rod-shaped; and (3) spirillum or spiral-shaped and curved. Many organisms also show definite patterns of arrangement which help in identification. Some various patterns include:

Diplococcus are arranged in pairs of cells or two-celled filaments;
Staphylococcus are arranged in irregular clusters of round cells resembling grape clusters;
and the **Streptococcus** tend to form rows of cells in a bead-like or chain-like arrangement.



2.1 Some bacterial forms: 1) diplococci, 2) streptococci, 3) staphylococci, 4) bacilli, 5) fusiform bacilli, 6) vibrios, 7) carcinae.

Although it is possible to **classify** bacteria by their shape and arrangement, it is not possible to **identify** bacteria by this alone. Other characteristics of bacteria include the ability to ferment carbohydrates, form gases and break down protein. Some of these products, as a result of bacterial growth, are toxic or irritating to the living tissue and can induce disease or injure tissue. Some methods of further identification are necessary to determine if a bacterium may or may not be pathogenic (disease-causing). Positive identification is important in making medical decisions, because one type may cause a disease while a similar one may be harmless.

Bacteria are microscopic in size and may be measured in terms of micrometers. A micrometer is equal to 1/1,000 of a millimeter or 1/25,400 of an inch. Most bacteria have dimensions slightly below or above one micrometer.

Bacteria and Their Structures

Bacteria are microscopic, single-celled organisms. They contain cytoplasm, nuclear particles, and a cytoplasmic membrane, all enclosed within a cell wall. Some types of the bacteria have various other structural parts.

The **cell wall** is extremely rigid and accounts for a possible 20 to 50 percent of the dry weight of the bacteria.

The **cytoplasmic membrane** is a thin structure found immediately beneath the cell wall. It serves as a semipermeable membrane. In other words, the cytoplasmic membrane controls the passage of nutrients and waste material into and out of the cell. If this membrane is damaged or punctured by physical or chemical agents, the bacterial cell is destroyed.

Nuclear material (DNA) is contained within the bacterial cells but is not organized into a distinct nucleus as described in the animal cells of Unit I. These nuclear bodies are thought to play a part in the bacteria's multiplication.

A bacterial **capsule** is a gelatinous envelope surrounding the cell. It is not present on all bacteria. Capsules are thought to be protective structures for the cell. In some disease-causing organisms the capsule appears to increase the ability of the cell to cause infection. Loss of the capsule often causes an inability for the organism to cause disease.

Flagella are thin, hairlike appendages found on the motile (moving) types of bacteria. The flagella extend through the cell wall. The length of a flagellum is usually several times the length of the bacterial cell, but, just a fraction of the cell in diameter. The flagella help the bacteria to move by whipping back and forth in a swimming motion. Nonmotile (nonmoving) species of bacteria do not possess flagella.

Bacterial Spores

Some bacteria have the ability to transform themselves into small, highly resistant **spores** or **endospores**. As spores, they are in a resting stage. They can resist heat and disinfectants and often remain alive for years, making regular disinfection important. The process of spore formation is not one of multiplication. One cell forms only one spore. When spores are transferred from an unfavorable environment into a favorable one, germination (a period of growth) occurs. The spore wall first ruptures and the bacterium develops into a new cell capable of growth and reproduction. The new cell, now on or within a suitable host, develops more cells by rapid division.

Conditions for Growth

Bacteria require suitable temperature, moisture, darkness and an ample food supply to grow and multiply. The majority of bacteria are active at temperatures ranging from 80 to 100 degrees F. Some may live through intense heat, cold or both. Moisture is essential for growth, although long periods of dryness will not kill some bacteria. Dryness, like low temperature, will produce a period of **dormancy** or rest. Exposure to sunlight retards growth and kills cells. The ultraviolet rays of the sun will not, however, injure or kill spores.

The food need for bacteria varies with the rate of growth. Many disease-producing bacteria need living tissues to survive and multiply. Some of these attack specific tissues. Others can thrive on environmental organic material.

Bacteria and Disease

As you recall from the discussion of nonliving agents in Lesson I, some bacteria contain a substance mildly poisonous to animal tissues. This substance is called **endotoxin.** It is released within the tissues when the bacterial cell disintegrates. Other bacteria secrete **exotoxin.** This stimulates the host to manufacture antitoxin to combat the bacterial toxin. **Every species** of pathogenic bacteria attacks the body of its host in a **different manner** and produces **varied** symptoms.

Three animal diseases, bovine mastitis, blackleg and brucellosis illustrate different diseases caused by bacteria. You will note that each of the bacteria will attack a different area or tissue in the animal's body and will produce varied symptoms.

Bovine Mastitis

Mastitis in the dairy cow is an inflammation of the mammary gland. It can be due to infectious or noninfectious causes. Common forms of infectious mastitis are caused by the organisms, *Streptococcus agalactiae* and *Staphylococcus aureus.* When bacteria invade the cow's mammary gland through the teat orifice (opening) mastitis usually occurs. The cow's udder is composed of four distinct quarters, therefore only the invaded quarter is involved. Once inside the teat barrier, the microorganisms multiply on the lining of the milk channels or in the milk-secreting tissue of the lower part of the affected udder quarter. Organisms are released from infected areas into the milk channels of the udder. They can then establish themselves in other areas of the quarter. If the infection spreads

rapidly through the whole quarter, it produces an acute infection. In the chronic form of mastitis, the spread of infection within the udder is slow. The organisms in the udder produce toxins and other injurious substances that result in inflammation. Reduced quality and quantity of milk occurs as a result of mastitis.

Milking machine function and sanitation affect the amount of exposure of the teat opening to the organism. Machine malfunction can damage the teat end which reduces its ability to keep out mastitis-producing organisms. Infection frequently occurs at milking time. Therefore, strict hygiene effort during milking is one of the most effective measures in preventing new udder infection. Faulty milking equipment, poor milking practices and environmental conditions also contribute to mastitis susceptibility. Many cases of mastitis are not apparent visually. This type is called subclinical mastitis. If it is not diagnosed and the proper control maintained, infection will increase and production will drop. Veterinarians use several on-farm tests for detecting subclinical mastitis.

Milk samples are frequently submitted to laboratories where the causative bacteria are cultured, identified and antibiotic sensitivity tests are conducted to aid in making management decisions to control the disease.

Information on the prevention and control of mastitis is widely available from your veterinarian, the Extension Service, USDA, colleges of veterinary medicine or colleges of agriculture.

Blackleg

Blackleg is a deadly disease caused by a soil-dwelling, rod-shaped bacillus called *Clostridium chauvoei.* The disease occurs when the organism enters the susceptible animal through food ingested from a contaminated environment. From the digestive tract organisms may enter the bloodstream.

Blackleg is an acute disease characterized by sudden high fever and swelling of the subcutaneous tissues and muscles of the thigh, shoulders or other areas. Lameness is evident because of muscle damage and soreness. Death usually occurs in 12 to 36 hours. It usually strikes healthy, young cattle from six months to two years of age. It can also infect susceptible older cattle and some other animal species. While increased outbreak of the disease is usually seen in the spring and summer months, individual cases can be seen during any season. Cultivated land, irrigated pastures or low, swampy regions appear to be more likely sources than upland pastures.

When infection is established in a susceptible animal, it is difficult and painful for the animal to move. Swellings occur from gas formation. These swellings crepitate (make crackling sounds) when pressed with the palm of the hand. They may be found in the rear leg, shoulder, loin or neck muscles. If the lesions are located in the deep, skeletal muscles, swellings and lameness may not be readily detected.

Following death, rapid decomposition (decaying) and bloating of the carcass usually occurs with this type of infection. The characteristics of the dead animal include spreading and stiffness of the legs due to swelling, and usually a blood-tinged froth may be found around the nostrils, rectum and mouth. There are, however, other diseases that resemble this appearance after death.

Although few cattle survive this infection, good management procedures and routine vaccination of all calves at one month of age and again at weaning time (8-10 months) can prevent an extensive outbreak.

2.2 Good management decisions can prevent blackleg.

Blackleg usually affects cattle, but sheep, goats and deer can also be infected. This disease is extremely difficult to wipe out because blackleg organisms remain infective to susceptible animals year after year in contaminated pastures. It can be controlled very well by vaccination, a preventive procedure.

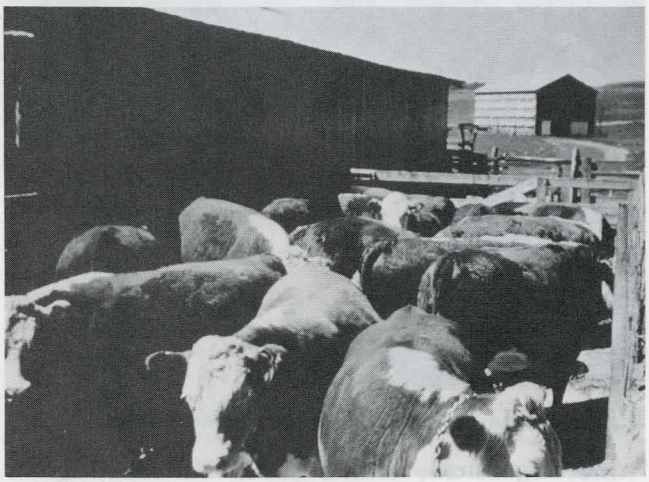
Brucellosis

Brucellosis (also called Bangs Disease or Contagious Abortion) is a bacterial disease that can infect both humans and animals (remember a disease shared by animals and humans is called a **zoonosis.**) It is a disease of great economic significance that occurs mainly in cattle, swine and goats. Three distinct species of the organism, *Brucella,* are responsible. *Br. abortus* (cattle), *Br. suis* (swine) and *Br. melitensis* (goats) tend to have affinity for each species of animal. All three organisms can cause a serious, generalized disease in humans called **undulant fever.**

In animals, however, the infection is concentrated in the reproductive organs such as the uterus and mammary gland of the female and the testicles of the male. The principal and usual visible sign the disease

produces is abortion. However, cattle and goats with this disease can shed the organism in milk. Drinking nonpasteurized milk from these animals can be a human health hazard.

Treatment of brucellosis in animals is generally not practical because of inconsistent results and cost. The control of brucellosis is under federal and state supervision because of the economic and public health significance. A policy aimed at total eradication is their goal, and basically involves a testing and vaccination program. The test identifies the infected, disease-carrying animals so they can be eliminated from the herd. The vaccinations are given to young heifers to protect against the disease before they mature to reproductive age. Cattle that have brucellosis appear healthy so the disease must be diagnosed by one of several blood tests and/or bacteriological procedures. It can also be diagnosed by the milk ring test, a milk test which is used for dairy cattle and goats.



2.3 Cattle may have brucellosis and appear to be healthy. Only diagnostic tests confirm infection.

In species other than sheep, spread of infection is primarily by ingestion. The vaginal discharges of infected animal's placentas, and aborted fetuses contain many organisms. *Br. abortus* (mainly found in cattle) may penetrate skin or mucous membranes; however, most infections probably enter through the mouth.

Abortion of a fetus is the primary evidence of infection with brucellosis. Infection does produce some immunity, because animals that abort usually do not lose their next conceptus (fetus). However, the infection frequently persists in a latent (dormant) form. These infected animals can remain a source of infection for others. If a live calf is born to an infected cow, the calf is frequently weak and the cow may have a decrease in milk production.

There is a lot that can be done to control brucellosis in cattle:

- Follow a rigid schedule of official vaccination of all replacement heifer calves.
- Be careful when buying new additions and buy only from known, clean herds. Insist on a negative blood test within thirty days of the time of purchase. Then, keep the animal(s) separated from your other animals until they are tested again and found negative thirty to sixty days later.
- If at all possible, try to buy animals that have been officially vaccinated, as well as tested.
- If an animal aborts, have your veterinarian examine and collect samples from the fetus and dam for laboratory analysis.
- Segregate any animal that aborts from all other animals in the herd until the cause is determined. Disinfect the areas of contamination.

Brucellosis in Swine

Brucellosis in swine causes a generalized infection with bacteria circulating in the blood. Infected swine present a special hazard to humans working in a packing house, because the disease can be spread through slaughter of the animal. Transmission of disease in swine, as in cattle and goats, occurs primarily by ingestion, but can also occur during mating. Blood testing identifies infected animals. Infected herds experience low fertility, abortions and weak piglets. Neither vaccination nor treatment is effective in swine; therefore, control by slaughter or a testing program is necessary.

Brucellosis in Sheep

The most serious problem brucellosis causes in sheep is damage to the epididymis (epididymitis). The epididymis is a tubular structure attached to the testicle. Ewes may become infected and can abort, but tend to be more resistant to the disease and recover quickly. In the ram, infection usually causes reduced fertility. Susceptible rams become infected when they breed a ewe recently bred by another infected ram. Spread, therefore, is increased during the breeding season, especially when young rams are with a flock along with older infected rams.

Control in sheep can be achieved through vaccination and by selecting young noninfected rams to be with ewes away from older rams. If necessary, two flocks can be maintained, one clean and one infected or suspect. Rams known to be infected should be eliminated from the flock and slaughtered.

Brucellosis in Goats

The disease in goats closely parallels that found in cattle and control measures are basically the same. Generally brucellosis prevention recommendations listed for cattle apply equally for all susceptible species.

Bacteria and Disease

Member Activity: Complete the following questions about bacteria.

1. Define the following terms:

   a. flagella

   b. capsule

   c. motile

   d. the suffix "itis"

   e. pathogens

2. What are the conditions for growth required by most bacteria?

3. When foods are dehydrated, the moisture content is lowered to a specific point. What effect does this have upon bacteria which could cause spoilage?

4. What is the name of a bacterium that causes bovine mastitis?

5. Look up what type of light is used in the "sterilamp" over the operating table that kills bacteria and insures sterility.

6. Choose either a pathogen which has infected your project animal or one that could infect it. Research it's characteristics, signs or symptoms, method of diagnosis, treatment and any side effects. Also include any effects on human health or economics.

7. Make a study of how bacteria are cultured (grown) in laboratories.

Unit II, Lesson III

VIRUSES AND VIRAL DISEASE

Words to Know:

Asymptomatic: no apparent signs or symptoms
Interferon: a natural antiviral agent produced by living cells in response to viral infection
Antiserum: blood serum from an animal which contains antibodies for a specific disease
Vaccine: a substance that actively stimulates the immune system to produce antibodies
Replication: process of duplicating or reproducing
Immunity: the state of being immune or resistant to disease
Dehydration: state of being critically low on body fluids, water
Incubation Period: the development without signs of infection from the time the disease agent enters until the first signs of disease appear
Reportable Disease: a disease that has animal, human health, economic or other implications that requires notification of state and federal authorities. Examples are rabies, brucellosis, scabies and anthrax. (These state and federal rulings are intended to alert authorities of disease occurrence so coordinated control efforts can be started.)

After reading this unit, you should be able to answer the following questions:

- What is a virus?
- How can viruses be controlled?
- What are the symptoms of rabies and how is it transmitted?
- Of what economic significance is TGE?
- How can rabies and distemper be controlled?

Viruses and Viral Diseases

A virus is a tiny particle, thousands of times smaller than a bacterium. It is incapable of growth or multiplication unless it is within a living cell, therefore, it is considered a parasite. Virus particles vary in size from 15 to 300 millimicrons. They also vary in structure (spheres, bullet-shaped, rods, crown-like, other) and chemical content. They are made of a coat of protein units arranged around a central nucleic acid core. This core can be made of deoxyribonucleic acid (DNA) or ribonucleic acid (RNA), which is the genetic material of the virus.

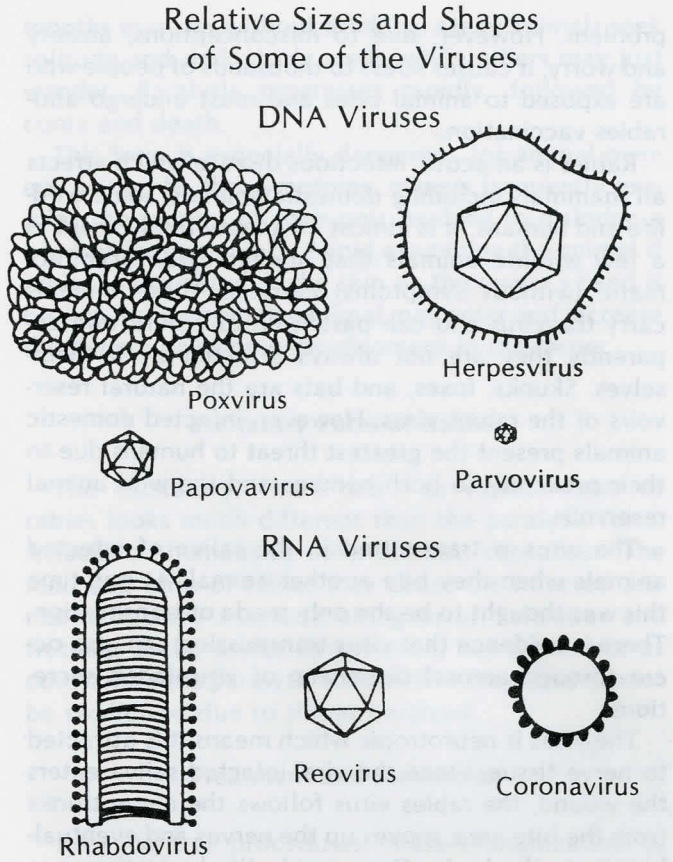
Most viral diseases spread rapidly through a group of susceptible animals inflicting damage that may vary from only an irritation to death of the host. In some viral diseases it is common to have carriers which shed the virus. Animals infected with viruses frequently have a fever, depressed white blood cell count (leucopenia), and do not respond to drug therapy (treatment). Needless to say, viral infections pose many problems in animal and human medicine.

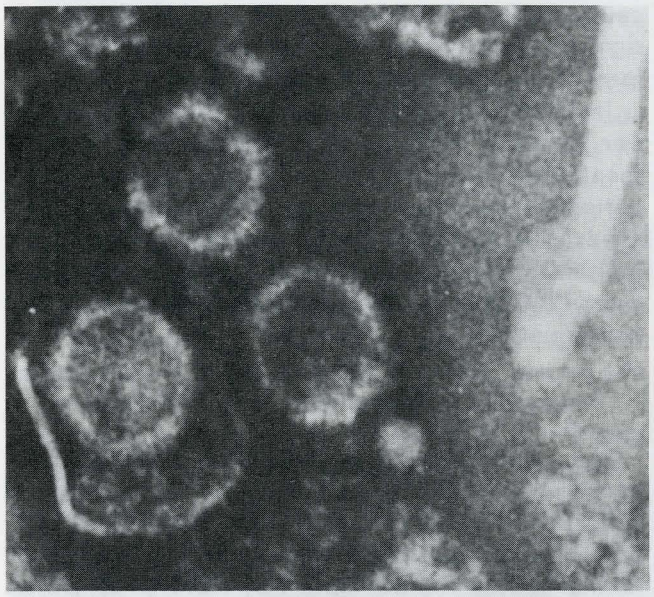
Viruses replicate (multiply) only in living cells. Each virus type tends to prefer specific cells and host species. Some viruses destroy nerve cells, such as the virus of rabies, or some may prefer epithelial cells, such as the poxviruses. Others attack the cells of the respiratory or nervous system of just one animal type, and may not involve another species at all. Some may produce tumors in the host, such as the virus that causes warts on cattle.

Classification of Viruses

No official classification system has been adopted for viruses; however, they are generally grouped first depending on whether they contain DNA or RNA. The DNA and RNA viruses are then further subdivided based on other characteristics such as: 1) structure, 2) envelope (covering), 3) composition, 4) shape of the protein in the virus, and 5) other factors. Using these classification methods, there are 15 known major virus groups that include several of the more common ones you may already be aware of. Four examples of these groups are:

A) poxviruses that cause small pox, cowpox and fowl pox
B) herpesviruses (rednose in cattle or cold sores in humans)
C) reoviruses (rotavirus) (causes diarrheas and other diseases)
D) coronavirus (which cause diarrheas in humans and animals)





3.1 Diagram of several DNA and RNA viruses. Bottom: Photo micrograph of herpesvirus (pseudorabies) approximately 165,000 X actual size.

Control of Viruses

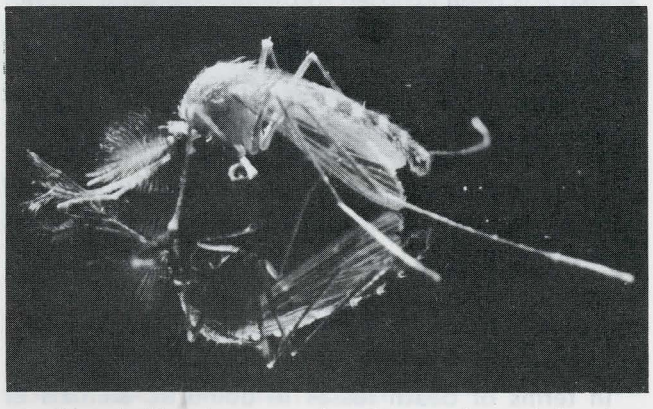
The control of any virus is extremely difficult after the disease has begun. There are, however, several methods that control some viral infections. Each of these will be discussed separately.

Immunological Methods: Immunological methods of control include vaccines and antiserums. When administered, vaccines stimulate tissue cells to form antibodies, an antiserum actually provides a temporary antibody blood level in the animal. When vaccines are used an **active immunity** develops and it may last a few months to many years. An antiserum contains antibodies (gamma globulin) which have been produced in another animal that has already developed immunity to that specific disease. In this case the animal does not manufacture its own antibodies, but is protected by using those from another animal. When antiserum is used a **passive immunity** develops and is only temporary, lasting a month or two. The main purpose of passive immunization is to protect individuals that have been exposed to a disease. Another type of temporary or passive immunity is the type transferred to a newborn when it feeds on the first milk (colostrum).

Treatment with Chemicals: The chemicals used to treat viruses are called antiviral compounds. These include medications or drugs used to control viral infections that have developed in the animal. The development and use of these compounds in the host animal has been limited because of adverse side effects caused by the drug. Research scientists are constantly working to develop new medications that will stop viruses from reproducing yet not cause undesirable side effects in the host animal.

Interferon: Interferon is a naturally-occurring antiviral. It is produced by living cells in response to a viral infection. This compound can be used safely and appears to be beneficial for treatment of certain viral infections. Interferon affects the inside of the cell and prevents replication of the virus within the host cell. Interferon affects viruses other than the specific virus that first stimulated its production in the cell. To be effective, interferon must be produced in the same species of animal that is to be treated. It is also expensive, and in limited supply.

Environmental factors: Viruses can also be controlled when the agent that transmits or carries the virus is controlled. For instance, the control of ticks and mosquitoes has helped eliminate some diseases. Quarantine, prohibition of animal importation from diseased areas or countries and slaughter of infected herds are other methods of control.

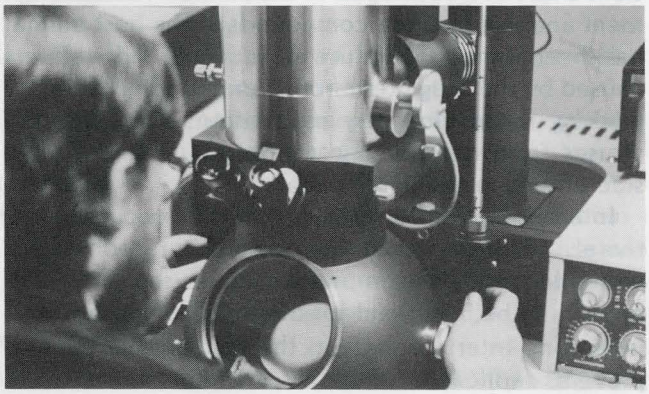


3.2 Control of insect vectors such as the mosquito can help reduce the spread of viral disease.

Characteristics

Viral infection begins when the host cell is invaded. The virus replicates within the cell and produces an alarming number of new, infective viral particles. As the virus replicates, the infected cell's structure and function are destroyed. These cellular changes cause clinical (visible) signs of disease.

A microscopic study of the infected host cell may show definite intracellular structures known as **inclusion bodies.** Inclusion bodies are masses of new material in the host cell. When found within the nucleus they are called intranuclear inclusions. Or if found within the cytoplasm they are called intracytoplasmic inclusions. One or both of these inclusions may be found within the same cell if more than one type of viral infection is present. The inclusion body found in rabies-infected cells is called a **Negri body.**



3.3 The electron microscope is necessary for studying the viruses.

You should know that bacteria are constantly present in the body. Most of them are harmless, but in some cases when stimulated by the presence of a virus, bacteria may become **secondary invaders.** A vicious circle is sometimes established by the virus and the secondary bacterial infection. The action of one increases the virulence (potency) of the other. Recovery from infection depends upon resistance to the disease or the ability to build immunity. If the animal has been exposed to the disease without prior infection, **antiserum,** if available, may be administered, complete with specific antibodies (passive immunity), to combat the virus. If the animal has not been exposed, **vaccine** is given to stimulate antibody production resulting in subsequent active immunity.

In the remaining portion of this lesson, you will have the opportunity to learn about some common viral diseases.

Rabies

In terms of death losses in domestic animals or humans, rabies in the United States is actually a minor problem. However, due to misconceptions, anxiety and worry, it causes stress to thousands of people who are exposed to animal bites and must undergo anti-rabies vaccination.

Rabies is an acute, infectious disease which affects all mammals including domestic animals, some wildlife and humans. It is almost invariably fatal except in a few wildlife animals that appear to be asymptomatic (without symptoms) carriers. These animals carry the virus and can pass it on to others, and apparently they are not always affected by it themselves. Skunks, foxes, and bats are the natural reservoirs of the rabies virus. However, infected domestic animals present the greatest threat to humans due to their proximity to both humans and the wild animal reservoirs.

The virus is transmitted in the saliva of infected animals when they bite another animal. At one time this was thought to be the only mode of transmission. There is evidence that virus transmission can also occur through aerosol dispersion of virus-laden secretions.

The virus is neurotropic which means it is attracted to nerve tissue. Once the viral-infected saliva enters the wound, the rabies virus follows the nerve trunks from the bite area, moves up the nerves and eventually infects the brain. Once inside the brain the virus causes brain lesions (damage). The brain lesions cause signs which may be exhibited either as the **paralytic form** or the **excitatory, "mad dog" form** of rabies.

Incubation may vary from 10 days to six months. The immunity of the bite victim, the dose of virus and location of the bite, may influence the incubation period. Once the disease has developed, it almost always results in death, although there have been animal and human rabies cases in which the individual survived. Rabies is a serious disease with public health consequences.

Signs

The earliest sign of this disease is a change from normal behavior. The signs may be easily confused with such things as indigestion, swallowing difficulty, or depression. Some infected animals may leave their normal spaces and wander off by themselves. Others may change behavior and become aggressive or overly friendly. Wild animals sometimes move into areas that they normally would avoid.

Paralytic Form of Rabies

The paralytic form of rabies is the more common type. The infected animal becomes withdrawn and depressed with little interest in food or water. Due to early paralysis of the throat muscles, there is much drooling. Dogs may attempt to drink, but do not swallow. Cattle and other animals may immerse their

mouths in water without drinking. Many animals seek solitude and dark shady areas, while others may just wander. Paralysis progresses rapidly, followed by coma and death.

This form is especially dangerous for animal owners. Misled by the symptoms, owners frequently examine the mouths of their pets, seeking to dislodge a bone or foreign object. Avoid examining the animal if rabies is suspected. If the skin on the owner's hand is broken, saliva from the animal may enter and increase the danger of disease development in the owner.

Excitatory Form of Rabies

The excitatory, "mad dog", or furious form of rabies looks much different than the paralytic form. Attacks on humans or other animals can occur. The mad dog form of rabies may cause the infected animal to become a vicious, biting terror. Salivation and frothing in the animal is common, but this is not as constant as the paralytic form where the saliva cannot be swallowed due to throat paralysis.

Treatment and Prevention

Area control procedures, mass immunization of dogs, and control of certain wildlife reservoirs (animal sources of infection) are the proper approach to rabies control. If an animal shows signs of rabies, contact your veterinarian immediately. You will be told what to do and what other decisions should be made relating to the incident. Because nearly all animals die from the disease, and because of the human hazard, it is necessary to vaccinate dogs, cats, and humans before infection develops. The vaccine used in the control of rabies in dogs and cats is very effective if administered properly. Use the vaccine only on the species recommended, because serious consequences can develop if a species other than that specifically recommended by the manufacturer is vaccinated.

Rabies in humans can be prevented by eliminating exposure to rabid animals and by prompt local wound treatment and immunization (vaccination) when exposed. Immunization suggestions for attending physicians are available from state health departments. A new vaccine is now available for human rabies prevention. This vaccine requires fewer shots, is less painful and produces fewer side effects than products used before.

3.4 Proper vaccination of dogs and cats will prevent rabies.

Due to the many combinations of animal or animal-human rabies exposure, the procedures may vary concerning the handling of the suspected animal and it's victim. Seek advice immediately from a veterinarian, physician, and state public health officials.

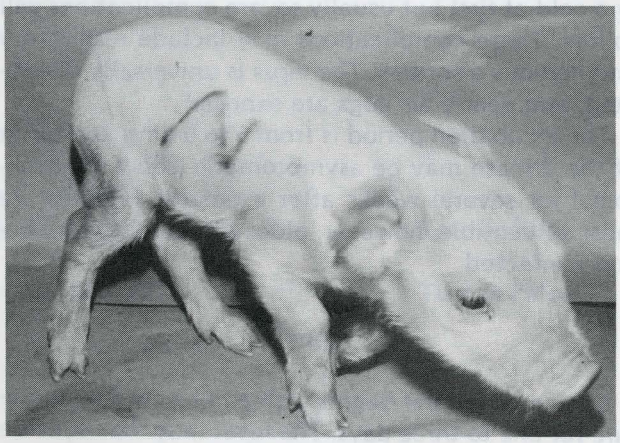
Never cut corners when dealing with the prevention of rabies. Contact government and state agencies for information about a community program to reduce carrier wildlife involved in the spread of rabies. Above all, the public must become informed and remain aware of the threat of rabies.

Transmissable Gastroenteritis (TGE)

TGE is a major viral disease of swine common in the swine-producing areas of the United States. Its effect on the very young is considerable, although older animals can also be affected. The virus attacks the cells lining the intestinal tract, and result in fluid loss, and diarrhea.

Signs

In piglets up to two weeks old, death losses are frequently disastrous. Profuse watery diarrhea, rapid dehydration from fluid loss and a very high death rate (up to 100 percent) may occur. The spread of TGE to susceptible pigs in the farrowing house is difficult to avoid.



3.5 TGE causes severe losses in very young swine.

In older swine, mild diarrhea and vomiting may occur for a few days, then there is usually apparent recovery from the disease. However, recovered animals frequently continue to shed the virus in the feces (carrier state) for a long time, providing a source of infection to others in contact with them.

Positive diagnosis of TGE is by laboratory methods, however, the clinical signs, such as rapidly spreading diarrhea that kills only the very young, would strongly suggest TGE.

Treatment and Prevention

Treatment for this disease includes replacing lost fluids, because drugs are generally ineffective.

Prevention is the preferred method of control. Prevention is accomplished by avoiding the introduction of infected pigs to a clean herd, and by maintaining strict sanitation of premises and equipment. The feces of infected pigs and carrier animals are sources of virus, so infection can be spread by dirty boots, equipment, dogs, wild animals or birds. The primary source of infection, however, is by addition of new pigs to the herd. Replacement animals should be kept separate from the main herd until they have been determined to be free of TGE by laboratory tests.

Immunization (vaccination) is possible, but, it has not prevented all losses. Immunity can be developed by deliberate exposure of sows to the virus before farrowing in natural outbreak conditions. This practice provides passive immunity to piglets by increasing protective antibodies in the sow's milk. The practice has had moderate success.

Consult a veterinarian about this disease. In control of any disease, **good management** is the key factor and in this disease, it is especially important.

Canine Distemper

Canine (dog) distemper is a highly contagious viral disease of dogs. The disease sometimes resembles only a cold at first but usually severe complications will follow. These complications may include respiratory and nervous disorders. The virus is universally distributed, and nearly all dogs are exposed.

The incubation period is from 6 to 9 days and onset of the disease may be asymptomatic (show no symptoms) for several weeks after exposure. Puppies are most susceptible; however, older animals can also become infected.

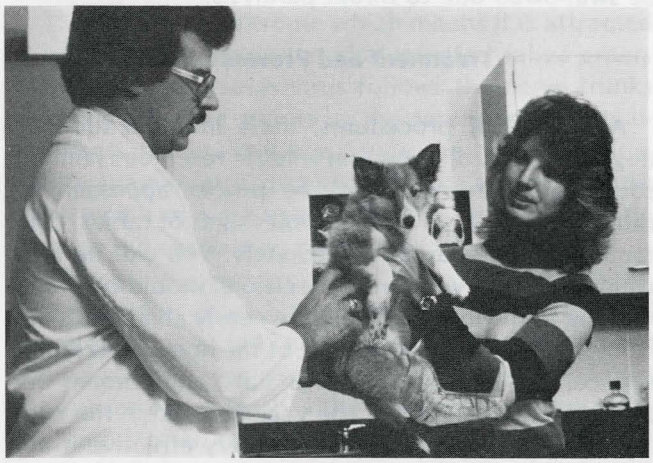
Signs

Canine distemper begins with an elevated temperature for one to three days. The fever may then subside for several days before a second elevation occurs. Inflammation and a gummy matter usually accumulate in the eyes and nose. The dog's appetite is usually poor and diarrhea will often develop. An apparent recovery may be followed in a few weeks by a permanent nervous disorder that is exhibited by chorea (localized muscle twitches), convulsions (severe muscle spasms) or paralysis to some parts of the body. Other serious side effects may occur in this disease. Tentative, positive diagnosis can be made from signs of eye and nasal discharge or fever followed by nervous system disorders. However, confirmation must be made by using laboratory methods.

Treatment and Prevention

As with other viral diseases, treatment, other than supportive, is of little value. Supportive treatment consists of good nursing care, stressing comfort for the animal. Regardless of the effort there are many cases that will not respond.

There are several very good vaccines available for distemper prevention. Properly administered, vaccines will effectively prevent this terrible disease of dogs. A veterinarian should be consulted for advice about proper immunization to prevent distemper and for recommendations to prevent other pet diseases.



3.6 Protection against canine distemper at an early age is important.

You are now aware of the severity and seriousness of some of the viral diseases. Remember many viral diseases can be **prevented** with effective vaccines, but the effectivness of **treatment** for all viral diseases is poor.

Viruses and Viral Disease

Member Activity: Complete the following information about viruses and viral diseases.

1. Characteristics of a virus.
   a. A virus is a parasite — True or False
   b. Each virus tends to attack a specific type of cell in certain herd animals — True or False
   c. A virus may be transmitted only by animal bites — True or False

2. Control of viruses.
   a. The best control of viruses is to feed antibiotics — True or False
   b. Immunity against viruses is one method of virus control — True or False
   c. Active immunity is of short duration — True or False
   d. Colostrum aids in developing passive immunity in a newborn — True or False

3. The signs of rabies in animals may include:

   a. _____

   b. _____

   c. _____

4. Rabies virus will most likely attack: (circle one)
   a. epithelial tissue
   b. nerve tissue
   c. muscle tissue

5. Susceptible animals and humans can become infected with rabies if the rabies virus enters an open wound. — True or False

6. TGE in swine is usually fatal to: (circle one)
   a. baby pigs
   b. mature pigs
   c. sows at farrowing time

7. How is TGE transmitted?

8. Canine distemper is a mild disease of dogs similar to a "cold" in humans. — True or False

9. Distemper in dogs can sometimes damage the central nervous system. — True or False

10. Explain the economic significance of viruses.

11. Choose one other viral disease besides those already discussed. List its method of transmission, symptoms, treatment, prevention and effects it may have on the animal.

Unit II, Lesson IV

EXTERNAL PARASITES

Words to Know:

Parasite: an organism that depends on another organism for its nourishment.

External Parasites (Ectoparasites): parasites deriving their nourishment from the outer surface of the body.

Vector: a living carrier (insect or other) which transfers an infective agent from one host to another.

Quarantine: restrictions placed on entering or leaving premises where a case of communicable disease exists.

Life Cycle: stages of development necessary for a parasite to reproduce from egg to adult.

Unthriftiness: a term used to describe poor gaining performance or conversion of food into usable body nutrients. There may be various causes such as parasitism, diseases, or nutritional inbalance.

After reading this section you should be able to answer the following questions:

- What are parasites?
- What are the two major groups of parasites?
- How do external parasites affect animals? How is this significant?
- How do parasites transmit disease?
- Why is it important to know the life cycle of a parasite when you are trying to control it?
- How can you control parasites by controlling the environment?

Parasites and Disease

A parasite is an organism that lives on or in another organism to provide nutrition for its own use. There are two main groups of parasites. External parasites live **on** another organism and internal parasites live **in** another organism. The other organism is called a **host.** This definition technically may include bacteria, and other microscopic life forms. However, in this project we will refer to several types of worms as internal parasites and certain insects as external parasites. There are even a few parasites that may be external at one time in their life cycle and internal at another time.

Parasites can create serious problems in animals and humans. The type of parasite and number present determines the severity of the damage that can occur. Some parasites can cause severe anemia (blood shortage) and death, while others may create only an irritation or rough skin appearance and may only be a nuisance to the animal. There are other parasites capable of carrying and transmitting disease organisms from one animal to another. These are called vectors.

External Parasites and Disease

External parasites affect animals in various ways, such as damaging the skin, disease transmission, anemia and weight loss. A parasite depends on its host for food and shelter and may spend all or part of its life cycle on the animal. Or, in other types, the parasite may cling to the site only long enough to feed. External parasites derive their nourishment from the blood, skin or other body tissues.

Damage caused by external parasites:

- Skin irritation is caused by the parasites piercing, burrowing, or chewing the skin when feeding. Also, the excreta (body discharges) from the parasite are very irritating to the skin.
- Invasion of tissue by maggots or larvae of screwworms and grubs cause physical damage.
- Toxins (poisons) excreted or secreted by stinging or biting are poisonous to the animal's system. Examples are bees, wasps, ticks, and mosquitoes.
- Allergies or sensitization to a substance can be caused by insect poisons. Example: allergic reaction in dogs caused by fleas, some mosquitoes.
- Injury to the eyes or ears caused by insects or their secretions.
- Paralysis, as caused by certain ticks.

Parasites may transmit disease in two ways. First, they can harbor certain disease organisms in their bodies, which they deposit in the host while feeding or sucking blood. Examples are Rocky Mountain Spotted Fever in humans and Texas Cattle Fever, both transmitted by ticks. The dog heartworm, transmitted by mosquitoes, is another example. Parasites may also transmit disease organisms on their feet, mouths, wings, or other parts of their body. This is called mechanical transmission. Pinkeye (eye infections) in animals may be transmitted in this manner by flies. The fly, after feeding on an infected animal, may light on an uninfected, susceptible animal and the disease has spread.

It is necessary to know the characteristics of parasites, how they live, multiply, affect animals, and how they may be controlled, before you can protect your animals. Some parasites are species specific (infest only one type of animal). Others may infest nearly all warm-blooded animals. Some parasites may prefer certain areas of the body for food and shelter, or have no preference and can be found anywhere. Knowing the parasite's life cycle is the key to successful control. The life cycle is the stages of development necessary for the parasite to reproduce from the egg to the adult. This sequence can be complex and is sometimes carried out through more than one animal. The life cycle is different for each species but usually consists of the egg, larva, pupa and adult stages. Multiplication of the parasite is stopped if the life cycle can be broken, either in the mature or immature form of the organism.

Control

Parasite control may require treating (medicating) the animal and its environment. Most parasites affecting domestic animals can be controlled with commercial insecticides. Care should be taken when using these products, because, in addition to destroying parasites, some are also poisonous to humans and animals when improperly used. Additionally, some insecticides can be used only on certain animal ages and species.

DO NOT use any insecticide on an animal unless you read the label and its precautions! It is very important to follow label directions closely. Label precautions should state:

4.1 Read labels carefully and follow instructions on all chemicals or medications.

- If the product may be used on the kind and age of animal you wish to treat.
- If the product is effective for controlling the parasite infesting the animal.
- Information about residue in meat and milk in food animals.
- How to use the product (as a dip, spray, dust, pour on, spot treat, feed additive, etc.)
- How to prepare before using. (Does water, oil, or some other product need to be added? If so, how much?)
- How much to use per animal.
- How to apply (when and where).
- How to handle product safely when mixing and applying to animal.
- Emergency procedures in case of adverse reaction.
- Antidote, physician notification and first aid, in case of accident.

Ticks

All ticks are parasitic during some time of their life cycle and they infest nearly all types of animals. The principal hosts for ticks are birds, wild animals, some domestic animals and humans.

Harmful Effects

Ticks are parasites needing a blood meal for their survival. Their primary importance, in addition to parasitism, may be as vectors (carriers) of diseases such as Tularemia, Rocky Mountain Spotted Fever and Q Fever.

Life Cycle

The typical tick life cycle involves mating on the host, and blood engorgement by the female. Following engorgement, she drops to the ground to lay eggs. These hatch in about two weeks into larvae or **seed ticks** (immature life form). Shrubs and brush hide these larvae where they remain several months waiting for an animal host. When an animal brushes up against the shrub, the larvae transfer to the host to ingest a blood meal. They then drop to the ground where they molt. They emerge as nymphs (second immature form) and the process is repeated. Eventually the nymphs develop into adult ticks, which also wait in the brush for an animal to come by and furnish another blood meal. At this point, mating and engorgement again occur. The animals attacked by all stages of the life cycle may be one species or from different species including humans. Ticks and their different stages are most likely to be seen in the warm seasons of the year. Heavy tick infestations can cause severe irritation, anemia, discomfort and unthriftiness during the several stages of their life cycle.

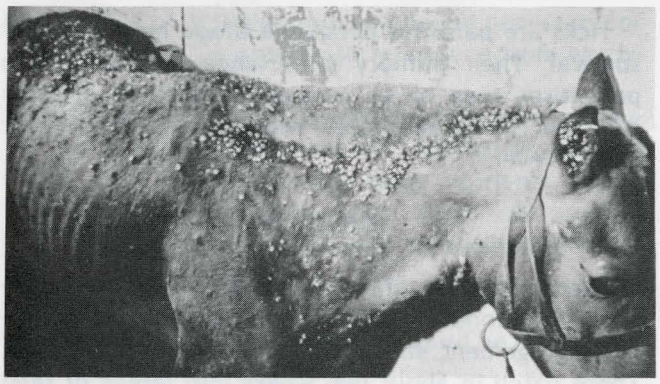
Ticks carry a wider variety of animal diseases than any other parasite. Approximately 24 of the ticks found in America may transmit from one to eight diseases affecting animals and humans. In addition to transmitting diseases, they injure the tissues around the feeding site.

Ticks are extremely hardy and can go without food for long periods of time. Under experimental conditions, one species went without food for 540 days in the larval stage, 548 days in the nymph stage and 1,053 days as an adult.

Control of Ticks

Individual ticks can be removed manually but you must take care not to break off the mouth parts that attach the tick to the host. Gentle traction is all that generally is required.

Control of ticks requires treating both the animal and its environment. Several insecticides are commercially available for such treatment. For those insecticides commonly used and recommended for your area, contact your state university parasitologist, or your local veterinarian, and follow directions very carefully. These people can provide information regarding the current regulations for the kinds and use of insecticides.

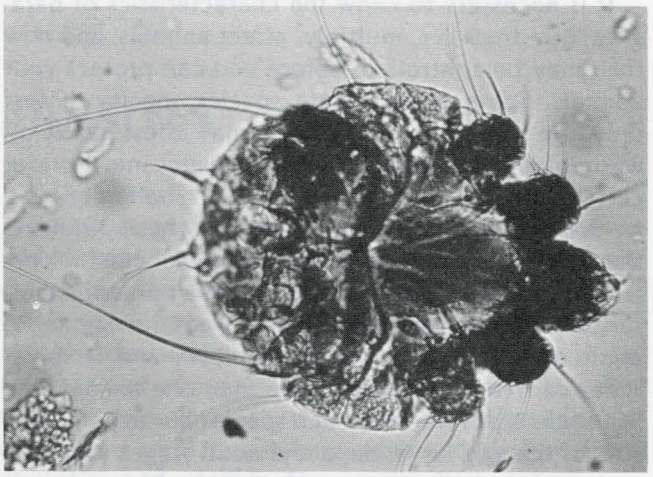


4.2 This horse is heavily parasitized with ticks.

Mites

Mites, which are the cause of mange, are microscopic pests that can cause severe skin irritation to nearly all animals. Several types of skin problems and ear canker in the dog, are aggravated by mites. Mites cause irritation by burrowing into the skin, feeding on the skin and sucking blood. There are several species of mites that create problems in poultry. They cause weight loss, discomfort, and a drop in egg production.

There are many types of mange mites that are costly to the owners of livestock and pets. Of these, *Sarcoptic, Chorioptic, Psoroptic* and *Demodectic* mange mites are the most common. Mange spread is so severe sometimes that state and federal authorities place quarantines on affected herds or flocks. Specific regulations are ordered to treat and stop spread of the mange.



4.3 This is what a mite looks like under a microscope. They are barely visible with the naked eye.

- The **sarcoptic mange mite** is usually found in horses and swine. It causes intense irritation as it burrows into the skin which causes infected animals to scratch and rub almost continuously. As the inflammation increases, the skin becomes dry, thickened and wrinkled with crusts forming in the infected area. All domestic animals may become infested with this species of mite.
- **Chorioptic** mange is the species usually affecting cattle. Like sarcoptic, it causes intense itching but starts most commonly around the rump, tail head and down the inside of the hind legs.
- **Psoroptic** mange is generally associated with sheep and causes the wool to fall out in patches, damaging the fleece and causing great loss to the sheep industry. Because of its seriousness, psoroptic mange is a reportable disease, and its spread must be limited. State and federal authorities quarantine infested herds or flocks and provide guidelines for its control.
- Another type of mange discussed here is **demodectic** and is of minor importance in livestock but causes considerable trouble in dogs. The organism spreads slowly and multiplies in the hair follicles. In the early stage, small patches of hair fall out. As the infection spreads, the nude patches become larger and the entire area becomes inflamed. The skin becomes thickened, has a raw appearance and oozes fluid from the infested area.

Another infection caused by mite infestation is **ear mange,** causing ear canker of dogs and cats. This mite does not burrow into the skin, but lives in the ear canal, feeding on tissue fluids obtained by piercing the skin with its mouth parts. The site becomes irritated and inflamed, causing the animal considerable pain. The ear canal soon becomes filled with debris from the mites. This debris frequently causes a secondary bacterial infection in the ear. Animals exhibit

symptoms of pain by shaking the head and continually scratching the ear. Scratching the infected ear often causes breaks in the skin (self-mutilation) and hair loss in this area.

Life Cycle

Mites go through the egg, larval, nymph and adult stages of development. The sarcoptic female mite, for example, burrows into the upper layers of the skin where she deposits her eggs. After a few days, the eggs hatch into the larval stage which are tiny mites with three pairs of legs. The larvae molt and develop into nymphs. The nymph then molts to become an adult; both the nymph and adult have four pairs of legs. The entire life cycle is completed in approximately two to three weeks. The complete life cycle of the other type of skin mites is similar to the above.

The ear mite deposits its eggs in the debris of the ear canal. The development of the eggs through several stages is similar to that of the sarcoptic mite, except that they do not burrow.

Control and Treatment

Mites are transmitted by direct contact with a susceptible animal from an infested one, or by contacting infested soil, bedding or equipment. Most mite infestations can be successfully treated with one or more insecticides applied to the animal.

Flies

Flies are one of the most costly parasites. They are not only a nuisance, but cause weight loss and transmit many diseases. Under the general heading of flies are mosquitoes, warble flies, bot flies, horse flies, house flies, stable flies, flesh flies, deer flies, blow flies, black flies, and midges. All of these flies have more than one species. Most flies are **multiple host** parasites, because they feed on one animal then another, biting and sucking blood. During the fly season, these pests are a constant nuisance and source of irritation. Animals defend themselves against the parasites continuously instead of eating and resting. This causes weight loss, lowered production and a general state of unthriftiness.

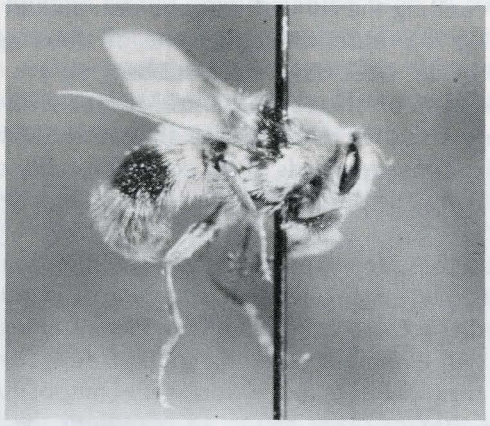
Some flies, such as the bot fly, screwworm fly and blow fly, in the adult stage (called flies) cause little discomfort to animals. The larval stages of these parasites, however, invade various animal tissues, causing severe damage and, in some cases, death. Infestation of tissues by larval (called maggots) stages of flies is called **myiasis.** The maggots of several flies invade tissue during their life cycle and the most notable of these is the screwworm fly. The house fly and some species of gnats do not bite or damage animal tissues. This does not make them any less important, as they are capable of mechanically transmitting disease organisms. Flies also serve as an **intermediate host** for some internal parasites.

Life Cycle

The egg, larva, pupa and adult stages constitute the life cycle of most species of flies. Environmental conditions necessary for completion of their life cycle through maturity are so variable in the many different species that it is impractical to give an example of each in this lesson. This information, however, is necessary in planning a control program for a specific parasite.

Horse Bots, Cattle Grubs, Wool Maggots and Myiasis in Dogs and Cats

These parasites all have one thing in common although they are very different. They all spend part of their larval life on or inside an animal host. The horse bot and cattle grub are larval stages of the bot fly and heel fly. These two larval stages actually spend the winter months within the warm body of a horse (bots) or a cow (grubs). Remember that these are not worms, but the intermediate stage of an external parasite.



4.4 Adult bot fly—most damage to the host is done by the larval stage of this fly. Actual size is about 3/4".

Since horse bots are so common and there is much interest in horses, the bot fly life cycle will be discussed. The adult fly lays small, light brown eggs on the hair of the chin or lower foreleg. They remain there until, under the activity of warmth and moisture of the mouth and tongue of the horse, the eggs hatch. The larvae transfer on the tongue to the mouth where they embed in the mucous membrane. After a month or so in the mouth, the larvae migrate or are swallowed into the stomach where they attach themselves to the stomach wall. The larvae remains attached to the stomach for 6 to 8 months, releases its hold on the

stomach wall, passes out in manure, develops further on the ground and finally emerges as a fly. The bot life cycle takes nearly a year while the adult fly may only live for a few weeks. The most damage done by the bot is in the stomach where it causes digestive disturbances and sometimes colic (internal pain).

The blow fly (wool maggots, fly strike) affects sheep by depositing eggs in sheep wool next to the moist skin areas particularly around the tail. These eggs hatch into larva (maggots) and begin feeding on the skin surface. As they develop, their own secretions cause severe skin damage, loss of wool, and occasionally death.

Myiasis of dogs and cats is caused by the "flesh loving" larva of certain flies that lay their eggs in small open wounds on these animals. Within a day or two the eggs hatch into larva. This causes extreme discomfort to the dog and cat since the larva actually create a much larger lesion than the original wound. Healing will not occur until these parasites are removed either manually or by the normal progressive development of the life cycle.

You can now understand some of the complexities of parasitism. Remember, what have just been described are external parasites as adults but may be internal parasites in larval stages.

Control and Treatment

Flies may be controlled in two ways: (1) by destroying or repelling the fly with insecticides; and (2) by interrupting reproduction during one of the stages of the life cycle. Dust bags, back rubbers, sprays, pour-ons, and even plastic ear tags impregnated with insecticide are effective methods of killing or repelling the adult fly. Other methods of fly control usually center on breaking the life cycle by cleanup or chemical methods.

Mosquitoes, for example, need stagnant water in which to lay eggs. Chemical spraying of ponds and still bodies of water, including water-catching containers will eliminate breeding spots. House flies and stable flies need manure, moist decomposition of plant matter or other refuse to complete the larval stage of development. Removal of this filth will eliminate a large majority of these pests in the larval stage. All flies, either in the adult or immature stages are susceptible to one or more of the insecticides approved for use on animals.

One of the most successful control programs deals with the reproductive traits of the screwworm fly. Adult screwworms deposit their eggs in open wounds where they hatch and the larvae burrow and feed on living tissue. For years, prevention of screwworm damage was attempted with repellents or bandages. Scientists discovered the screwworm fly's breeding habits has made it possible to limit the reproduction of this pest. The female fly mates only once, and the males can easily be sterilized by irradiation. The Department of Agriculture raised male screwworm flies by the millions, sterilizing and releasing them by aircraft in affected areas. Then when the females mate with a sterile male, nonfertile eggs are produced. This program has been so successful the screwworm is nearly nonexistent in controlled areas.

Lice

Lice (singular: louse) are external parasites of humans and animals. They are classified as **biting lice** and **sucking lice.** Infestation by lice is called pediculosis. Lice are small, flat, wingless insects with three pairs of legs. All domestic animals may become infested with one or more species of lice. Lice annoy the animal and transmit disease. Infestation by most species of lice on farm animals is more apparent in the late fall and winter. In cases of severe infestation, animals and poultry become unthrifty. There may be a

4.5 Lice-infested hog. This type of louse is approximately 1/4" long.

loss of hair or feathers, or the undercoat or feathers may have an unkempt appearance. In some instances, blood loss may reach a point where animals become extremely weak, making them susceptible to other diseases. Lice cause irritation and intense itching as a result of the constant biting, sucking and crawling. In an effort to relieve the discomfort, the animal rubs against objects, scratches and bites at its body. Skin abrasions, resulting from this action, may lead to secondary bacterial infection. Lice are quite species-specific (tend to stay on one species of animal); however, there are so many louse species that nearly all animal species, including humans, are subject to infestation.

Life Cycle

The entire life cycle of the **louse** takes place on the host animal. The louse egg is commonly called a **nit.** Nits are glued to the hair shafts by a substance secreted by the louse. Within these nits, the nymph develops. In a week or ten days, the nymph emerges as an immature louse. The immature louse is smaller than the adult but looks similar. The immature louse molts several times and in two to three weeks reaches maturity. A total of three or four weeks are required to complete the life cycle.

Control and Treatment

Lice are usually transmitted from one animal to another by direct contact. If separated from the host, they die in a few days to a week. Nits may continue to hatch for several weeks if removed from the host, but newly-hatched larvae must feed within one or two days or they die. Louse control requires direct application of the insecticide to the animals as well as their living quarters and bedding. Most approved insecticides will control lice. Use only those insecticides approved for use on the species of animal to be treated.

Fleas

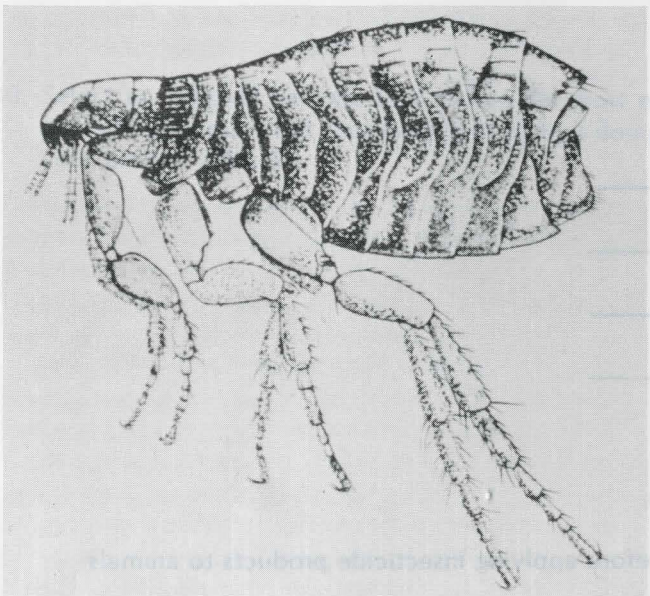
To date, more than 1,000 species of fleas have been identified. They all have the same basic characteristics; small, wingless, flat-sided and blood-sucking. Like other blood-sucking parasites, they are known to transmit diseases, including tularemia, typhus and plague. They also serve as intermediate hosts for several species of tapeworms. Fleas may be found on all animals, including humans, although they are generally thought of as parasites of dogs, cats, rats and other rodents. They cause considerable irritation to their hosts by constant biting and crawling around in the hair and on the skin. They are generally found on the head, shoulders, rump and tail head of the host.

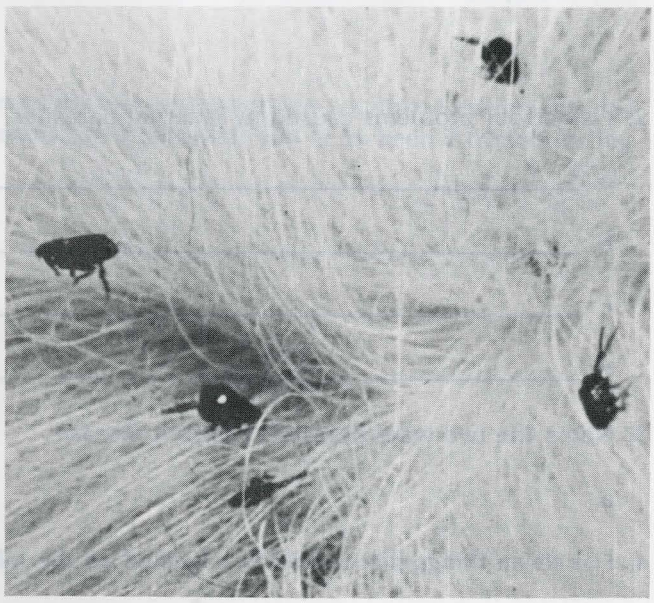
Life Cycle

The egg, larva, pupa and adult stages make up the life cycle of the flea. The eggs are usually laid while the female is on the host, but they soon drop off and hatch into worm-like larvae. They remain in the larval stage for approximately two weeks. After this they spin a tiny cocoon and develop into the pupal stage. If environmental conditions are favorable, the adult emerges in one or two weeks. The minimum time to complete the life cycle is three to six weeks; maximum time ranges from several months to over a year in some species. Adult fleas can live several weeks without food, but need blood to reproduce. When on a host, they usually feed at least once a day.

Control and Treatment

Many insecticides and chemical-impregnated flea collars are effective for controlling fleas on animals, but effectiveness is limited if the animal's living quarters are not treated. As a rule, the same insecticide applied to the animal can be used to treat the environment. Cats and puppies are extremely sensitive to most insecticides, thus care should be taken to use only recommended products. They should also be administered exactly as the label reads.





4.6 Diagram of flea (left) and photograph of actual fleas in the hair of a dog. Flea size is about 1/8".

External Parasites

Member Activity:

1. Define the following:

   a. multiple host parasites

   b. external parasites

   c. nymph

   d. nits

   e. myiasis

   f. pediculosis

   g. species specific

   h. life cycle

2. Name four problems caused by external parasites.

   a. _____

   b. _____

   c. _____

   d. _____

3. Name the two ways parasites transmit disease.

   a. b.

4. List seven things that should be checked on the label before applying insecticide products to animals.

5. Name the four stages in the life cycle of most external parasites.

a. _____

b. _____

c. _____

d. _____

6. In what ways do flies affect animals?

7. Name the type of mite that could infest your project animals. What insecticides should be used to kill this type of mite?

8. How are these parasites transmitted from one animal to another?

a. lice

b. ticks

c. fleas

9. Pick an external parasite. Explain what insecticide you would use to eradicate it and in what form you would use it. Give the advantages and disadvantages of using this particular insecticide.

10. Select an external parasite that causes the most problems in your section of the country. Explain why this parasite is a pest, what your county or state is doing to eradicate it and what you do to keep it from infesting your project animal.

Unit II, Lesson V

INTERNAL PARASITES

Words to Know:

Definitive host: a parasite host in which the parasite reaches the adult stage
Host-specific: parasite preference for one species of animal
Viable: capable of living
Emaciation: an extreme loss of flesh, a wasting of body condition
Rupture: a break or tear of any organ or other soft body parts
Hemorrhage: the escape of blood from the vessels
Anemia: below normal number of red blood cells
Intermediate host: a host harboring an immature form of a parasite at some stage of a parasite's life cycle

After reading this section, you should be able to answer the following questions:

- What types of damage can internal parasites do?
- What are intermediate hosts? Definitive hosts?
- What are direct life cycles and indirect life cycles?
- How can internal parasites be prevented and controlled?

Internal Parasites

As mentioned earlier, any organism that lives at the expense of its host is a parasite. Technically, bacteria, viruses and fungi are parasites. For this project, however, we will refer to internal parasites in animals as being several types of worms that live within an animal.

Internal parasites are destructive in all animals. However, young animals of nearly all species are more susceptible to severe effects. Wild animals, poultry, horses, food animals and companion animals are all susceptible and are frequently parasitized.

As with external parasites, internal parasites affect animals and humans in several ways. Parasitism may retard growth, development, performance and even decrease disease resistance in all species. Parasites can cause tremendous economic loss, poor health and discomfort. Some may cause death while others may be so mild that signs of parasitism are absent. Primary damage from internal parasites may include:

- Tissue destruction
- Obstruction of normal passageways due to the physical presence of the parasite
- Anemia from blood sucking
- Parasite use of nutrients intended for the host
- Discomfort and stress from the presence of certain parasites

The severity of effects in an animal depends on the particular parasite involved. It also depends on the number of parasites, the stage of the life cycle the parasite is in, the age and resistance of the host.

The parasites we will study in this lesson are the helminths, commonly called worms. They are grouped into three general classifications: nematodes (roundworms), cestodes (tapeworms), and trematodes (flukes).

Nematodes - Roundworms

A wide variety of nematodes infect pets and domestic animals. The most commonly occurring ones are the strongyles, ascarids, pinworms, and stomach worms.

Cestodes - Tapeworms

Many species of tapeworms affect pets and domestic animals. Life cycles of the cestodes are complex and usually involve intermediate hosts such as insects or other animals.

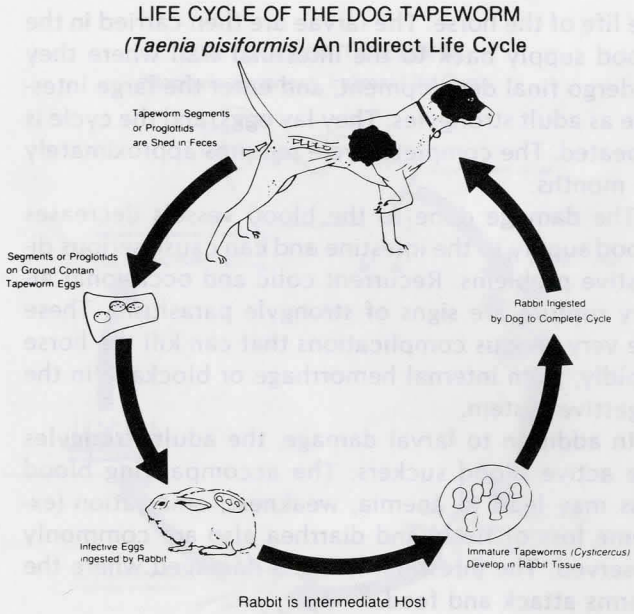
Trematodes - Flukes

Flukes can cause serious damage. However, infestation is not common except where the snail population is great, as the snail is necessary for completion of the life cycle.

Internal Parasite Characteristics and Life Cycles

Each parasite seems to prefer a specific animal host. When an adult worm is specific for a certain host, that host is called the **definitive host.** Many worm parasites require one or two other animals or insects as **intermediate hosts** before they can complete their life cycle and mature in the definitive host.

Worm parasites have varied life cycles. However, they may be classified as having **direct** or **indirect cycles.** In the **direct cycle,** the adult worm lays fertile eggs while in the host. These eggs usually pass out



5.1 A life cycle of the dog tapeworm. This is an indirect life cycle.

with the feces (manure) and become infective to the definitive host again. Those parasites having an **indirect life cycle** spend their intermediate life in one or more other hosts. After maturing they become infective when ingested by the definitive host. For example, one species of dog tapeworm spends its larval stages in the flea, after the flea has ingested the worm egg. Then the flea must be ingested by the dog to complete the life cycle. This type of tapeworm can even affect humans if the infective flea is ingested.

The characteristics of internal parasites are important to know if control is to be effective. To just deworm an animal without considering where new infection will occur is not good control. You must work on management, sanitation, and other sources such as the intermediate parasite host as in the example of the flea. In that case, flea control would be very important. This would reduce the possibility of tapeworm reinfection or transmission to other pests or people.

Internal Parasite Prevention and Management Procedures

Most internal parasites are host-specific (those that prefer one species) and rarely infect other animal species. Under farm conditions it is unlikely to raise parasite-free animals. However, it is possible to devise programs that reduce parasitism.

Basically, methods of sanitation and reducing the number of parasite eggs present are the keys to control of most internal parasites. Routine deworming of known infective hosts will reduce egg numbers. Remember that eggs are passed from one host in their manure. Reinfection occurs upon ingestion of these eggs by a susceptible animal. Anything that reduces the concentration of eggs will reduce the level of reinfection.

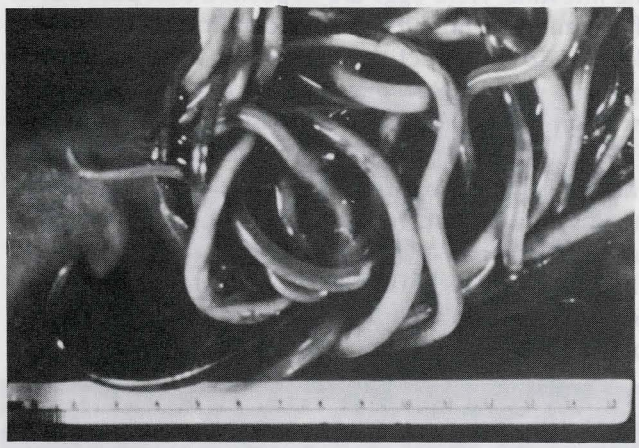
These steps are only a part of good control. It is necessary to develop management methods that are effective, practical and economical. Physical condition of the animal is also important. Since parasite damage is more severe in the malnourished animal, proper nutrition will tend to reduce parasite effect. Your goal should be to reduce high concentrations of infected animals, reduce ground contamination, and thus reduce high new infection rates. This can be accomplished by pasture rotation, not overgrazing, reseeding of pastures, cleaning holding facilities daily, and avoiding manure contamination of feed and water.

Spreading of manure piles exposes worm eggs to drying and the destructive effects of sunlight. Warmth and moisture in the environment favors parasite egg development and infection. For companion animals, similar parasite transmission exists, but reduced parasitism is possible since food contamination by feces can be controlled easier.

Internal Parasites and Disease

In this lesson some of the more common domestic animal parasites are described. Their life cycles, migrations through the body, the damage that can occur and their control will be emphasized.

Ascarids



5.2 A mass of adult ascarids shown in approximate size. Measure is 15 inches long.

Ascarids are a type of roundworm and one of the most important worm species affecting livestock and pets. Ascarids do minor damage to the animal except when the adult parasites are so numerous they actually block the intestine or liver bile duct. The migrating ascarid larvae create most of the damage. Adult female ascarids lay thousands of eggs a day. Eggs are passed out in the manure causing ground contamination. The eggs are resistant to adverse environmental changes and remain alive for years. When ingested, the larvae emerge from the egg in the intestine. They then penetrate the intestinal wall and are carried in

the blood to the liver or other organs. Here they develop further, causing more tissue damage. As the larval stage progresses, they are transported in the blood to the lungs where they are coughed up and swallowed. They locate in the small intestine and grow to become adults. Development from the egg, larva migration and return to the intestine takes from 7 to 8 weeks in swine but vary from this in other species.

This pattern of worm larva migration illustrates the complexity of parasitism and may bear little relationship to the concept we generally associate with worms.

In the young, a "pot" belly, dry hair coat, unthriftiness, poor weight gain and coughing are typical signs of ascarid infection. Roundworms respond well to oral worm medication. But a single dose of the drug is not sufficient as the description of the life cycle illustrates. It will not kill the larvae, so new adults develop. Treatment repeated frequently and good management are necessary for control.

Strongyles

Three strongyles *Strongylus vulgaris, S. edentatus* and *S. equinus* are very important equine internal parasites. Although these parasites are termed large strongyles, they are quite small measuring 1-2 inches in length. The large strongyles of horses are also known as bloodworms. The adult strongyles inhabit the intestine. Here eggs are deposited that pass out in the manure. Under favorable conditions, the larvae develop to the infective stage within 7 days after the eggs are passed. New infection occurs by ingestion of infective larvae, which move to the large intestine. The *S. vulgaris* larvae (the most damaging strongyle) then penetrate the intestinal wall, and migrate to the nearby small blood vessels. Their migration continues upward to larger blood vessels that supply blood to the intestines and rear legs. This migratory period of 6-8 weeks results in arterial inflammation, blood supply blockage and blood clots, all that can endanger the life of the horse. The larvae are then carried in the blood supply back to the intestinal wall where they undergo final development, and enter the large intestine as adult strongyles. They lay eggs, and the cycle is repeated. The complete cycle requires approximately six months.

5.3 Although these strongyles are only 1 to 1½ inches long, they and their larval stage can be devastating to the horse.

The damage done to the blood vessels decreases blood supply to the intestine and can cause serious digestive problems. Recurrent colic and occasional artery rupture are signs of strongyle parasitism. These are very serious complications that can kill the horse rapidly, from internal hemorrhage or blockage in the digestive system.

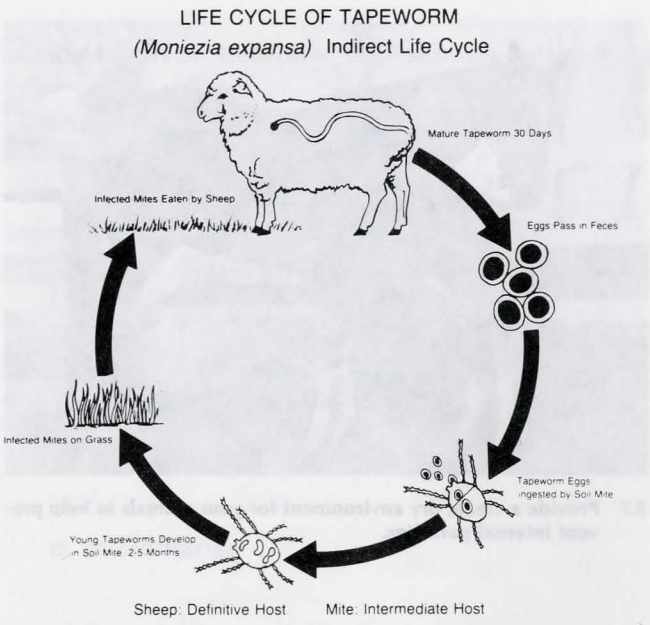
In addition to larval damage, the adult strongyles are active blood suckers. The accompanying blood loss may lead to anemia, weakness, emaciation (extreme loss of flesh) and diarrhea also are commonly observed. The intestinal lining is damaged where the worms attack and feed.

During the very serious larval phase of their life, strongyles are difficult to kill with conventional dewormers. Therefore, control programs stressing prevention of new infection with routine deworming treatments are recommended. Deworming all horses regularly every six to eight weeks is helpful, but it will not eliminate all strongyles. Several good dewormers are available as granules, pastes, liquids and boluses. A new injectable dewormer for horses has just become available that appears to have great merit. It is apparently effective against both larval and mature stages of worms. Anyone who owns horses should be aware of these costly and dangerous parasites. To prevent worm resistance from developing, drugs possibly should be alternated. Strongyle control is an essential component of an equine health program.

Internal Parasites in Sheep

Of the domestic livestock species, sheep are very susceptible to infection with stomach worms. Blood-sucking worms are common in sheep and occur in massive numbers. Under certain conditions, parasitism in sheep can give the impression of an acute infection from other causes. Sheep grazing a heavily contaminated pasture can incur massive infection rates which can result in death. Warm, moist conditions encourage outbreaks such as this since the total life cycle can be completed in a time span as short as 8 to 9 days.

Signs of parasitism in sheep may include general unthriftiness, diarrhea, and rough hair coat. If the worm level is moderate and nutrition is adequate, external evidence of parasitism may be absent. Repeated treatment is quite effective in reducing the parasite load but reinfection is quite rapid. Diagnosis is generally confirmed by microscopic identification of worm eggs in manure samples.



5.4 Life cycle of the tapeworm in sheep.

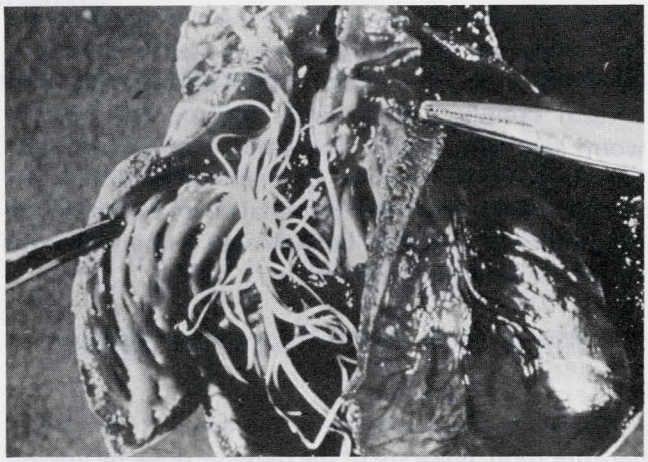
Internal Parasites in Dogs and Cats

In the dog and cat, ascarids and other roundworms (especially hookworms), create the most serious problem.

The hookworm in the dog is a small parasite that sucks blood from the intestine. Sometimes the parasitism is great enough to cause anemia, weakness, and even death, the primary signs in young animals. Hookworm infection may occur from direct, larval ingestion, or penetration of the skin. Occasionally even prior to birth the unborn puppy may become infected by migrating larva.

Heartworm of the Dog

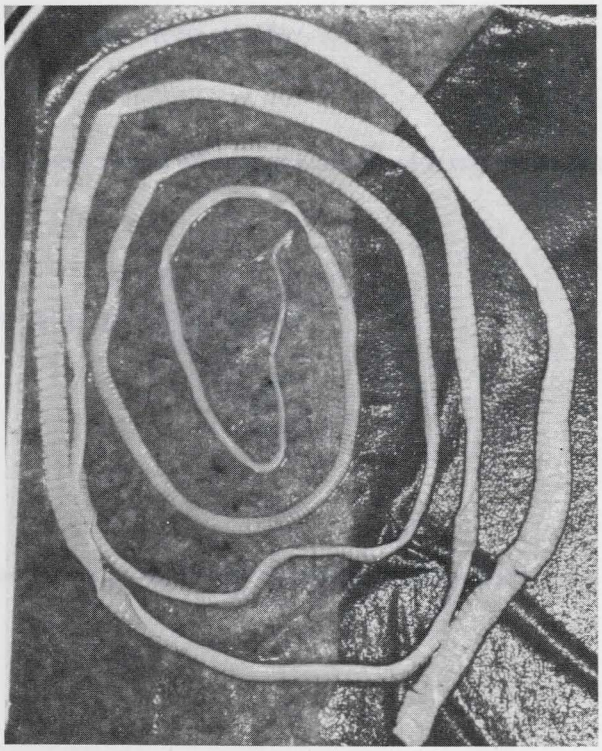
The heartworm is another internal parasite of the dog that is interesting, and can cause serious complications. Occasionally the heartworm infects cats and even more rarely humans. The adult worm lives within the heart, and releases an immature form to the bloodstream. These are actually immature embryos called microfilariae. These are incapable of further development until ingested by certain mosquito species. The mosquito serves as the intermediate host and ingests the microfilariae while feeding on the infected dog. Within the mosquito, larval development continues. When the mosquito feeds again on another dog, the parasite is transferred again to the definitive host. Development to adult heartworm may take several months. Then the cycle begins again.



5.5 Photo of adult heartworms within the heart.

Tapeworms

Tapeworms do not usually produce severe, well-defined signs or symptoms in dogs or cats. There are some species of animal tapeworms that can infect humans. The number of infecting tapeworms, the age and condition of the host influences the degree and severity of infection. Signs are usually those of unthriftiness, irritability, shaggy coat, colic, mild diarrhea and poor physical condition. In dogs, passage of tapeworm segments that may cling to the posterior (rear) end of the dog proves tapeworm infection. Also, the presence of tapeworm eggs in the feces under microscopic examination is diagnostic for tapeworm infection.



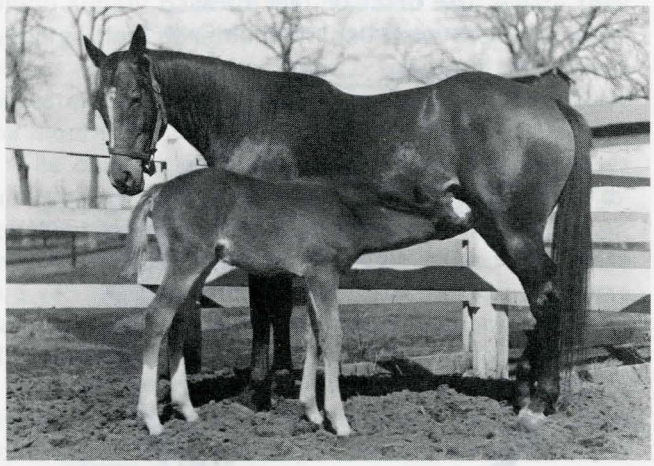
5.6 Tapeworm showing segmented parts.

Identification of the parasite type is essential before treatment begins. The type is usually identified by microscopic examination of the parasite egg from a fecal sample. Certain drugs destroy one type of worm and not another. The amount of anthelmintic (dewormer) used must be determined accurately, as drugs used for deworming animals may be toxic. Follow-up deworming may be indicated and instructions should be followed explicitly.

Important Parasitism Reminder

Many people treat their animals for the adult parasite form, unaware of the damage done by migrating larvae. It is important to know the life cycles of the individual worms in order to break the cycle. A well-planned parasite control program is based on the knowledge of the life cycles, a sound prevention program, and a regular treatment schedule. The veterinarian is the only one qualified to give sound advice on this subject.

For cattle, sheep and horses, the pasture areas should be rotated every few months. In swine, the premises must be clean. These animals should be treated two or three times a year. Periodic fecal examinations will aid in determining the need for additional treatments. Fecal examinations for dogs and cats should be made periodically, and sanitation practices should be used in their living spaces. Again, good management will reduce disease problems.



5.7 Provide a clean, dry environment for your animals to help prevent internal parasites.

Internal Parasites

Member Activity: Complete the following information about the reading material.

1. Define the following:

   a. intermediate hosts

   b. host-specific

   c. definitive hosts

   d. microfilariae

   e. direct life cycle

   f. indirect life cyle

2. Why is diet important when animals are infected with parasites?

3. Which would you treat first, the adult worm parasites or their larval forms? Why?

4. If your project animal had tapeworms, explain the treatment you would administer, along with the name and the amount of the drug used.

5. If your project animal was infected with hookworms, what signs would it exhibit?

6. Explain the life cycle of the large roundworm (ascarid).

7. In your opinion, what is the most important sanitary measure to be followed to prevent reinfection?

8. Explain any prevention program you have in effect.

9. Select one or two parasites that are commonly found in your project animal. Research their life cycles, effects upon the host, preventive measures and treatment drugs.

Optional for Further Reading:

10. What parasites can be transmitted to humans from animals? Are the effects of the parasite the same in both animals and humans? Are the methods of treatment the same?

NUTRITION AND DISEASE

Words to Know:

Maintenance requirements: amount of nutrients required by an animal to maintain itself when it is not at work, pregnant or lactating.

Lactation: production of milk.

Metabolism: the complex chemical changes nutrients undergo to maintain a living organism.

Nutrients: substances required by living organisms for growth, maintenance, production, reproduction and lactation.

Essential nutrients: those nutrients not produced by the body.

After reading this section you should be able to answer the following questions:

- Explain what energy nutrients are. Name two major energy nutrients.
- How are proteins used in an animal's body?
- Give the two categories of minerals.
- What role does water play in a balanced diet?
- Name the stages of nutrition.
- Give four possible reasons for nutritional disease in an animal.

Nutrition and Disease

The importance of animal nutrition cannot be overemphasized as it relates to animal production, health and disease. **Nutrition** is defined as a function of living plants and animals that consists of the taking in, digestion and assimilation (utilization) of material so that tissue is built up and energy is released. Proper nutrition means more than just feeding. Nutritional requirements vary between animals due to many factors. These factors include much more than quality and quantity of food.

Animals are similar to people. At one level of nutrition some get thin, some stay the same, and some gain weight. For an animal to remain at a constant weight, it must be fed a maintenance requirement. Alert animal owners recognize the individual animal variation and will adjust to its needs. With this as a base, further nutritional requirements are needed for growth, pregnancy, lactation, and activity. This demonstrates that feeding animals adequately is not left to guesswork.

Nutrition does have an important bearing on disease. The immune system is the ultimate factor in protection against disease. Poor nutrition can cause deficiency disorders that can impair the efficiency of this system.

Energy Nutrients

Every movement made by the body, both voluntary and involuntary, requires energy. Energy nutrients provide fuel for the body's activities. After food is digested, energy nutrients are carried to the body tissues by the blood, to be used for energy. During movement, the nutrients are "burned" by the body, giving off heat. This is how body temperature of an animal is maintained.

Carbohydrates are the main energy nutrients. They are composed of complex compounds of carbon, hydrogen and oxygen. Carbon is the essential element of carbohydrates. Sugars are examples of simple carbohydrates while starch and cellulose are examples of the more complex carbohydrates. Corn and some forages are examples of high carbohydrate feeds. Animals digest sugars and starches with ease and receive a high feeding value (more energy) from them. Plants, largely composed of cellulose, are difficult to digest, due to the high fiber content. However, some animals are well adapted to digest high fiber feed (hay).

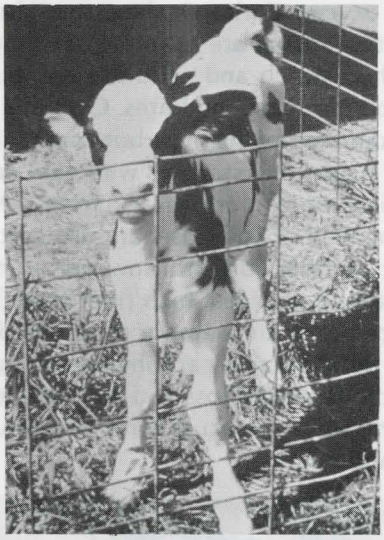
Hypoglycemia is an example of a disorder caused by a direct deficiency in carbohydrates. Signs of this problem include weight loss and lack of energy in the chronic form, while the acute form may result in chilling, coma and death.

6.1 Hypoglycemia occurs when a deficient amount of carbohydrates are fed.

Fats are also energy nutrients made up of carbon, hydrogen and oxygen. They contain more carbon and hydrogen and less oxygen than carbohydrates. Because of this, they are able to produce more energy than equal weights of carbohydrates. Fats may be formed in the body by conversion of excess carbohydrates. Or they may be ingested and used directly as fat from plant or animal origin. They are deposited in the tissue spaces under the skin and throughout other tissues in the body and are used for a reserve energy source.

Tissue Building Nutrients

While carbohydrates and fats supply the animal with energy, proteins supply the body with complex chemical compounds. These compounds are called amino acids, which help build body tissues. **Proteins** contain carbon, hydrogen, oxygen, and nitrogen and some also contain sulfur, phosphorus or iron. During digestion, proteins in the food are broken down to amino acids which are taken into the bloodstream. Cells absorb them and build new proteins in the animal system. These proteins then become part of the protoplasm to aid in growing or repairing body tissues. Since protein is only stored in small amounts in the body, an adequate supply must be available in the feed. Good quality alfalfa and soybean meals are examples of high protein feeds.



6.2 Healthy calf and deficient calf. Deficiency in protein or other nutrients can result in poor growth and unthrifty appearance.

Proteins eventually become muscle, internal organs, bone and blood. Skin, wool, feathers, hair, horns, nails and hooves are also made of protein. The excess nitrogen portion of the protein that is not used is excreted and voided in the urine. The remaining portion of these compounds are then available to use as energy.

Deficiencies in protein may result in impaired growth, pot-bellied appearance, and sometimes accumulation of fluid under the skin (edema).

Vitamins are organic substances found in small amounts in foods. They are essential to normal metabolism. An animal requires large quantities of energy nutrients and proteins. However, only a small amount of vitamins are essential to maintain health. When vitamins were first named in 1911, letters were used to designate each group such as Vitamin A, B, or C. When it was later discovered that vitamins were complex compounds, numbers were added to the letter for identification, such as B_1 or B_2. Today, vitamins have chemical names, but are still referred to by letters and numbers for easy identification.

Vitamin deficiency may cause a variety of diseases depending upon which vitamin is lacking. No two vitamins are chemically similar or have the same job in the body. Some may be stored by the animal but most must be replenished constantly. Only one, vitamin D, is produced by the animal through the help of sunlight. The best way to maintain and supply vitamins is with a balanced diet.

Vitamin A may be found in the carotene in green grass; vitamin D in sun-cured hay; vitamin B complex can be manufactured in the rumen of ruminant animals and also may be found in yeast, milk and hay; vitamin C is made by livestock metabolic processes or may be found in fresh fruits and vegetables; vitamin E is found in good hay and grain; and vitamin K may be found in good hay and also can be manufactured in the rumen. Synthetic sources of the fat-soluble vitamins are available and are often added to diets in the form of vitamin premixes or pacs.

To function properly, the body must have a continual supply of fresh water. This requirement is met by (1) obtaining water in food; (2) oxidation (which is a metabolic process) in cells with water produced as a by-product; and (3) drinking water. The amount of water required by an animal varies with the temperature, humidity and amount of body activity such as exercise or lactation.

Diseases from vitamin deficiencies are quite common and can be prevented by balancing the diet. Vitamin A is necessary for the development of healthy epi-

thelial tissue. This tissue is very important and is found in every part of the body. Deficiency of vitamin A can cause a variety of problems including night blindness, retarded growth and greater susceptibility to infections. Another example of a vitamin deficiency disease is rickets, a bone development disease. A deficiency of vitamin D disturbs the proper use of calcium and phosphorus needed for proper bone growth.

Minerals are naturally-occurring inorganic chemical substances that are essential to animal life. There are at least 15 mineral elements known to be required by animals.

These mineral elements are grouped into two categories: (1) the major minerals consisting of calcium, phosphorus, sodium, chlorine, magnesium, potassium, and sulfur and (2) the trace minerals known to be **essential** in very small amounts. The trace minerals include iron, copper, iodine, zinc, cobalt, manganese and several others.

Mineral supplementation is necessary when the feed supplies insufficient quantities. The required amount depends upon feed type, its quality, condition and the type of animal receiving the feed. For example, fast-growing, young animals will need supplemental calcium and phosphorus for bone development, while a heavily-lactating cow may need supplemental salt NaCl (sodium chloride) to maintain high production.

An animal completely deficient in iron (a trace mineral) will develop anemia (a blood disorder) and can die if the condition is not corrected. Iron and other minerals are essential for the body to make hemoglobin and red blood cells necessary for carrying oxygen.

Other essential trace minerals are just as important and in some cases can cause severe illness and death if either is supplied in too large or small quantities.

Water

Because it is so common, we seldom think of water as essential to a balanced diet. However, it is more important than food. It makes up most of the total body weight of animals and humans. The fluid part of the blood, called **plasma,** is 91 to 92 percent water. Water helps take food and waste products to and from body tissues. It moves nutrients from the digestive tract to the blood, and removes tissue wastes from the body through the skin as sweat and through the kidneys as urine. Loss of water results in **dehydration** and if not controlled can cause eventual death. Water also helps regulate body heat when sweat **evaporates** from the body surfaces.

The Stages of Nutrition

The successive stages of nutrition are digestion, absorption, assimilation and excretion. These stages were discussed in Unit I as the steps necessary to convert food into usable nutrients. These nutrients come from carbohydrates, fats, proteins, minerals, water and vitamins. They are assimilated in all parts of the body where they become body tissue, are stored as fat, or are used for energy. The process of using these absorbed nutrient products is called **metabolism.** Each of the end products is metabolized in a different way depending upon the tissue and its function.

Carbohydrates, fat, and protein metabolism involves so many complex chemical interactions it is not practical to discuss them here. However, a major point to be considered is that even if the ration ingested is balanced, there can still be nutritional disease if any disorder impairs the digestive and metabolic processes that prevent assimilation of essential nutrients. Examples of this may include intestinal blockage which inhibits digestion or possibly pancreas malfunction that disturbs normal carbohydrate metabolism.

Treatment of Nutritional Deficiencies

If animals are doing poorly, an attempt should be made promptly to determine the cause. Frequently nutritional deficiencies are the cause. To determine the absence of essential nutrients a chemical analysis of the ration must be done. Usually a correction in the diet will solve the problem. However, there are times when certain feed ingredients are not available in the feed sources and these nutrients would then have to be supplied with a supplemental additive or injectable medication.

Rarely, there are some animals and humans unable to assimilate certain nutrients by normal digestive processes. These require injections of certain refined vitamins, minerals or other nutrients to continue living. Many medical developments in nutrition have prevented suffering, and extended the lives of animals and people afflicted with these disorders.

6.3 Some nutritional diseases require supplemental medication to enable the animal to continue living.

Following illnesses, animals should have the best balanced nutrients available in correct quantities to hasten recovery. Remember, carbohydrates and fats to supply energy, protein to repair and build tissue and vitamins, minerals and clean, fresh water are all necessary for a quick recovery.

Nutritional Disease Prevention

You now are aware of the importance of proper nutrition for yourself and your animals. To properly nourish your animal, the diet must be adequate in amount and contain the right proportion of various nutrients. If the diet is lacking either of these, you are feeding an unbalanced ration. As mentioned, nutritional disease may occur due to unbalanced rations, poor digestion, absorption or metabolism. This can create a tendency to develop other diseases, causing poor growth and weight gains, low production and decreased fertility. These items increase costs thus reducing profits to livestock owners.

By learning more about nutrition, you will be able to formulate a balanced ration for your animals. Use these guidelines and get more information from your veterinarian, state university representatives, Extension agents, USDA publications and other technical service people. The feeding program you develop must meet the needs of your animals and it will be worth the effort. As with other causes of disease, many losses can be controlled by good management. A good manager knows how to properly feed animals. Remember, the basic facts to consider when formulating rations are:

1. Species of animal
2. Type of feed available
3. Feed quality and quantity
4. Stage of Production
   a. Maintenance requirement
   b. Age - growing or not
   c. Pregnant
   d. Lactating mammals and poultry laying eggs
   e. Activity - hard working or mostly at rest
5. Feed Costs - is this feasible in your project?

Nutrition and Disease

1. Define the following terms:

   a. protein

   b. nutrition

   c. amino acids

   d. major minerals

   e. trace minerals

   f. metabolism

   g. digestion

2. What is the purpose of feeding a ration high in nutritional value?

3. What are five main types of nutrients?

4. What nutrient is formed in the body by conversion of excess carbohydrates?

5. Give the two types of carbohydrates and explain the difference between them.

6. What difference is found in the make-up of fats and carbohydrates?

7. The _____ are the building blocks of the body.

8. What diseases could affect your project animal if vitamin D were removed from the diet?

9. What principles must you follow when planning a feeding program?

10. What people or resources would you contact in your area to find out the correct way to use nutrient requirement tables?

11. Choose a nutritional disease. Explain what causes it, symptoms and treatments.

12. On the chart below name feed factors to consider to maintain animal comfort.

    a. Prolonged cold weather - adult animal _____

    b. Normal weather - growing animal _____

    c. Cold weather - heavily exercised animal _____

13. Feed list. Complete the chart (High, Medium, Low)

	Carbohydrate	Fats	Protein
a. Hay	_____	_____	_____
b. Grain	_____	_____	_____
c. Soybean Meal	_____	_____	_____

Unit II, Lesson VII

POISONS AND DISEASE

Words to Know:

Toxins: noxious or poisonous substances
Neurotoxins: toxins that affect the nervous system
Zootoxins: toxins derived from animals (for example, bee stings, snake venom)
Phytotoxins: toxins derived from plants (for example, poison ivy)

After reading this section you should be able to answer the following questions:

- What are poisons?
- Why do the majority of the poisoning cases occur?
- What steps should you take if you feel your animal has been poisoned?
- What are two reasons for salt poisoning?
- How do organophosphates cause poisoning?
- What can the long term action of antifreeze poisoning be?

Poisons and Disease

Disease involves the effects of adverse environmental conditions and the response by which the body tissues attempt to neutralize or overcome the effects. Poisons (toxins) are frequently present in the environment where domestic animals live. Therefore, they pose a constant threat just as with other disease agents.

Poisons are substances which chemically disturb or upset normal tissue function and activities and produce disease. The size of the dose is generally proportionate to the damage caused. Poisons do not perpetuate themselves but can accumulate if poorly excreted. A poison that is cumulative may be nontoxic at first but as more is taken in it accumulates to a toxic level. Sometimes poisons cause necrosis (death) of the cells contacted. Some poisons may affect breathing or digestion, while others may involve the nervous or other systems. A few poisons can stimulate production of neutralizing antibodies as do bacteria and viruses, but most poisons do not stimulate the immune system. There are even essential nutrients, which if fed in excess, are toxic and result in disease. Vitamins A and D and sodium chloride (salt) are examples of essential nutrients that have caused livestock poisonings.

7.1 Handling chemicals and animal sprays correctly can prevent accidental poisonings.

Poisons and how they relate to animal health are interesting. A majority of the poisoning problems that occur are due to negligence on the part of the animal owner. Over 2,000 man-made chemicals are considered toxic and new ones are being introduced each year. Our animals are required to live in the environment we provide for them. If we force animals to live in adverse housing or if they must consume contaminated food or water, the chance of poisoning increases. Poor animal husbandry practices contribute to the conditions that cause poisonings. Alert veterinarians recognize these factors and will associate the high risk to animals belonging to poor managers. Something as innocent as overfeeding or overgrazing pastures can sometimes cause disasters. Animals generally will not consume toxic plants if there is other forage or grass available. Overfeeding grain, in some instances, is very toxic and may cause death.

Poison Exposure

Generally animal exposure to poisons are by the oral (ingested) route but there are other means in which exposure occurs. "Pour-on" insecticides, sprays, injections, and inhalation poisonings are not uncommon.

Sources of Poisons

1. Orally-consumed toxins:
   a) Normal feed - too much grain can be toxic.
   b) Normal feed - carrying high levels of nitrates, cyanide or other toxins.
   c) Poisonous plants.

d) Feed additives - growth stimulants or medications.
e) Deprivation of water - causes salt poisoning.
f) Accidentally added to feed or water - insecticides, herbicides, fertilizer and others.

2. Environmental Poisons
a) Agricultural chemicals - insecticides, herbicides, fungicides.
b) Industrial chemicals - heavy metals (lead, mercury, copper), polybrominated biphenyls (PBB).
c) Oil products.
d) Antifreeze - methanol and ethylene glycol.
e) Gases - carbon monoxide, hydrogen sulfide - poor ventilation.

3. Biotoxins
a) Zootoxins - Venomous animals (snakes and insects).
b) Fungi - mycotoxins (mold toxins).
c) Bacteria - endotoxins and exotoxins.
d) Allergens - pollens, hair, and other
e) Phytotoxins - plant origin.

4. Drugs and Medications - injectable and oral
a) Dewormers and antibiotics.
b) Insecticides - sprays, pour-ons, dips
c) Adverse or anaphylactic (shock) reactions

Poisoning of domestic animals is common due to the current widespread use of agricultural chemicals that cause accidental intoxications. It is important that the public is aware of the dangers of these chemicals. As with other diseases, poisons can create acute or chronic disorders, depending upon the toxin, its dose and how exposure occurred. Some of the more common poisoning of animals will be described and the management procedures that should be initiated if poisoning occurs.

7.2 Improper storage and disposal can sometimes cause accidental poisonings.

Important Priorities in Animal Poison Cases

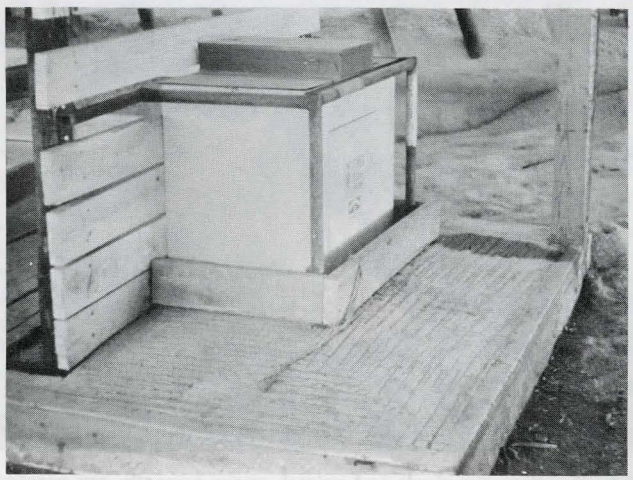
- Call a veterinarian immediately.
- Prevent further exposure. Remove animal from source.
- Attempt to determine the source and type of poison.
- Read the label on chemical container, if available, for emergency instructions.

There are so many types of poisonings, it is not feasible or practical to attempt a description of each. Therefore, only a brief description of salt poisoning and organophosphate insecticide poisoning in animals and antifreeze poisoning in dogs and cats is included in this lesson.

Salt Poisoning

Salt poisoning is also called water deprivation. Actually it is a poor name because the condition does not occur unless water is unavailable for the animal to drink. Salt poisoning can occur from two causes and is due to man's negligence in proper livestock management. The first cause occurs when an excess of salt is ingested with feed along with a limited water supply. The second cause occurs when animals have no access to water at all. The poisoning signs and effects of salt poisoning are identical and can be very serious. Animals can go several weeks without feed but in a few days without water they become uneasy or sick and many may die. Hot weather aggravates the condition. Signs include: restlessness, calling out, depression of appetite, dehydration, and constipation. Convulsions and coma may precede death. Fresh water must be available at all times. Check your watering tanks daily because water supply failures account for the majority of salt poisoning cases.

Treatment for salt poisoning is usually ineffective.



7.3 Properly operating waterers can prevent "salt poisoning" in livestock.

Organophosphate Toxicities

Due to the many compounds from this group of chemicals that are used in agriculture, accidental poisonings are common. Organophosphate toxicities affect the nervous system, mainly in the nerve synapses where a normal body chemical, acetylcholine, is produced. This chemical is normally quickly hydrolyzed (a chemical reaction) by the enzyme cholinesterase, therefore stopping the nerve signal. The organophosphates inhibit the action of cholinesterase. This allows acetylcholine to remain at the synapses. If acetylcholine remains, a continuous nerve stimulation exists which accounts for the tremors and convulsions seen early in this type of poisoning. Paralysis may eventually occur due to exhausted muscles being unable to respond to continuous nerve impulses. Signs of organophosphate poisoning, in addition to the muscle spasms, may include salivation, diarrhea, difficult breathing, and sweating. Death usually occurs from lack of oxygen because of harm done to the respiratory system.

The progression of serious effects is rapid and corrective procedures must be started immediately by a veterinarian.

Animals exposed and poisoned by "pour-on" or surface type organophosphate insecticides should be washed thoroughly with soap and water to reduce further absorption of the insecticide.

Antifreeze Poisoning

Antifreeze (ethylene glycol) poisoning in dogs and cats is quite common, especially in the fall of the year when antifreeze compounds are used before cold weather. This type of antifreeze has a rather sweet taste and is, therefore, readily consumed by some animals.

The action of this poison may cause an early acidosis (over acid) of the blood, which is serious. However, further damage occurs later to the kidneys. This damage is sometimes so severe that if death did not occur from acidosis, probably uremia from kidney failure would cause death.

The signs exhibited from this poisoning may include depression, staggering, and vomiting, followed by coma 6 to 12 hours after ingestion. Signs will vary according to the dose ingested.

Treatment of this toxicity can be favorable if the dosage ingested is not too high and treatment starts soon enough. A veterinarian must be contacted immediately so that drugs can be administered which counteract acidosis and the adverse action that is apt to occur to the kidneys.

General Information

Many acutely sick animals, regardless of the cause, may be brought to the veterinarian whether poisoning has occurred or not. Immediate treatment must be started just based on symptoms observed because the animal's life may be endangered. It is very important to have a history of conditions that occurred recently, and especially information about recent insecticide, or other chemical use in the area so better medical decisions can be made. Labels from suspected containers of toxic materials can be very important if animals have been exposed to them.

Instructions to the owner of poisoned animals may include:

- Keep the animal warm or comfortable.
- Clean chemical from the skin surface with water if chemical was exposed only to the surface.
- Avoid exposing yourself to the toxic chemical (use rubber gloves).
- Remove animal from further exposure.

Food poisoning of pets is actually one of the most common of all poisonings. Careful storage of food is important. Keep pets from eating garbage because molds, bacterial toxins or other poisons can be present.

7.4 Proper containment of garbage can prevent some types of food poisoning of your dog or cat.

As with all other disease-causing agents, toxicity prevention is linked directly to proper management. Negligence and carelessness cannot be tolerated when dealing with chemicals around animals. Particular attention must be devoted to handling and storing common household products. This is a common source of problems and can be extremely dangerous to both animal and human life.

Poisons and Disease

1. Define the following terms:

   a. zootoxins

   b. phytotoxins

   c. cumulative poison

   d. poison

   e. anaphylactic

2. What are the categories poisons are classified into?

3. List some of the more common chemical poisons.

4. List some of the common poisonous plants found in your area. Explain how you should eradicate them.

5. What are organophosphates? What biological affects do organophosphates have?

6. How do poisonous plants constitute a hazard to grazing animals?

7. Give the two reasons for salt poisoning. How can this problem be eliminated?

8. What does this phrase mean? "The size of the dose of poison is generally proportional to the damage that is caused."

9. Choose an example of a chemical, plant or insecticide poison and discuss the effects it would have on your project animal. Find out the symptoms, treatment, long range effects of the poisoning, and preventive measures.

10. Which poison is most likely to be in contact with your project animal.

    a. Decomposed garbage

    b. Rat and mouse poison

    c. Antifreeze

    d. Agricultural insecticides

    e. Poisonous plants

11. Describe procedures to follow if your animal is exposed to items in question 10.

STRESS AND DISEASE

Words to Know:

Stressors: factors that can produce stress
Stress: the body's response to demands placed on it
Environment: everything living and nonliving surrounding an animal
Eustress: a favorable stress

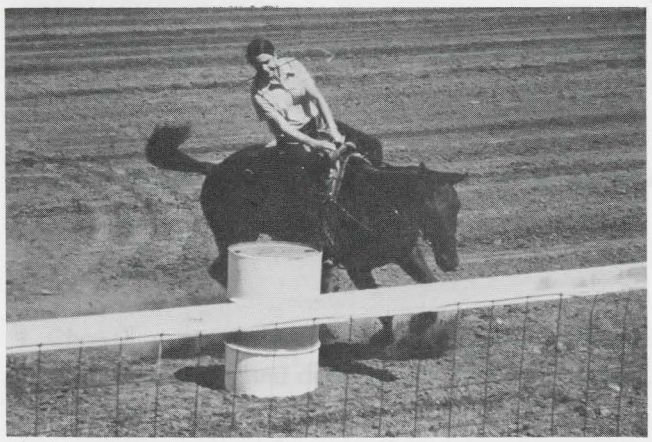
After reading this section you should be able to answer the following questions:

- Explain what stress is. Give 10 examples of stress.
- What variables determine an animal's reaction to stress.
- Give the three stages of bodily response to stress.
- Explain how good management can reduce stress.

Stress and Disease

Stress can be defined as the body's nonspecific response to any demand placed on it, whether the demand is pleasant or unpleasant. This condition can be either natural or man-made. Natural conditions may include environmental, uncomfortable weather or possibly the natural habits of the animal which may be enjoyable, yet stressful. These factors that can produce stress are called stressors.

It is impossible to avoid all stress conditions, and, in fact, this would be undesirable. To keep animals healthy, they should be exercised (a type of stress) to maintain proper physiological body function. The term **eustress** is a new word that means favorable stress. Therefore, it is very important to recognize conditions that produce **excess** stress over a prolonged period. Prolonged exposure to stressors can lead to disease problems whether you are in livestock production or merely caring for your pet.



8.1 Exercising your animal creates a type of stress that is favorable and necessary.

maintain proper physiological body function. Therefore, it is very important to recognize conditions that produce **excess** stress over a prolonged period. Prolonged exposure to stressors can lead to disease problems whether you are in livestock production or merely caring for your pet.

The effects of stressors on an animal can be quite variable. The severity of the reaction depends upon animal species, age, resistance, nutritional status, stressor type, and duration of exposure to the stressor. Individual animals in a group that are exposed to identical environmental conditions, will also vary in their reaction to the stressor. Some of the group will show definite behavior changes while others may appear unaffected. An animal may show signs of restlessness, whimpering, discomfort or other evidence of stress. The importance of knowing the normal animal is now obvious if you are to recognize signs of stress.

Evidence of the body's response to stress is exhibited in three successive stages:

The Alarm Reaction is the stage where body mechanisms are alerted and mobilized for meeting the stress situation. If excitement or fright is the stressor, the brain responds by signaling the pituitary gland to stimulate the adrenal gland. The adrenal gland then secretes adrenalin into the bloodstream. Adrenalin prepares the body to react more effectively to the excitement stressor. Following the secretion of adrenalin into the blood stream, the bronchioles in the lungs dilate, enabling the body to receive more oxygen; energy content of the blood rises; the heart beats more strongly and rapidly, making a greater blood supply available to the muscles. All of these reactions prepare the animal to meet a stressful situation.

The Stage of Resistance is the stage when the body defenses which handle a particular stressor have been alerted and the body has somewhat adapted to the stress.

The Stage of Exhaustion occurs after repeated mobilization of body defenses and overwhelming stressors have exhausted the body's ability to combat the adverse condition. Thus, a combination of individual stressors over a long time which the body could cope with one at a time may together overwhelm defenses and cause disease or death.

The physiologic effects of the stage of exhaustion occurs primarily when stressors have been applied over prolonged periods. This follows the resistance stage when the animal's adaptation to the stress factors was greatest. Periods such as these may cause disease outbreaks in susceptible animals. Body

resistance is limited in the length of time it can be sustained. For example, storms of short duration create stress that animals can endure quite well. However, when the storm is long, large numbers of stress-exposed animals often become ill. Reducing a prolonged stress period tends to reduce health problems.

Kinds of Stressors

Environmental Stressors. The dictionary defines environment as "something that surrounds." Many of the environmental stressors can be controlled by you, the animal owner. Where animals are housed, the amount of space per animal, temperature, bedding, fresh air supply, moisture, light, odors and drafts can individually or together affect the well-being of your project animal. Other environmental stressors include population pressures (where certain animals cannot tolerate living in larger, crowded groups), noise level and the frequent presence of enemies.

8.2 Deep snow and poor food access over prolonged periods can produce adverse stress.

Environmental stressors are especially important for the well-being of young animals. Newborn or poorly-nourished animals are quite sensitive to chilling. When a wet calf, pig, puppy or chick is exposed to cold winter or a cold floor without bedding, it can rapidly lose body heat. It begins shivering to adapt to the stress. Shivering is part of the defense mechanism for generation of heat. Heat is generated from generally available but limited supplies of glucose (blood sugar) in the animal's blood. Other vital chemical changes also occur to attempt to return the animal to a normal state to maintain life.

Nutrition Stressors. Animals fed a diet deficient in one or more of the essential nutrients necessary for maintaining well-being will attempt to mobilize body reserves to prevent further elimination of the nutrient. Lack of sufficient vitamin A in the diet, for example, will stimulate the animal to draw upon stored vitamin A reserves in the liver. Prolonged lack of this vitamin will bring on signs of vitamin A deficiency. Other sudden changes of diet can sometimes be an important stressor for all animals.

8.3 This overweight dog is exposed to the stresses of obesity.

Pathogenic Stressors (Bacteria or Viruses). As you have learned, these play an important part in stressing a susceptible animal. A well-fed animal, living in a good environment, can endure more exposure to all pathogens and parasites better than a debilitated animal. However, the well-fed animal can be in danger, too. For example, a few weeks after weaning (a stress period) calves, lambs or foals may become ill from pathogens that were present but may have not been a problem before weaning.

Injury or Abuse Stressors. Repeated injury may be an important reason why animals fail to resist certain infections. The farmer who injures his cows by faulty milking procedures or a defective milking machine, makes it possible for organisms in the cow's environment to invade the udder tissue and produce mastitis (mammary infection). Pecking with the beak in a poultry flock can cause severe physical stress to the chickens that are repeatedly attacked resulting in poor performance. These conditions must be corrected or reduced.

Fatigue or Hard Work. Fatigue or hard work generally is not an undesirable stressor if adequate rest, plus a good environment and nutrition are available. Prolonged fatigue, however, with no opportunity for rest can be stressful and harmful to animal efficiency and production.

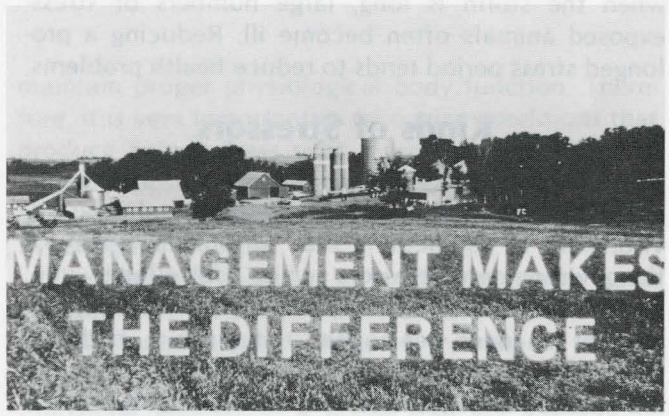
There are many other conditions which serve as stressors. These are directly related to the specific animal and what is needed to keep it in good health. Many stressors can be controlled and we should all attempt to improve the animal conditions with which we are associated.

Reducing Stressors

To reduce stressors that affect the animal we must recognize what is uncomfortable and undesirable for the particular animal. Each animal is different, so you must use the knowledge you have about the normal animal. Stress can affect normal behavior and early recognition of any sign can be helpful. Anything that can make the animal uncomfortable, especially over long periods, is a potential stressor that can contribute to disease. The need for a clean, dry, draft-free animal environment is obvious. Reduction of breeding places for flies and mosquitoes are also indirect ways of reducing stressors. Provision for adequate feed and clean water are certainly measures which reduce stress.

As you will recall in all the previous lessons, animal management has been a very important factor. Strains of livestock that resist stress well can be developed by management decisions based on hereditary and genetic traits. Management decisions can control a large number of stressors, however, every living thing must cope with some man-made or natural stressors.

Animals or other life forms that have become extinct were those that were unable to adjust to stress and/or the diseases that developed from their stressors.



8.4 Minimize adverse stress by proper management. Avoid the causes of stress.

Stress and Disease

1. Define the following terms:
   a. Stressors

   b. Stress

   c. Eustress

2. What is your definition of stress?

3. Explain in detail the reaction of the body to alarm or excitement.

4. What stressors are present when animals are shipped?

5. What diseases and/or injuries may result from these stressors?

6. What procedures could you follow when moving an animal from familiar living areas to new surroundings, to reduce stress?

7. Why are parasites, viruses, and bacteria called stressors?

8. Why is it important to spend time just watching your project animal?

9. Study your animals in its environment and then study the environment more closely. What stressors are present in the environment? Are they affecting your animal in any way? Make a list of the stressors and tell how you might control or eliminate them.

10. Give an example of favorable stress.

Unit II, Lesson IX

HEREDITY AND DISEASE

Words to Know:

Heredity: the passing on of certain characteristics from parent to offspring, by means of chromosomes

Genetics: a branch of biology that deals with heredity

Spermatozoa: a male reproductive cell, the specific output of the testes, which impregnates the ovum in sexual reproduction

Ovum: the female reproductive cell which, after fertilization, is capable of developing into a new member of the same species

Chromatin: material found in the nucleus of a fertilized egg; forms chromosomes

Genes: found on the chromosomes; determines characteristics of individuals

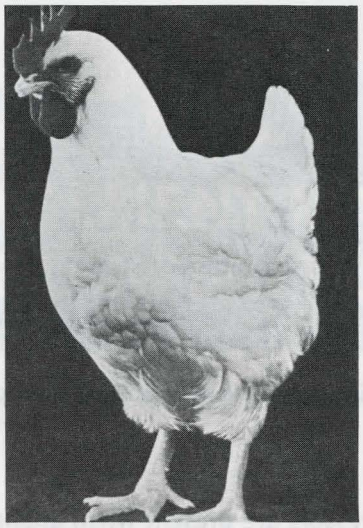
After reading this section you should be able to:

- Explain the responsibility of animal breeders.
- Explain what chromosomes are and where they are found.
- Explain how heredity and environment play important roles in an individual.
- Explain how heredity can affect animals in regard to disease.

Heredity and Disease

Generally animal health depends largely on management factors such as satisfactory food, shelter, and disease prevention. However, heredity is a large and important factor. If defective animals are used for breeding purposes, their offspring are likely to inherit a tendency for the same defects their parents possess. No amount of good food or shelter can prohibit this tendency.

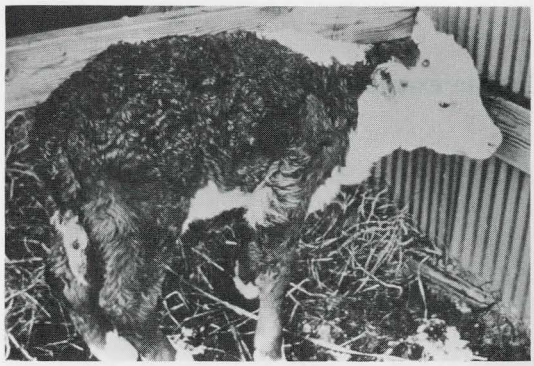
Some animals naturally resist certain diseases but there has been limited research in this area of disease control. The development of genetic disease resistance in plants has been very successful. This shows the need for further development of these traits in animals. Most approaches to date in disease control have been centered around eliminating the causative organism. The ideal animal would be one developed by selective breeding, superior in all desirable characteristics.



9.1 Healthy chicken. Management decisions to develop better livestock involve hereditary factors.

Offspring of defective parents may be of normal size and appearance but may lack vitality, be born dead or die within the first few weeks of life, or never overcome the physical handicap with which they were born. By breeding only from known, vigorous, mature and sound animals, diseases and other weaknesses can be avoided. For example, in some breeds of dogs, the ball and socket joint of the hip does not fit snugly. The ball has a tendency to slip from the joint, thereby, giving the animal a dislocated hip. Puppies born from a mating of this breed may inherit this tendency. They may or may not possess this weakness but they still can transmit it to future generations. Animal breeders, therefore, have a tremendous responsibility to see that family histories are clean and only vigorous animals, free of poor traits, are used for breeding.

Successful breeders examine the size, energy, and masculine traits in the male. They note the fine quality and maternal characteristics in the female. They also study other favorable characteristics of the dog or livestock family so they will improve chances of producing high quality individuals.



9.2 Genetic weakness can cause inferior offspring.

What is Heredity?

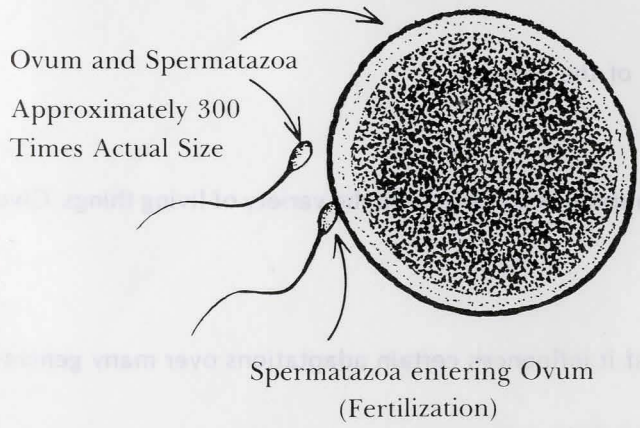
Heredity is the tendency of all organisms to resemble their parents. Heredity and environment are the two main factors determining the makeup of an individual, but it is difficult to know where one stops and the other begins. Quite often, one has an influence on the other. A dog's body, for example, is controlled by heredity and partially by the food it eats, the amount of exercise, the action of hormones from the glands and other factors. But the dog's main traits, such as eye, skin, coat, color, and many other characteristics or tendencies are inherited.

Regardless of the type of reproduction, heredity determines the characteristics of the new animal, plant or even bacteria.

Genetics

How characteristics are passed from parents to offspring is the essence of the science of genetics. The cell is the basic structural unit of the animal's body and is also the unit of function for all the body's activities. The cell is also considered a unit of heredity. Every cell making up an animal's body functions the way it does because of a genetic "blueprint" drawn up at the time of conception.

You already have learned that every living thing develops from a single cell. In animals and humans there are structures present in the sperm and egg that are capable of producing life. The egg cell from the mother and the sperm from the father contain all the links a new animal has with its parents. Briefly, the cell contains a nucleus lying near the center of the cell. This nucleus contains a twisted mass of thread-

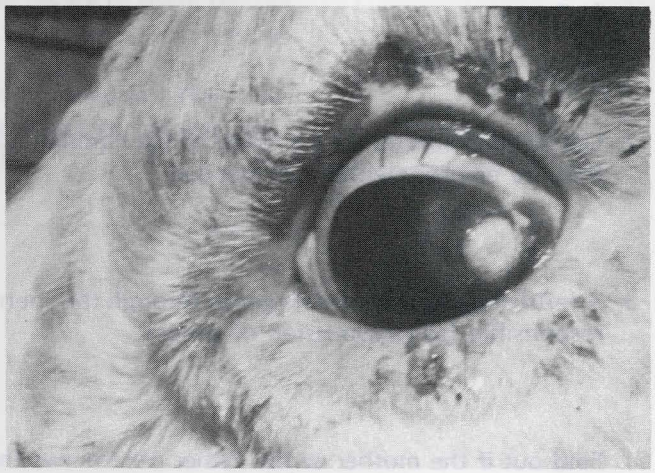


9.3 Diagram of sperm and ovum. These structures contain all the genetic links from the parents to the new offspring.

like material called chromatin. Chromatin carries the genes and will form the chromosomes. During cell division, the chromatin changes to form several rod-shaped bodies, that are called chromosomes. The chromosomes contain the genes. Genes are beadlike strands which determine the characteristics of the individual. You may think of the genes as containing detailed plans of every external and internal detail of the newly-formed animal.

The tendency to resist or develop certain diseases in addition to the true genetic disorders that are inherited are important to consider in animal production. Some individuals within a species are resistant to disease while others are extremely susceptible. Your horse may become ill but you or your cat rarely would get the disease because your own species generally is resistant to equine disease.

Selection of animals known to be resistant to disease is very time consuming because offspring development takes much longer than in plants and other life forms. In disease outbreaks where all but a few become ill, knowing which animals remain healthy and if those animals are family related is significant. Care must be taken to consider more than just one disease resistance because the same animals may be more susceptible to certain other diseases. There are some animals known to be resistant to disease just from their visual appearance. For example, in cattle, the hereford breed is more susceptible to cancer eye than some other breeds.



9.4 If a cancer is found early, surgical removal is possible without loss of the eye.

As genetically superior animal strains are identified, rapid development of new individuals is possible and probable with the advent of embryo transplantation. These are expanding and exciting new fields in animal and veterinary science that offer opportunity to those interested in these areas.

It is through work such as this that the ideal animal may be developed that is not only pathogen resistant but also efficient in reproduction, growth and other favorable traits.

You can now understand why selective breeding of disease-resistant individuals, free of genetic abnormalities, are key management factors. More on genetics can be learned from books available from animal scientists, veterinarians, Extension personnel or libraries.

Heredity and Disease

1. Define the following:

   a. Heredity

   b. Environment

   c. Genetics

   d. Chromatin

   e. Chromosomes

   f. Genes

2. List some characteristics or traits of your animal. Categorize the traits as to those that are hereditary and those that are environmentally influenced.

3. A fertilized egg receives its genes through the sperm as well as through the egg. What part of the cell is chiefly responsible for transmission of genes?

4. Find out if the mother or the father determines the sex of the offspring.

5. Find out the meaning of the word **mutant.** Explain how mutations contribute to the variety of living things. Give one example of a good mutation.

6. Explain what role the environment has on animals and if it influences certain adaptations over many generations.

7. Explain how genetics can be important when purchasing breeding stock to raise puppies or livestock for future sale.

8. Of what importance is the history of genetic traits of animals?

CONCLUSION

After completion of Unit II, you have learned the general causes of many disease processes. Discussion of the causes of specific diseases were limited because there are virtually too many and it would defeat the objectives of this unit.

However, there is one common factor that almost always relates directly to disease development or prevention. This is **management.** Regardless of which lesson you analyze you will find that management decisions are the key. The disease-causing effects of bacteria, viruses, parasites, poisons, nutrition, stressors and genetics can all be reduced by proper management decisions. Poor conditions predispose disease development and sometimes cause "accidents" harmful to the animal. An accident is an adverse event caused by carelessness, unawareness, ignorance or combinations thereof. Almost all accidents could be prevented by proper management decisions.

Individuals working in animal production are much more successful when they are aware of these factors and work continuously to improve environmental conditions for their animals.

Therefore, in animal disease prevention **YOU ARE THE MANAGEMENT KEY! BE AWARE, BE KNOWLEDGEABLE, AND BE CAREFUL!**