With livestock or pets, it is preferable to prevent or minimize the spread of a disease. This not only avoids potential death, but increases profitability. Understanding how pathogens and diseases are spread will help you respond appropriately and maintain the health of your animals. You have many options at your disposal to prevent disease. In addition to disinfection, cleanliness, and vaccinations, biosecurity is important with preventive care.

Objective:
Describe the various types of animal pathogens, illustrate how diseases are spread, and analyze animal responses to disease.

Key Terms:
- adaptive immunity
- antibody
- antiseptic
- bacterium
- biosecurity
- disinfectant
- fungus
- immunity
- infectious disease
- innate immunity
- noninfectious disease
- pathogen
- protozoan
- species immunity
- vaccination (immunization)
- vaccine
- virus
Animal Disease

A disease is an illness related to the dysfunction of an internal system or structure. Most diseases have distinct signs and symptoms. Diseases are classified as infectious and noninfectious.

An infectious disease is a type of disease that can be spread through the environment. Infectious diseases are contagious, which means that they can be passed from one animal to another by direct or indirect contact. In contrast, a noninfectious disease is a noncommunicable disease that cannot be spread through the environment.

ANIMAL PATHOGENS

A pathogen is a disease-causing agent. Any harmful microorganisms, such as bacteria, fungi, protozoa, or viruses are pathogens. It is important to note that not all microorganisms are pathogens. In fact, some microorganisms are beneficial, and even necessary, for animal health. For example, microorganisms within the rumen of cattle are necessary for the digestion of plants. An organism that gains nourishment or protection from another organism by living in, with, or on it is a parasite. Certain parasites, bacteria, fungi, protozoa, and viruses are the cause of most health issues within livestock and pets.

Bacteria

A bacterium is a one-celled microorganism that lacks a true nucleus. In other words, the cell is noncompartmentalized, and the DNA (usually circular) is found throughout the cytoplasm rather than within a membrane-bound nucleus. Bacteria vary in size and shape. In order for bacteria to grow and multiply, they require a specific level of nutrients, moisture, darkness, and temperature. Most bacteria prefer temperatures ranging from 40°F to 140°F.

BLACKLEG: Blackleg is the common name for a bacterial infection caused by *Clostridium chauvoei*. It occurs in calves, sheep, and goats. The symptoms of lameness, loss of appetite, lesions, and hot, painful swelling on a limb can sometimes be seen; however, due to its rapid development, death is usually the first symptom. For this reason, vaccinating for blackleg is recommended.

FIGURE 1. Even though this calf appears healthy, it could die tomorrow if it has not been vaccinated for blackleg.
PNEUMONIA: Pneumonia is most commonly caused by highly infectious bacteria known as *Pasteurella haemolytica* (*M. haemolytica*) or *Pasteurella multocida*. If cattle are dying from a respiratory disease, it is frequently caused by one of those two particular bacteria. The bacteria multiply quickly during periods of stress or poor weather. Symptoms include depression, loss of appetite, and high fever, but death can occur suddenly and with few signs.

TETANUS: Tetanus is caused by a toxin produced by the *Clostridium tetani* bacteria which are commonly found in soil, dust, and manure. All animal species (with horses and lambs being most susceptible) can become infected. Generally, bacteria enter a wound from a nail, wire, or other item that has punctured the skin. Vaccination is the best prevention.

Viruses

A virus is a microorganism that can only multiply in living cells and is composed of RNA or DNA surrounded by a protein sheath. Viruses are the tiniest organisms that cause disease. In fact, a virus is 100 times smaller than a single bacterium. Viruses are unable to live independently of living cells. They must enter and take over a cell in order to grow or multiply.

BVD: Bovine viral diarrhea (BVD), one of the costliest cattle diseases, is a contagious viral disease that is present in feces and urine. It can be spread from humans and cattle that are switched between different operations. Signs of the disease include coughs, discharges from nose and mouth, diarrhea, and fever. Biosecurity is an important part of keeping this disease from spreading.

PEDV: Porcine epidemic diarrhea virus (PEDV), which only impacts pigs, was first confirmed in the United States in 2013. PEDV causes porcine epidemic diarrhea, which has a high death rate in all ages of swine. Signs of infection include severe diarrhea and vomiting. It is contracted by oral contact with contaminated feces. Proper disinfection protocols help limit this virus.

EQUINE FLU: Equine influenza is a highly contagious viral disease in horses. Symptoms of equine flu include fever, coughing, nasal discharge, and loss of appetite. Vaccinations of the most current flu strains are recommended to prevent infection. If infection occurs, the horse should have complete rest to avoid secondary infections such as pneumonia. As with humans, most flu deaths occur due to dehydration and secondary bacterial infections. Keep an infected animal near a water source and in a sterile environment.

Protozoa

A protozoan is a parasitic, single-celled microorganism that can only multiply within a host organism. Protozoa can be free living, although they generally live as parasites in...
plants and animals in order to multiply. A vast majority of protozoa are harmless, but there are some diseases caused by pathogenic protozoa.

▶ TRICH: Trichomoniasis (Trich) is a venereal disease in cattle and other animals that causes early abortions. This can cause a considerable economic loss for a livestock operation.

▶ COCCIDIOSIS: Coccidiosis is a parasitic disease caused by the coccidian protozoa. It leads to decreased weight gain and sometimes death in cattle, sheep, goats, pets, and poultry.

▶ TOXOPLASMOSIS: Toxoplasmosis is caused by the *Toxoplasma gondii* protozoa. It can affect most warm-blooded animals, including birds, livestock, pets, and people. Cats carry the only environmentally-resistant stage of the protozoa in their feces, which means that they are the leading cause of spreading toxoplasmosis through direct contact. When an animal has toxoplasmosis, the protozoa live in the “meat.” People can be infected by eating meat that is undercooked. It can cause flu-like symptoms, complications with pregnancies, and death in people and animals. Humans generally have immune systems that can fight off toxoplasmosis, but deaths and miscarriages have been reported.

**Fungi**

A fungus is a spore-forming organism that feeds on living matter. Yeasts, molds, smuts, blights, mildew, and mushrooms are fungi that get their energy from living or dead plants and animals. Some fungi are beneficial. For example, *Penicillium ascomycetous* fungi are used in the production of penicillin. However, pathogenic fungi cause many diseases in plants and animals, including lumpy jaw and ringworm.

▶ LUMPY JAW: Lumpy jaw is an infectious disease of cattle and swine caused by the fungus called *Actinomyces bovis*. The fungi cause swelling to the jawbone or head of the animal (particularly the mandible and the maxilla), with abscesses forming near the molars. This affects the animal’s ability to eat and drink properly and causes discomfort.

▶ RINGWORM: Ringworm (caused by microscopic fungi) is a contagious disease of the outer layer of skin that can...
impact all animals (including humans). Ringworm causes round, scaly, and hairless patches accompanied by itching and discomfort. With livestock, this discomfort can cause issues with an animal’s eating habits and temperament, which puts a strain on an operation.

THE SPREAD OF DISEASE

Quickly detecting, treating, and isolating sick animals is important when maintaining herd health, along with properly cleaned environments and biosecurity.

Early Detection of Sickness

Early symptoms of sickness are not always easily detected. Thus, animals should be closely observed every day for potential illnesses. Visual signs of poor health may include loss of appetite, lethargy, depression, droopy ears, a dull or rough hair coat, sunken eyes, a lowered head, isolating behaviors, teeth grinding, coughing, labored breathing, nasal discharge, and/or an abnormal disposition.

Early detection and isolation will help to prevent, or at least minimize, the spread of disease, since contagious diseases can be spread from simple contact, water and food sources, or shared facilities. Even if you think a disease is noncommunicable, isolation is recommended until determined by a vet. Provide individualized care to treat the illness until a vet is able to arrive.

Additionally, early detection and treatment can lead to a quicker recovery. Late detection increases the likelihood of a larger loss in profitability, since the disease can result in death, a reduction in productivity, herd infection, or an increased use of medical supplies.

Cleanliness

Cleanliness is important when keeping animals disease free. Manure provides an ideal environment for the increase of microbes, and many diseases are passed through feces. For this reason, the continuous removal of manure and urine is necessary to decrease occurrences of contamination. Also, all animals are susceptible to disease, so the prevention of pathogens through cleaning and disinfection is important.
The Disease Triangle

Infectious diseases are spread through the environment. It takes three components to create the perfect situation for a pathogen to infect an animal. This is referred to as the disease triangle and includes a susceptible host, the presence of a pathogen (causal agent), and favorable environmental conditions.

Antiseptics and Disinfectants

Antiseptics and disinfectants can be used to minimize the likelihood of disease. An open wound provides a way for pathogens to enter the body, so an antiseptic is needed. An antiseptic is a substance applied to the skin that kills or prevents the growth of pathogenic microbes. A disinfectant is a cleaning substance that destroys the microbial causes of disease. Cleaning livestock facilities and equipment with alcohol, iodine, chlorine bleach, or other disinfectants will lessen the chance of contagions to spread.

Biosecurity

Biosecurity is a set of procedures for protection against harmful biological or biochemical agents. The use of biosecurity reduces the likelihood that a pathogen will be carried from place to place by people, clothing, animals, equipment, or vehicles.

New Animals

The largest biosecurity risk occurs when new animals are brought onto the premises. If they are immediately commingled with the other animals, any pathogens become a group problem. Consequently, new animals should be isolated (quarantined), for the first 30 days to monitor their health status. Isolation is important for pets as well, although only a few days of isolation should suffice. Diseases such as distemper and parvo are commonly associated with new pets.

Visitors

Visitors are another risk for the introduction of new pathogens. Farmers who visit may have been exposed to other animals. Visitors who travel to other countries may have come in contact with diseases that are exotic to the United States. Therefore, it is recommended to restrict access to your property. Visitors should not enter areas near the animals unless absolutely necessary. Visitors should have clean clothes and boots, and they should utilize shower-in/shower-out procedures before entering or exiting a facility. Other unwelcome guests, such as rodents, birds, or other wildlife can also carry pathogens. Try to make animal-feed containers and livestock facilities inaccessible to other animals. Proper cleanliness and disinfection can help reduce rodent populations.
Biosecurity

Biosecurity includes relatively simple strategies that should be taken to keep diseases out of your farms and food supply. In order to ensure an extra measure of protection for your livestock, continue to educate yourself on management practices that can prevent or reduce the likelihood of disease transmission. Review the following resources for additional suggestions on biosecurity measures.

- Illinois Department of Agriculture: [https://www2.illinois.gov/sites/agr/Animals/AnimalHealth/Pages/Biosecurity-Measures.aspx](https://www2.illinois.gov/sites/agr/Animals/AnimalHealth/Pages/Biosecurity-Measures.aspx)
- Penn State: [https://extension.psu.edu/4-h-livestock-biosecurity-tips-fact-sheet](https://extension.psu.edu/4-h-livestock-biosecurity-tips-fact-sheet)

Shared Equipment

Livestock equipment can also be a source of pathogen transmission. Equipment (tractors, gear, pens, etc.) should not be shared with other farms unless thoroughly disinfected. Vehicles that transport animals, feed, or items among properties should be disinfected between each location by spraying their tires, body, and undercarriage with specialized disinfectants.

IMMUNE RESPONSES TO DISEASE

Even when the most stringent sanitation and biosecurity measures are used in the prevention of disease, animals can still be exposed to antigens. An animal’s immune system tries to fight off an illness with antibodies. An antibody is a defensive protein produced to attack specific antigens. An antigen is a toxin or foreign invader that corrupts cells and causes illness (such as a pathogen). An animal’s ability to fight antigens is determined by its immunity. Immunity is the ability to resist a disease. Disease prevention can be achieved through innate or adaptive immunity.

FIGURE 5. Livestock facilities should have signs that inform visitors about biosecurity.
Innate Immunity

Innate immunity is a natural, biological aversion or barrier to certain antigens. Also referred to as natural immunity, this is when an animal’s defense to a specific disease is inherited genetically, as from a parent. Species immunity, breed resistance, and individual resistance are the three types of natural immunity.

- **Species immunity** is the immunity of a specific species to a disease. Some diseases can affect multiple species or specific species. For example, hog cholera is a disease that affects only swine.
- Breed resistance is when a disease is less effective on a specific breed of a species. In sheep, scrapie is more common in Suffolk than in Dorset breeds.
- Individual resistance is when a disease does not affect certain animals within a herd, but other animals in the same herd become sick.

Adaptive Immunity

Adaptive immunity is a body’s defense mechanism for fighting unknown antigens. In adaptive immunity, animals establish immunity to a specific disease through exposure, and then their bodies produce their own antibodies to fight off that disease. Also referred to as acquired immunity, adaptive immunity can be further divided into two categories, passive and active immunity.

Passive Immunity

Passive immunity is the presence of antibodies that fight an illness without exposure to the antigen that causes the illness. For example, the antibodies received by newborn animals from their mother’s first milk, colostrum, provides a passive immunity to many antigens the mother has encountered.

Active Immunity

Active immunity is the creation of antibodies in response to an exposure to an antigen. Animals develop active immunity after becoming ill or receiving a vaccination. Their bodies develop antibodies in preparation for another encounter with the illness.

Vaccination (immunization) is the act of providing an immunity to specific antigens, artificially. Generally, this includes exposure to an antigen in order to promote the production of antibodies—via a vaccine. A vaccine is an artificially-produced, antigen-based
substance designed for the body’s production of antibodies and immunity to a disease. Usually, the antigen within the vaccine is in a weakened form.

**Summary:**

A disease is an illness related to the dysfunction of an internal system or structure. Most diseases have distinct signs and symptoms. Diseases are classified as infectious and noninfectious. An infectious disease is a type of disease that can be spread through the environment. Infectious diseases are contagious, which means that they can be passed from one animal to another by direct or indirect contact. In contrast, a noninfectious disease is a noncommunicable disease that cannot be spread through the environment.

A pathogen is a disease-causing agent. Any harmful microorganisms, such as bacteria, fungi, protozoa, or viruses are pathogens. An organism that gains nourishment or protection from another organism by living in, with, or on it is a parasite. Certain parasites, bacteria, fungi, protozoa, and viruses are the cause of most health issues within livestock and pets.

Quickly detecting, treating, and isolating sick animals is important when maintaining herd health, along with properly cleaned environments (through the use of disinfectants) and biosecurity.

Even when the most stringent sanitation and biosecurity measures are used in the prevention of diseases, animals can still be exposed to antigens. An animal’s body tries to fight off illness with antibodies. An antibody is a defensive protein produced to attack specific antigens. An antigen is a toxin or foreign invader that corrupts cells and causes illness. An animal’s ability to fight antigens is determined by its immunity. Immunity is the ability to resist a disease. Disease prevention can still be achieved through innate or adaptive immunity.

**Expanding Your Knowledge:**

Ask your teacher if you may invite a local veterinarian and/or livestock producer to speak to your class regarding the types of biosecurity strategies that they employ on a daily basis. Visit a local large-scale producer. Take pictures of signage and materials used to maintain biosecurity. Share your findings with the class.
Checking Your Knowledge

**Part One: Matching**

*Instructions:* Match the word with the correct definition.

- a. immunity  
- b. vaccine  
- c. virus  
- d. adaptive immunity  
- e. pathogen  
- f. innate immunity  
- g. antiseptic  
- h. infectious disease  
- i. antibody  
- j. disinfectant

1. a body’s defense mechanism for fighting unknown antigens  
2. a cleaning substance that destroys the microbial causes of disease  
3. an artificially-produced, antigen-based substance designed for the body’s production of antibodies and immunity to a disease  
4. a natural, biological aversion or barrier to certain antigens  
5. a defensive protein produced to attack specific antigens  
6. a microorganism that can only multiply in living cells and is composed of RNA or DNA surrounded by a protein sheath  
7. a disease-causing agent  
8. the ability to resist a disease  
9. a substance applied to the skin that kills or prevents the growth of pathogenic microbes  
10. a type of disease that can be spread through the environment

**Part Two: Completion**

*Instructions:* Complete the following statements.

1. Animals develop ____________________ immunity after becoming ill or following a vaccination.
2. ____________________ are classified as infectious and noninfectious.
3. ____________________ is most commonly caused by *Pasteurella haemolytica* or *Pasteurella multocida*, which are highly infectious bacteria.
4. A/An ____________________ is a parasitic, single-celled microorganism that can only multiply within a host organism.
5. Infectious diseases are ____________________, which means that they can be passed from one animal to another by direct or indirect contact.
6. The use of _________________________ reduces the likelihood that a pathogen will be carried from place to place by people, clothing, animals, equipment, or vehicles.

7. _________________________ is caused by a toxin produced by the Clostridium tetani bacteria which are commonly found in soil, dust, and manure.

8. Even if you think a disease is noncommunicable, _________________________ is recommended until determined by a vet.

9. The disease triangle includes a _________________________, the presence of a pathogen (causal agent), and favorable environmental conditions.

10. _________________________ animals should be isolated (quarantined), for the first 30 days to monitor their health status.

Part Three: True/False

Instructions: Write T for true or F for false.

_______1. Passive immunity is acquired through direct contact with disease-causing organisms.

_______2. A single bacterium can be 100 times larger than a virus.

_______3. An open wound provides a way for pathogens to enter the body, so a disinfectant is needed.

_______4. A noninfectious disease is not contagious.

_______5. Manure provides an ideal environment for the growth and spread of pathogenic microbes.

_______6. PEDV causes porcine epidemic diarrhea, which only affects older swine.

_______7. Most bacteria prefer temperatures ranging from 40°F to 140°F.

_______8. An animal’s body tries to fight off illness with antigens.

_______9. Unlike viruses, bacteria have a structured cell with an enclosed nucleus.

_______10. Due to its rapid development, death is usually the first symptom of blackleg.