Before You Read

Think of a disease that you have had. On the lines below, write the name of the disease and answer the following questions. Is the disease contagious? How is it spread? What causes the disease? Is there a cure? These are the types of questions that scientists ask about diseases.

Pathogens Cause Infectious Disease

An infectious disease is a disease caused when a pathogen is passed from one organism to another, disrupting homeostasis. Colds and athlete’s foot are examples of infectious diseases. Pathogens (PA thuh junz) are the cause of infectious diseases. Some, but not all, types of bacteria, viruses, protozoans, fungi, and parasites are members of this group.

Not all members of these groups are harmful. Some types of bacteria and protozoans normally live inside your body and on your skin. These organisms help protect your body from pathogens.

Germ Theory and Koch’s Experiments

With the invention of the microscope, scientists discovered microorganisms. Louis Pasteur showed that microorganisms from the air could grow in nutrient solutions. With knowledge gained from discoveries like these, scientists began to develop the germ theory. The germ theory states that some microorganisms are pathogens. Scientists were not able to prove this theory until Robert Koch, a German physician, performed experiments on anthrax (AN thraks).
How was the first pathogen identified?
Robert Koch studied anthrax, a deadly disease that affects cattle and sheep and can also affect people. Koch isolated the anthrax bacterium from the blood of cattle that had died from the disease. After growing the bacterium in a laboratory, Koch injected it into healthy cattle. These cattle developed the disease anthrax. Koch then isolated the anthrax bacterium from the blood of the newly infected cattle and grew it in a laboratory. Koch compared the characteristics of the two sets of cultures. They were identical. This showed that the same type of bacterium caused the illness in both sets of cattle.

What are the steps in Koch's postulates?
Koch's experimental steps became known as Koch's postulates. Koch's postulates are rules for showing that an organism causes a disease. The figure below lists and illustrates these rules. Scientists still follow Koch's postulates to identify a specific pathogen as the cause of a specific disease.

Artificial media are gels containing nutrients that the bacteria need to live and reproduce. Scientists use artificial media to grow bacteria in the laboratory. Some pathogens, including viruses, will not grow on artificial media. Scientists need cultured cells to grow viruses.

Picture This
2. Sequence  On the line below, write the letters of the following items in the correct sequence.
   a. pathogen injected into healthy animal causes the disease
   b. pathogen from second animal shows same characteristics as the first
   c. pathogen grown in laboratory
   d. pathogen isolated from animal with the disease
Spread of Disease

Of the many microorganisms that surround us, only a few cause disease. The table below lists some common human infectious diseases. To spread, a pathogen needs a reservoir and a way to spread. A disease reservoir is a source of the pathogen in the environment. Reservoirs might be animals, people, or objects such as soil or a dirty countertop.

How do humans act as reservoirs of pathogens?

Humans are the main reservoir for pathogens that infect humans. People can pass pathogens directly or indirectly to other people. Individuals can be capable of passing a pathogen, even if they have no symptoms of the disease. These people are called carriers. Humans can spread colds, influenza (flu), and sexually transmitted diseases, such as human immunodeficiency (ih MYEWN nuh dih fih shun see) virus (HIV), without knowing they are infected.

Can other animals pass pathogens to humans?

Other animals can also carry pathogens, such as influenza and rabies, that can infect humans. Pigs and birds can spread influenza pathogens. Rabies can pass to humans from dogs and wild animals such as bats, foxes, and skunks.

### Picture This

4. **Draw Conclusions**

Use of insect repellent can help protect you from which disease? (Circle your answer.)

- a. tetanus
- b. athlete’s foot
- c. West Nile virus

### Human Infectious Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Cause</th>
<th>Affected Organ System</th>
<th>How Disease is Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetanus</td>
<td>bacteria</td>
<td>nervous system</td>
<td>soil in deep puncture wound</td>
</tr>
<tr>
<td>Strep throat</td>
<td>bacteria</td>
<td>respiratory system</td>
<td>droplets/direct contact</td>
</tr>
<tr>
<td>Meningitis</td>
<td>bacteria or virus</td>
<td>nervous system</td>
<td>droplets/direct contact</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>bacteria</td>
<td>skeletal and nervous system</td>
<td>vector (tick)</td>
</tr>
<tr>
<td>Chicken pox</td>
<td>virus</td>
<td>skin</td>
<td>droplets/direct contact</td>
</tr>
<tr>
<td>Rabies</td>
<td>virus</td>
<td>nervous system</td>
<td>animal bite</td>
</tr>
<tr>
<td>Colds</td>
<td>virus</td>
<td>respiratory system</td>
<td>droplets/direct contact</td>
</tr>
<tr>
<td>Influenza</td>
<td>virus</td>
<td>respiratory system</td>
<td>droplets/direct contact</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>virus</td>
<td>liver</td>
<td>direct contact with exchange of body fluids</td>
</tr>
<tr>
<td>West Nile</td>
<td>virus</td>
<td>nervous system</td>
<td>vector (mosquito)</td>
</tr>
<tr>
<td>Giardia</td>
<td>protozoan</td>
<td>digestive tract</td>
<td>contaminated water</td>
</tr>
<tr>
<td>Malaria</td>
<td>protozoan</td>
<td>blood and liver</td>
<td>vector (mosquito)</td>
</tr>
</tbody>
</table>
What are some other reservoirs?

Some bacteria normally found in soil, such as tetanus, can cause disease in people. Infection can result if the contaminated soil gets into a deep wound.

Contaminated water and food are reservoirs of pathogens. Sewage treatment plants prevent human feces from contaminating the water supply. Food can become contaminated through contact with humans or insects.

What are the main methods of transmission?

Pathogens are mainly transmitted to humans in four ways: (1) direct contact, (2) indirectly through the air, (3) indirectly through touching contaminated objects, and (4) by vectors, organisms that carry pathogens.

Direct Contact Direct contact with other humans can spread diseases such as colds, herpes (HUR peez), infectious mononucleosis (mah noh new klee OH sus) (also known as “mono” or the “kissing disease”), and sexually transmitted diseases.

Indirect Contact Some pathogens can be passed through the air. When an infected person sneezes or coughs, pathogens can pass to another person or to an object in tiny mucous droplets. Many pathogens can survive on objects touched by humans. Careful hand washing and cleaning of cooking surfaces and utensils can help prevent the spread of pathogens.

Vectors The most common vectors are arthropods, which include biting insects such as mosquitoes and ticks. Flies can pick up pathogens by landing on infected material, such as feces. Flies then spread the pathogens by landing on materials handled or eaten by humans.

Symptoms of Disease

Symptoms such as aches, coughing, and sneezing result when a pathogen invades cells in your body. Recall from Chapter 18, as the virus multiplies, it damages tissues and kills some cells.

Bacteria that invade the body sometimes produce harmful chemicals or toxins. The toxins travel in the bloodstream and can cause damage in different parts of the body.

All viruses and some types of bacteria and protozoans invade and live inside cells. They damage and sometimes kill the cells, causing symptoms in the host.
Disease Patterns

Health agencies constantly observe disease patterns to help control the spread of disease. The Centers for Disease Control and Prevention (CDC) receives information from doctors and clinics and publishes a weekly report about the number of cases of specific diseases. The World Health Organization (WHO) watches disease patterns worldwide.

Some diseases, such as the common cold, are known as endemic diseases. **Endemic diseases** are continually found in small amounts within the population. A large outbreak of the same disease in an area is an **epidemic**. If an epidemic is widespread through a large region, such as a country, a continent, or worldwide, it is called a **pandemic**.

Treating and Fighting Diseases

Doctors might prescribe a drug, such as an antibiotic, to help the body fight a disease. A substance that can kill or slow the growth of other microorganisms is an **antibiotic** (a n ti bi AH tihk). Many fungal secretions, such as penicillin, are used as antibiotics. Other antibiotics are manufactured.

Over the last 60 years, the widespread use of antibiotics has caused many bacteria to become resistant to particular antibiotics. Resistance develops through natural selection. Some bacteria in a population might have a trait that enables them to survive a particular antibiotic. These surviving bacteria reproduce and pass on this trait. Because bacteria can reproduce quickly, the number of resistant bacteria in a population can increase quickly as well. The figure below shows the rise in the United States of penicillin-resistant gonorrhea (gah nuh REE uh).

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**Think it Over**

7. **Contrast**

   How is a **pandemic** different from an **epidemic**?

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**Picture This**

8. **Compare**

   Penicillin-resistant gonorrhea increased most rapidly between which two years?
   (Circle your answer.)
   a. 1981 and 1982
   b. 1988 and 1989
   c. 1989 and 1990

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