

# 31.1 Pathogens and Human Illness

## VOCABULARY

germ theory  
pathogen  
vector

**KEY CONCEPT** Germs cause many diseases in humans.

### MAIN IDEAS

- ▶ Germ theory states that microscopic particles cause certain diseases.
- ▶ There are different types of pathogens.
- ▶ Pathogens can enter the body in different ways.

## Connect to Your World

### VIRGINIA STANDARDS

**BIO.1.J** The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which alternative scientific explanations and models are recognized and analyzed.

**BIO.4** The student will investigate and understand life functions of Archaea, Bacteria and Eukarya. Key concepts include

**BIO.4.d** human health issues, human anatomy, and body systems.

**BIO.4.f** evidence supporting the germ theory of infectious disease.

**BIO.4.EKS-7**

Diseases caused by germs, such as the *E. coli* bacteria on the previous page, can be fatal. From 1330 to 1352, the bacteria that caused the Black Death killed 43 million people worldwide, or 13 percent of the population at the time. In 1918, a viral disease called the Spanish flu killed between 20 and 50 million people worldwide, or as much as 3 percent of the population. Because diseases can have devastating effects, scientists become concerned whenever new diseases appear.

### ▶ MAIN IDEA

## Germ theory states that microscopic particles cause certain diseases.

A disease can be either infectious or noninfectious. Infectious diseases, such as flu and polio, can be passed from one person to another because infectious diseases are caused by germs. In contrast, cancer and heart disease are noninfectious diseases. These diseases are called noninfectious because a sick person cannot pass the disease to, or infect, a healthy person. Noninfectious diseases are not due to germs; they may result from genetic factors or lifestyle.

## FIGURE 1.1 History of Medicine

Most modern understanding about diseases occurred after Pasteur's **germ theory**.

B.C. 7000

**Spirits** Ancient societies drill holes in people's heads to release the evil spirits believed to cause disease.



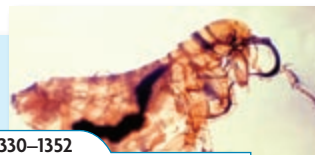
B.C. | A.D.

B.C. 460–B.C. 377

**Humors** Greek physician Hippocrates hypothesizes that fluids, called humors, cause disease.

A.D. 1330–1352

**Herbal treatments** People use incense in an attempt to cure those with the Black Death, caused by bacteria transmitted by rats' fleas.

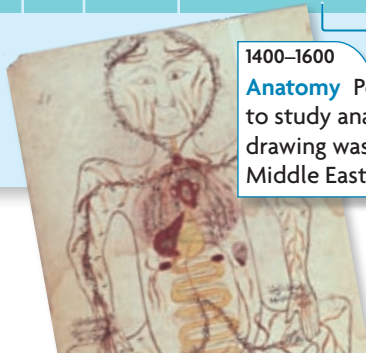


(LM; magnification 15×)

1400 | 1600

1400–1600

**Anatomy** People begin to study anatomy. This drawing was made in the Middle East in 1555.



1857

**Germ theory** Louis Pasteur hypothesizes that disease is caused by small "animals."



1865

**Antiseptic technique** Joseph Lister finds that cleaning his surgical tools reduces patients' infections.

(l) ©Science Museum/Science & Society Picture Library; (c) ©Science Source/Photo Researchers, Inc; (tr) Louis Pasteur, c. 1865, Charles Reutlinger. ©Adoc-photos/Art Resource, NY; (bc) Bibliothèque Nationale, Paris. ©Bridgeman Art Library

On the other hand, infectious diseases can be passed from one person to another because infectious diseases are caused by germs.

Today, it seems obvious that some germs cause infectious disease, but this concept is only a little more than 100 years old. It was not until the 1850s that French scientist Louis Pasteur helped make the connection between microorganisms and disease. His theory, called the **germ theory** of disease, proposed that specific microorganisms caused diseases. These disease-causing agents are called **pathogens**. Pasteur hypothesized that if pathogens were eliminated from the body, a person would not get sick.

Pasteur's germ theory led to rapid advances in our understanding of disease, as shown in **FIGURE 1.1**. But at the time, germ theory was not immediately accepted. It took the work of two other scientists to bring about the complete acceptance of Pasteur's germ theory.

Between 1861 and 1865, about half of British surgeon Joseph Lister's patients died from infections after otherwise successful operations. After hearing Pasteur's germ theory, Lister began using a weak acid to clean his operating tools and his patients' wounds before surgery. The number of his patients who died from infection dropped dramatically to near zero.

Meanwhile, German scientist Robert Koch found that he could make a healthy animal sick by injecting it with pathogens from a sick animal. From his experiments, he concluded that four conditions must be met before one can say that a certain pathogen causes a disease. These conditions are called Koch's postulates.

- The pathogen thought to cause the disease must be present in every case in which the disease is found.
- The pathogen must be isolated and grown outside the body in a pure, uncontaminated culture.
- Healthy animals infected with the pure culture must develop the disease.
- The pathogen must be re-isolated and cultured from the newly sick animals and must be identical to the original pathogen.

**Contrast** How is germ theory different from earlier theories about disease?

**READING TOOLBOX**

**TAKING NOTES**  
Use a main idea diagram to study germ theory of disease.

germ theory

```

    graph TD
      A[germ theory] --> B[ ]
      A --> C[ ]
      A --> D[ ]
      A --> E[ ]
  
```

(c), (c) Bettmann/Corbis; (r) ©Garof/Photo Researchers, Inc.; (b) ©Yale Joel/Time Life Pictures/Getty Images; (br) ©pixelman/Shutterstock (inset) ©Craig van der Lende/Photographer's Choice/Getty Images

**1883**  
**Koch's postulates** Robert Koch finds four conditions that prove a pathogen causes a disease.

**1900**  
**Applying antiseptic technique** Cities around the world start treating drinking water with chlorine, reducing the cases of cholera.

**1928**  
**Antibiotics** Sir Alexander Fleming discovers penicillin.

**1955**  
**Polio vaccine** Jonas Salk's vaccine against polio becomes available. The disease is eliminated in the U.S. in 1994.

**2002**  
**New diseases** First cases of SARS, a disease that affects the respiratory system, spring up in China.

**2005**  
**Polio comeback** Worldwide efforts increase to vaccinate people against polio, and the polio virus reemerges in fewer than ten people in the U.S.