

- (e) *Alopex lagopus* - arctic fox      (f) *Eutamias alpinus* - alpine chipmunk  
 (g) *Sciurus arizonensis* - Arizona gray squirrel    (h) *Sylvilagus aquaticus* - swamp rabbit

## 9.2 Practice (page 338)

1. Most scientists do not consider viruses to be living organisms.
2. A bacteriophage might destroy harmful bacteria.
3. Viruses are not composed of cells. There is no respiration, viruses do not require food, and a virus does not reproduce outside of its host.
4. Viruses range in size from about 20 to 400 nm in diameter, Red blood cells are approximately 1000X larger. See Figure 1.
5. Many examples could be provided. DNA viruses cause smallpox, chickenpox, and mononucleosis. RNA viruses cause measles, mumps, the common cold, influenza, HIV, and polio.
6. Lysis is the destruction or "bursting open" of a cell, e.g., when an invading virus replicates in a bacterium. In the lysogenic cycle, the virus does not kill the host cell outright. It may coexist with the cell and be carried through many generations without apparent harm to the host. (*Retroviruses* are RNA viruses that infect animal cells, copy their code into the DNA of the host cell and then get the host cell to produce viral proteins.)
7. Distemper and rabies are commonly sited.
8. Wash your hands. Avoid people who cough.

## Section 9.2 Questions (page 340)

1. Viruses are often referred to as parasites because they are active once inside a host cell.
2. The following are three possible explanations.  
 At one time viral ancestors were cellular organisms that lived as parasites on other cells. Due to their parasitic existence, they gradually lost their own cellular components and eventually became reduced to their present form.  
 Viral ancestors were once free-living, precellular forms that later became parasites of cellular organisms.  
 Viruses arose from detached fragments of the genetic material of cellular organisms.
3. Bacteriophages that do not cause lysis of their host are called *temperate phages*.  
 Virulent phages destroy the bacterium. The temperate phage injects nucleic acid into the host bacterium, similar to the way in which the virulent phage acts, but it does not take control of the cell. Instead, its nucleic acid becomes integrated into the host DNA and acts as another set of genes on the bacterial chromosome.
4. This provides new gene combinations beyond those possible by sexual reproduction.
5. Answers will vary. There is continuous research into vaccines, producing new vaccines and improving others so that they are effective over longer periods.
6. There has been a resurgence of polio because of this type of thinking. Viruses do not always break down outside of a host and may be introduced to an unvaccinated host many years later.
7. There is no way of completely predicting the effect of genetically engineered viruses upon ecosystems and human health.

8. As vectors of foreign genes, viruses could be used to destroy diseased cells, like cancer cells, and to introduce genes into humans to replace harmful recessive or defective genes.

### 9.3 Practice (page 344)

1. Bacterial cells are prokaryotic. All bacteria are single celled.  
Bacterial cells contain no membrane-bound nucleus or organelles (like mitochondria).  
Bacterial cells have a single chromosome.  
Most bacteria reproduce asexually by binary fission (splitting in two).

2.

Characteristic	Bacteria	Viruses
Composed of cells	√	No
Independent life	√	No
Contain nucleic acids	√	√
Composed of proteins	√	√

3. Under an old classification system, cyanobacteria were often called blue-green algae because these bacteria had chlorophyll and carry out photosynthesis. Under this previous system, algae were classified as plants because some had the ability to carry out photosynthesis.
4. Shape classification are: spherical (plural: cocci; singular: coccus); rod-shaped (plural: bacilli; singular: bacillus), and spiral (plural: spirilla; singular: spirillum). See Figure 2 for an illustration.
5. **Endospores** contain genetic material encapsulated by a thick, resistant cell wall. These forms develop when environmental conditions become unfavorable and allow the organism to survive until favorable conditions return.
6. **Binary fission** is a form of asexual reproduction in which one cell splits into two. The single strand of bacterial DNA doubles, resulting in identical genetic material being transferred to each new cell. Following duplication of the genetic material, the bacterium produces a cross wall and divides into two identical cells.
7. **Conjugation** is a form of sexual reproduction in which genetic material is exchanged between two cells. In conjugation, two conjugal pairs or mating types, referred to as donor and recipient, make cell-to-cell contact through a cytoplasmic bridge. Plasmids are transferred from the donor to the recipient. Conjugation allows for increased genetic variation.

### 9.3 Practice (page 346)

8. Infectious diseases spread because they get passed from one individual to another in a variety of ways. The main modes of disease transmission are: moisture droplets and dust in the air, direct contact, fecal contamination of water and food, wounds (cuts and scratches) and animal bites.
9. Antibiotics are chemicals produced synthetically or by microorganisms that inhibit the growth of or destroy certain other microorganisms.
10. Antibiotic resistance appears to develop from mutations within a bacteria population. When a bacteria population is first exposed to antibiotics, some members may have mutations that allow them to survive the antibiotic. These individuals then reproduce

and pass their resistance to the next generation. The scientific research clearly indicates that the most common type of bacterial resistance to antibiotics is caused by bacteria that contain R (resistance) factors. These factors are plasmids with genes that code for enzymes that inactivate specific drugs. These various R factors can be recombined in conjugation.

11. Toxic Shock Syndrome is caused by a toxin produced by the bacterium *Staphylococcus aureus*. It has been associated with the use of tampons and similar products. Specific bacteria grow in nutrient-rich environments with limited oxygen.

### Investigation 9.3.1 (pages 346–348)

- (a) Answers will vary.
- (b) Area 4 was a control to show the normal rate of bacterial growth.
- (c) Antiseptic are substances that prevent bacteria growth, e.g. alcohol, boric acid. These are safe to the body. Disinfectants may be antiseptics or germicides. Heat can be used as a disinfectant. Not all disinfectants are safe for the body.
- (d) Bleach inhibits bacterial growth.

### Section 9.3 Questions (pages 348–349)

1. **Binary fission** is a form of asexual reproduction in which one cell splits into two.  
**Conjugation** is a form of sexual reproduction in which genetic material is exchanged between two cells.
2. Anaerobic bacteria are likely to be found in areas low in oxygen such as bogs, canned goods, or deep wounds.
- 3.

Bacteria	Product
Clostridia	Production of butanol and acetone from molasses
Acetobacter	Production of vinegar from alcohol
Intestinal bacteria	Synthesizes vitamins in humans
Lactobacilli	Production of lactic acid from sugar
Azotobacter; Nitrobacter	Fixation of nitrogen in soils
Streptococci; Lactobacilli	Yoghurt and cheese production
Streptomyces group	Source of antibiotics, e.g., streptomycin, terramycin, neomycin, and erythromycin

4. The resistance of bacteria to antibiotics is related to the greater exposure of microbes to antibiotics. Bacteria with the appropriate R factor survive treatment by antibiotics and are able to reproduce.
5. Place the substance or chemical being investigated on a Petri dish and streak the agar with a bacterial culture. Examine the culture a few days later for a kill zone.
6. The antibiotic must be tested in humans for toxicity. Does it alter any normal chemical reactions within a person? Does the antibiotic destroy beneficial bacteria, such as *E. coli*, which normally inhabit the gut.
7. (a) The raw hamburger could contain *E. coli* or other bacteria. Although cooking destroys the *E. coli*, the blood and meat fragments that remain on the plate have *E. coli*. By placing the cooked hamburgers back on the same plate, it is likely that bacteria will be re-introduced to the food.

(b) The hamburger is ground, which increases the oxygen content and can introduce microbes deep into the meat. Hamburger often comes from scraps containing various intestinal products that may have come into contact with *E. coli*.

8. Antibacterial creams reduce the population of harmful microbes. Unfortunately, the soaps and creams also reduce the population of "good" bacteria. By removing harmless microbes from the surface of the body, a space is created for colonization by more harmful species. Also, some beneficial organisms which provide essential actions are removed, which decreases their value until the population can recover.
9. The small dosages kill weaker bacteria; but leave those with genes that provide an advantage against the antiseptic. Through natural selection, stronger varieties of microbes live and reproduce. The population of microbes changes in favor of those with some resistance to the antiseptic.
10. Answers will vary. There is also an advantage in being exposed to some germs. The body develops antibodies against foreign invaders, such as bacteria and viruses.

#### 9.4 Practice (pages 356–357)

1. The three groups that make up the kingdom Protista are: Plantlike (often called "Algae"), animallike (often called "Protozoans"), and fungilike protists (often called "slime moulds" or "Gymnomycota").
2. The *phytoplankton* protists are photosynthetic autotrophs. They produce a significant portion of the oxygen supply in the Earth's atmosphere and play an important role in the carbon cycle.
3. Animallike protests are called protozoans.
- 4.

Animallike	Plantlike
Movement (flagellum)	Chloroplasts
No cell wall	Light sensitive pigment (eye spot)
Capable of feeding	Capable of photosynthesis

5. Both an amoeba and a human white blood cell engulf objects by phagocytosis.
6. Sporozoans lack independent locomotion.
7. An amoeba moves by extending its pseudopods.  
A *Paramecium* has small cilia (hairlike structures) that beat in unison to propel the protist.  
An euglenid has a flagellum, a whip-like tail that moves in a corkscrew motion.
8. Conjugation is considered a form of sexual reproduction because genetic material is exchanged between two individuals.
9. Algae are the primary food source in marine ecosystems and they also produce 67% of the Earth's global oxygen by photosynthesis.
10. The name "slime moulds" is derived from the slimy trail left behind as the organisms move over the ground. They produce a fruiting body that resembles a mould.
11. Birds migrate to topical regions where biting insects are frequently vectors for the spread of sporozoan parasites, such as malaria.
12. (a) Runoff from agricultural land would increase the amount of algae on the lake. Eventually, the algae die and decomposing bacteria rob oxygen from the lake to break down the algae. This dramatically lowers oxygen levels for the lake.

(b) Eutrophic lakes are generally shallow, warmer, have an excellent supply of vital nutrients. Many species of photosynthetic organisms can take advantage of these favourable abiotic conditions. In general, it would appear that during its life, a lake slowly changes from oligotrophic (lacking in plant nutrients with large amount of dissolved oxygen) to eutrophic, eventually filling in and becoming dry land. Humans sometimes accelerate eutrophication by adding nutrient-rich substances such as human wastes, fertilizers in the runoff from agricultural land, and other household and industrial products to lakes.

(c) When the plants die, decomposers return nutrients to the lake. However, the decomposers also use oxygen—making less oxygen available for animals that extract oxygen from the water.

**Activity 9.4.1** (pages 357–358)

- (a) Many protists change shape as they move, making it difficult to estimate their size and shape.
- (b) Oral refers to the mouth; contract means to constrict and squeeze; a cyst is a sac or vesicle; chloroplasts contain chlorophyll for photosynthesis.
- (c) Food is swept by cilia through the oral groove into the gullet. From the gullet, food enters a vacuole where digestion occurs. Wastes are expelled from the food vacuole through the anal pore.
- (d) A *Paramecium* has small cilia (hairlike structures) that beat in unison to propel the protist.
- (e) This dense substance slows the protists.
- (f) Trichocysts are used as a defense mechanism.
- (g) Answers will vary. *Paramecia* usually reproduce by binary fission; they occasionally undergo conjugation.
- (h) *Spirogyra* is not classified as a plant because it is a unicellular organism.
- (i) *Euglena* is a plantlike organism because it has chloroplasts.
- (j) Conjugating cells appear as two cells joined together.
- (k) Stop functioning. In water, an excess enters the *Paramecium* by osmosis, but in salt water the cells will be close to isotonic.