

# Answer Key

## Unit 1 Diversity of Living Things

### Unit Preparation Questions (Assessing Readiness)

(Student textbook pages 4–7)

- d
- e
- c
- a.** Photosynthesis is the process that producers, such as plants, algae, and some bacteria, use to chemically convert carbon from carbon dioxide into glucose using light energy from the Sun. Oxygen is also produced in the process.

**b.** Cellular respiration is a process that releases the energy stored in glucose. Carbon dioxide and water are also produced in the process. The chemical reactions involved in cellular respiration occur in most species, including species of plants and animals.
- An ecosystem is all the interacting parts of a biological community and its environment—terrestrial are land-based ecosystems, while aquatic are water-based ecosystems.
- A sustainable ecosystem is one that is capable of withstanding pressure and giving support to a variety of organisms. Sustainable ecosystems endure, but they also support a wide variety of organisms.
- Sustainable ecosystems continue in the same state, while supporting a wide variety of organisms. If the ecosystem cannot continue in the same state, then organisms will have to move to another ecosystem or perish.
- Sample answers: I agree with the statement because consumers need the oxygen produced by producers or that consumers need to eat producers; I disagree with the statement because producers need carbon dioxide made by consumers and need nutrients made by consumers (for example, feces or decomposer products).
- The average global temperatures are increasing. Scientists predict this trend will continue. Warmer average temperatures will increase evaporation. Closer

to the equator it will mean less rainfall. Polar regions could experience more precipitation. As Earth's atmosphere warms, so do its oceans. This warming could result in increased severity and frequency of storms.

- Ecosystem services are the natural result of all the activities that occur in the biosphere. Ecosystem services allow ecosystems to function, which is a requirement of sustainability.
- A sustainable ecosystem must maintain a state of balance between its diverse living parts and its non-living, physical environment. This state of balance is called equilibrium. An ecosystem that is in equilibrium tends to have a high degree of biodiversity. Such an ecosystem tends to be a sustainable ecosystem.
- Five times in the past there were short periods when many species disappeared. These are known as mass extinctions.
- a
- d
- A microscope is a delicate and expensive piece of technology. Not handling it properly or not following the proper procedures could damage or even destroy the microscope. You should use two hands—one hand holding the arm while the other holds the base of the microscope.
- a
- a.** and **b.** Sample answer:

Letter	Structure	Function
A	Eyepiece (ocular lens)	You look through the eyepiece and it magnifies the object.
B	Revolving nose piece	This rotating disk holds two or more objective lenses; turn it to change lenses.
C	Stage clips	These hold microscope slides above the light source, under the lens.
D	Diaphragm	The diaphragm controls the amount of light reaching the specimen being viewed.
E	Light source	Shining a light through the specimen makes it easier to see the details.

F	Base	The base supports the microscope.
G	Fine-adjustment knob	Use the fine-adjustment knob with medium- and high-power objective lenses to bring the object into sharper focus.
H	Coarse-adjustment knob	The coarse-adjustment knob moves the tube up and down to bring the object into focus; only use it when using the low-power objective lens.
I	Stage	The stage supports the microscope slide; an opening in the centre of the stage allows light from the source to pass through the specimen.
J	Objective lenses	Objective lenses magnify the specimen; each lens has a different power of magnification—low (4x), medium (10x), and high power (40x).
K	Arm	The arm connects the base and the tube; use the arm for carrying the microscope.

**18.** Step 1: Obtain a piece of onion epidermis by bending a piece of onion until it snaps. The two halves will only be attached by the epidermis.

Step 2: Carefully peel off the transparent epidermis from the rest of the onion piece. Lay the epidermal cells flat on a clean microscope slide.

Step 3: Add several drops of iodine stain to the onion cells. Leave the stain on the section for several minutes.

Step 4: Blot off the extra stain with a paper towel. Add a few drops of water to the specimen to remove the extra stain, and then blot off the water.

Step 5: Add one drop of water. Place a cover slip on the microscope slide, edge first. Carefully lower the cover slip over the section.

**19.** Step 1: Place the microscope on a flat surface.

Step 2: Look from the slide and rotate the revolving nosepiece until the low-power objective lens clicks into place.

Step 3: Use the coarse-adjustment knob to lower the low-power objective until the objective lens is 1 cm above the stage.

Step 4: Look through the eyepiece and adjust the diaphragm until the view is as bright as possible. Use the coarse-adjustment knob to raise the objective lens until the specimen comes into focus.

Step 5: Use the fine-adjustment knob to sharpen the focus.

Step 6: Once the onion epidermal cells are in focus, carefully rotate the revolving nosepiece to the medium-power objective lens.

Step 7: Sharpen the focus using the fine-adjustment knob only.

Step 8: Next, view the cells using the high-power objective. Carefully rotate the nosepiece until the high-power objective clicks into place.

Step 9: Sharpen the focus using the fine-adjustment knob only.

**20.** c

**21.** d

**22.** b

**23.** a

**24.** a

**25.** a

**26.** A – vacuole, B – nucleus, C – cell wall, D – cell membrane, E – mitochondria, F – chloroplast

**27.** a – site of protein synthesis; b – converts energy in food molecules into a form cells can use; c – stores water and nutrients in plant cells; d – transports materials throughout the cell

**28.** Step 1. Place cells on a microscope slide Step 2. Add a drop of water Step 3. Cover with a cover slip Step 4. Observe under a microscope. If a cell wall and or chloroplasts are present, the cells came from a plant. If no cell wall is visible, then the cells came from an animal. NOTE: Not all plant cells will have chloroplasts e.g., onion epidermal cells

**29.** The nucleus is where ribosomes are made. The ribosomes move into the cell to help produce proteins. Proteins make up much of a cell's structure and are required for activities necessary for the cell's survival.

**30.** d

**31.** a (NOTE: Some students may pick (c) but point out that this diagram is showing an animal cell, not a plant cell.)

**32.** Sample answer: The image shows the diffusion of ink in water. Ink moves from an area of high concentration to an area of low concentration.

- 33.** A cell membrane is referred to as selectively permeable because not all materials can cross it; some are kept out—or in.
- 34.** Diffusion occurs through a selectively permeable membrane. Particles diffuse from areas of high concentration to areas of low concentration until they reach a point of equilibrium.
- Osmosis is the movement of water molecules across a selectively permeable membrane in response to water. Water moves from areas of greater concentration to areas of lesser concentration to equalize the number of water molecules inside and outside the cell.
- 35.** Materials that the cell needs, such as oxygen, diffuse across the membrane from outside the cell (where they are more concentrated) to the inside (where they are less concentrated). It also is the process that allows some waste products to leave the cell.
- 36. a.** Water would move across its cell membrane and the amoeba would swell up and could burst.
- b.** There would be more water molecules inside the organism than in the salt water. Water would move across the cell membrane by osmosis. The amoeba would shrivel up and die.
- 37.** Water will leave the tubing due to the fact that water is in higher concentration inside the tubing and lower concentration outside the tubing. The tube will decrease in size. Ink will not enter the tubing because the membrane is not permeable to it (even though it is in higher concentration outside the tube).

## Chapter 1 Classifying Life's Diversity

### Learning Check Questions

#### (Student textbook page 13)

1. Scientists must identify, define, and name species to ensure species are correctly described using scientifically accepted standards. Correctly naming species allows scientists to communicate and share findings about endangered species, disease causing organisms and their cures, native and invasive species. The scientific name reduces any confusion about what species are being discussed. In comparison, the common name can vary regionally.
2. Species exhibit tremendous variation and each of the species concepts has limits as to how it can be applied.
3. B is correct because both parts of the name are italicized, the genus name is capitalized, and the species portion begins with a lowercase letter. A is incorrect because the name is typed and underlined. The name should only be underlined if it is hand written. C is incorrect because it is not italicized. D is incorrect because the species portion is capitalized.

4. Because each species has only a single (2-part) scientific name that is applied throughout the world in all languages. People discussing the same species can communicate without the confusion of multiple common names.
5. Graphic organizers should include clear descriptions of each concept and appropriate organization to easily compare the advantages and disadvantages of each concept, as provided in Table 1.1.
6. According to the biological species concept, donkeys and horses are not members of the same species because the horse and the donkey produce mules, which although viable, are not fertile.

#### (Student textbook page 19)

7. The main goal of modern classification is to assign species to taxa so that the classification reflects both morphological similarities and hypotheses about their evolutionary history.
8. Answers should show that anatomy is a branch of morphology that focuses on the structure of organisms. Physiology is about physical and chemical functions of organisms.
9. New information might show that previous classifications did not reflect the most accurate relationships between organisms. Therefore, new species need to be classified and previously identified species may need to be reclassified according to the most up-to-date information.
10. By examining their anatomy and physiology in greater detail, one could determine how many characteristics they have in common and therefore, exactly how closely related the two groups really are.
11. Pair B, a red panda and a raccoon, are more closely related because they are found on the same branch of the tree diagram.
12. Most closely related are gorillas (1), followed by dogs (15), chickens (45), and frogs (57).

#### (Student textbook page 26)

13. Scientists look for similarities and differences at a much higher taxonomic rank, such as kingdoms or even domains.

14. The study of cell types and genes led scientists to add a rank higher than kingdom, called the domain.

15. Sample answer:

	Prokaryotic cells	Eukaryotic cells
Meaning of name	"Before the nucleus"	"True nucleus"
Presence of nucleus	No membrane-bound nucleus	Has a membrane-bound nucleus
Size	Small compared to eukaryotic cells	On average, 1000 times larger than prokaryotic cells
Internal structure	Simple internal structure	Complex internal structure

16. Answers should contain the three domains and six kingdoms, as seen in Figure 1.15.

17. The tool is a dichotomous key. A dichotomous key consists of a number of steps, each of which has two choices. In this case, the animal either has hair or it does not have hair.

### (Student textbook page 33)

18. Genetic diversity: refers to the variety of heritable characteristics (genes) in a species; species diversity: refers to the variety and abundance of species in a given area; ecosystem diversity: refers to the variety of ecosystems in the biosphere

19. In Algonquin Park, you will find river ecosystems, forest ecosystems, and marsh ecosystems.

20. A gene pool is the sum of all the versions of all the genes in a population.

21. Gene pools of different populations usually contain different types or combinations of versions of genes. All of these variations are contained by the species, which therefore has larger genetic diversity than the gene pools of any given population.

22. Genetic diversity increases the likelihood that a species can survive changes in their environment, such as climate change, a change in resource availability, a change in a population of predators, the introduction of a non-native species, or a disease.

23. Some students may agree with humans intervening because human actions have sometimes led to a species being endangered in the first place. Other students may disagree, claiming that an organism's inability to adapt is part of a natural process.

## Caption Questions

**Figure 1.1 (Student textbook page 10):** One possible response is that scientists may analyze differences between the two organisms, such as size, appearance, behaviour, or chemistry.

**Figure 1.6 (Student textbook page 18):** Sample answer: Both the oviraptor and cassowary appear to have similar leg structures and both have crests on the top of their heads.

**Figure 1.12 (Student textbook page 21):** Rangifer tarandus

**Figure 1.14 (Student textbook page 25):** Sample answers: The prokaryotic cell has a flagellum while the eukaryotic cell does not. The prokaryotic cell has a cell wall, while the eukaryotic cell shown here does not.

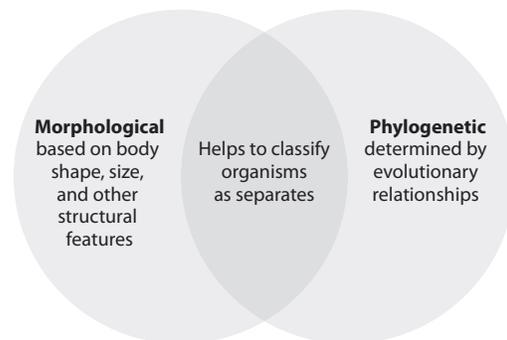
**Figure 1.18 (Student textbook page 31):** Examples of genetic diversity are different hair colour or eye colour within humans. An example of ecosystem diversity is a lake ecosystem versus a pond ecosystem.

## Section 1.1 Review

### (Student textbook page 16)

- In the morphological species concept classification is based on the body shape, size, and other structural features, of organisms. In the phylogenetic species concept classification is determined by evolutionary relationships among organisms. Both species concepts are used to help classify organisms as separate species. Both have advantages and disadvantages.

Sample answer:



- Using the biological species concept I would infer that the red-sided garter snake and the eastern garter snake are the same species because they interbreed and produce viable, fertile offspring. Since the eastern garter snake and the eastern ribbon snake coexist but do not interbreed, I would infer that these are two separate species.

3. Binomial nomenclature is the two-part scientific name given to a species. The first part of the name states the genus and the second part of the name states the species.
  4. Classification (although taxonomy would also be acceptable). Classification can apply to any objects, for example, baseball cards. Taxonomy refers specifically to the act of classifying living things into hierarchical levels.
  5. winter vs. non-winter; ball vs. non-ball; foot vs. “implement”; indoor vs. outdoor; etc.
  6. Sample answer: Do Keep Pond Clean Or Froggie Gets Sick
  7. A rank is a level within the classification scheme. Currently, there are usually eight ranks ranging from domain as the most inclusive to specific epithet, which applies only to one species. A taxon is any named example of a rank.
  8. Domain, kingdom, phylum, class, and order
  9. There are more organisms in the kingdom level and they show greater variation than the number and variety of species at the species level. Organisms that are the same species will be very similar.
  10. a. Animalia
    - b. *Stagmomantis carolina*
    - c. Domain Eukarya
  11. The current system tells us the genus (which has a set of characteristics associated with it) and the species (which tells us a unique characteristic sometimes). Only having two parts to the name is much simpler.
2. Answers should focus on the idea that knowing how organisms are related can help with classifying a species or the development of pharmaceutical drugs. The classification of a species may also affect its conservation status.
    - a. Biologists can apply knowledge learned about one organism to another (for example, all fish have gills).
    - b. Biology students can learn general characteristics about families and apply those to understanding a specific genus (for example, family bovidae, both males and females, all have permanent horns of a similar structure. Therefore, oryx, since it is in the same family, also has permanent horns of a similar structure). This simplifies the study process.
    - c. Pharmaceutical laboratory assistants can understand that closely related species (for example, in the same genus) will have similar physiology and should react similarly to drugs.
    - d. Conservation ecologists can understand the ecological importance of similar organisms and concentrate conservation efforts on at-risk genera or families.
  3. dinosaur fossils with feathers, claws on bird wings, similarities in bone structure
  4. The nucleotide sequences suggest that turkey vultures may be more closely related to storks than to the vultures of Asia and Africa.
  5. Some might say the genetic information should prevail over the morphological information. Others might say one should try to apply the biological species test to see if that helps.
  6. The leopard is more closely related to the domestic cat because of where the branch occurs on the phylogenetic tree. The leopard and the domestic cat stem from the same branch. The wolf is on a different branch.
  7. Reindeer and red deer are in the same family. Family is a more specific taxon than oryx.
  8. By understanding the genetic relatedness of species, you can predict the impact on an ecosystem. Genetic analysis can identify species as they enter the country.

## Section 1.2 Review

(Student textbook page 23)

1. Sample answer:

Type of evidence	Anatomical evidence	Physiological evidence	DNA evidence
Description	Similarities in morphology	Similarities in body functions	Similarities in DNA
Example	Dinosaurs are related to birds.	Guinea pigs are not rodents.	Fungi are more closely related to animals than to plants.

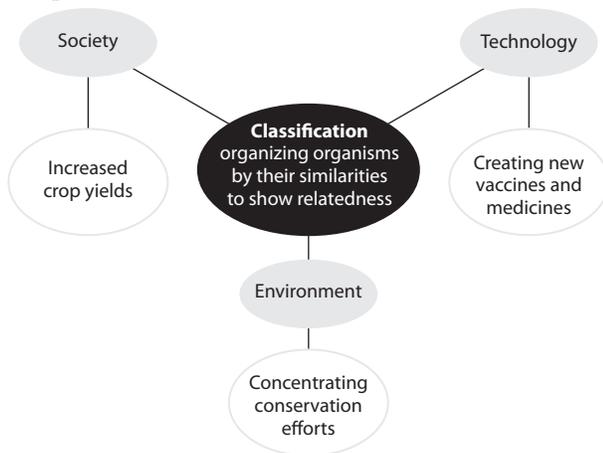
9. a. By classifying an organism, we can get accurate population counts of that organism and we may find that it is not in fact endangered. Finding out that a species is endangered or new generally gets people excited and more likely to protect them.

b. Sample answer:

Dear CITES,  
 Forest-dwelling elephants (*Loxodonta cyclotis*) are very different from bush elephants (*Loxodonta africana*). Until recently, they were believed to be the same species. *Loxodonta cyclotis* were considered to be variations on *Loxodonta africana*, which is considered threatened. Now that the forest dwellers have been reclassified, the number of each type of elephant has been drastically reduced. Please consider declaring that both species of elephant are endangered so that we don't lose either species.

Yours truly,  
 Student Body

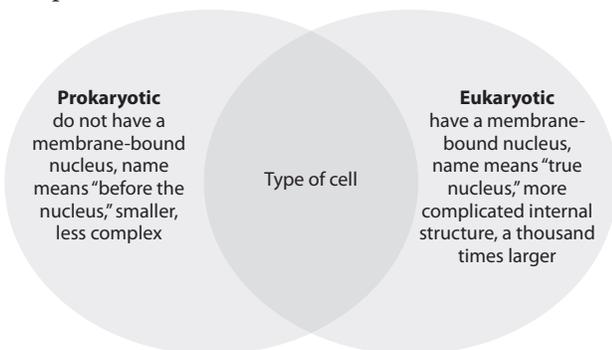
10. Sample answer:



### Section 1.3 Review

(Student textbook page 30)

1. Sample answer:



2. Domains: Bacteria (Kingdom: Bacteria), Archaea (Kingdom: Archaea), Eukarya (Kingdoms: Protista, Fungi, Plantae, Animalia)

3. By looking at the cell types and genetic differences

4. A dichotomous key is a system for logically narrowing down the identification of a specimen, one step at a time. Each step of the key consists of a two-part decision, where there are two choices. After you choose the description that matches the organism, you move to the next set of choices as directed by the key. You continue through the two-pronged choices in order to narrow down the solution.

5. Autotrophs make their own energy-yielding food, unlike heterotrophs, which have to consume other organisms for energy.

6. a. autotrophic and heterotrophic

b. asexual

c. small, unicellular prokaryotes that may have a cell wall

d. Animal cells do not have cell walls.

7. Scientists in the early days of taxonomy would have classified all photosynthetic organisms as Plantae, and therefore cyanobacteria would have been classified as in this kingdom.

8. Domain—Eukarya, cells have a nucleus; kingdom—Protista, unicellular

9. Red eft, which is a juvenile red-spotted newt

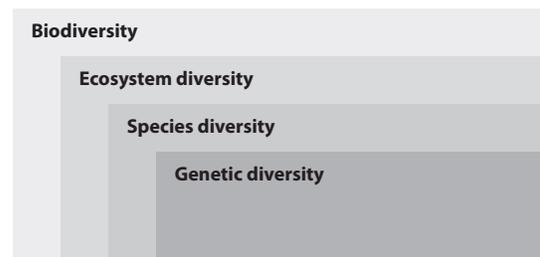
10. Answers should include:

Characteristic	Plantae	Animalia
Number of cells	Multicellular	Multicellular
Cell wall material	Cellulose	No cell walls
Nutrition	Autotrophic	Heterotrophic
Reproduction	Sexual	Sexual

### Section 1.4 Review

(Student textbook page 37)

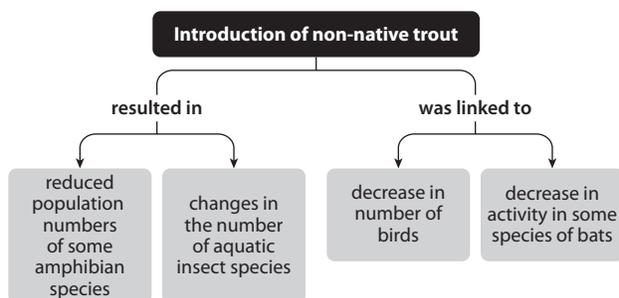
1. Sample answer:



2. The best answer is that it is both. It is a species because the plant on its own is one organism. It is an ecosystem because it contains abiotic factors and other species.

3. They are all ecosystems and this says that they can be small or large and that they are virtually everywhere.
4. The higher both types of diversity are, the better able a population or ecosystem is able to resist disease.
5. More ecosystem diversity means more ecotourism, more educational value, etc. Without ecosystem diversity many services would be missing; for example, raw materials from forests would be missing if we lost forest ecosystems.
6. Ecosystems with higher species diversity are more resilient and can provide ecosystem services with more consistency.
7. As plant species diversity increases, productivity increases, the number of invasive species decreases, and disease decreases. Overall, as plant species diversity increases, the ecosystem is healthier.
8. The more species diversity there is, the more structural diversity there will be and vice versa.
9. **a.** open ocean; The ocean is the largest of the ecosystems listed.  
**b.** cropland: Cropland is a human-made ecosystem, the others are natural.  
**c.** Students should name the ecosystem and give their reasons. Sample answer: Swamps provide the most important ecosystem service due to the fact that they provide water and water is essential for life.
10. Ecosystem diversity and species diversity are connected. If ecosystem diversity, which is the variety of ecosystems in the biosphere, decreases, the diversity of habitats that species can occupy also decreases. If ecosystems and the different habitats they contain disappear, some of species that occupy them will likely disappear as well, decreasing species diversity.

11. Sample answer:



## Chapter 1 Review Questions

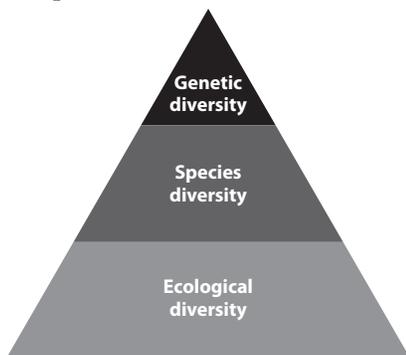
(Student textbook pages 45–7)

1. a
2. b
3. c
4. b
5. d
6. c
7. d
8. e
9. It allows scientists to communicate easily and reduces confusion.
10. Binomial nomenclature is a two-part naming system consisting of the generic name and specific classification.
11. A domain is a taxon with a rank higher than kingdom in the modern classification system. An example of a domain is Eukarya.
12. same genus
13. **a.** False, all bacteria are prokaryotes.  
**b.** True  
**c.** False, the phylogenetic species concept classifies organisms based on their evolutionary histories.
14. They belong to the same genus but different species.
15. Recreation, water supply, food production, nutrient recycling, pollination (see Table 1.6 for more).
16. Similar anatomical structures (like bones) in similar places (attached to torso) made of similar parts (long bones, etc.).
17. I would examine it under the microscope. I would also test the substance that makes up the cell wall (if it has one). I would look for chloroplasts to see if it is an autotroph. The data I need includes the number of cells, the presence or absence of a nuclear membrane and a cell wall, and the substance the cell wall is made of.
18. I would use Table 1.6 to determine what kingdom it belongs in. It belongs in kingdom Fungi.
19. A monoculture is less likely to resist the invasion of non-native plants, resist disease, grow as much biomass, and remove as much nitrate.
20. Answers should include a key that uses a series of two-part choices to identify the organism.

- 21.** To differentiate them so that population counts could be accurate. They are still the same species (they can interbreed) but they have enough common variation to distinguish them. It will help conservation efforts.
- 22.** Snakes and lizards are more closely related than snakes and crocodiles. Crocodiles and birds are more closely related than birds and snakes. They all share a common ancestor very long ago; however, the common ancestor of snakes and lizards lived more recently than the common ancestor of crocodiles and birds, which was more recent than the common ancestor of all four vertebrate animals.
- 23.** Sample answer:

<b>Domain: Eukarya</b>		<b>Domain: Bacteria</b>	
<b>Kingdom Fungi</b> • unicellular and multicellular • cell walls made of chitin • heterotrophic	<b>Kingdom Animalia</b> • multicellular • no cell walls • heterotrophic	<b>Kingdom Bacteria</b> • cell walls contain peptidoglycan • prokaryotic	
<b>Kingdom Plantae</b> • multicellular • autotrophic • cell walls made of cellulose	<b>Kingdom Protista</b> • unicellular and multicellular • autotrophic and heterotrophic • sexual and asexual	<b>Domain: Archaea</b> • cell walls do not contain peptidoglycan • prokaryotic	
• eukaryotic cells			

- 24.** The most important difference is whether the nucleus is surrounded by a membrane or not.
- 25.** Answers should include the idea that by overharvesting plants, the biodiversity of the ecosystems could be affected. Ecosystems with lower biodiversity are less resilient. Also, there may be implications for the food web.
- 26.** Letter should indicate that lack of diversity leads to a lack of resilience and the possibility that all bananas could become extinct if a disease were to occur.
- 27.** Sample answer:



- 28.** Organizer should reflect the content of the chapter as summarized on page 44. Concepts should be organized from the most general to the most specific and include the key terms of the chapter. The organizer should show multiple levels (general to specific) and valid cross links among concepts, using appropriate linking words or symbols. The organizer should have an effective title and be easy to follow.
- 29. a.** Answers should show that organisms that behave in a similar way are more likely to be closely related, but it would not be enough on its own.
- b.** It could be parental behaviour, feeding behaviour, migrating behaviour, hibernating behaviour, etc.
- 30. a.** garter snake and a ribbon snake are in the same genus
- b.** three
- c.** two
- d.** painted turtle, because they are in the same family
- 31.** Animals will be reclassified as genetic relatedness is discovered.
- 32.** Answers should show that the determination of species may need further study, such as whether or not the offspring are fertile.
- 33. a.** Animal A – damselfly; Animal B – dragonfly; I based my decision on the description of the wings.
- b.** They have similar body shapes and wing structure.
- 34.** Binomial nomenclature is universally accepted. Common names are regional and can lead to confusion.
- 35.** Atmospheric gas supply, climate regulation, photosynthesis; loss of sea ice will kill organisms, which will reduce consumption of CO<sub>2</sub>, which will lead to increased global temperatures.

### Chapter 1 Self-Assessment Questions

(Student textbook pages 48–9)

1. d
2. b
3. e
4. d
5. a
6. b
7. e
8. d
9. e
10. e

11. Protista
12. The coyote belongs to the Genus *Canis* and the species *Canis latrans*.
13. Canidae. It is in the same Genus as dogs and coyotes, which are also Canidae.
14. Sample answer: Louis Armstrong, Michael Bubl , John Coltrane, Faith Hill, Diana Krall, Lady Gaga, John Lennon, Sara McLaughlin, Oscar Peterson, Sting
  - 1a. Jazz musician..... go to 2
  - 1b. Not jazz musician..... go to 3
  - 2a. Canadian..... go to 4
  - 2b. Not Canadian..... go to 5
  - 3a. Female..... go to 6
  - 3b. Male..... go to 7
  - 4a. Female ..... Diana Krall
  - 4b. Male..... go to 8
  - 5a. Trumpet and vocals..... Louis Armstrong
  - 5b. Saxophone.....John Coltrane
  - 6a. Canadian..... Sara McLaughlin
  - 6b. Not Canadian..... go to 9
  - 7a. Member of the Beatles..... John Lennon
  - 7b. Member of the Police..... Sting
  - 8a. Vocalist..... Michael Bubl 
  - 8b. Pianist..... Oscar Peterson
  - 9a. Country..... Faith Hill
  - 9b. Electronica..... Lady Gaga
15. plant a natural space, place nest boxes, place bird feeders, plant a variety of trees, build a pond
16. one used genetic diversity, the other used structural diversity
17. Using the genetic species concept, they are different species. Using the morphological species concept they are the same species. Not enough information to tell using the biological species concept.
18. The disease killed them all. They were not genetically diverse and had no immunity.
19. no, because you cannot tell if it is a fungus like protist or a fungus
20. Eukaryotic cells have internal membranes; prokaryotic cells do not (see Figure 1.14).
21. Ecosystem services are the benefits experienced by organisms, which are provided by sustainable ecosystems. This could be to supply raw materials, treat waste, supply water, produce food, recycle nutrients.
22. fungi – multicellular, cell walls, heterotrophic

23. A phylogenetic tree is like a family tree. The organisms that are closest together are more closely related (like you and your brothers or sisters). The common ancestor on a phylogenetic tree is like your grandparents. You and your cousins share a grandfather. If two organisms are closely related, they are classified into similar groups called taxons. This is like your family being in one group and your friend's family being in a different group.

## Chapter 2 Diversity: From Simple to Complex

### Learning Check Questions (Student textbook page 55)

1. Structural diversity describes the variations within cells, between cells, and how they are organized in living organisms. Structural diversity also describes an organism's internal and external features.
2. For: They contain genetic material that provides the information needed to proliferate. Against: They are not cellular and they have no cytoplasm. They are incapable of living and reproducing independently of another organism.
3. Viruses are considered by many not to be living organisms, such as prokaryotes and eukaryotes, because they are dependent on the internal machinery of other cells for replication. Viruses do not have most of the cellular structures that prokaryotes and eukaryotes have. Prokaryotes do not have a membrane-bound nucleus or organelles, which eukaryotes do.
4. Viruses can be classified according to the size and shape of their capsids, as well as by the types of diseases that they cause.
5. In the lytic cycle, viral genetic material uses the copying machinery of the host cell to make new viruses. In the lysogenic cycle, the viral DNA inserts itself into the host cell's chromosome, where it may remain dormant before it becomes active. Once active, the viral DNA leaves the host's chromosome and uses the host cell's machinery to produce more viruses.
6. If this virus were to infect crops without control, it would destroy entire fields and have severe economic impact on farmers' incomes, crop prices, and ultimately the consumer.

### (Student textbook page 62)

7. The three common forms of bacteria and archaea are the cocci, bacilli, and spiral-shaped forms.
8. Cyanobacteria

9. Thermophile: archaea that can live in high-temperature environments; halophile: archaea that can live in very salty habitats; acidophile: archaea that can live in very acidic conditions
10. Mesophiles have a greater chance of survival than extremophiles because there are more habitats in which mesophiles can survive. Also, competition for resources might be relatively lower in environments with moderate conditions than extreme conditions, since there are more of them.
11. Both are biological (or chemical) processes that produce a by-product. Methanogenesis produces methane as a by-product, whereas photosynthesis generally produces oxygen. In prokaryotes, photosynthesis occurs mainly in bacteria, but methanogenesis appears to be unique to archaea.
12. No. Although there are multiple bacteria aggregated together, they are not joined to form a multicellular organism.

**(Student textbook page 69)**

13. Multicellularity is not found in prokaryotes. There is a greater structural diversity (cells, bodies, specialized tissues) in eukaryotes than in prokaryotes.
14. The theory of endosymbiosis proposes that eukaryotic evolution occurred in part when one cell engulfed a different cell type, which survived and became a part of the host cell.
15. Mitochondria and chloroplasts have the following in common with prokaryotes: similar membranes and ribosomes, reproduce by binary fission, contain circular chromosomes with similar genes.
16. Modern cyanobacteria have genes that closely match those in chloroplasts. It is thought that they descended from the same ancestor because they both perform photosynthesis.
17. Prokaryotic aggregations are usually made of genetically identical cells, but even when aggregated they reproduce separately (by binary fission). Multicellular eukaryotes are made of many different types of cells that work together. Their reproduction results in a whole new organism that usually has the same complexity as its parent.
18. About two billion years ago: first eukaryotes evolved; 1.2–1.5 billion years ago: first multicellular organisms appeared; about 550 million years ago: large, complex eukaryotes appeared

**(Student textbook page 76)**

19. Taxonomists group protists together mainly because they do not fit into the other kingdoms, rather than because they are similar or closely related to one another.
20. It is used for movement and for engulfing food.
21. Venn diagram should show that both are used for movement. Flagella are fewer per organism, longer, and are used exclusively for movement. Cilia are more numerous per organism, shorter, and are used for movement and to move particles along the perimeter of the cell.
22. Both are fungus-like protists. Plasmodial slime moulds have a streaming blob structure, called a plasmodium, which contains many nuclei. They feed by engulfing small particles of food into their cytoplasm. Cellular slime moulds have an individual amoeboid cell structure, with one nucleus in each cell. Each cell feeds by ingesting tiny bacteria or yeast cells. When food becomes scarce, the cells release a chemical that causes them to gather together to form a pseudoplasmodium.
23. Sample answer: Sporozoans of the genus *Plasmodium* are one type of parasite that cause harm in humans (for example, malaria). Amoebas of the species *Entamoeba histolytica*, a form of cercozoan, are also a parasite, which feed on the lining of the small intestine in humans and cause serious illness.
24. The statement says that many scientists use the word protozoan to refer to a one-celled organism with a nucleus. This organism is not a plant, fungus, or animal. It cannot make its own food, so it must look for food from other sources. Examples of these kinds of organisms include an amoeba and a ciliate.

**Caption Questions**

**Figure 2.1 (Student textbook page 52):** Sample answer: Each bacterium consists of a single, rod-shaped cell. The blue whale is multicellular and has fins. The red cedars are tall trees with branches, leaves, and bark.

**Figure 2.2 (Student textbook page 54):** The capsid of the polio virus forms many flat surfaces to give the virus a crystalline shape, while the capsid of the HIV forms a spherical coating around the virus's genetic material. The tobacco mosaic virus has a cylindrically shaped capsid, and the T4 virus has a capsid-covered head attached to a protein tail and several tail fibres.

**Figure 2.7 (Student textbook page 60):** With large populations of livestock worldwide, there is an immense amount of methane released into the air each day. This is likely contributing to global warming and climate change.

**Figure 2.10 (Student textbook page 63):** In conjugation, different amounts of DNA are exchanged between cells. The resulting cells are new genetic forms of the prokaryotes and represent an increase in biodiversity.

**Figure 2.15 (Student textbook page 68):** The theory is supported by the circular chromosome of mitochondria, which has many genes that are similar to those in prokaryotes, and mitochondria reproduce by binary fission, which is also how free-living prokaryotes reproduce.

**Figure 2.21 (Student textbook page 74):** Once sporozoites enter the human liver they reproduce asexually to form a second type of spore-like cell.

## Section 2.1 Review Questions

(Student textbook page 58)

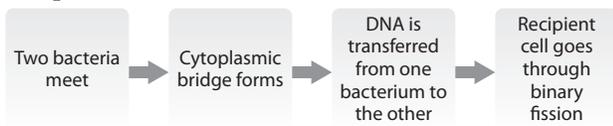
- Answers may include: prokaryotes do not have a membrane-bound nucleus or organelles and eukaryotes do; prokaryotes are smaller than eukaryotes; many prokaryotes are anaerobic, most eukaryotes are aerobic
- A – prokaryotic, they are bacteria; B – eukaryotic, multicellular organisms are eukaryotic; C – eukaryotic, trees are made from plant cells, which are eukaryotic
- Viral production somewhat resembles an assembly line. Each step is defined and moves the process to the final result—the release of many replicated viruses. It differs from a factory in that the machinery is the organelles of a living cell. The host cell is destroyed when the replicated viruses are released.
- Diagrams should show that the insulin gene is inserted into the viral DNA. The virus then infects a host cell and the newly replicated viruses all contain the insulin gene.
- lytic cycle: cold, possibly measles; lysogenic cycle: shingles, warts, HIV. People do not realize they are infected and do not take any precautions to prevent the spread of the disease to others.
- Sample answer: You could try to block the initial attachment of a virus to the host cell. If not, then try to block the replication stage of the lytic cycle.
- virus attaches to suitable host cell, matching protein receptors on the surface of the cell membrane  
– the virus injects or releases its DNA or RNA  
– the host is triggered to duplicate the viral genetic code, which is used to make copies of the virus  
– the new viruses are assembled in the host cell  
– eventually the host cell breaks open, releasing the new virus
- Bacteria, viruses and eukaryotic cells all contain nucleic acids. Bacteria cells do not have nuclei (or any internal membranes) and are small (1–10 micrometres). Eukaryotic cells have nuclei and are large (100–1000 micrometres). Viruses are made of a protein coat (not a cell membrane) and are much simpler in structure.
- Sample answer: Viruses are dormant when outside of a cell. Rather than being destroyed when exposed to unfavourable conditions, viruses remain intact until they occupy a cell.
- The disease-causing agents are prions. Prions cause disease when they convert from their normal form into harmful particles that have the same chemical composition but a different molecular shape.
- New retroviruses in humans are difficult to detect because they become part of the host's chromosomes. Once this occurs, they are not easily detected by medical tests.
- A provirus is viral DNA that has become part of the host cell's chromosomes. Graphic organizers should include the following steps: a. The virus attaches to the cell membrane and injects its RNA into the cell. b. The viral RNA is copied into DNA by the host cell. c. The viral DNA enters the host cell's chromosome.
- Sample answer: Having a standardized scientific naming system for viruses allows scientists from around the world to communicate quickly and accurately. Time can be saved in making identifications and sharing information if viruses are given standardized names.
- Sample answer: The rapidity with which a retrovirus can mutate makes it very difficult to develop effective treatments. Once a treatment is developed for one strain of a retrovirus, a new and equally pathogenic virus can emerge through mutation, making the treatment ineffective.
- Graphic organizers should include the following information: Viruses: consist of genetic material (DNA or RNA) surrounded by a protein coat called a capsid. Viruses can cause disease, sometimes severe, in humans, as well as in other organisms humans depend on, including important food crops such as wheat, oats, and barley. Prions consist mostly or entirely of a single protein. Although prions are normally found in the human body, they can cause deadly brain diseases (CJD) if they convert from their normal form to a harmful form. Prions also cause disease in animals that humans rely on as food sources, such as cows and sheep.

**Section 2.2 Review Questions**  
(Student textbook page 66)

1.

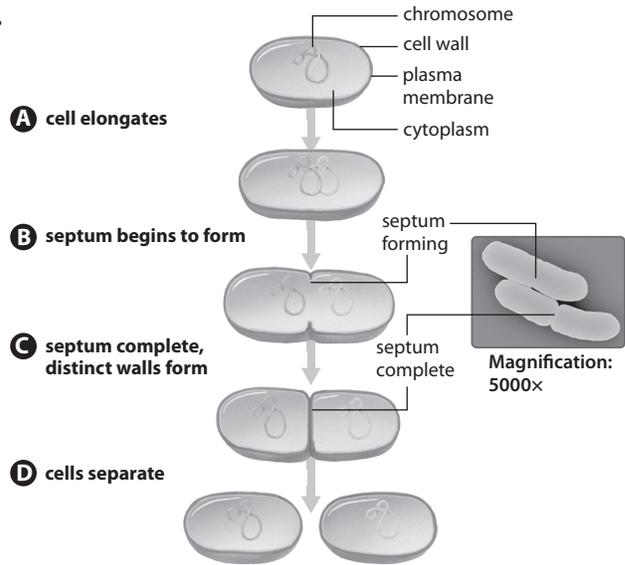
Shape	Name	Picture
Round	Cocci	
Rod-shaped	Bacilli	
Spiral-shaped		

2. a. true  
 b. False; some bacteria cause illness in humans  
 c. False; many bacteria are mesophiles  
 d. False; some bacteria are photosynthetic, some Archaea undergo methanogenesis
3. It allows the bacterium to survive harsh conditions (heat, cold, drying out, etc.) for short or even incredibly long periods of time.
4. a. In the gram stain, a gram-positive bacterium turns purple due to large amounts of protein in the cell wall.  
 b. The modern approach is to study the DNA sequences of genes.
5. The Gram-positive bacterium is the one with the thick cell protein layer that has stained purple; the Gram-negative bacterium has a thin protein layer that stained pink.
6. Sample answer:



7. The endospores on the fresh fruit are exposed to oxygen. When the endospores are in an anaerobic environment, they produce toxins that can make people sick.

8.

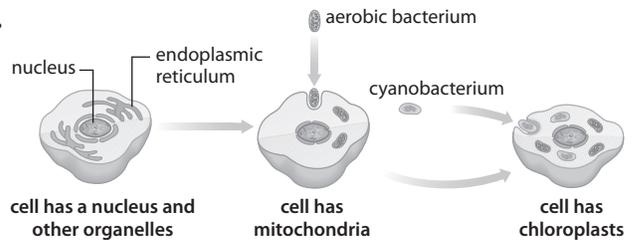


9. Some archaea are methanogens. They live in the intestines of cows and during anaerobic respiration, release methane gas. Methane gas is a greenhouse gas.
10. We would not have as much oxygen.
11. If too much antibiotic was taken, the probiotic bacteria would be killed and the disease-causing bacteria might grow quickly, which could cause other life threatening diseases.
12. Ethanol can be used as a fuel (to replace fossil fuels). If bacteria can be harnessed to make it, we could reduce our reliance on fossil fuels and use renewable resources.

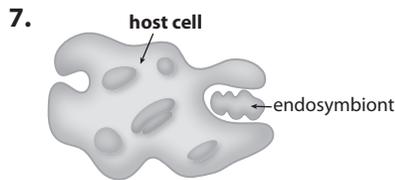
**Section 2.3 Review Questions**  
(Student textbook page 71)

1. More genes mean that the cell can make more proteins. Cells are more diverse in size, shape, mobility, and specialized functions.
2. Answers should include evidence such as single circular chromosomes in chloroplasts and mitochondria, both organelles undergo binary fission, have matching genes, and similar ribosomes.

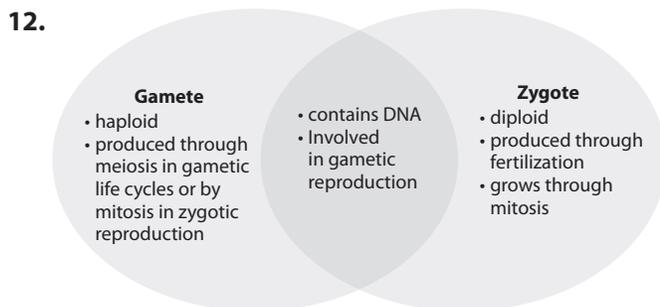
3.



4. The latter, because all eukaryotic cells have mitochondria. If the chloroplast came first, and the mitochondrion second, then some cells (like animal cells) would have to eventually lose the chloroplasts.
5. Organisms using the gametic sexual life cycle are diploid, but organisms using the zygotic sexual life cycle are only diploid as a zygote and the organism is haploid.
6. A primitive prokaryotic cell could engulf bacteria. It used some of this bacteria as a food source. When it ate aerobic bacteria, it didn't digest it; instead it used the energy that the bacteria produced to help it diversity.



8. Binary fission
9. Primitive prokaryotes engulfed other prokaryotes and did not digest them. They lived symbiotically with the endosymbiont providing energy to the host and the host protecting the endosymbiont.
10. Some groups of cells absorb nutrients, other groups are sensory, and other groups digest food.
11. Prokaryotic cells undergo binary fission. The offspring are identical to the parents unless conjugation or mutation has occurred. Eukaryotic organisms can divide through mitosis (asexual) or meiosis (sexual). The production of haploid cells through meiosis allows eukaryotic "parents" to produce a new offspring that is similar to them but not identical.



13. a. sexual, zygotic
- b. sexual, sporic
- c. asexual
- d. sexual, gametic

## Section 2.4 Review Questions

### (Student textbook page 78)

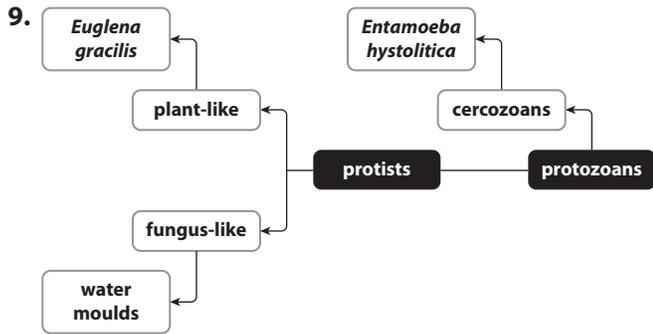
1. Organisms are grouped in Kingdom Protista because they are not plant, fungi, or animals, rather than because they are closely related to each other.
2. The three main groups are animal-like protists, fungus-like protists, and plant-like protists. Animal-like protists ingest other organisms for food or they are parasites, taking nutrients from the organisms in which they reside. Fungus-like protists absorb their nutrients from other organisms. Plant-like protists contain photosynthetic pigments in their chloroplasts that they use to convert solar energy into sugar.

3. Sample answer:

### Protozoans: A summary

<b>Representative organisms</b>	Amoeba, paramecium, Trychonympha
<b>Methods of locomotion</b>	Use pseudopods, cilia, flagella to swim
<b>Relationships with other organisms</b>	Parasitic, cause disease, symbiotic with other organisms
<b>How they affect an ecosystem</b>	Eat producers, act as food for larger predators, control populations through disease

4. a. They are heterotrophic (extra-cellular digestion); cell structure is similar.
- b. They are sessile and cells have cell walls.
- c. They are heterotrophic and ingest their food; they can be unicellular.
5. Some species of dinoflagellates, the type that cause red tides, produce a toxin that gets concentrated in the tissues of shellfish. If humans eat those shellfish, they can become seriously ill or die.
6. a. The highest concentrations are at noon each day.
- b. The majority of the diatoms are a half metre below the surface at midnight.
- c. Diatoms are undergoing photosynthesis.
7. a. Mosquitoes breed in swampy, marshy areas.
- b. By draining these areas, ecosystems are being destroyed, along with habitats and organisms that live there.
8. a. Euglenoids – has chloroplasts and an eyespot
- b. Cercozoans – has pseudopods
- c. Flagellate – has two flagella
- d. Ciliate – has cilia



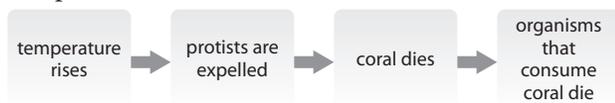
10. It eats bacteria but it also performs photosynthesis.

11. Students may choose to make a cycle chart or a flow chart to represent the diatom life cycle. Key points that should be included in the organizer include: a. Diatoms reproduce asexually by mitosis. b. Sometimes diatoms will reproduce sexually through meiosis. c. During sexual reproduction, gametes are released and fertilized. d. A zygote forms after fertilization. e. Rigid cell walls made of silica form around the zygote.

12. Dinoflagellates live in coral. They use nitrogen waste and CO<sub>2</sub> from the coral and provide the coral with O<sub>2</sub> and food.

Flagellates live in termite mounds and produce enzymes to convert cellulose to sugar, which the termites can use. The flagellates have a steady supply of food from the termites and a protected place to live.

13. Sample answer:



## Chapter 2 Review Questions

(Student textbook pages 83–5)

- a
- b
- b
- b
- d
- d
- d
- c
- Agree. Protozoa are animal-like protists that consume other organisms.
- the apple tree and the great white shark because they are in the same domain; the bacterium and archaeon are in different domains

11. because they can survive all sorts of harsh conditions that we might impose (like heat, drying out, or chemicals) and then can “germinate” back into active disease-causing bacteria

12. A. bacilli

B. spiral

C. coccus

13. They are bacteria-like, having a circular chromosome with bacteria-like genes; they reproduce inside the cell by binary fission; they have their own bacteria-like ribosomes for making their own proteins

14. plant-like, fungus-like, and animal-like protists

15. Asexual reproduction will produce a clone that is genetically identical. Sexual reproduction involves an exchange of haploid nuclei that merge to form diploid individuals that are a new combination of genes from two individuals

16. They eat and produce food through photosynthesis.

17. Are cells the same individual, having the same genes? Are the cells prokaryotic? Do the cells individually reproduce, or does the collection produce a special reproduction cell to start a new individual? Can each cell of the chain become either cell type?

18. This mode of engulfing bacteria is like the action of amoeba. However, the human body creates the white blood cells, but the amoeba has its own chromosomes and it reproduces asexually.

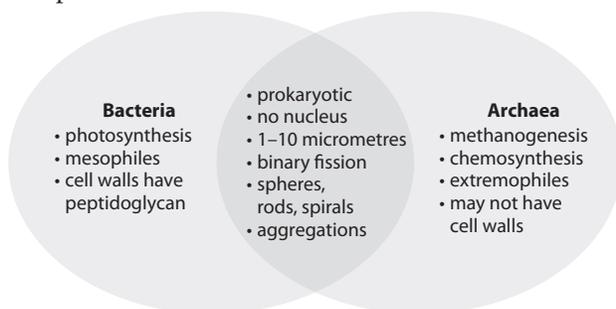
19. Early conditions on Earth were likely very harsh—cold or hot, volcanic, UV light from the sun, perhaps acidic, etc.—and some archaeons can cope with extreme conditions very well.

20. Answers should articulate that it is good to get rid of the bad ones, but there is a cost and so we should not be reckless with our use of such products. Sometimes, it is necessary.

21. Swipe the bacteria onto several plates of nutrient agar. Seal one plate. This will represent the anaerobic conditions. Leave the lid off of one plate (or put a loose aerated lid on it). This will represent aerobic conditions. Put a lid on one plate and do not seal it. This will represent the “control”. Place the plates into a warm area under the same lighting conditions and observe the growth daily for two weeks.

- 22. a.** The control group should have nothing extra added to its environment. All variables should remain the same.
- b.** The independent variable was the type of substance added to the protozoan's environment (salt water, vinegar, or sugar water). The dependent variable was the protozoan's behaviour.
- c.** Possible hypothesis: The effect of a change in environmental conditions (for example, a change in salinity, acidity, or carbohydrate concentration of water) will negatively affect a protozoan's behaviour.
- 23.** Gather several bean plants (about 5–6 plants). Mass them all. Inoculate 3 of them with Rhizobium and do not inoculate the others. Place them in equal sized pots containing the same soil in the same quantities. Water them daily (the same amount). After two weeks, remove the plants from their pots, rinse off the soil and mass them.
- 24.** No, because even though they are small and simple, they need cells for survival, so they probably came later.
- 25.** Cartoons should contain accurate information as reflected in Figure 2.3.
- 26.** This image will be dinoflagellates, made of cells that have endosymbiotic mitochondria and chloroplasts, living endosymbiotically within coral animal, which itself has cells that have endosymbiotic mitochondria.
- 27.** It is artificial because it is all the eukaryotes except three groups (animals, fungi, plants). Probably, it is more defensible to have each group be a kingdom, not just the three that are “large” organisms.

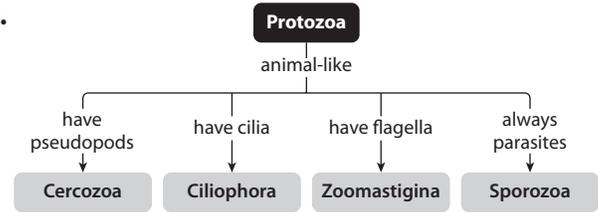
**28.** Sample answer:



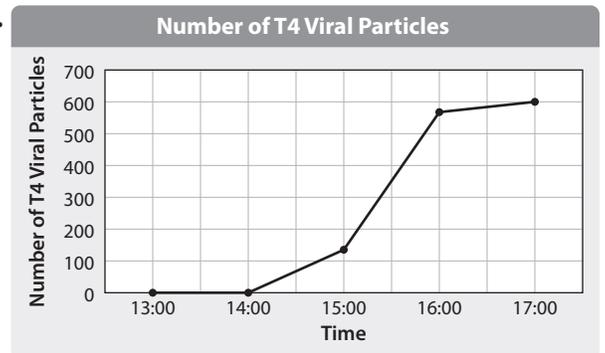
- 29. a.** Sample answers: I support prevention, if living conditions are improved, quality of life will improve as well as the reduction of TB. Encouraging people to finish prescriptions will help with all bacterial resistance; I support finding new medicines. They could discover something that treats other diseases as well as TB.

- b.** Increase education and awareness of risks through TV and radio ads. Teach programs in school to help children be more aware of TB and how it is transmitted.

**30.**



**31. a.**



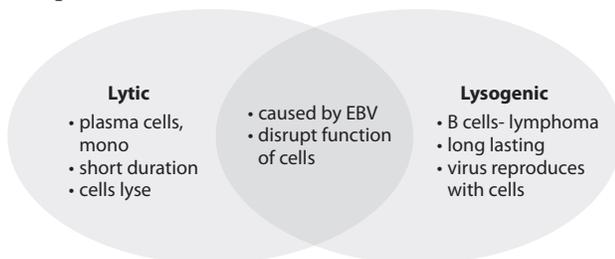
- b.** logarithmic (slow then fast then slow)
- c.** the population will crash due to lack of food
- d.** The T4 would not have been able to reproduce; it would be a flat line.
- 32.** Organizer should reflect the content of the chapter as summarized on page 82. Concepts should be organized from the most general to the most specific and include the key terms of the chapter. The organizer should show multiple levels (general to specific) and valid cross links among concepts, using appropriate linking words or symbols. The organizer should have an effective title and be easy to follow.
- 33.** Yes, it is a protist. It is not an archaeon or bacterium because it has eukaryotic cells. It is not an animal or a fungus because it has chloroplasts. It is not a plant because plants are multicellular.
- 34.** This means that when the virus enters the cell, it has the gene to make human insulin, and the infected cell then produces insulin, which could be harvested for human injections.
- 35.** If the conditions we make are new, we may be encouraging evolution of new extremophiles. We should be careful about changing nature, but if the new organisms help contain the negative environmental consequences, that is a good result.

- 36.** Yes, it was successful. Draining pools took breeding grounds away. Insecticides killed immature mosquitoes. Screens kept mosquitoes out of homes and hospitals. Killing adults reduced the breeding population.
- 37.** Filter drinking water, beer, and swimming pools.
- 38.** The bacteria would eat the oil. When they ran out of food, they would die and the ecosystem could recover.

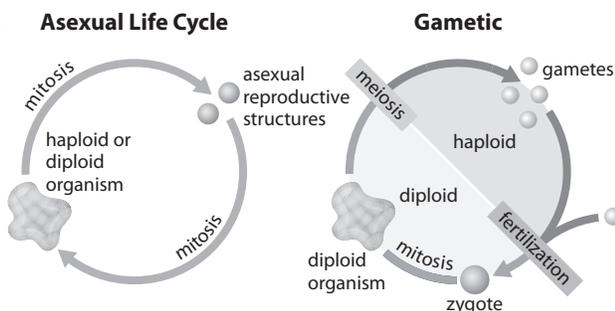
## Chapter 2 Self-Assessment Questions

(Student textbook pages 86–7)

- d
- b
- a
- c
- d
- b
- b
- d
- a
- c
- Sample answer:



- sexual reproduction increases diversity, which increases resilience
- chloroplasts perform photosynthesis, mitochondria perform cellular respiration
- algae—they are not true plants because they do not have embryos. They are not true protists because they are multicellular.
- Asexual Life Cycle**



- Advantage—very specific to bacteria. Disadvantage—if they mutated, they could kill helpful bacteria
- Archaea are able to live in extreme environments. They are extremophiles. Bacteria are mesophiles (need moderate environments).
- Sample answer: Carefully sterilize food containers so that bacteria are not introduced into the food. Wash all surfaces that come into contact with bacteria sources (for example, meat) carefully and don't mix knives or cutting boards.
- it doubles
  - between 50 and 60
  - Binary fission produces 2 copies from 1. Bacteria are so small, they do not need much time to grow before they divide again. If they are in a nutrient rich environment, they will reproduce quickly.
- A cercozoid (amoeba). Same shape and method of locomotion (pseudopods).
- They are predators. Amoebas engulf their food. Paramecium “eat” by using their oral groove.
- Prokaryotic cells acted as hosts, which engulfed endosymbionts and the endosymbiont was not destroyed. The two organisms supported each other.
- Two bacteria can join together via a cytoplasmic bridge. The plasmid can travel from one bacteria to the other. The recipient divides by binary fission and the plasmid is now in two bacteria.
- HIV reproduces lysogenically. It hides in its host until it is triggered to reproduce lytically.
- Bacteria, viruses, and protists all contain nucleic acids. Bacteria cells do not have nuclei (or any internal membranes) and are small (1–10 micrometres). Eukaryotic cells (protists) have nuclei and are large (100–1000 micrometres). They can have wide diversity in the cell structure (cilia, flagella, chloroplasts, pseudopods). Viruses are made of a protein coat (not a cell membrane) and are much simpler in structure.

## Chapter 3 Multicellular Diversity

### Learning Check Questions

(Student textbook page 93)

- Scientists disagree about whether green algae belong in the protist kingdom or the plant kingdom.
- Unicellular algae include Pyrrophytes, Chrysophytes, and Euglenophytes. Multicellular algae include Rhodophytes, Phaeophytes, and Chlorophytes.

3. Colour
4. Answers should include a diagram similar to Figure 3.3 (C) and include the labels, “stipe,” “holdfast,” and “blade.”
5. Because phycoerythrin is sensitive to light waves that reach deeper sea levels, red algae can thrive at greater ocean depths than other algae.
6. Agree; some are unicellular, some occur in colonies, and some are multicellular.

**(Student textbook page 97)**

7. Bryophytes are nonvascular plants. They lack vascular tissue such as xylem and phloem. They are small and live in moist areas. They have rhizoids instead of roots.
8. Both are bryophytes that live in moist areas and low-light conditions. Both are only one cell thick. Mosses have short, vertical stems with appendages that look like leaves. The liverworts appear as “leafy” stems or as small, flattened blades. Liverworts grow more horizontally than vertically.
9. Bryophytes were the first plants to grow on Earth 460 million years ago, converting a barren landscape into green environments.
10. Gametophyte and sporophyte
11. They reduce soil erosion and are important in bog development, as a food source for animals, and in nutrient cycling within ecosystems.
12. Without roots and vascular tissue, bryophytes rely on osmosis and diffusion to transport water and nutrients into their bodies, which would be harder to do in sunny areas, where any moisture would dry out quickly.

**(Student textbook page 101)**

13. They produce haploid spores, not seeds. They do have vascular tissue (xylem and phloem) for internal transport, which allows them to grow tall. The sporophyte is the dominant generation in their lifecycle.
14. The sporophyte
15. Unlike angiosperms, gymnosperms have seeds that are not enclosed in protective tissue but are instead exposed on the surface of cone scales.
16. Approximately 280 million years ago, the climate became cooler and drier, which led to the extinction of most large spore-producing plants that could not survive the long periods of drought and freezing.

17. Male cones are soft, while female cones are large, hard, and made of scales.
18. The function of pollen grains is to transport sperm from the male cones to the female cones. The pollen grains are released into the wind and may land on female cones where they release their sperm.

**(Student textbook page 107)**

19. A mycelium is the non-reproductive part of the fungus, consisting of a net-like mass of branching hyphae. Mycelia live in soil and on other nutritious substances.
20. Fungi are more like animals than plants. DNA analysis helps confirm this relationship.
21. To obtain nourishment, parasitic fungi absorb nutrients from a host, predatory fungi trap and digest their prey, mutualistic fungi obtain their nourishment from a partner, and saprobial fungi feed on dead or decaying material.
22. The antibiotic penicillin is derived from the fungus *Penicillium*. Cyclosporin (from a soil fungus) is used after transplant surgery to combat a patient’s tendency to reject the new organ. Foods like soy sauce and some cheese are made using members of this group.
23. The fruiting body
24. If fungal diseases are not stopped, there will be increased crop loss resulting in less food and higher economic losses for farmers.

**(Student textbook page 113)**

25. All animals are eukaryotic, multicellular organisms. Their cells do not have cell walls. They are heterotrophs that usually ingest and then digest their food. They are usually mobile, or have the ability to move in at least one stage of their lives. They reproduce sexually and produce an embryo that undergoes stages of development.
26. Tissues are made of groups of similar cells that are specialized to perform specific tasks; tissues, in turn, are organized into organs and organ systems, each with particular functions.
27. Asymmetry describes a body shape that is irregular and cannot be divided into matching halves, such as in sponges. Bilateral symmetry describes bodies that can be divided into two mirror halves only, such as a turtle. Radial symmetry describes bodies for which there are multiple ways to divide the organism to make matching halves, such as a hydra.

- 28.** The three layers are the ectoderm, mesoderm, and endoderm. The development of these three layers helps sort cells into an arrangement that produces specialized tissues and organs in the adult animal.
- 29.** Acoelomates have a flattened body and do not have a fluid-filled cavity for complex organ systems. Coelomates have a fluid-filled body cavity that provides space for the development and suspension of organs and organ systems.  
Humans are coelomates because we have a cavity that contains complex organ systems.
- 30.** Graphic organizers should include information about the definition of segmentation (the division of the body into repetitive segments). They should also include the fact that individuals can survive damage to one segment because the other segments can function normally, and these organisms have more effective mobility because the segments can move independently, allowing for complex patterns of movement.

**(Student textbook page 117)**

- 31.** Both are used in sexual reproduction to produce a zygote. External fertilization occurs when gametes combine outside the body. Internal fertilization occurs when the egg and sperm combine inside the female body.
- 32.** Sponges are asymmetrical and do not have tissues.
- 33.** Freshwater hydras, marine jellyfish, and sea anemones and corals. They have tissues, radial body symmetry, and a gastrovascular cavity where food is digested.
- 34.** Both are forms of cnidarians. A polyp is a sessile that lives attached to surfaces. The tentacles are oriented upward, as in an adult coral. A medusa is a mobile form with tentacles usually oriented downward, as in a jellyfish.
- 35.** Segmented worms have a coelom, segmented body, bilateral symmetry, and organ systems including circulatory, digestive, excretory, and nervous.
- 36.** Shelled snails and slugs (gastropods) include species that are terrestrial, aquatic, or marine. Clams and relatives (bivalves) include species that are found in fresh water or in salt water. Octopuses and squids (cephalopods) are marine species only.

**(Student textbook page 121)**

- 37.** Tube feet are small muscular, fluid-filled tubes, which end in suction cup structures, such as the ones found in echinoderms. They are used for locomotion, but some sea stars also use them to open up mollusc prey that is protected within shells.
- 38.** The rigidity of an insect exoskeleton protects the animal; it provides points of attachment for wings and legs and it resists drying out, allowing insects to occupy dry environments.
- 39.** They have a notochord and a dorsal nerve cord.
- 40.** Sample answer: A swim bladder allows a fish to rise and sink in the water column, which makes any activity underwater, such as catching prey or escaping predators, easier to accomplish.
- 41.** They have two pairs of limbs.
- 42.** Waterproof body scales that prevent dehydration; breathe only through lungs (do not need moist skin for respiration); lay shelled, amniotic eggs that resist drying out; fertilization is internal, removing the need to release gametes into moist environments.

**(Student textbook page 127)**

- 43.** The biodiversity crisis is the current decline in genetic, species, and ecosystem diversity that may represent a mass extinction, due to the currently high extinction rate.
- 44.** Studying long-term datasets, manipulating systems by changing climate conditions in a controlled setting, modelling
- 45.** Answers should include information about decreasing temperature and vegetation zones that are more cold tolerant as you move up the mountain.
- 46.** Lichens are a key winter food for caribou. Lichens are suffering due to competition from increases in plant growth, and increases in snow or freezing rain make it more difficult for caribou to dig lichens out. Earlier springs have resulted in earlier plant growth in northern regions. This change in timing means that when migrating caribou arrive, the plants have already reached their peak growth and have less nutritional value.
- 47.** Warming results in habitat loss, since it reduces the amount of suitable land area for plant growth. The remaining areas that are suitable for growth become more fragmented, which can isolate plant populations, thus leading to a lack of genetic diversity.

48. An increase in temperature could result in too many females and too few males being produced, which could eventually reduce breeding and result in declining turtle populations.

### Caption Questions

**Figure 3.1 (Student textbook page 90):** Sample answer: Similarities to plants (DNA or cell structure)

**Figure 3.6 (Student textbook page 93):** Fungi are more closely related to animals because they both descended from ancestral heterotrophic eukaryotes. Plants descended from ancestral photosynthetic eukaryotes, on the opposite side of the phylogenetic tree.

**Figure 3.29 (Student textbook page 115):** Polyps have tentacles extended upward and outward, while medusae move with tentacles pointed downward.

### Section 3.1 Review Questions

(Student textbook page 95)

- Answers should make reference to chlorophylls *a* and *b*, cell structure, cellulose in the cell wall and DNA sequences in favour of being plants, and reference to the lack of embryos and aquatic habitats in favour of them being protists.
- It keeps them upright without the need for a strong stem.
- Ecologically – photosynthesis, producers in the food chain  
Economically – brown, support fisheries; red – sushi wraps, dairy thickener; green – support fisheries
- Plants are noted for their photosynthetic ability. Green algae produce a significant portion of the oxygen on Earth. Some green algae look very similar to plants.
- unicellular, have flagella
- production of embryos, development of vascular tissue, production of seeds, production of flowers.
- embryo – an organism's early pre-birth stage of development; small multicellular plants
- The evolution of xylem and phloem, through the use of lignin, allowed plants to grow to larger sizes because they had the capacity for moving water and substances in the water. Without it, plants would still be small.
- Roots absorb water, anchor the plant and provide structure; leaves perform photosynthesis.
- Because vascular tissue allows plants to grow to larger sizes, without it a terrestrial landscape would be covered with plants that grow close to the ground.

- Sketches should be similar to **Figure 3.8** and should include the following labels: gametophyte (haploid), mitosis, male gamete, female gamete, fertilization, sporophyte (diploid), meiosis, and spores. Organisms that use alternation of generations as a form of sexual reproduction have two multicellular stages in their life cycle. The haploid version (gametophyte) produces haploid gametes by mitosis. Haploid cells only contain one set of chromosomes. When fertilization occurs and the gametes fuse, they develop into the diploid version of the organism (sporophyte). The diploid cells contain two sets of chromosomes. The sporophyte produces spores by meiosis, which develop into the gametophyte.
- The remaining three circles on the concept map should be filled in with the following three terms or phrases (in any order): multicellular, photosynthetic, cellulose-based cell walls

### Section 3.2 Review Questions

(Student textbook page 104)

- Nonvascular plants like mosses, vascular seedless plants like ferns, gymnosperms like coniferous trees, and angiosperms like roses
- a. In the seedless, non-vascular plants  
b. In the gymnosperms and angiosperms
- Answers should include information from Table 3.2.
- The larger sporophyte produces spores by meiosis, and the smaller gametophyte produces gametes by mitosis.
- Seeds allow plants to reproduce sexually without needing water (initially), provide protection against harsh environment conditions, can survive without water for many years, and can be dispersed in a variety of ways (wind, etc.).
- Most gymnosperms are coniferous trees, and most of them are evergreen.
- Cones are either male or female, and are different in form and persistence. Answers will vary, but if cones were both male and female, the pollen from one cone would be highly likely to fertilize the female part of the cone. Being either male or female, this increases the chance of fertilizing a female cone on another tree.
- The squirrels gather cones from all over the forest, but carry them back to their midden. This will cause mixing of cones from various areas.

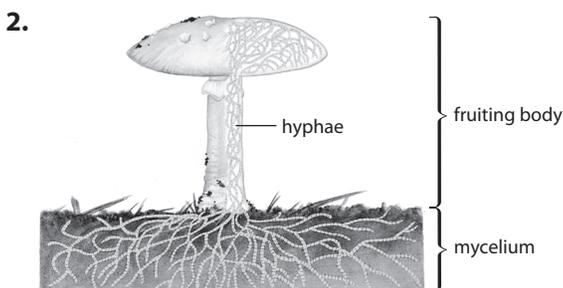
9. One versus two cotyledons	
monocots have flower parts in threes (or multiples)	monocot leaves have parallel veins

- 10.** The bland landscape will be wind-pollinated, because the plants are not using devices like showy flowers for attracting insects. The colourful landscape will be insect-pollinated, because flowers are for the purpose of attracting pollinating animals.
- 11.** Both lists will be this order: non-vascular, vascular seedless, gymnosperms (seeds but no flowers), and angiosperms (both seeds and flowers). Over time, plants have become increasingly complex, and the older groups increasingly less significant in terms of current diversity.
- 12.** A fruit is a mature ovary that contains seeds. The ovary develops from the base of the flower and, sometimes, additional parts of the flower or plant become part of the fruit as well. Fruits represent adaptations to disperse seeds successfully. Many animals eat sweet fruits and excrete the seeds in a new location. Burrs stick to the fur of animals, such as bears. Some fruits, such as coconuts, float to new locations.
- 13.** Sample answer: Having knowledge of plant classification could help me determine if I was in a tropical location, a temperate location, or a colder area, such as taiga or tundra. I would examine the plants around me, looking at their leaves, stems, general size and shape, and evidence of spore, cone, or flower formation. I would look at the conditions under which the plants are growing, such as the amount of light or moisture they are receiving. I would classify them into main groups such as nonvascular, seedless vascular, gymnosperms, or angiosperms.

### Section 3.3 Review Questions

(Student textbook page 110)

- 1.** Fungi are multicellular, eukaryotic, heterotrophic. They perform extracellular digestion. Fungi can be parasitic, predatory, mutualistic or saprobial.



- 3.** Create two green bins with equal amounts of organic matter. Measure the height. Add fungi to one bin and no fungi to the other. Measure the height of the organic matter in 2 weeks.

- 4.** The fungi that grow on the leaves are saprobial. The ants have a mutualistic relationship with the fungus. The fungus gets food and appropriate conditions, and the ant gets food from the fungus.
- 5.** Answers should include: spore production, budding, and fragmentation.
- 6.** If all of the fungi stayed in the same place, there would be too much competition for nutrition. Spores allow them to spread to new areas that have more food.
- 7.** Cordyceps – infects brains of insects and digests them  
Chytrid – infects potato plants and causes potato wart
- 8.** Sample answer:

Phyla	Description	Nutrition	Reproduction	Impact on Humans
Imperfect	Diverse Examples: <i>Penicillium</i> , <i>cyclosporin</i>	Saprobial	Asexually	Antibiotics, destroy food, flavour cheese
Chytrids	Aquatic with flagella Examples: <i>Synchytrium</i> <i>endobioticum</i>	Parasitic	Sporic	Potato warts
Zygospor	Multicellular, terrestrial Examples: common moulds (bread mould)	Saprobial	Sporic, asexually	Destroy food
Sac	Unicellular Examples: yeast, Dutch elm disease	Saprobial, parasitic	Budding, spore fusion	Used in baking, destroy crops
Club	Gills, mycelium, cap Examples: button and shiitake mushrooms	Parasitic, saprobial	Sporic	Food, decomposers

- 9.** mycellium
- 10.** The Ascomycetes produce spores in asci and the Basidiomycetes produce spores in basidia.
- 11.** Students should include in their flowcharts the steps in the life cycle of a mushroom as shown in Figure 3.21.
- 12.** The stem rust could kill all of the wheat. This would cause a shortage, hunger, increased prices.
- 13.** A composite organism is one that is made of a partnership that each partner depends on (obligate). Lichen species are each a unique organism that is dependent upon a fungus and photosynthetic partner.

- The algae make sugar for the fungi to absorb and digest. The fungi provide nutrients to the algae so that it can make the sugar.
- They would die or have to move to another area.

### Section 3.4 Review Questions

(Student textbook page 124)

- To show radial symmetry, students could sketch jellyfish, corals, sea anemones or any other cnidarian or echinoderm. The caption should note that these animals will look roughly the same when viewed from any angle on an imaginary axis (shown in the diagram) drawn through the centre of the body from the base to the top. To show bilateral symmetry, students can sketch any other animal; the caption should note that the animal can be viewed as mirror halves along only one plane through a central axis (which should be shown in the diagram).
- coelom – a fluid filled body cavity that provides space for organs, it allows for organ systems
- The presentation should show an asexual cloning cycle during good conditions and a sexual cycle during poor conditions, involving eggs and sperm.
- The tentacles capture prey and move it toward the mouth.
- Due to the presence of stinging tentacles, a Portuguese man of war is likely a cnidarian. It will have radial symmetry with a flattened mouth-down form.
- The mantle is a membrane that surrounds the internal organs of molluscs. In shell-producing species like snails and bivalves, it also secretes the calcium carbonate.

7. Molluscs, Flatworms	
<ul style="list-style-type: none"> <li>all have coelom</li> <li>some have a large brain</li> <li>all have 2 body openings</li> </ul>	<ul style="list-style-type: none"> <li>no coelom</li> <li>primitive nervous system</li> <li>one body opening</li> </ul>

- echinodermata – radial symmetry, spiny endoskeletons, tube feet, including a water vascular system
- allows them to retain moisture

10.

Characteristic	Chelicerates	Myriapods	Crustaceans	Insects
# of body segments	2	>3	<3 segments	3
Pairs of legs	6	1 or 2 pairs per segment	5 pairs	3 pairs
Antennae	None	1 pair	2 pairs	1 pair
Other features	Feeding tubes	Simple eyes	Fused segments	Wings

- It would sink.
- Climate change, habitat destruction, increased ultraviolet radiation, pollution, and diseases that have moved internationally are all possibilities. Answers should include a relevant solution for each issue.
- scales, prevent dehydration; internal fertilization, decreases chances of fertilized eggs being consumed by a predator; shelled eggs, prevents dehydration
- The eggs would make them too heavy to fly.
- The hypothesis should be a tentative explanation. There will be no wrong answer, but students might use the idea of plate tectonics, and suggest that in the past there were marsupial and monotreme mammals everywhere, but after Australia split away, placental mammals evolved elsewhere.

### Section 3.5 Review Questions

(Student textbook page 129)

- The current decline in genetic, species, and ecosystem diversity may represent a mass extinction on the scale of the great extinctions in the past.
- Some possible threats would be habitat destruction, competition from invasive species, and pollution.
- Warmer temperatures will tend to produce more females so it would tend to influence the sex ratio such that there would be fewer males and more females. If the warming was extreme, it could result in no males being produced. In either system, if only one sex is produced, it would eventually result in extinction.
- It can influence growth rates, densities, timing of emergence if they are insect larvae, and even sex ratio.
- The caterpillar timing has advanced with warmer, earlier springs, and so have the songbirds that feed them to their young.
- Birds won't change their migration timetable but when they arrive back they will find that spring is further ahead than is ideal.

7. Answers are expected to be speculative. Students may suggest: We would have warmer surfaces and cooler depths, and this is likely to change which species do well in both layers, and it may affect levels of dissolved oxygen. Or, students may note that water is the most dense at 4°C. When the ice melts (0–4°C) on a Canadian lake in spring, the 4°C water falls to the bottom of the lake, creating a convection current and “mixing” the lake.
8. Changing temperatures will change the precipitation patterns and growing seasons. Some areas that are temperate may become tropical due to increased rain and temperature and others may become desertified due to decreased rain.
9. Increased temperatures will cause skeletal malformations.
10. Some pollinators will miss out on their flowers if the flowers bloom earlier or later and the pollinator life cycle does not change with the changing temperatures.
11. Marmots could starve due to their emergence prior to food availability. Climate change has caused increased temperature and increased snowfall. Rising temperatures will signal their emergence but the snow will still be too deep to melt and food will not be available.

### Quirks and Quarks Feature Questions

#### (Student textbook page 128)

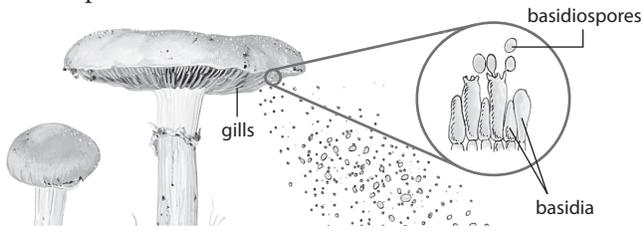
1. Sample answer: Dr. Danby’s data showed that trees common to the boreal forest area further up the mountain had not been there as long as trees living further down the mountain. This suggests that the area with a climate that supported species in the boreal forest expanded up the south face of the mountain between 1925 and 1950.
2. Sample answer: Predicted changes suggest that there will be less habitat available for Dall sheep and caribou, and their populations will shrink. Moose populations will likely expand as the size of their habitat increases. Aboriginal populations will have to adapt to a change of food source or move their communities to find populations of Dall sheep and caribou large enough to support them.
3. Student answers should include possible educational qualifications as well as experience and personal traits such as curiosity.

### Chapter 3 Review Questions

#### (Student textbook pages 137–9)

1. d
2. b
3. d
4. d
5. c
6. d
7. a
8. c
9. Plant cell walls are made primarily of cellulose. Fungal cell walls are made primarily of chitin. Animal cells do not have cell walls.
10. The main characteristic that distinguishes these two groups is the presence or absence of a backbone. Animals without backbones are invertebrates, whereas those with backbones are vertebrates. All but one (34/35) animal phyla are made entirely of invertebrates.
11. Students could choose from any of amphibians, reptiles, birds, and mammals. Good examples would be bat wings, dolphin flippers, kangaroo hind legs, and perhaps snakes, whose modification of limbs resulted in their loss.
12. Both birds and mammals are endothermic (they maintain their internal temperature, and they have a four-chambered heart).
13. Animals could suffer some damage to one segment and still have additional segments. Different segments allowed for mobility. Different segments have legs, so that in combination they can move the organism more efficiently.
14. They are both multicellular, photosynthetic organisms that in some cases look superficially similar. Plants evolved from algae so it is difficult to define where one group stops and the next group begins.
15. Spore – A haploid reproductive structure that can produce a new organism without fertilization. Examples are bryophytes, club mosses, horsetails, ferns. Seed – A diploid reproductive structure of plants made up of an embryo, stored food, and a tough outer coat. Examples are gymnosperms and angiosperms (corn, beans, maples)
16. When meteors hit Earth, many organisms died.
17. Cut open examples of each type of seed. Add iodine and observe.

18. Sample answer:



Phylum name is Basidiomycota, which is related to basidium the club-shaped hyphae of the fruiting bodies of fungi.

19. wear a mask to prevent inhalation of spores, wear gloves to protect hands from toxins

20. a. gametophytes become smaller

b. sporophytes become larger

c. It is large and produces cones that contain seeds, therefore it is a spermatophyte. It is in the sporophyte generation because the sporophyte is larger than the gametophyte in spermatophytes.

21. platyhelminthes – bilateral, flat (not segmented), no coelom, cephalized

22. a. 25°C

b. more males

c. There will be fewer females and population sizes will decrease due to the fact that the female lays eggs and the males just fertilize them (one male could fertilize more than one female).

23. Sample answer:

Characteristic	Zygotic	Gametic	Sporic
Dominant stage	Haploid	Diploid	Both
Examples	Ferns	Humans	Moss
Meiosis products	Spores	Gametes	Spores
Spores produced?	Yes	No	Yes

24. a. to d. Sample answer: Show large, labelled, coloured cross-section of lichen and briefly explain parts. Have some pictures of some different lichens (if possible bring in some samples) and go through the different types. Emphasize that they are an important food source for many animals.

25. Exoskeleton	Endoskeleton
Students could include images of snails, spiders, or insects.	Students could include images of humans, sea stars, or sea cucumber.

26. Sample answer: It is easy to understand how humans have a negative impact on the diversity of living things. You only have to consider topics such as habitat destruction, alien species, illegal trade, poaching, and pollution. However, depending on what you value human activity makes it easier for certain organisms to flourish. Urban animals such as raccoons, skunk, starling, and gulls thrive around human activity. Many alien species have been introduced that people value and enjoy having around, such as purple loosestrife. Human farmland creates habitat for open country species, etc.

27. Answers should show: symmetry, presence of coelom (or not), number of body layers, presence or absence of segmentation, presence or absence of exoskeleton, and any other distinguishing features.

28. Answers should include:

Type of Angiosperm	Seed Leaves	Veins in Leaves	Vascular Bundles in Stems	Flower Parts
Monocots	 one cotyledon	 usually parallel	 scattered	 multiples of three
Dicots	 two cotyledons	 usually net-like	 arranged in ring	 multiples of four and five

29. Students should be able to identify the similarities and differences between the three major classes of molluscs—bivalves, gastropods, and cephalopods. Similarities: all have bilateral symmetry, three layers of cells, a coelom, two body openings, a muscular foot, and a mantle surrounding the internal organs. Differences: bivalves are marine and freshwater species that have hinged shells; gastropods can be non-shelled or shelled (usually a coiled shell), and are found in terrestrial, freshwater, and marine ecosystems; cephalopods are marine organisms with grasping tentacles that can propel themselves with great bursts of speed.

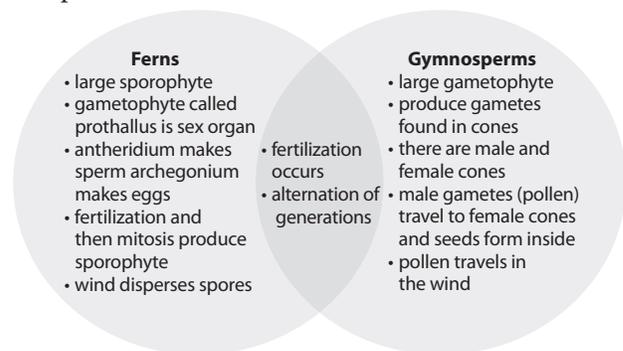
- 30.** Answers should demonstrate the following differences:  
 Monotremes- lay eggs  
 Marsupials- have a pouch that immature offspring continue to gestate inside  
 Placental mammals- young are fully developed at birth
- 31.** Answers should demonstrate an understanding of all Key Terms and Key Concepts in the chapter.
- 32.** The theme of answers should be that complexity has increased over time. If complexity came before simplicity, rather than the other way around, it would be a major challenge to the idea of evolution.
- 33. a.** Approximately: Archaea 0.01%, Bacteria 0.3%, Protists 2% , Plants 14%, Fungi 4%, Animals 80%  
**b.** about 300 000  
**c.** They are approximate because many species have not yet been discovered, and many small things are likely to have been missed.
- 34.** Answers should show an understanding that: amphibians live between habitats (terrestrial and aquatic) and can indicate when either habitat is damaged; they absorb toxins through their skin; they are at risk to water and air pollution.
- 35.** They can travel farther to get food.
- 36.** Embryos that are protected from dessication; reproduction that does not involve water; vascular systems to transport water and nutrients
- 37.** No hair, no feathers, has a jaw, has paired fins, has a cartilaginous skeleton: Class Chondrichthyes.
- 38.** One way would be to dissect the seeds to count whether there were one or two cotyledons. Another way would be to plant the seeds and see what grew (and whether it had flower parts in threes or multiples of three for monocots, or perhaps whether it had parallel leaf veins as in monocots).
- 39.** Answers should address both parts of the question clearly, using the key concepts summarized on page 137. Refer to BLM A-31 (on accompanying CD) Gathering Information Rubric for detailed assessment criteria.

### Chapter 3 Self-Assessment Questions

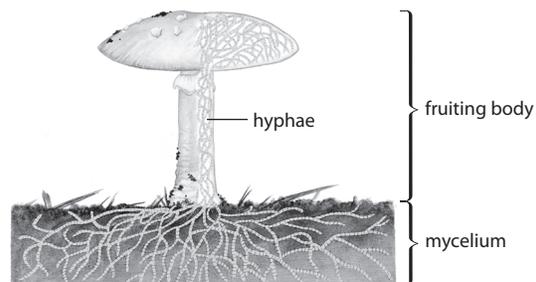
(Student textbook pages 140–1)

1. a
2. d
3. b
4. a

5. c
6. d
7. d
8. a
9. d
10. a
11. Answers should show an understanding that seaweeds are large, multicellular algae that are divided into three main groups based on their colour: red, brown, or green. Tables should compare and contrast these three groups based on their physical structures and habitats.
12. both contain chlorophyll *a* and *b*, cellulose cell walls, store energy as starch, and have similar DNA sequences
13. Answers should include the information in Table 3.3. Students may choose to display their answers in a graphic organizer.
14. flowers: to attract pollinators and increase diversity; seeds in fruit to obtain nutrients and be protected; fruits also increase chance that a plant will be transported to a new area; vascular tissue; some dicots can increase in width from year to year (create wood) which allows them to grow taller and obtain more sunlight
15. Sample answer:



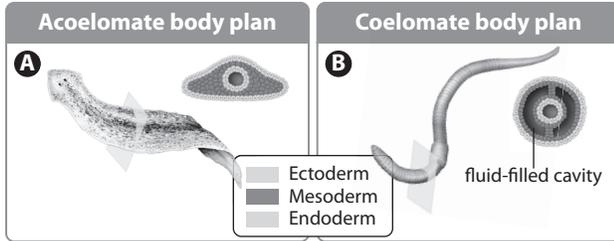
**16.**



17. They are composite organisms made of a fungus and a photosynthetic organism.
18. increased food sources; larger plants

19. The Canadian prairies contain grass as the dominant plant due to the low amounts of rain. If higher latitudes get more rain, grassland will be replaced by deciduous forest as the dominant plant. This will decrease the area available for farming. Grain can also get diseases if it is too wet; this will decrease crop yields.

20. Sample answer:



21. echinodermata- endoskeleton, water vascular system

22. arthropoda- jointed appendages, exoskeleton

23. Mammal: makes milk, has hair

24. a. The effect of temperature on dissolved oxygen

b. dependent- oxygen, independent- temperature (the levels of oxygen depend on the temperature)

c. inverse relationship (as temp increases, O<sub>2</sub> decreases)

d. Metabolic rate increases to accommodate for the reduced availability of oxygen. Increased metabolic rate increases demand for oxygen (it takes more energy). As climate change increases water temperature, there will be less oxygen available, this will stress aquatic organisms who will need to travel deeper to get cooler. There may not be food there for them and they might die.

25. The more biodiverse an ecosystem is, the more resilient it is to disturbance.

## Unit 1 Review Questions

(Student textbook pages 145–9)

1. b

2. b

3. b

4. c

5. b

6. b

7. c

8. b

9. b

10. b

11. d

12. It is a system of naming things using a two-part name, the first being the genus and the second being the specific epithet. *Homo sapiens* (typed) or Homo sapiens (written) or *Canis familiaris* (typed) or Canis familiaris (written)

13. Anatomy is about the structure of organisms and physiology is about the functioning of organisms. Both are used in determining relationships among organisms.

14. The most recent kingdom is the Archaea and it forms its own domain.

15. The ability of an ecosystem to maintain an equilibrium, or balance, even in the face of significant outside disturbances

16. A virus is covered in a protein coat called a capsid, it has no organelles, and it is about 1/100 000 the size of a eukaryotic cell.

17. It is the creation of methane (CH<sub>4</sub>) by archaea when they are decomposing in anaerobic conditions, such as in the digestive tract of plant eating mammals

18. Sexual life cycles have probably existed longer. By considering fossils, red algae appear to be the oldest multicellular organisms fossils that reproduced sexually.

19. thallus is the brown algae body, holdfast is the brown algae anchoring structure, and blades are the brown algae leaf-like structures

20. The gametophyte is haploid and the sporophyte is diploid in both cases. In the bryophytes, the gametophyte is the dominant, larger, longer-lasting stage. In the seedless vascular plants, the sporophyte is the dominant, larger, longer-lasting stage.

21. Yeast

22. Sponges are asymmetrical, meaning there is no regularity to their body form. Sea stars (or starfish) are radially symmetrical, meaning that a single individual could be divided in half in numerous ways to produce a pair of symmetrical half-bodies. Human beings are bilaterally symmetrical, meaning that a single individual could be divided in half in only one way to produce a pair of symmetrical half-bodies

- 23.** In some species of reptiles, including the tuatara, the pre-incubated egg is neither male nor female genetically. Instead, the incubation temperature determines the sex of the developing embryo inside the egg. If the climate-warming trend continues, increasingly more males will be produced in tuatara populations. Some climate models predict that only male tuataras will be born later this century. An all male population would not be able to reproduce and the species would face extinction.
- 24.** Sample answer for an American bullfrog: Domain Eukarya, Kingdom Animalia, Phylum Chordata, Class Amphibia, Order Anura, Family Ranidae, Genus *Rana*, Specific epithet *catesbiana*.
- 25.** Bacteria perform important ecosystem services including decomposition and nutrient cycling. If all of the bacteria in an ecosystem were wiped out, plants may not get enough nutrients, which would decrease their growth and production, which would, in turn, affect herbivores and other consumers higher up in the food chain. Populations of these organisms would likely decrease as a result.
- 26.** Sample answer: I would have a prokaryotic domain that would include the Bacteria and Archaea kingdoms and keep the Eukarya domain with the other four kingdoms.
- 27.** The fungus would likely be reclassified based on the structure of the fruiting body it produced.
- 28.** Students should design an experiment in which they would observe the virus as different variables are manipulated. The results would help answer the question because you would see how many of the characteristics viruses display as well as which ones. Also, after observing the viruses and seeing how different variables affect them, you might have a better understanding of whether they are alive or not.
- 29.** Students should list the main difference among these groups, how they obtain nutrition, as well as some of the distinguishing characteristics within each group, such as how they move, the structure of the organism, and their habitat.
- 30. a.** Spanish flu; It was the most deadly possibly because people knew less about viruses at that time. They did not know how to reduce the spread of the virus. They did not have a vaccine against the virus.
- b.** They are several reasons why a flu epidemic may end. First, there is genetic variation among humans, so not all humans may become ill, or if they do become ill, they may make a full recovery. Second,

it is not to the advantage of the virus to kill every host. If all of its hosts are dead, the virus is essentially dormant. The virus cannot function outside of a host.

- 31.** Students should design an experiment in which all variables remain constant except for water temperature, such as having several tanks of rockweed, each with a different water temperature. Students should indicate that they would measure the growth rate of the rockweed in each tank regularly, then compare the rates to see if the hypothesis was supported.
- 32. a.** As water depth increases, the percent of amphibian embryos that survive increases. When water levels are low, only a small percent of embryos survive.
- b.** As global warming occurs, evaporation rates increase due to increased temperatures. This means water depth may decrease, leading to low survival rates of embryos. Also, changes in precipitation may mean less rain is falling, which would also lead to a decrease in water depth.
- 33.** Students should indicate the independent variable is soil temperature and the dependent variable is the growth of the gametophyte. Constants would include the amount of light, water, and nutrients provided to the plants.
- 34.** Structural diversity is about internal and external variety in living organisms. The biodiversity crisis is mostly about threats to species, but loss of genetic diversity and threats to ecosystems (and therefore ecosystem diversity) are also part of the crisis. Structural diversity is not an element of the biodiversity crisis.
- 35.** Sample answer: For a blue whale, the student would identify and briefly explain three anatomical features (e.g., the baleen system for filtering out plankton, the fins for swimming, the blow hole for breathing, etc.) and physiological features (a system for holding its breath, warm-bloodedness, a system for withstanding pressure, etc.).
- | Anatomical Features                  | Physiological Features           |
|--------------------------------------|----------------------------------|
| Baleen system for filtering plankton | System for holding its breath    |
| Fins for swimming                    | Warm-bloodedness                 |
| Blowhole for breathing               | System for withstanding pressure |
- 36.** It is possible since all species contain genes and all ecosystems contain species.

**37.** Students should indicate that the organisms that cause red tides (dinoflagellates) produce a toxin that becomes concentrated in the tissues of some shellfish. If humans ingest those shellfish, they can become seriously ill or die.

**38. a.** canned food that is infected (bulging cans)

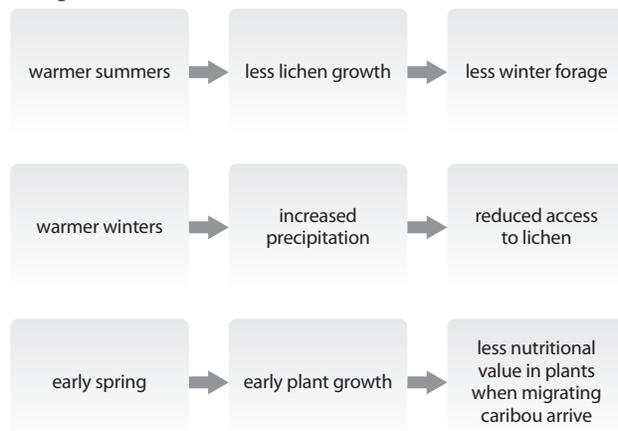
**b.** paralysis

**c.** induced vomiting and then an antitoxin

**d.** be very careful with home canning. Do not eat food from bulging cans.

**39.** Students should use non-science language, or explain any science terms used, to differentiate between the two.

**40.** Sample answer:



**41.** Students should use a graphic organizer, such as a table or concept map, to show the features of each group.

Lampreys – have gills, jawless, lack paired fins, skeleton made of cartilage, suction mouth, no swim bladder

Sharks and rays – have gills, jaws, paired fins, skeleton made of cartilage, no swim bladder

Bony fish - have gills, jaws, paired fins, and swim bladder, skeleton made of bone

**42. a.** Sample answer: I agree with the change. It makes sense to have a common name that accurately describes an organism rather than promotes a misconception.

**b.** Accept all reasonable answers regarding silverfish common names.

**43.** Sample answer:

Algae Type	Red Algae	Brown Algae	Green Algae
Habitat	Dominant in tropical oceans and are found the deepest	Found in cooler oceans	Found in a tremendous variety of habitats, including freshwater, sea ice, and even sloth fur
Complexity	Multicellular	Multicellular and in some cases immense	Unicellular and multicellular forms
Unique features	Have additional pigments that reflect red light	Appear to be the most complex protists	Are often symbiotic partners
Connection to land plants	Not thought to be direct ancestors of land plants	Not thought to be direct ancestors of land plants	Are thought to be the direct ancestors of land plants

**44.** Students should use a series of images that convey the idea that species are in genera, and genera are in families, etc. Boxes might work, but so would circles within circles.

**45.** Saprobial example will have a mycelium below the surface contacting rotting organic matter. Parasitic example will have its mycelium inside an organism, probably an insect. Predatory example will have a mycelium below the surface with devices that capture tiny worms. Mutualistic example will have a mycelium that is intimately connected to the roots of a living plant.

**46.** If organisms are endangered, it is important to define what a species is and to be sure to distinguish similar but different species or to recognize separate populations as the same species, if possible. Then, it is important to label these distinct species so that in constructing law we can have a label to identify these species that need protection. The law cannot be ambiguous about what is a species and what an owner's obligations are.

**47.** The first logical distinction would be prokaryotic and eukaryotic cell choices. Within the prokaryotes, the next (final distinction would be whether cell walls have peptidoglycan). Within the eukaryotes will be harder, but no cell walls would lead to animals and cell walls would leave the other three, then chitinous cell walls would distinguish fungi, leaving plants and protists which could be distinguished by treating plants as multicellular.

- 48.** Answers depend on which class students choose. Dichotomous keys should show a series of two choices.
- 49.** Students should propose a way of growing methanogens in anaerobic conditions (probably buried in some way, as in a substrate like compost or landfill), and then harvesting the methane as it is produced and escapes the substrate, and then using it for fuel, minimizing the leakage of methane into the atmosphere. Students may say that it still has a climate effect because carbon dioxide is still a greenhouse gas.
- 50.** Some fungi are sources of antibiotics and some are sources of food (mushrooms, Roquefort cheese, soy sauce). Some fungi cause disease in humans or disease in plants that are important sources of food for humans.
- 51.** Sample answer: Protists could be classified by their complexity. Unicellular protists could stay as protists and the others would be placed into Plantae, Fungi, and Animalia.
- 52.** Sample answer: It is true that mass extinctions can happen naturally, and it is true that diversity rebounds over several million years. However, mass extinctions are devastating to life and if a mass extinction we caused also caused our own demise, it would not be much comfort to say they happen naturally anyway. So, I think we should take steps to reduce the rate of extinction, including changing our actions if necessary.
- 53. a.** The biological species concept focuses on whether two individuals can interbreed to produce fertile offspring. Some fungi reproduce sexually and some asexually, and some both, so even without the partner, in asexual cases the biological species concept doesn't help. The same can be said for the protist or the cyanobacterial partner. In addition, when the "species" is really made of two species, it does not fit with the biological species concept either.
- b.** Yes, because the phylogenetic species concept is based on ancestry or evolutionary history, but the two partners would have different ancestry.
- 54. a.** Probably not since they look and sing differently
- b.** Do their offspring survive and are they fertile? (They do survive and they are fertile.)
- c.** You would need information about DNA sequences.
- 55.** The only similarity in the animals is that they fly. They are structurally different (e.g., dragonflies have no bones) as well as genetically different. We have many more species to classify now so we need more discreet characteristics for our classification.
- 56.** Sample answers: View 1—Agree, because we know there have been ice ages in the past. Major events have caused extinctions and the best organisms have survived.  
View 2—Agree, because humans have interfered through the use of fossil fuels and have caused acceleration of natural changes. We need to act to reduce our impact on the natural environment.
- 57.** Answers should include bacteria being part of the normal flora of the human digestive tract.
- 58.** Order Pinnepedia- has no wings, has hair, has flippers
- 59. a.** morphological species concept  
**b.** genetic species concept

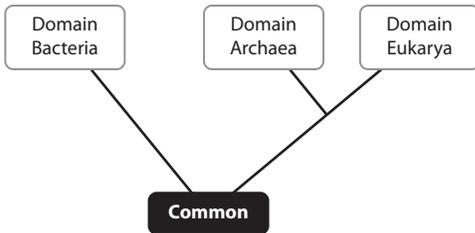
### Unit 1 Self-Assessment Questions

(Student textbook pages 150–1)

1. e
2. d
3. a
4. a
5. c
6. b
7. d
8. d
9. c
10. b
11. In the lysogenic cycle, the viral DNA enters and becomes part of the host cell chromosome. Once this occurs, the infected cell has permanently acquired the viral genes. The viral DNA that has become part of the host chromosome is then referred to as a provirus. A provirus can invade a cell but does not kill it.
12. The origin of eukaryotic organisms represents the merger of two or more prokaryotic cells. In endosymbiosis, one cell engulfs a different type of cell. However, the engulfed cell survives and becomes an internal part of the engulfing cell. In the example, *Hatena* is heterotrophic. However, once it engulfs green algae, it behaves like an autotrophic protist. The green algae survive inside the predator just like the photosynthetic prokaryotes (cyanobacteria) are thought to have survived inside evolving eukaryotic cells.

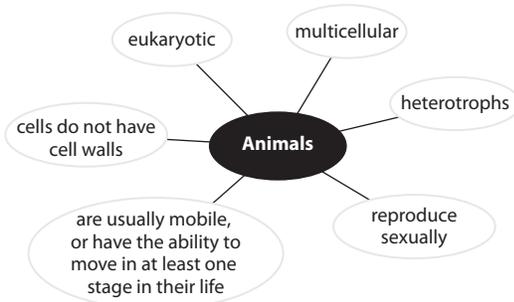
**13.** The level of diversity most impacted by this highway is genetic diversity. If animals do not use the wildlife crossing structures, then the genetic diversity of the separated populations could be affected. The crossing structures are an attempt to allow these animals to move from one side of the highway to the other and maintain the genetic diversity of these species.

**14.** Sample answer:

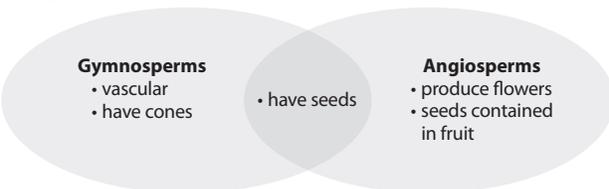


**15.** Both groups have a body form that displays bilateral symmetry, a complete digestive tract, a ventral nerve chord, and a heart. Body segmentation is the one feature that clearly shows the relationship between these two groups of invertebrates.

**16.** Sample answer:



**17.** Sample answer:



**18.** Harmful—viruses cause diseases that make people sick, some damage or destroy food crops causing food shortages, and can have economic impact  
Beneficial—can be used in some types of biotechnology, they could be used to control specific bacteria populations, and they could be used to insert beneficial genes into human cells

**19.** Green algae and plants have chlorophyll *a* and chlorophyll *b* in their cells. Both have cell walls composed primarily of cellulose and both groups store excess carbohydrates as starch. DNA analysis shows similar gene sequences.

**20.** A saprobe is an organism that feeds on dead organisms or organic wastes. Saprobial fungi are decomposers whose mycelia absorb nutrients from dead or decaying organic matter. They play an important role in the recycling of nutrients in ecosystems. Removing this group would disrupt the nutrient cycles resulting in fewer nutrients being made available to plants (autotrophs).

**21.** Sample answer: Pollinators help maintain plant populations. A decrease in pollinators could lead to a decrease in new plants produced, which can affect both natural and artificial ecosystems. A decrease in production of food crops could have a major social and economic impact throughout the world.

**22.** Increasing ocean temperatures could result in the destruction of coral reefs. As a result, sources of food and shelter will disappear. If the reefs are destroyed then the plants and animals associated with these ecosystems will also disappear. The result will be a loss of biodiversity. In terms of impact on humans, coral reefs are highly productive, providing a habitat and breeding ground for commercially important species of fish, shrimp, and lobsters. Reefs also act as natural buffers, protecting vulnerable coastal areas from bearing the full brunt of storms.

**23.** The low pH would result an extremely acidic environment. The organism would have to be an extremophile and likely be a member of the Kingdom Archaea.

**24.** These fish were able to move in very shallow water and perhaps onshore by using their muscular, paired fins as rudimentary feet. Those fish with lungs could breathe air when their limb-like fins pushed their heads above the water. These fish had evolved many of the biological prerequisites for moving onto a new environment—land.

**25.** Chondrichthyes has a skeleton made of cartilage. Osteichthyes has a skeleton made of bone.