Chapter 1
Introduction to Biology

Biology is the science that studies living things, their structure and function. All living things (*organisms*) are composed of microscopic (too small to be seen by the human eye) units called cells. The cell is the basic unit of function for all living things. How can we tell if something is alive? Living things perform various *life functions* or *processes.*

Life Functions

The following sections introduce the major life functions.

Nutrition

Nutrition is the process by which an organism takes in food and uses this food for energy, growth, and repair. First the organism takes in food from its environment. This process is called *ingestion.* These large food molecules are *digested,* broken down into many small molecules, so that they can enter the cells through a process called absorption. When digested, large food molecule AB is broken down to produce small food molecules A and B ($AB \rightarrow A + B$). When in the cell, some end products of digestion can be used for energy production.

Is a green plant alive? We all know that plants don't eat food. Plants make their own food by photosynthesis. Plants take in carbon dioxide and water from their environment, producing a sugar called glucose. This glucose serves as food for the plant.

Transport

Transport is the life function by which materials such as food, water, and oxygen from the environment are distributed to all cells of the organism. The transport system also carries waste products away from the cells. In humans and other animals, the blood circulatory system is responsible for carrying out this life function. In many plants, specialized structures called vascular bundles carry materials throughout the organism.

Respiration

Respiration provides the organism with the energy needed to carry out all the other life processes. During the process of respiration, oxygen is brought into the organism and is used to chemically release energy that is stored in food. Respiration in animals takes place on two different levels. On the organism level, oxygen is taken in and carbon dioxide is released. We usually refer to this process as breathing. On the cellular level, food and oxygen interact chemically to produce energy and the waste products carbon dioxide and water. This process is generally referred to as cellular respiration.

Excretion

As organisms perform their various life functions, waste products are produced. These waste products are often harmful or poisonous to the organism. Excretion is the removal of cellular waste products such as water, carbon dioxide, and nitrogen waste from an organism.

Elimination

Not all the food that is eaten by an organism is capable of being digested and can be classified as waste. The removal of undigested food as a semisolid waste material is called elimination.

Reproduction

Reproduction is the life function by which organisms produce new individuals of the same kind (species). Reproduction also produces new cells in an organism that are necessary for growth and repair. Reproduction is necessary for the survival of the species. If no individual members of a species reproduce, the species becomes extinct. However, reproduction is not necessary for the survival of an individual member of a species.

Growth

Growth is the increase in the size of the organism. Growth results from the reproduction of new cells and from the increase in cell size.

Repair

Repair is the ability of an organism to fix or mend a damaged part. Some organisms have the ability to replace a lost or damaged part. For example, a starfish that loses an arm can grow back the missing arm.

Synthesis

Synthesis is the process by which two or more smaller molecules are combined to form a larger molecule. For example, $A + B \rightarrow AB$. Small molecule A combines with small molecule B to form large molecule, AB. Synthesis is a building process (photosynthesis is an example of a synthesis reaction). The new, larger molecules produced by synthesis can be used to form cell parts, or they can be incorporated into the body of the organism (*assimilation*).

Locomotion

Locomotion is the ability of an organism to move from one place to another. Animals depend on locomotion for finding food, locating a mate, and avoiding predators. Most plants have very limited locomotion. Their leaves can grow toward light and their roots toward water.

Regulation

Regulation is the ability of an organism to respond to a *stimulus* (a change in the environment); the reaction of the organism is the *response.* A stimulus generally upsets the *homeostasis* (the stable internal environment) of an organism; the response returns the organism to homeostasis. Homeostasis occurs when all systems within the organism are in balance and working properly.

For example, human body temperature is approximately 37°C. If the temperature of the room in which the person is in rises from 22°C to 38°C (this is a stimulus), homeostasis is upset. The person begins to sweat (this is the response); sweating cools the body allowing the person to maintain a constant internal body temperature of 37°C (homeostasis). A person can also return to homeostasis by turning on an air conditioner or by going into a cool room. Regulation is the life function that allows an organism to adapt to a changing environment.

Two systems in humans help regulate the body and maintain homeostasis; they are the nervous system and the endocrine system. The nervous system is composed of the brain, spinal cord, and nerve cells. The endocrine system is composed of ductless glands (glands that do not have tubes). Examples of some endocrine glands are the pituitary gland, thyroid gland, and adrenal glands.

Metabolism is a term that is used to refer to all the chemical reactions that take place within an organism. Metabolism includes all the life functions that are performed by an organism.

Example Problems

The following problems are based on the life functions.

1. How does a biologist determine whether something is living or nonliving?

   Answer: A biologist determines whether something is living or nonliving by observing whether or not most of the life functions are performed.

2. How is nutrition in plants different from nutrition in animals?

   Answer: Plants make their own food, but animals must eat other organisms for food. Plants make food by the process of photosynthesis. Animals must hunt, capture, ingest, and digest food.

3. Place the following life functions into a logical sequence: digestion, transport, ingestion, absorption, excretion, and respiration. *Explain* why you selected this sequence.

   Answer: ingestion → digestion → transport → absorption → respiration → excretion

   ingestion—food is taken into the organism.

   digestion—food is broken down into small particles that can enter a cell.

   transport—food is distributed to all cells of the organism.

   absorption—food molecules enter the cell.

   respiration—the digested food is used for the production of energy.

   excretion—the waste products of digestion (carbon dioxide and water) are removed from the organism.

Work Problems

Use these problems on life functions for additional practice.

1. Why must an organism possess a transport system?
2. Explain why homeostasis is necessary for the survival of the organism.
3. Explain the following statement: "Reproduction is necessary for the survival of the species, but not for the survival of the individual."

Worked Solutions

1. In large organisms, most cells are not in direct contact with the environment. Such organisms require a transport system so that materials such as food, water, and oxygen from the environment can be distributed to all cells.
2. The life function of regulation allows the organism to adapt to changes in its environment. An organism that cannot respond to changes in its environment might become damaged or die.

   Stimulus → Homeostasis is upset. → Response → Homeostasis is restored.

   A stimulus (change in the environment of the organism) occurs.

   Homeostasis is upset (out of balance).

   The organism responds to the stimulus.

   Homeostasis is restored (balance).
3. Reproduction is necessary for the survival of the species. If no members of a species reproduce, the species becomes extinct. However, reproduction is not necessary for the survival of an individual member of a species. For example, if no humans reproduced, the human species would become extinct. But, an individual person does not have to reproduce to survive.

Tools of the Biologist

To study living things and carry out experiments, biologists use a variety of tools. One of the most important tools of the biologist is the microscope. Several different kinds of microscopes exist, and each one is specialized for a specific purpose. Two other tools used by the biologist are the microtome and the centrifuge.

Microscopes

Microscopes are fundamental to the study of biology. The following sections introduce these basic tools.

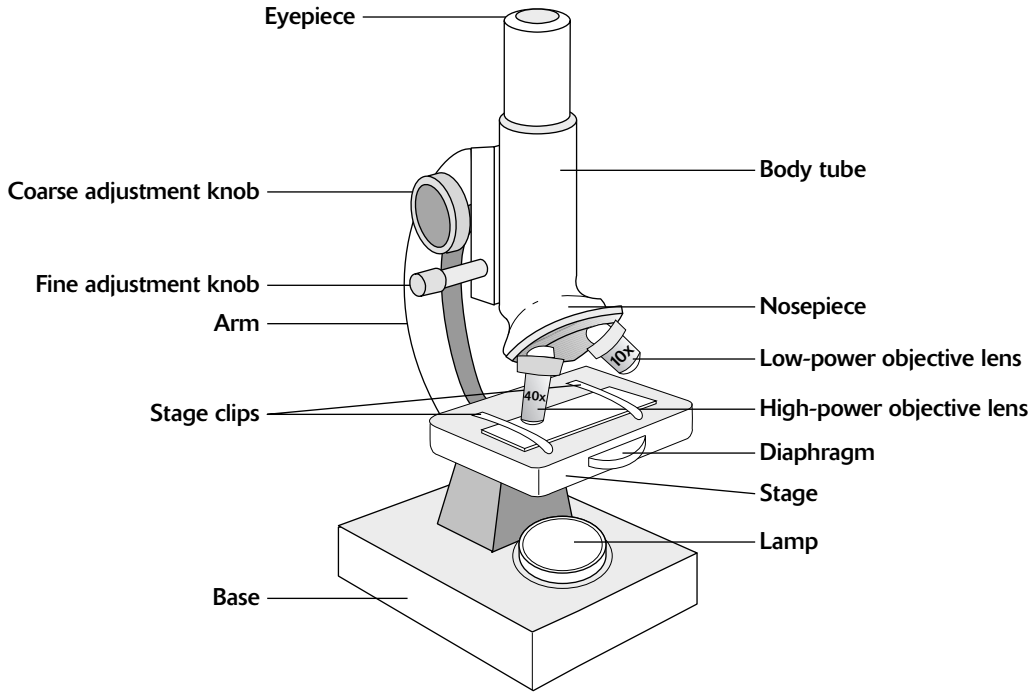
Simple Microscope

The simple microscope consists of a single convex lens that is capable of magnifying an object. When magnified, an object looks bigger, but its true size remains the same. A magnifying glass and a hand lens are examples of simple microscopes. A good simple microscope can magnify up to 300X.

Compound Microscope

The compound microscope uses two convex lenses at the same time. A good compound microscope can have a magnification up to 2,000X. The following diagram shows a typical compound microscope.

The Compound Microscope



The following table is based on the diagram of the compound microscope. The column on the left lists the structure, and the column on the right gives its function.

The Compound Microscope	
Structure (Part)	***Function (Job)***
Ocular (eyepiece)	A convex lens used to magnify the image (usually 10X).
Tube (barrel)	Supports the eyepiece and the nosepiece.
Coarse adjustment knob	Moves the tube up and down and produces a rough focus of the image.
Fine adjustment knob	Moves the tube up and down by very small amounts and produces a sharp focus of the image.
Arm	Used to carry the microscope.
Nosepiece	Contains the high- and low-power objective lenses.
Low-power objective lens (LP)	A convex lens used to magnify the image (usually 10X).
High-power objective lens (HP)	A convex lens used to magnify the image (usually 40X).
Stage	Supports the glass slide and contains the specimen being observed.

(continued)

The Compound Microscope *(continued)*	
Structure (Part)	***Function (Job)***
Stage clips	Hold the slide in place.
Diaphragm	Adjusts the amount of light passing through the stage.
Light source (lamp or mirror)	Illuminates the specimen.

Example Problems

The following problems review the compound microscope.

1. Which parts of the compound microscope magnify the specimen?

   Answer: The eyepiece, low-power and high-power objective lenses magnify the specimen.

2. Identify the parts of the microscope that are used for support and carrying.

   Answer: The arm and base of the microscope are used for support and carrying.

3. Where on the microscope is the specimen placed?

   Answer: The specimen is on a slide that is placed on the stage of the microscope under one of the objective lenses.

Work Problems

Use these problems on the compound microscope for additional practice.

1. Which part of the microscope produces sharp focus?
2. How many lenses does a compound microscope use at one time?
3. Why must the specimen that is placed on a slide be thin?

Worked Solutions

1. The fine adjustment knob produces sharp focus by moving the tube up and down by very small amounts.
2. The compound microscope uses two lenses at a time. One is the ocular, and the other is either the low-power or high-power objective lens.
3. The compound microscope is a light microscope, and to see a specimen, light must be able to pass through it. Therefore, the specimen must be thin.

Microscope Measurement

If the eyepiece of a microscope magnifies 10X and the low-power objective magnifies 10X, the total magnification using these two lenses together is 100X (10 × 10). If the eyepiece magnifies 10X and the high-power objective magnifies 40X, the total magnification of the microscope is 400X (10 × 40). When using the high-power lens, your field of view is smaller, but your specimen looks larger. As magnification increases, the field of view of a microscope decreases proportionately. For example, if the magnification of a microscope is doubled, the field of view is cut in half. Also, the specimen appears to be upside down when viewed through a microscope, and the slide might need to be moved around to locate the specimen.

A microscope can also be used to measure the size of a specimen such as a cell. The micrometer (μm) is the unit used for cellular measurement. One millimeter (mm) is the equivalent of 1,000 μm. If the field of view of a microscope measures 1.5mm, it is equal to 1,500 μm (1.5 × 1,000). A cell that takes up half of this field of view measures 750 μm (1,500 ÷ 2).

Stereomicroscope or Dissecting Microscope

This microscope uses dual eyepieces and an objective lens producing a three-dimensional image of a specimen. This microscope is used to study small organisms, either plant (moss, duckweed) or animal (insects, earthworms). Typically, these microscopes magnify from 10X to 40X. Also, as the name suggests, they can be used to dissect small organisms.

Electron Microscope

The electron microscope differs from the other microscopes in that it does not use light to illuminate the specimen. Instead, a beam of electrons is used to produce an image resulting in upward of 300,000X magnification. Electron microscopes can be used to study viruses and bacteria. The major advantage of the electron microscope is its high magnification. Its main disadvantage is that the specimen cannot be alive because it is placed in a vacuum inside the microscope.

Example Problems

The following problems are based on microscope measurement.

1. What is the size of a cell when the diameter of the field of view of a microscope is 1,000 μm and 10 equal-sized cells fit across the field of view?

   Answer: 100 μm

   Field of view size ÷ number of cells = cell size.

   1,000 μm ÷ 10 = 100 μm

2. The size of a cell when measured under low power (100X) is 240 μm. Find the size of the same cell when measured under high power (400X).

   Answer: 240 μm

   The size of a cell does not change as the magnification of the microscope increases. The cell only looks bigger.

3. How many micrometers long is a cell that measures 1.25 mm?

   Answer: 1,250 μm

   1 mm = 1,000 μm

   $1.25 \times 1{,}000 = 1{,}250$ μm

   An alternate solution is to move the decimal three places to the right. This is the same as multiplying by 1,000.

Work Problems

Use these problems on microscope measurement for additional practice.

1. What is the *maximum* magnification of a microscope having a 10X eyepiece, a 43X objective and a 90X objective?
2. How many millimeters long is a cell that measures 375 μm in length?
3. How does the letter *P* look when viewed through a microscope?

Worked Solutions

1. 900

   Some compound microscopes have three lenses on the nosepiece. To find the *maximum* magnification of the microscope, multiply the magnifying power of the eyepiece (10X) with that of the most powerful objective lens (90X).

   $10 \times 90 = 900$

2. 0.375 μm

   1mm = 1,000 μm

   375 mm ÷ 1,000 = 0.375 μm

   An alternate solution is to move the decimal three places to the left. This is the same as dividing by 1,000.

3. The letter *d* appears to be upside down when viewed through a microscope because the microscope inverts the image. If you turn your book upside down, you can see how the image should look.

Other Tools

In addition to microscopes, biologists use the following tools:

- **Microtome:** This instrument is used to slice a specimen very thin so that it can be observed with a light or electron microscope.
- **Centrifuge:** The centrifuge is used to spin specimens at very high speeds. The heaviest and densest parts settle to the bottom, and lighter parts remain at the top. If human blood is subjected to centrifugation, plasma (the liquid part of the blood) stays at the top, and the blood cells settle to the bottom.
- **Microdissection Tools:** These tools are extremely small and are used with the aid of a microscope to remove or add parts to cells. Cloning, which will be discussed in a later chapter, is one use for these tools.

The Scientific Method

The scientific method is an organized series of steps used by biologists to solve a problem. Although different biologists use different approaches to solve a problem, they all use certain steps in common.

1. **Problem Statement:** identify a question to be answered.
2. **Hypothesis:** Form an educated guess that provides a possible answer to the problem statement.
3. **Experiment:** Perform the actual procedures used to support or reject a hypothesis. The item being tested or changed is called the *independent variable.* The *dependent variable* is the change that occurs due to the procedures performed on the independent variable. The independent variable controls or determines the dependent variable. Generally, for an experiment to be considered valid, a *control* must be present. The control serves as a comparison point or group.
4. **Results:** Collect and record the outcomes and information (*data*) obtained as a result of the experiment. A biologist determines the results by observing, measuring and weighing. The data that a biologist gathers are often presented in a table or a graph. This makes it easier to interpret the results of the experiment.
5. **Conclusions:** Using the results of the experiment, a biologist either supports or rejects the hypothesis, thus answering the original question.

An experiment must be capable of being repeated and producing substantially similar results. Otherwise, the original experiment must have been flawed in some way and is therefore not valid. The greater the number of experimental test subjects used, the more statistically valid the results. Only one independent variable should be used in an experiment. Everything else in the experiment must be kept constant.

Example Problems

The following paragraph illustrates the use of the scientific method. Read the paragraph and answer the example problems that follow.

A student at the beach noticed that as she walked further and further into the water, the temperature of the water seemed to get colder. She wondered if any correlation existed between water temperature and water depth. The student performed the following experiment: She measured

the temperature of the water at five different depths and compared her results to the surface temperature of the water. The following table indicates her findings:

Water Temperatures at Various Depths	
Water Depth (Meters)	***Temperature (°C)***
0	20
10	18
20	15
30	12
40	10
50	7

1. What is the problem statement for this investigation?

   Answer: How is water temperature affected by water depth?

   A problem statement should always be in the form of a question. In this investigation the student was measuring the temperature of the water at different depths.

2. State an appropriate hypothesis for this investigation.

   A. As the depth of the water increases, temperature increases.

   B. As the depth of the water increases, temperature decreases.

   C. As the depth of the water increases, temperature remains the same.

   A hypothesis is an educated guess that might provide an answer to the question. At this point, the student does not know the answer to the question. However, she noticed that as she went further into the water, the temperature of the water seemed to get colder. This is why hypothesis **B** is the best choice. It is possible that as depth increases, water temperature increases or remains the same. Hypotheses **A** and **C** are also acceptable because the hypothesis can be accepted or rejected based on the results of the experiment.

3. Identify the independent variable.

   Answer: The independent variable is water depth.

4. What is the control in this investigation?

   Answer: The temperature of the water at the surface (0 meters) is the control for this experiment.

   A control can serve as a comparison point in an experiment. We are measuring the temperature of the water at different depths and comparing the results to the temperature of the water at the surface. Without knowing the surface temperature of the water, we would not be able to determine whether water temperature increases, decreases, remains the same, or varies with water depth.

5. Write a conclusion for this experiment based on the results given in the preceding table.

   A. As water depth increases, water temperature decreases.

   B. As water temperature decreases, water depth increases.

   C. As water temperature increases, water depth decreases.

   An examination of the table shows an inverse (opposite) relationship existing between the two variables in this experiment; as one increases, the other decreases. Although all three answers are correct, answer **A** is preferred because it clearly demonstrates that the independent variable (water depth) is responsible for determining or controlling the dependent variable (water temperature).

Work Problems

Work problems 1–5 are based on the following passage and the accompanying table.

Some people believe that taking high doses of vitamin C reduces the number of days that a person suffers from the common cold. To test this belief, two groups of 100 people per group were selected. Group A (cold sufferers) was given 1,000 mg of vitamin C each day for one week beginning with the first day of cold symptoms. Group B (cold sufferers) was given a placebo (a substance of no remedial value, such as sugar) each day for one week beginning with the first day of cold symptoms. The following table indicates the results of the experiment:

Effects of Vitamin C on Cold Sufferers

Number of Days with a Cold	*Group A Number of Cold Sufferers Receiving 1,000 mg Vitamin C per Day*	*Group B Number of Cold Sufferers Receiving Placebo*
1	100	100
2	98	97
3	53	56
4	41	38
5	10	8
6	2	3
7	0	0

1. What is the problem statement for this experiment?
2. State the hypothesis.
3. Identify the dependent variable.
4. Which is the control group?
5. State the conclusion for this experiment.

Worked Solutions

1. Does 1,000 mg per day of vitamin C reduce the number of days a person suffers with the common cold?

   We are looking to see the effect of vitamin C on the common cold. We want to know whether the vitamin reduces the number of days that a person has a cold.

2. Taking 1,000 mg per day of vitamin C reduces the number of days a person suffers with the common cold.

   A hypothesis is an educated guess. We are wording the hypothesis in this manner because we are hopeful that vitamin C works. However, if we do not believe that vitamin C works, we can word the hypothesis in the negative: Taking 1,000 mg per day of vitamin C does not reduce the number of days a person suffers with the common cold.

3. The dependent variable is the change (number of individuals) that occurs due to the procedure performed. The use of 1,000 mg of vitamin C per day is the independent variable.

   The dependent variable in this experiment is the number of individuals with the common cold.

4. Group B is the control group.

   A control group is a comparison group. In this experiment we are comparing the results of giving vitamin C to group A to the results of giving a placebo to group B (the control group). If we did not have a control group, it would appear that vitamin C is effective because with each passing day fewer people had a cold. However, when we look at the control group, we see approximately the same result.

5. Vitamin C has no effect on the duration of the common cold.

   We can come to this conclusion because the result of taking vitamin C is the same as not taking vitamin C. Note that our conclusion rejects the hypothesis.

Chapter Problems and Answers

Problems

The following is a description of the life functions of the African antelope. For problems 1–10, fill in the name of the life function that is suggested.

A herd of antelope running across the African plains. _____ is an exciting sight to see.
1

The grass the antelope consume is broken down chemically in the stomach and the small intestine by the action of enzymes _____. The broken-down food substances eventually
2

reach all the cells of the antelope by way of the blood stream _____(3). In the cells, the nutrient molecules undergo chemical reactions being built up _____(4), after which they become living parts of the cell. Powerful lungs supply oxygen, which when combined with food results in the production of energy _____(5). Waste products from the body's activities pass to the skin and kidneys to be removed from the body _____(6). Meanwhile, undigested food solids are _____(7). A sharp sense of smell warns the animal of approaching danger _____(8). Young antelope are usually born singly in the springtime _____(9). The increase in the size of the young antelope over a year is surprising _____(10).

For problems 11–18, answer the question.

11. What is the size of a cell being observed through a microscope if the low-power field of view size is 1,200 μm and the number of cells counted across the diameter of the field of view is 10? _____

12. What is the size of a cell if the low-power field of view measues 1,300 μm and the number of cells counted across the diameter of the field of view is 10? _____

13. How do we find the size of a cell, if we know the size of the field of view and the number of cells that fit across the diameter of the field of view? _____

14. What is the size of a cell measured under high power (400X magnification) if the size of the cell measured under low power (100X magnification) is 80 μm? _____

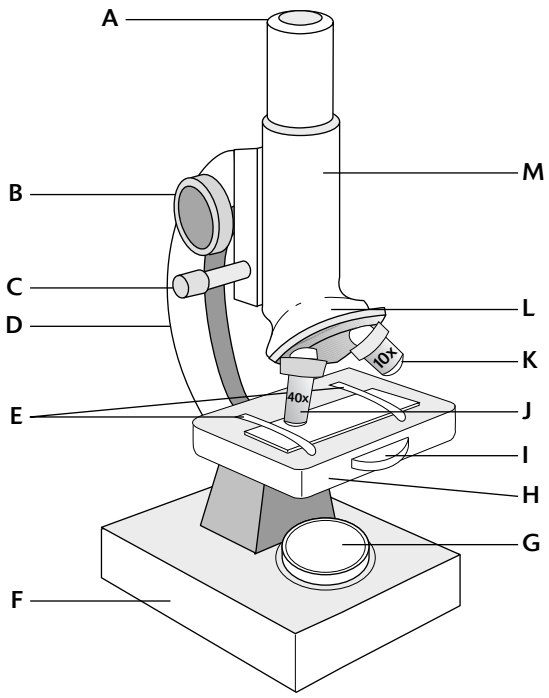
15. When switching from low to high power, the real size of the cell _____.

16. Under high power a cell only looks _____.

17. How many amoeba (small one-celled animals) can be seen under high power if the high-power field of view of a microscope measures 400 μm and the amoeba measures 200 μm? _____

18. How many micrometers long is a cell that measures 0.75 mm? _____

Problems 19–21 are based on the following diagram of a microscope.



19. Which part of the microscope is the high-power objective lens? _____

20. Which part of the microscope is used to select the desired objective lens? _____

21. Which *two* parts of the microscope are used for focusing? _____

For problems 22–25, give the name of the biological tool that is associated with each description.

22. This tool produces a three-dimensional image. _____

23. This tool separates materials based on their density. _____

24. This tool is used to remove parts of cells. _____

25. This tool does not use light for magnification. _____

Answers

1. **Locomotion.** The antelope are running and moving from one place to another.

2. **Digestion.** Digestion is a process by which large food molecules are broken down.

3. **Transport.** This is the life function by which materials such as food, water, and oxygen from the environment are distributed to all cells of the organism. In animals, the blood circulatory system is responsible for carrying food substances to all parts of the organism.

4. **Synthesis.** This is a building process by which smaller molecules are combined to form larger molecules.

5. **Respiration.** This life function provides the antelope with energy. During the process of respiration, oxygen is brought into the antelope and is used to chemically release energy that is stored in food.

6. **Excretion.** This is the removal of waste products (water, carbon dioxide, nitrogen waste) from an organism. The skin and kidneys are organs of excretion.

7. **Eliminated.** Not all the food that is eaten by the antelope is capable of being digested. The removal of undigested food as a semisolid waste material is called elimination.

8. **Regulation.** Regulation is the ability of an organism to respond to a stimulus; the reaction of the organism is the response. The antelope's keen sense of smell can detect a stimulus such as the scent of a lion and warns the animal of the approaching danger. The antelope can respond to this situation by running away. Regulation is the life function that allows the organism to survive by enabling it to adapt to changes in its environment.

9. **Reproduction.** This is the life function by which organisms produce new individuals of the same kind (species).

10. **Growth.** This is the increase in the size of the organism.

11. **120 µm.** 1,200 µm ÷ 10 = 120 µm. You must indicate the correct unit of measurement, micrometers (µm), in your answer.

12. **130 µm.** 1,300 µm ÷ 10 = 130 µm. You must indicate the correct unit of measurement, micrometers (µm), in your answer.

13. **The field of view size divided by the number of cells equals the cell size.** Keep in mind that this works only if the cells are approximately the same size.

14. **80 µm.** The size of a cell does not change when magnified. Magnification just makes the cell look bigger. You must indicate the correct unit of measurement, micrometers (µm), in your answer.

15. **Remains the same.** Increasing the magnification does not change the actual size of a cell.

16. **Bigger.** Increased magnification results in a cell that looks bigger.

17. **Two.** Divide the field of view size by the size of the amoeba: 400 µm ÷ 200 µm = 2 amoeba.

18. **750 mm.** 1,000 µm = 1 mm. Multiply 0.75 by 1,000, or move the decimal three places to the right. You must indicate the correct unit of measurement, millimeters (mm), in your answer.

19. **J.** Structure **J** is the high-power objective lens. This lens is longer; it has greater magnification (40X) than the low-power objective lens (10X).

20. **L.** This is the nosepiece, which holds the objective lenses. The nosepiece is capable of being turned to select either the low-power or high-power objective lens.

21. **B and C.** Letter **B** indicates the coarse adjustment knob, which moves the tube up and down to produce a rough focus of the image. Letter **C** indicates the fine adjustment knob, which moves the tube up and down by very small amounts to produce a sharp focus of the image.

22. **Stereomicroscope.** This tool uses dual eyepieces and an objective lens, producing a three-dimensional image of the specimen. The effect obtained is similar to using binoculars.

23. **Centrifuge.** This tool is used to spin specimens at very high speeds. The heaviest and densest parts settle to the bottom, and lighter parts stay at the top.

24. **Microdissection tools.** These tools are extremely small and are used with the aid of a microscope to remove or add parts to cells.

25. **Electron microscope.** This tool uses a beam of electrons to produce an image, resulting in upward of 300,000X magnification.

Supplemental Chapter Problems

Problems

For problems 1–20, select the *best* answer.

1. The taking in of food by an organism is called:

   A. digestion **B.** ingestion **C.** assimilation **D.** reproduction

2. The sum total of all the life functions is known as:

   A. homeostasis **B.** regulation **C.** synthesis **D.** metabolism

3. All the following are necessary for the survival of the organism *except:*

   A. homeostasis **B.** metabolism **C.** reproduction **D.** regulation

4. The life functions of an organism work together to maintain stability and constant conditions within an organism. This concept is referred to as:

   A. assimilation **B.** homeostasis **C.** transport **D.** respiration

5. A general function of a transport system is to:

   A. receive stimuli from the external environment

   B. bring materials from the external environment into contact with all the cells of the organism

   C. break down nutrients so that the cells can use them

   D. remove solid waste materials from the digestive system

6. The change of digested food into the living matter of the cell is called:

   A. ingestion **B.** digestion **C.** absorption **D.** assimilation

7. The process by which an organism obtains the energy it needs by releasing the chemical energy in nutrients is:

   A. ingestion **B.** synthesis **C.** respiration **D.** digestion

8. The cells of an organism are capable of chemically combining simple substances to form more complex substances. This process is called:

   A. synthesis **B.** digestion **C.** assimilation **D.** respiration

9. Which of the following life functions allows an organism to respond to changes in its environment?

   A. transport **B.** regulation **C.** respiration **D.** synthesis

10. The removal of metabolic wastes from an organism is known as:

    A. excretion **B.** repair **C.** transport **D.** synthesis

11. Which instrument is used to observe the structure of a virus?

    A. simple microscope **B.** compound microscope
    C. ultracentrifuge **D.** electron microscope

12. Which tool is used to move a cell part from one cell to another?

    A. dissecting microscope **B.** ultracentrifuge
    C. microdissection tools **D.** electron microscope

13. Insects, earthworms, and other small organisms can best be studied by using:

    A. a dissecting microscope **B.** an ultracentrifuge
    C. microdissection tools **D.** an electron microscope

14. This microscope uses one convex lens.

    A. simple microscope **B.** compound microscope
    C. ultracentrifuge **D.** electron microscope

15. A student looking at his finger through a microscope sees a totally black field of view. The most probable explanation for this is that:

    A. the microscope is not properly focused **B.** the microscope is too powerful
    C. the microscope is not powerful enough **D.** the student's finger is too thick

16. The total magnification of a microscope using a 10X ocular and a 60X objective lens is:

    A. 50X **B.** 70X **C.** 600X **D.** 6000X

17. Which part of the microscope regulates light?

    A. diaphragm **B.** ocular **C.** fine adjustment knob **D.** coarse adjustment knob

18. A student measures the length of a paramecium to be 100 μm under low power (100X magnification). He switches to high power (400X magnification) and measures the paramecium. What is the size of the paramecium under high power?

    A. 25μm **B.** 100μm **C.** 400μm **D.** 4,000μm

19. How many millimeters is a cell that measures 675 micrometers?

    A. 0.675mm **B.** 6.75mm **C.** .000675mm **D.** 675mm

20. The field of view of a microscope is 1,000 micrometers. A student counts five cells of equal size going across the field of view. How long is each cell?

    A. 20μm **B.** 200μm **C.** 500μm **D.** 5,000μm

Answers

1. **B.** "Life Functions," p. 15
2. **D.** "Life Functions," p. 15
3. **C.** "Life Functions," p. 15
4. **B.** "Life Functions," p. 15
5. **B.** "Life Functions," p. 15
6. **D.** "Life Functions," p. 15
7. **C.** "Life Functions," p. 15
8. **A.** "Life Functions," p. 15
9. **B.** "Life Functions," p. 15
10. **A.** "Life Functions," p. 15
11. **D.** "Tools of the Biologist," p. 18
12. **C.** "Tools of the Biologist," p. 18
13. **A.** "Tools of the Biologist," p. 18
14. **A.** "Tools of the Biologist," p. 18
15. **D.** "Tools of the Biologist," p. 18
16. **C.** "Tools of the Biologist," p. 18
17. **A.** "Tools of the Biologist," p. 18
18. **B.** "Tools of the Biologist," p. 18
19. **A.** "Tools of the Biologist," p. 18
20. **B.** "Tools of the Biologist," p. 18