

Name: _____
Mr. Willis
Biology: _____
Date: _____

1st Semester
Biology – The Nature of Science
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1

1.1 What Is Science?

1. What is science?

2. What are the goals of science?

Scientific Methodology: The Heart of Science

Questions 3–5 refer to spontaneous generation, the idea that life can arise from nonliving matter. Spontaneous generation was accepted by many in the scientific community up until the mid-nineteenth century. A series of simple experiments tested the validity of this idea.

3. Evidence used to support spontaneous generation was the observation that foods over time become covered in maggots or fungal and bacterial growth. The inference behind spontaneous generation is that there is no “parent” organism. Write this inference as a hypothesis using an if–then sentence that suggests a way of testing it.

4. In 1668, Francesco Redi proposed a different hypothesis to explain the specific example of maggots that appear on spoiled food. He had observed that maggots appear on meat a few days after flies have been seen on the food. He inferred that the flies had left behind eggs too small to see. Redi’s experiment is shown below. What conclusion can you draw from Redi’s experiment?



5. What facts did Redi’s experiments establish? What broader scientific understanding about life did the experiments explore? How does the example of these experiments demonstrate science as a way of knowing?

1.2 Science in Context

1. Describe how new ideas are generated.

2. How are science and technology related?

3. It took hundreds of years of discussion and the experiments of Louis Pasteur in the nineteenth century for the larger scientific community to accept that spontaneous generation of life was not a valid scientific concept. Referring to the diagram, describe how modern methods of communication have changed the scientific process.

Scientific Theories

For Questions 4–8, identify whether each statement is a hypothesis or a theory. For a hypothesis, write an “H” on the line. For a theory, write a “T.”

_____ 4. The rate that grass grows is related to the amount of light it receives.

_____ 5. All life is related and descended from a common ancestor.

- _____ 6. The universe began about 15 billion years ago.
- _____ 7. New tennis balls bounce higher than old tennis balls.
- _____ 8. Caffeine raises blood pressure.

Science and Society

9. How can bias affect the application of science in society? What role does a good understanding of science play in this phenomenon?

10. What is it about science, as a way of knowing, that makes it self-correcting?

1.3 Studying Life

- 1. The genetic molecule common to all living things is _____.
- 2. The internal process of _____ enables living things to survive changing conditions.
- 3. Living things are capable of responding to different types of _____.
- 4. Living things have a long history of _____ change.
- 5. The continuation of life depends of both _____ and _____.
- 6. The combination of chemical reactions that make up an organism’s _____ help to organize raw materials into living matter.

Fields of Biology

7. Biology is made up of many overlapping fields, each of which uses different tools to gather information about living things. Fill out the table below with information about two fields of biology—one that appeals to you, and one that does not. Include a description of each field and the tools scientists in the field use, as well as your impressions of each.

Field of Biology	Description of Field	Why It Does or Does Not Appeal to Me

Performing Biological Investigations

8. Describe the system of measurement most scientists use when collecting data and doing experiments.

9. Why do scientists need a common system of measurement?

10. Your teacher is doing a long-term experiment by having you and your classmates grow plants at home. You are testing the hypothesis that plant growth is affected by the amount of water a plant receives. All the data will be compiled in three weeks. Why isn’t it a good idea to use the 8-ounce measuring cup from your kitchen or the 12-inch ruler you have on your desk?

Chapter Vocabulary Review

For Questions 1–8, complete each statement by writing the correct word.

- 1. The act of noticing and describing events or processes in a careful, orderly way is called _____.
- 2. The information gathered during an experiment is called _____.
- 3. A(n) _____ is a logical interpretation based on what scientists already know.

4. A(n) _____ is a scientific explanation for a set of observations that can be tested in ways that support or reject it.
5. A(n) _____ is a well-tested explanation that unifies a broad range of observations and hypotheses.
6. In _____ reproduction, the new organism has a single parent.
7. A(n) _____ is a signal to which an organism responds.
8. _____ is an organized way of gathering and analyzing evidence about the natural world.

For Questions 9–17, write the letter of the definition that best matches each term on the line provided.

Term

- | | |
|-----------------------|--------------------------------|
| _____ 9. biology | _____ 14. control group |
| _____ 10. bias | _____ 15. independent variable |
| _____ 11. homeostasis | _____ 16. dependent variable |
| _____ 12. metabolism | _____ 17. biosphere |
| _____ 13. DNA | |

Definition

- A. in an experiment, the group exposed to the same conditions as the experimental group except for one independent variable
- B. the study of life
- C. living things maintaining a relatively stable internal environment
- D. a molecule containing the universal genetic code
- E. a point of view that is personal rather than scientific
- F. a living planet
- G. the combination of chemical reactions through which an organism builds up or breaks down materials
- H. in an experiment, the variable that is manipulated
- I. in an experiment, the responding variable

2.1 The Nature of Matter

For Questions 1–3, complete each statement by writing the correct word or words.

1. A chemical element is a pure substance that consists entirely of one type of _____.
2. Atoms of the same element that differ in the number of neutrons they contain are called _____.
3. An atom is made up of protons, neutrons, and _____.

Chemical Compounds

4. What is a chemical compound?

5. What do the formulas for table salt, NaCl, and water, H₂O, indicate about these compounds?

6. How are chemical bonds important in metabolism?

2.2 Properties of Water

The Water Molecule

For Questions 1–4, write True or False on the line provided.

- _____ 1. Water is a polar molecule.
- _____ 2. Hydrogen bonds are an example of adhesion.
- _____ 3. Covalent bonds give water a low heat capacity.
- _____ 4. A hydrogen bond is stronger than a covalent bond.

2.3 Carbon Compounds

1. How many valence electrons does each carbon atom have?

2. What gives carbon the ability to form chains that are almost unlimited in length?

Macromolecules

For Questions 3–5, complete each statement by writing the correct word or words.

3. Many of the molecules in living cells are so large they are called _____.
 4. _____ is the process that forms large organic molecules.
 5. When two or more _____ join together, a polymer forms.
6. Create a table in which you compare the components and functions of the following macromolecules: carbohydrates, lipids, nucleic acids, and proteins.

7. How did organic compounds get their name? How is the word related to its meaning?

2.4 Chemical Reactions and Enzymes

1. What is a chemical reaction?
-
2. Complete the table about chemicals in a chemical reaction.

Chemicals in a Chemical Reaction	
Chemicals	Definition
Reactants	
Products	

Energy in Reactions

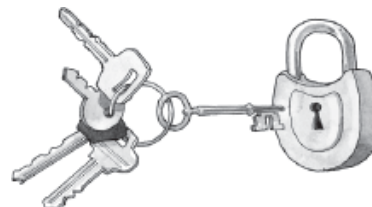
3. What is released or absorbed whenever chemical bonds form or are broken?

Enzymes

4. How does the addition of a catalyst affect the energy of activation of a chemical reaction?

For Questions 12–13, refer to the Visual Analogy comparing the action of enzymes to a lock and key.

5. How is a substrate and its enzyme like a lock and its key?



or words.
cells

7.1 Life Is Cellular

For Questions 1–6, complete each statement by writing the correct word

1. The invention of the _____ made the discovery of _____ possible.
2. Robert Hooke used the name _____ to refer to the tiny empty chambers he saw when he observed magnified cork.
3. German botanist Matthias Schleiden concluded that _____ are made of cells.

4. German biologist Theodor Schwann concluded that _____ are made of cells.
5. Rudolph Virchow concluded that new cells are produced from _____.
6. The _____ combines the conclusions made by Schleiden, Schwann, and Virchow.

Exploring the Cell

For Questions 7–9, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 7. The size of the image formed by a light microscope is unlimited because light that passes through matter is diffracted.
- _____ 8. Fluorescent dyes help scientists see the movement of compounds and structures in living cells.
- _____ 9. Transmission electron microscopes form a 3-D image of the surface of a specimen.

Prokaryotes and Eukaryotes

10. Complete the table about the two categories of cells.

Two Categories of Cells			
Category	Definition	Size range	Examples
Prokaryotic cells			
Eukaryotic cells			

11. Which category of cells—prokaryotic or eukaryotic—is your body composed of? _____

7.2 Cell Structure

1. What does the term *organelle* mean literally? _____

Organelles That Store, Clean Up, and Support

2. What are vacuoles?

3. What are the two roles of the central vacuole in plant cells?

4. What is the role of lysosomes in the cell? Why is this a vital role?

Organelles That Build Proteins

5. What are ribosomes? What do they do?

6. In which organelle are the lipid components of the cell membrane assembled?

7. What is the difference between rough ER and smooth ER?

8. Describe the role of the Golgi apparatus in cells.

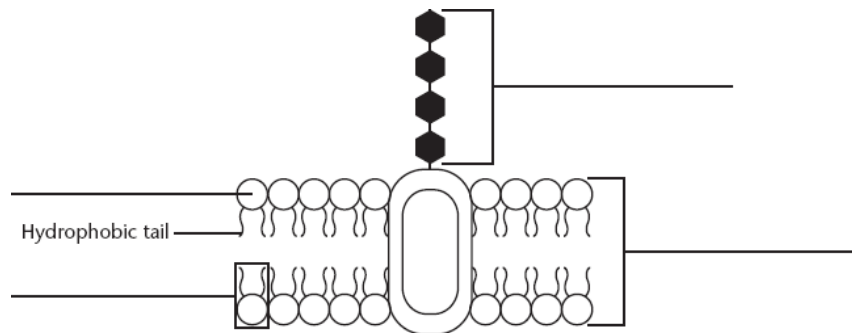
For Questions 9–12, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 9. Chloroplasts are never found in animal cells.
- _____ 10. Unlike chloroplasts, mitochondria are surrounded by a double membrane.
- _____ 11. Nearly all of the mitochondria in your cells were inherited from your mother.
- _____ 12. Both chloroplasts and mitochondria lack genetic information in the form of DNA.

Cellular Boundaries

For Questions 13–16, complete each statement by writing the correct word or words.

- 13. Most cell _____ are porous to water and other materials but strong enough to support and protect cells.
- 14. Nearly all of the plant tissue called _____ is made up of cell walls.
- 15. Besides supporting and protecting a cell, the cell membrane _____ what enters and leaves the cell.
- 16. Complete the diagram of a section of a cell membrane. Then, on the line below the diagram, write the name of the model that describes the cell membrane’s structure.



7.3 Cell Transport

For Questions 1–4, write the letter of the correct answer on the line at the left.

- _____ 1. Which of the following must be true for diffusion to occur?
 - A. Molecules or particles must have different sizes.
 - B. Special protein channels must always be available.
 - C. There must be areas of different concentrations.
 - D. Energy must be available.

- _____ 2. Which term refers to the condition that exists when *no* net change in concentration results from diffusion?
 - A. concentration
 - B. equilibrium
 - C. osmosis
 - D. randomness

- _____ 3. Which of the following statements tells how facilitated diffusion differs from simple diffusion?
 - A. Particles move through cell membranes without the use of energy by cells.
 - B. Particles tend to move from high concentration to lower concentration.
 - C. Particles move within channel proteins that pass through cell membranes.
 - D. Particles tend to move more slowly than they would be expected to move.

For Questions 4–6, match the situation with the result. Write the letter of the correct answer on the line at the left

Situation

- _____ 4. Cells are in an isotonic solution.
- _____ 5. Cells are in a hypertonic solution.
- _____ 6. Cells are in a hypotonic solution.

Result

- A. The cells lose water.
- B. The cells gain water.
- C. The cells stay the same.

7. In the table below, draw how each type of cell will look after being placed in a hypertonic solution.

Appearance of Cells in a Hypertonic Solution	
Animal Cells	Plant Cells

Active Transport

8. What is the function of active transport in moving small molecules and ions across cell membranes? Give an example.

9. How does ATP enable transport proteins to move ions across a cell membrane?

10. What are the proteins used in active transport called? _____

11. Most sports drinks are isotonic in relation to human body fluids. Explain why athletes should drink solutions that are isotonic to body fluids when they exercise rather than ones that are hypotonic to body fluids (contain a greater proportion of water in comparison to the fluids in and around human body cells).

7.4 Homeostasis and Cells

For Questions 1–5, complete each statement by writing the correct word or words.

- The term _____ refers to the relatively constant internal physical and chemical state of a living cell.
- Some unicellular eukaryotes, called _____, contain chloroplasts.
- Other unicellular eukaryotes include _____ and algae.

Multicellular Life

4. How are the cells of a multicellular organism like a baseball team?

5. Starting with the outermost circle of the diagram, explain how each level is related to the next level within each circle.

8.1 Energy and Life

Heterotrophs and Autotrophs

For Questions 1–5, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

- _____ 1. All heterotrophs must eat food to get energy.
- _____ 2. Autotrophs do not need to eat food because they make food.
- _____ 3. The energy in food originally came from ATP.
- _____ 4. The term photosynthesis means “pulling apart with light” in Greek.
- _____ 5. The energy of sunlight is stored in the chemical bonds of carbohydrates.

6. Complete the table comparing two types of organisms.

Autotrophs and Heterotrophs		
Type	Description	Examples
Autotrophs		
Heterotrophs		

7. Suppose that you ate a hamburger on a wheat roll with lettuce, tomatoes, and onions for lunch. As you ate, you took in food molecules from plants and animals. Explain why all the energy in the food molecules of this hamburger could be traced back to the sun.

8.2 Photosynthesis: An Overview

For Questions 1–6, complete each statement by writing the correct word or words.

- The _____ of light determines its color.
- Chemicals that absorb light are called _____.
- Chlorophyll makes plants look green because it _____ green light.
- The visible light absorbed by chlorophyll _____ the energy level of the chlorophyll's electrons.

An Overview of Photosynthesis

For Questions 5–7, write the letter of the correct answer on the line at the left.

- _____ 5. What are the reactants of the photosynthesis reaction?
- | | |
|-----------------------------|----------------------------------|
| A. chlorophyll and light | C. carbohydrates and oxygen |
| B. carbon dioxide and water | D. high-energy electrons and air |
- _____ 6. What are the products of the light-dependent reactions?
- | | |
|---------------------------|---------------------|
| A. chloroplasts and light | C. oxygen and ATP |
| B. proteins and lipids | D. water and sugars |
- _____ 7. Where do the light-independent reactions occur?
- | | |
|---------------|-----------------|
| A. stroma | C. chlorophyll |
| B. thylakoids | D. mitochondria |

Factors Affecting Photosynthesis

8. What are three factors that affect the rate at which photosynthesis occurs?

9. Would a plant placed in an atmosphere of pure oxygen be able to conduct photosynthesis? Explain your answer.

10. Photosynthesis plays an important role in supplying energy to living things. Considering what the products of photosynthesis are, what is another way in which photosynthesis is vital to life?

9.1 Cellular Respiration: An Overview

For Questions 1–4, complete each statement by writing the correct word or words.

- A calorie is a unit of _____.
- The Calorie used on food labels is equal to _____ calories.
- A Calorie is also referred to as a _____.
- Cells use the energy stored in chemical bonds of foods to produce compounds that directly power the cell's activities, such as _____.

Overview of Cellular Respiration

For Questions 5–10, complete each statement by writing the correct word or words.

- The equation that summarizes cellular respiration, using chemical formulas, is _____.
- If cellular respiration took place in just one step, most of the _____ would be lost in the form of light and _____.

7. Complete the table comparing photosynthesis and cellular respiration.

A Comparison of Photosynthesis and Cellular Respiration		
Aspect	Photosynthesis	Cellular Respiration
Function	energy capture	
Location of reactions	Chloroplasts	
Reactants		
Products		

8. How does an understanding of the process of cellular respiration support the theory that the cell is the basic functional unit of life?

9.2 The Process of Cellular Respiration

1. How many ATP molecules per glucose molecule does a cell gain from each of the three stages of cellular respiration?

2. Besides glucose, what other kinds of molecules can be used to produce ATP in cellular respiration?

3. Why is cellular respiration considered an efficient process?

4. Where does the heat that warms your body come from? Explain your answer.

10.1 Cell Growth, Division, and Reproduction

Limits to Cell Size

For Questions 1–4, write True if the statement is true. If the statement is false, change the underlined word or words to make the statement true.

_____ 1. As a cell’s size increases, its amount of DNA also increases.

_____ 2. The amount of activity in a cell is related to its volume.

_____ 3. The smaller the cell, the smaller its ratio of surface area to volume.

_____ 4. The information crisis in a cell is solved by the replication of the DNA before cell division.

5. In the visual analogy of the growing town, what does the library represent? Identify two characteristics that make it a good choice for this analogy.



Cell Division and Reproduction

For Questions 6–8, complete each statement by writing the correct word or words.

6. _____ is the formation of new individuals.

7. For single-celled organisms, cell division is a form of _____ reproduction.

8. Most multicellular organisms reproduce by _____ reproduction.

9. Use the table to compare and contrast asexual and sexual reproduction.

Asexual and Sexual Reproduction	
Similarities	Differences

10. Vascular tissue helps plants transport water against the force of gravity. Because of this, plants that lack vascular tissue do not grow very tall. How is this situation similar to the information you have learned in this lesson? Explain.

10.2 The Process of Cell Division

Chromosomes

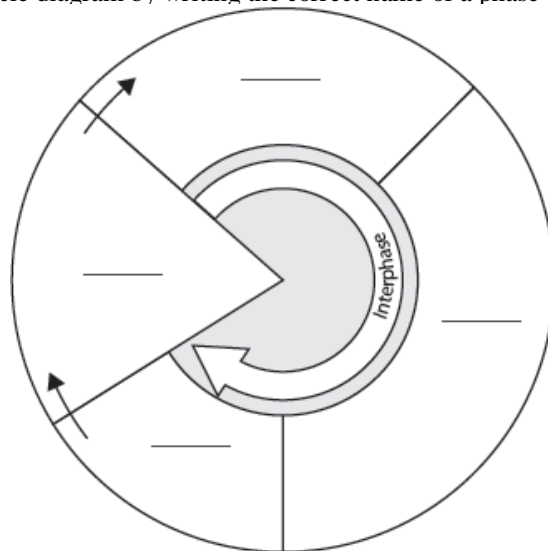
For Questions 1–5, complete each statement by writing the correct word or words.

1. Cells carry genetic information in packages of DNA called _____.
2. Most _____ have only one circular strand of DNA.
3. In eukaryotic cells, the genetic structure consists of DNA and a tightly wound protein, which together form a substance called _____.
4. The beadlike structures formed by DNA wrapped around _____ molecules are called nucleosomes.
5. _____ make possible the precise separation of DNA during cell division.

The Cell Cycle

6. What happens during interphase?

7. Complete the cell cycle diagram by writing the correct name of a phase on each line.



8. In eukaryotic cells, what happens in the G₁ phase that differs from the G₂ phase?

9. In eukaryotic cells, what are the two main stages of cell division?

Mitosis

10. During prophase, when cell chromosomes become visible, what are the duplicated strands of DNA called? What is the name for the area in which these duplicated strands are joined?

11. What structures are spindle fibers attached to that help pull the paired chromosomes apart?

For Questions 12–15, match the description of the event with the phase of mitosis in which it occurs. Each phase may be used more than once.

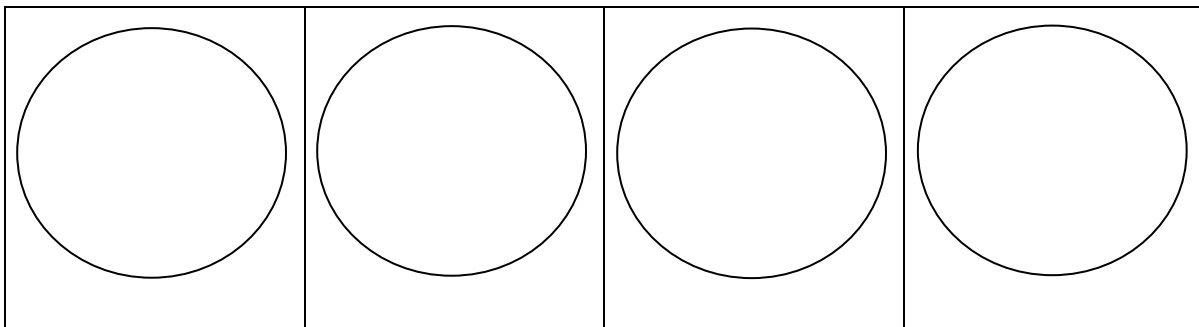
Event

- _____ 12. The chromosomes separate and begin to move to opposite sides of the cell.
- _____ 13. The chromosomes become visible. The centrioles take up positions on opposite sides of the nucleus.
- _____ 14. A nuclear envelope re-forms around each cluster of chromosomes. The nucleolus becomes visible in each daughter nucleus.
- _____ 15. The chromosomes line up across the center of the cell.

Phase of Mitosis

- A. Telophase
- B. Prophase
- C. Metaphase
- D. Anaphase

16. The four circles below represent the nucleus of a cell going through mitosis. Draw four chromosomes as they go through each phase. Label each phase and describe what is happening to the DNA.



Cytokinesis

17. What is cytokinesis?
