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Student Lab Safety Form

Student Name: ________________________________

Date: ________________________________

Lab Title: ________________________________

In order to show your teacher that you understand the safety concerns of this lab, the following questions must be answered after the teacher explains the information to you. You must have your teacher initial this form before you can proceed with the lab.

1. How would you describe what you will be doing during this lab?

2. What are the safety concerns associated with this lab (as explained by your teacher)?
   - ____________________________________________
   - ____________________________________________
   - ____________________________________________
   - ____________________________________________
   - ____________________________________________
   - ____________________________________________

3. What additional safety concerns or questions do you have?

Adapted from Gerlovich, et al. (2004). The Total Science Safety System CD, JaKel, Inc.
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# Table of Contents

## Chapter 6  Chemistry in Biology

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<td>31</td>
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<td>Student Recording Sheet</td>
<td>35</td>
</tr>
</tbody>
</table>
Before reading Chapter 6, predict answers to questions about the chapter content based on what you already know. Circle the letter of the correct answer, and then explain your reasoning.

1. Derek is watching a documentary about the scientists who worked on the Manhattan Project and who succeeded in splitting atoms. The documentary explains what makes up atoms. Which explanation is given?
   A. Atoms are composed of electrical charges that are made of only energy.
   B. Atoms are hard, solid balls of matter that are the smallest known particles.
   C. Atoms are made of a hard particle called a nucleus surrounded by electrons.
   D. Atoms are made of three particles called electrons, neutrons, and protons.
   Explain.

2. Jackie’s uncle is undergoing radioactive iodine treatments for thyroid cancer. The radioactive iodine used by the doctor is an isotope of the element iodine. Jackie researches the term isotope. Which definition for the term does she learn?
   A. atoms of the same element with a different number of neutrons
   B. atoms of the same element with a different number of protons
   C. atoms of the same element with a negative charge
   D. atoms of the same element with a positive charge
   Explain.

3. Abla is taking a nutrition class as an elective. She learns about the four most common organic macromolecules in human beings. About what macromolecules does she learn?
Launch Lab

How does the nutrient content of foods compare?

Your body’s structure and function depends on chemical elements. The chemical ingredients that your body needs to function properly are found in nutrients like fats, protein, carbohydrates, minerals, vitamins, and water. In this lab, you will investigate those nutrients.

Procedure
1. Read and complete the lab safety form.
2. Construct a data chart to record grams or percent of each nutrient listed in the lab introduction. Include columns labeled Serving Size, Calories, and Calories from Fat.
3. Study the Nutrition Facts label on a cereal box. Record data for the cereal provided.
4. Choose three additional labeled food items. Predict how the nutrients in these items compare with the nutrients in the cereal. Use the Nutrition Facts label to record data for each item.

Data and Observations

Analysis
1. Evaluate What factors influenced your predictions of the nutrient content of the food items? Were your predictions correct? Explain.

2. Infer Which food item has the greatest nutritional value per serving? Justify your answer.
**MiniLab**

**CHAPTER 6**

**Test for Simple Sugars**

What common foods contain glucose? Glucose is a simple sugar that provides energy for cells. In this lab, you will use a reagent called Benedict’s solution, which indicates the presence of –CHO (carbon, hydrogen, oxygen) groups. A color change determines the presence of glucose and other simple sugars in common foods.

**Procedure**

1. Read and complete the lab safety form.
2. Create a data table with columns labeled *Food Substance*, *Sugar Prediction*, *Observations*, and *Results*.
3. Choose four *food substances* from those provided. Read the food labels and predict the presence of simple sugar in each food. Record your prediction.
4. Prepare a *hot water bath* using a *hot plate* and 1000-mL beaker.
5. Label four *test tubes*. Obtain a *graduated cylinder*. Add 10 mL of a different food substance to each test tube. Then add 10 mL *distilled water*. Swirl gently to mix.
6. Add 5 mL of Benedict’s solution to each tube. Use a clean *stirring rod* to mix the contents.
7. Using *test tube holders*, warm the test tubes in the hot water bath for 2–3 min. Record your observations and results.

**Data and Observations**

**Analysis**

1. **Interpret Data** Did any of the foods contain simple sugars? Explain.

2. **Think Critically** Could a food labeled “sugar free” test positive using Benedict’s solution as an indicator? Explain.
What factors affect enzymatic browning? When sliced, an apple’s soft tissue is exposed to oxygen, causing a chemical reaction called oxidation. Enzymes in the apple speed this reaction, producing darkened, discolored fruit. In this lab, you will investigate methods used to slow enzymatic browning.

**Procedure**

1. Read and complete the lab safety form.
2. Predict the relative amount of discoloration each of these apple wedges will show when exposed to air. Justify your prediction.
   - Sample 1: Untreated apple wedge
   - Sample 2: Apple wedge submerged in boiling water
   - Sample 3: Apple wedge submerged in lemon juice
   - Sample 4: Apple wedge submerged in sugar solution
3. Prepare 75 mL of each of the following: boiling water, lemon juice, and sugar solution in three 250-mL beakers.
4. Slice an apple into four wedges. Immediately use tongs to submerge each wedge in a different liquid. Put one wedge aside.
5. Submerge the wedges for three minutes, then place on a paper towel, skin side down. Observe for 10 min, then record the relative amount of discoloration of each apple wedge.

**Data and Observations**

**Analysis**

1. **Analyze** How did each treatment affect the chemical reaction that occurred on the fruit’s soft tissue? Why were some of the treatments successful?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. **Think Critically** A restaurant owner wants to serve fresh-cut fruit. What factors might be considered in choosing a recipe and preparation method?

   __________________________________________________________
   __________________________________________________________
**Background:** The compound hydrogen peroxide, \( \text{H}_2\text{O}_2 \), is produced when organisms metabolize food, but hydrogen peroxide damages cell parts. Organisms combat the buildup of \( \text{H}_2\text{O}_2 \) by producing the enzyme peroxidase. Peroxidase speeds up the breakdown of hydrogen peroxide into water and oxygen.

**Question:** What factors affect peroxidase activity?

**Materials**

Choose materials that would be appropriate for this lab. Possible materials include:

- 400-mL beaker
- kitchen knife
- hot plate
- test-tube rack
- ice
- beef liver
- dropper
- distilled water

- 18-mm × 150-mm test tubes
- buffer solutions (pH 5, pH 6, pH 7, pH 8)
- 50-mL graduated cylinder
- 10-mL graduated cylinder
- tongs or large forceps
- square or rectangular pan
- stopwatch or timer
- nonmercury thermometer
- 3% hydrogen peroxide
- potato slices

**Safety Precautions**

**WARNING:** Use only GFCI-protected circuits for electrical devices.

**Plan and Perform the Experiment**

1. Read and complete the lab safety form.
2. Choose a factor to test. Possible factors include temperature, pH, and substrate (\( \text{H}_2\text{O}_2 \)) concentration.
3. Form a hypothesis about how the factor will affect the reaction rate of peroxidase.
4. Design an experiment to test your hypothesis. Create a procedure and identify the controls and variables.
5. On a separate sheet of paper, create a data table for recording your observations and measurements.
6. Make sure your teacher approves your plan before you proceed.
7. Conduct your approved experiment.
8. **Cleanup and Disposal** Clean up all equipment as instructed by your teacher and return everything to its proper place. Wash your hands thoroughly with soap and water.
Analyze and Conclude

1. **Describe** how the factor you tested affected the enzyme activity of peroxidase.

2. **Graph** your data, then analyze and interpret your graph.

3. **Discuss** whether or not your data supported your hypothesis.

4. **Infer** why hydrogen peroxide is not the best choice for cleaning an open wound.

5. **Error Analysis** Identify any experimental errors or other errors in your data that might have affected the accuracy of your results.
You need fats in your diet for your body to function properly, but the amount of fat and the kind of fat you eat can affect your health. The best fats in your diet are unsaturated fats. These fats help keep you healthy when they are eaten in moderation. Unsaturated fats can be monounsaturated (one double bond between carbon atoms) or polyunsaturated (more than one double bond between carbon atoms). Sources of monounsaturated fats include olive oil and canola oil. Sources of polyunsaturated fats include soybean oil, sunflower oil, salmon, and walnuts.

Eating too many fats of any kind can lead to becoming overweight. Saturated fats (no double bond between carbon atoms) also increase the risk of heart disease. Most saturated fats are found in animal products, such as beef, butter, and whole milk. Another kind of fat also linked to heart disease is trans-fatty acid, or trans fat. Trans fats do not exist naturally in foods. Manufacturers make trans fats by adding hydrogen to vegetable oil. This process of hydrogenation turns liquid oils into solid fats and increases how long foods can keep without spoiling. Trans fats are found in some margarines, shortenings, and many processed foods, such as crackers and cookies.

When people choose foods at a supermarket, they can read labels on processed foods to determine the amounts of saturated fats, unsaturated fats, and trans fats in the foods. If they want to buy ground beef, they can choose among different amounts of fat in the beef. Labels on packages of ground beef might have numbers such as 80/20. This means the ground beef is 80 percent lean and 20 percent fat. In this activity, you will determine the fat content of three samples of ground beef.

**Procedure**

1. Read and complete the lab safety form.
2. Obtain three different samples of ground beef and label them 1, 2, and 3, respectively. Observe the appearance of each sample, and record your observations in Table 1. Based on your observations, predict the percentage lean and percentage fat that would appear on each sample's store label.
3. Using a balance, a large plastic cup, and a plastic spoon, measure out 100 g of sample 1 ground beef and place it in a large beaker. Fill the beaker three-fourths full with water, set it on a hot plate, and heat to boiling.

   **WARNING:** Use care when working with a heat source. Avoid touching the ground beef with your hands.
4. Use tongs or gloves to remove the beaker from the heat source, and allow it to cool 10 min.
5. The fat will form a separate layer above the water. Pour as much of the fat as you can into a graduated cylinder. Use care so as not to pour off water into the graduated cylinder. It might be necessary to gently scrape remaining fat particles from the beaker and add them to the graduated cylinder. Determine the volume of fat in sample 1 ground beef, and record the volume in Table 1. Calculate the mass of the fat by multiplying the volume of fat by 0.9 g/mL, the density of fat.
6. Calculate the percentage of fat by dividing the mass of fat by the mass of sample 1 and multiplying by 100 percent. Record the percentage of fat.
7. Repeat steps 3–6 for the other two beef samples.
Table 1

<table>
<thead>
<tr>
<th>Ground Beef Sample</th>
<th>Appearance</th>
<th>Prediction of Percent Lean/Percent Fat</th>
<th>Volume of Fat (mL)</th>
<th>Mass of Fat (g)</th>
<th>Percentage of Fat in Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
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</tr>
</tbody>
</table>

Analyze and Conclude

*Respond to each question.*

1. **Explain** How accurate were your predictions of the percentage of lean and percentage of fat of the ground-beef samples?

2. **Compare** How do the percentage of lean and percentage of fat of the three ground-beef samples compare?

3. **Connect** How does the percentage of fat affect the appearance of ground beef?

**CAREERS IN BIOLOGY**

**Dietetics** Visit the biologygmh.com for information on dieticians. What are the responsibilities of a dietician?
Scientists have identified more than ten million organic compounds. To understand and work with such a large number of compounds, chemists divide organic compounds into a number of families, with the members of each family having similar physical, chemical, and biological properties. Each family is characterized by a group of atoms known as a functional group. For example, the alcohols are a family of organic compounds that contain the hydroxyl (–OH) group. The characteristic properties of the functional group determine to a large extent the chemical, physical, and biological properties of the members of that family.

**Categorize** In addition to the families of organic macromolecules discussed in the text, many simple organic families are important in biological processes. Some members of those families occur naturally in plants and animals and have important biological functions. Others do not occur naturally in living organisms, but they have important effects on the functioning of those organisms.

**Research** Working in a small group, choose one of the organic families listed in the table below. Consult reference books at the library to fill in the table for the organic family your group chose.

**Portray** Prepare a one-page report on the biological significance of one member of the organic family you researched. Work with other groups in the class on a presentation that will combine the results from all groups in an interesting and informative way.

<table>
<thead>
<tr>
<th>Organic Family</th>
<th>Functional Group</th>
<th>Examples</th>
<th>Biological Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkanes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkenes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aromatic hydrocarbons</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohols</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Aldehydes</td>
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<td></td>
<td></td>
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<tr>
<td>Ketones</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Esters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carboxylic acids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amides</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Complete the network tree about organic macromolecules. These terms may be used more than once: amino acids, carbohydrates, \((\text{CH}_2\text{O})_n\), DNA, fatty acid tails, lipids, nucleic acids, nucleotides.

- **1.** include monosaccharides and have a general formula of \((\text{CH}_2\text{O})_n\).
- **2.** include which are steroids which have a central carbon atom.
- **3.** include which are RNA and are made up of.
- **4.** are made of.
- **5.** and have.
- **6.** include.
- **7.** and have.
- **8.**
In your textbook, read about the structure of atoms.

Label the diagram of an atom. Use these choices:

- electron
- energy level
- neutron
- nucleus
- proton

1. _______________  3. _______________
2. _______________  4. _______________
5. _______________

In your textbook, read about elements, compounds, and chemical bonds.

If the statement is true, write true. If the statement is false, replace the italicized term or phrase to make it true.

6. On the periodic table, each element has a unique name and formula.

7. The periodic table is organized into horizontal rows, called periods, and vertical columns, called elements.

8. Water is composed of hydrogen and oxygen.

9. Atoms of the same element that have different numbers of neutrons are called isotopes.

10. The period of an element is the amount of time it takes for half of a radioactive isotope to decay.

11. A combination is a substance formed when two or more different elements combine.

12. The two main types of chemical bonds are covalent bonds and van der Waals forces.
In your textbook, read about reactants and products.

Fill in the blanks with the correct number of molecules to balance the chemical equation.

\[ C_6H_{12}O_6 + (1) \quad O_2 \rightarrow (2) \quad CO_2 + (3) \quad H_2O \]

Respond to each statement.

4. **State** the principle that explains why there must be the same number of atoms of each element on each side of an equation.

5. **Identify** which number indicates the number of atoms of each element in a molecule of a substance.

In your textbook, read about activation energy and enzymes.

Refer to the graph of the reaction pathway.

6. Draw a line on the graph that approximates the reaction pathway if an enzyme is added to the reactants.

**Match the description in Column A with the term in Column B.**

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. minimum amount of energy required for reactants to form products</td>
<td>A. enzyme</td>
</tr>
<tr>
<td>8. substance that lowers energy needed to start a chemical reaction</td>
<td>B. substrate</td>
</tr>
<tr>
<td>9. protein that is a biological catalyst</td>
<td>C. activation energy</td>
</tr>
<tr>
<td>10. molecule that binds to an enzyme</td>
<td>D. catalyst</td>
</tr>
</tbody>
</table>
In your textbook, read about water’s polarity. 
*Label the diagram. Use these choices:*

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________

In your textbook, read about mixtures with water. 
*For each statement below, write true or false.*

5. A mixture is a combination of two or more substances in which each substance retains its individual characteristics. 
   ________________

6. A suspension is a mixture that has a uniform composition throughout. 
   ________________

7. In a mixture, the solvent is the substance that is dissolved. 
   ________________

8. A mixture of sand and water is a heterogeneous mixture. 
   ________________

9. A suspension is a homogeneous mixture in which water is mixed with a substance that does not dissolve in it. 
   ________________

In your textbook, read about acids and bases. 
*Use each of the terms below only once to complete the passage.*

  acids  bases  biology  buffers  hydrogen ions  neutral  pH

Substances that release hydrogen ions when dissolved in water are called (10) ____________________________ . The more (11) ____________________________ a substance releases, the more acidic the solution becomes. Substances that release hydroxide ions when dissolved in water are called (12) ____________________________ . Acids and bases are key substances in (13) ____________________________ . The concentration of hydrogen ions in a solution is called (14) ____________________________ . Pure water is (15) ____________________________ and has a pH value of 7.0. (16) ____________________________ are weak acids or weak bases that can react with strong acids or strong bases to keep the pH within a particular range.
In your textbook, read about the building blocks of life.

For each statement below, write true or false.

1. Carbon atoms can bond together in straight chains, branched chains, or rings.  
2. Large molecules containing carbon atoms are called micromolecules.  
3. Polymers are molecules made from repeating units of identical organic compounds that are linked together by hydrogen bonds.  
4. Carbon is a component of almost all biological substances.  
5. Macromolecules can be organized into vitamins, lipids, proteins, and nucleic acids.

In your textbook, read about carbohydrates, lipids, proteins, and nucleic acids.

Label the diagrams. Use these choices: saturated fat, unsaturated fat.

6.  
7.  

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Carbohydrate</th>
<th>Lipid</th>
<th>Protein</th>
<th>Nucleic Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Stores coded genetic information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Makes up fats, oils, and waxes in biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Makes up muscles, skin, and hair</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Forms double-helix structures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Is made of amino acids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Includes glucose, lactose, sucrose, and glycogen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Stores energy and is part of membranes</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15. Contains peptide bonds</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guía de estudio

CAPÍTULO 6
Sección 1: Los átomos, los elementos y los compuestos

En tu libro de texto, lee acerca de la estructura de los átomos.

Identifica el diagrama de un átomo. Usa estas opciones:

<table>
<thead>
<tr>
<th>electrón</th>
<th>neutrón</th>
<th>nivel de energía</th>
<th>núcleo</th>
<th>protón</th>
</tr>
</thead>
<tbody>
<tr>
<td>e⁻</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p⁺</td>
<td>n₀</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. ____________________________
2. ____________________________
3. ____________________________
4. ____________________________
5. ____________________________

En tu libro de texto, lee acerca de los elementos, compuestos y enlaces químicos.

Si la afirmación es verdadera, escribe «verdadero». Si la afirmación es falsa, substituye el término o la frase en cursiva para volverla verdadera.

6. En la tabla periódica, cada elemento tiene un nombre y fórmula únicos.

7. La tabla periódica está organizada en filas horizontales, llamadas períodos, y columnas verticales, llamadas elementos.

8. El agua está compuesta de hidrógeno y oxígeno.

9. Los átomos del mismo elemento que tienen diferentes números de neutrones se llaman isótopos.

10. El período de un elemento es la cantidad de tiempo que toma para que la mitad de un isótopo radiactivo decaiga.

11. Una combinación resulta cuando dos o más elementos diferentes se combinan.

12. Los dos tipos principales de enlaces químicos son los enlaces covalentes y las fuerzas de van der Waals.
En tu libro de texto, lee acerca de los reactantes y los productos.

Llena los espacios en blanco con el número correcto de moléculas para mantener el balance de la ecuación química.

\[
\text{C}_6\text{H}_{12}\text{O}_6 + (1) \text{O}_2 \rightarrow (2) \text{CO}_2 + (3) \text{H}_2\text{O}
\]

Responde a cada afirmación.

4. **Indica** el principio que explica por qué debe haber el mismo número de átomos de cada elemento en cada lado de una ecuación.

5. **Identifica** cómo se indica el número de átomos de cada elemento en una molécula de una sustancia.

En tu libro de texto, lee acerca de la energía de activación y de las enzimas.

**Consulta la gráfica de la ruta de reacción.**

6. Traza una línea en la gráfica que aproxima la ruta de reacción si se agrega una enzima a los reactantes.

Relaciona la descripción de la columna A con el término de la columna B.

<table>
<thead>
<tr>
<th>Columna A</th>
<th>Columna B</th>
</tr>
</thead>
<tbody>
<tr>
<td>cantidad mínima de energía necesaria para que los reactantes formen productos</td>
<td>A. enzima</td>
</tr>
<tr>
<td>sustancia que reduce la energía necesaria para iniciar una reacción química</td>
<td>B. sustrato</td>
</tr>
<tr>
<td>proteína que es un catalizador biológico</td>
<td>C. energía de activación</td>
</tr>
<tr>
<td>molécula que se enlaza a una enzima</td>
<td>D. catalizador</td>
</tr>
</tbody>
</table>
En tu libro de texto, lee acerca de la polaridad del agua.

Identifica el diagrama. Usa estas opciones:

- enlace covalente
- enlace de hidrógeno
- extremo ligeramente negativo
- extremo ligeramente positivo

1. ____________________
2. ____________________
3. ____________________
4. ____________________

En tu libro de texto, lee acerca de las mezclas con agua.

Para cada afirmación a continuación, escribe «verdadero» o «falso».

5. Una mezcla es una combinación de dos o más sustancias en la cual cada sustancia retiene sus características individuales.
   _____________

6. Una suspensión es una mezcla que tiene una composición totalmente uniforme.
   _____________

7. En una mezcla, el solvente es la sustancia que se disuelve.
   _____________

8. Una mezcla de arena y agua es una mezcla heterogénea.
   _____________

9. Una suspensión es una mezcla homogénea en la cual el agua se mezcla con una sustancia que no se disuelve en ella.
   _____________

En tu libro de texto, lee acerca de los ácidos y las bases.

Usa cada uno de los siguientes términos sólo una vez para completar el párrafo.

- ácidos
- amortiguadores
- bases
- biología
- íones de hidrógeno
- neutra
- pH

Las sustancias que liberan íones de hidrógeno cuando se disuelven en agua se llaman (10) _____________________. Mientras más (11) _____________________ libere una sustancia, más ácida se vuelve la solución. Las sustancias que liberan íones de hidróxido cuando se disuelven en agua se llaman (12) _____________________. Los ácidos y las bases son sustancias clave en la (13) _____________________. La concentración de íones de hidrógeno en una solución se llama (14) _____________________. El agua pura es (15) _____________________ y tiene un valor de pH de 7.0. Los (16) _____________________ son ácidos débiles o bases débiles que pueden reaccionar con ácidos fuertes o bases fuertes para mantener el pH dentro de un límite particular.
En tu libro de texto, lee acerca de los bloques edificantes de vida.

Para cada afirmación a continuación, escribe «verdadero» o «falso».

1. Los átomos de carbono se pueden enlazar en cadenas rectas, cadenas ramificadas o anillos.

2. Las moléculas grandes que contienen átomos de carbono se llaman micromoléculas.

3. Los polímeros son moléculas de unidades repetitivas de compuestos orgánicos idénticos que están unidos mediante enlaces de hidrógeno.

4. El carbono es un componente de casi todas las sustancias biológicas.

5. Las macromoléculas pueden organizarse en vitaminas, lípidos, proteínas y ácidos nucleicos.

En tu libro de texto, lee acerca de los carbohidratos, lípidos, proteínas y ácidos nucleicos.

Identifica los diagramas. Usa estas opciones: grasa insaturada, grasa saturada.

6. 

7. 

Completa la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Carbohidratos</th>
<th>Lípidos</th>
<th>Proteínas</th>
<th>Ácidos nucleicos</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. Almacenan información genética codificada.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Constituyen las grasas, los aceites y las ceras en biología.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Constituyen los músculos, la piel y el pelo.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Forman estructuras de hélice doble.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Están compuestos de aminoácidos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Incluyen la glucosa, la lactosa, la sucrosa y el glicógeno.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Contienen enlaces péptidos.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section Quick Check

CHAPTER 6

Section 1: Atoms, Elements, and Compounds

After reading the section in your textbook, respond to each statement.

1. Define **ionic bond**.

2. **Identify** the particles that make up atoms, and state their charges.

3. **Clarify** the difference between carbon-12 and carbon-14 in terms of their abundance, stability, and atomic structure.

4. Oxygen has eight protons in its nucleus. **Calculate** the number of neutrons and electrons in a neutral oxygen-16 atom. Show your work and explain.

5. When 200 mL water and 2.5 g sodium chloride are combined, they make a saltwater solution. When 100 mL water and 5 g sodium chloride are combined, they also make a saltwater solution. **Conclude** whether or not salt water is a compound. Explain.
Quick Check

After reading the section in your textbook, respond to each statement.

1. **State** the term for the amount of energy that is needed for a chemical reaction to occur.

2. **Summarize** the relationship between an enzyme and a substrate.

3. **Classify** which of the compounds in the reaction below are reactants and which are products.
   \[ \text{PbO}_2 + 4\text{HCl} \rightarrow \text{PbCl}_2 + \text{Cl}_2 + 2\text{H}_2\text{O} \]

4. **Compare** endothermic reactions and exothermic reactions.

5. **Predict** Suppose four atoms of oxygen gas (O$_2$) and two atoms of hydrogen gas (H$_2$) are combined. Determine how many atoms of water (H$_2$O) and oxygen gas (O$_2$) will be produced.
Section Quick Check

CHAPTER 6

Section 3: Water and Solutions

After reading the section in your textbook, respond to each statement.

1. Tell how a solution is made. Use the terms solute and solvent in your answer.

2. Discuss the importance of buffers in biology.

3. Explain why water molecules are polar.

4. Indicate whether a solution will have more OH⁻ or H⁺ if the pH value of the solution is 10.

5. Determine whether each of the following is a solution or a heterogeneous mixture: oil mixed with vinegar by shaking to make a salad dressing that settles into an oil layer and a vinegar layer; carbon dioxide dissolved in water to make carbonated water for making soft drinks. Explain.
### Quick Check

**Section 4: The Building Blocks of Life**

*After reading the section in your textbook, respond to each statement.*

1. **Recall** what polymers are.

2. **Review** why carbon can form a variety of organic compounds in a variety of shapes.

3. **Express** the importance of nucleic acids to living organisms.

4. **Compare** and **contrast** saturated fats and unsaturated fats in terms of their structures.

5. **Assess** why the structure of proteins is so complex.

---

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recall what polymers are.</td>
<td></td>
</tr>
<tr>
<td>2. Review why carbon can form a variety of organic compounds in a variety of shapes.</td>
<td></td>
</tr>
<tr>
<td>3. Express the importance of nucleic acids to living organisms.</td>
<td></td>
</tr>
<tr>
<td>4. Compare and contrast saturated fats and unsaturated fats in terms of their structures.</td>
<td></td>
</tr>
<tr>
<td>5. Assess why the structure of proteins is so complex.</td>
<td></td>
</tr>
</tbody>
</table>
Section 6.1
Vocabulary Review

Explain the difference between the vocabulary terms in each pair.

1.

2.

3.

4.

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

5. A B C D
6. A B C D
7. A B C D
8. A B C D

Constructed Response

9.

10.

11.

Think Critically

12.

13.

Section 6.2
Vocabulary Review

Write the letter of the definition that best matches each vocabulary term.

14. ________________
15. ________________
16. ________________
17. ________________
CHAPTER 6
Assessment
Student Recording Sheet

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.

18. A B C D
19. A B C D
20. A B C D

Constructed Response
21.
22.

Think Critically
23.
24.

Section 6.3
Vocabulary Review
Explain the relationship between the vocabulary terms in each pair.

25.
26.
27.
28.
29.

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.

30. A B C D
31. A B C D
32. A B C D

Constructed Response
33.
34.
35.
CHAPTER 6
Assessment

Student Recording Sheet

Think Critically

36. __________________________________________

37. Record your answer for question 37 on a separate sheet of paper.

Section 6.4
Vocabulary Review
Write the vocabulary term that best completes each sentence.

38. _____________________________ 39. _____________________________
38. _____________________________ 40. _____________________________

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.

42. A B C D 43. A B C D 44. A B C D

Constructed Response

45. __________________________________________

46. __________________________________________

Think Critically
47. Record your answer for question 47 on a separate sheet of paper.

Additional Assessment

48. Writing in Biology Record your answer for question 48 on a separate sheet of paper.

Document-Based Questions

49. __________________________________________

50. __________________________________________

Cumulative Review

51. __________________________________________

52. Record your answer for question 52 on a separate sheet of paper.
CHAPTER 6
Assessment Student Recording Sheet

Standardized Test Practice

Multiple Choice

Select the best answer from the choices given, and fill in the corresponding circle.


Short Answer

Answer each question with complete sentences.

9. __________________________________________________________________________
10. __________________________________________________________________________
11. __________________________________________________________________________
12. __________________________________________________________________________
13. __________________________________________________________________________
14. __________________________________________________________________________

Extended Response

Answer each question with complete sentences.

15. __________________________________________________________________________
16. __________________________________________________________________________

17. Record your answer for question 17 on a separate sheet of paper.

Essay Question

18. Record your answer for question 18 on a separate sheet of paper.
Before reading Chapter 7, predict answers to questions about the chapter content based on what you already know. Circle the letter of the correct answer, and then explain your reasoning.

1. During the nineteenth century, many scientists and naturalists studied microscopic organisms using magnifying lenses and simple microscopes. After studying plant tissues, animal tissues, and protozoans under the microscope, scientists summarized their observations of cells and formulated the cell theory. Which would not be included as part of the cell theory?
   A. All living things are made of one or more cells.
   B. Cells are the building blocks of living structures.
   C. Parent cells pass genetic material on to daughter cells.
   D. Unicellular organisms can grow from organic molecules.

   Explain.

2. Science students in Alma’s class are observing prepared slides of the cells of maple tree leaves and mammal skin cells. As they study the cells under the microscope’s highest magnification, their teacher records their observations on the board. Which would be included in the teacher’s list?
   A. Both the animal and plant cells have an oval shape and are about the same size.
   B. Both types of cells have a membrane that is also surrounded by a cell wall.
   C. The leaf cells have green organelles called chloroplasts; the animal cells do not.
   D. The skin cells have a nucleus, but the cells of the leaves have no nucleus.

   Explain.

3. Soto puts a drop of green food dye into a glass of water and observes the dye forming colorful swirls before eventually turning the water green. Explain Soto’s observations.

   Explain.
All things are made of atoms and molecules, but only in living things are the atoms and molecules organized into cells. In this lab, you will use a compound microscope to view slides of living things and nonliving things.

Procedure
1. Read and complete the lab safety form.
2. In the space below, construct a data table for recording your observations.
3. Obtain slides of the various specimens.
4. View the slides through a microscope at the power designated by your teacher.
5. As you view the slides, fill out the data table you constructed.

Data and Observations

Analysis
1. Describe some of the ways to distinguish between the living things and the nonliving things.
   
   
   
   
2. Write a definition of a cell based on your observations.
MiniLab

CHAPTER 7

Discover Cells

How can you describe a new discovery? Imagine you are a scientist looking through the eyepiece of some newfangled instrument called a microscope and you see a field of similarly shaped objects. You might recognize that the shapes you see are not merely coincidence and random objects. Your whole idea of the nature of matter is changing as you view these objects.

Procedure

1. Read and complete the lab safety form.
2. In the space below, prepare a data table in which you will record observations and drawings for three slides.
3. View the slide images your teacher projects for the class.
4. Describe and draw what you see. Be sure to include enough detail in your drawings to convey the information to other scientists who have not observed cells.

Data and Observations

Analysis

1. Describe What analogies or terms could explain the images in your drawings?

2. Explain How could you show Hooke, with twenty-first century technology, that his findings were valid?
MiniLab

CHAPTER 7

Investigate Osmosis

What will happen to cells placed in a strong salt solution? Regulating flow and amount of water into and out of the cell is critical to the survival of that cell. Osmosis is one method used to regulate a cell’s water content.

Procedure

1. Read and complete the lab safety form.
2. Prepare a control slide using onion epidermis, water, and iodine stain as directed by your teacher.
3. Prepare a test slide using onion epidermis, salt water, and iodine stain as directed by your teacher.
4. Predict the effect, if any, that the salt solution will have on the onion cells in the test slide.
5. View the control slide using a compound microscope under low power and sketch several onion cells in the space below.
6. View the test slide under the same magnification, and sketch your observations.

Data and Observations

Analysis

1. Analyze and Conclude Was your prediction correct or incorrect? Explain.

2. Explain Use the process of osmosis to explain what you observe.
BioLab
CHAPTER 7
Selective Permeability of Membranes

Background: All membranes in cells, including the plasma membrane and the membranes that surround organelles in eukaryotic cells, are selectively permeable. In this lab, you will examine the movement of some biologically important molecules through a dialysis membrane that is analogous to the plasma membrane. Because a dialysis membrane has tiny pores, it is only permeable for tiny molecules.

Question: Which substances pass through a dialysis membrane?

Materials
- cellulose dialysis tubing (2)
- 400-mL beakers (2)
- string
- scissors
- distilled water
- small plastic dishpan
- starch solution
- albumin solution
- glucose solution
- NaCl solution
- iodine solution (tests starch)
- anhydrous Benedict’s reagent (tests glucose)
- silver nitrate solution (tests NaCl)
- biuret reagent (tests albumin)
- 10-mL graduated cylinder
- test tubes (2)
- test-tube rack
- funnel
- wax pencil
- dropper

Safety Precautions

WARNING: Always wear goggles in the lab.

Procedure
1. Read and complete the lab safety form.
2. Construct a data table in the space on page 46 as instructed by your teacher.
3. Collect two lengths of dialysis tubing, two 400-mL beakers, and the two solutions that you have been assigned to test.
4. Label the beakers with the type of solution that you place in the dialysis tubing.
5. With a partner, prepare and fill one length of dialysis tubing with one solution. Rinse the outside of the bag thoroughly. Place the filled tubing bag into a beaker that contains distilled water.
6. Repeat step 5 using the second solution.
7. After 45 minutes, transfer some of the water from each beaker into separate test tubes.
8. Add a few drops of the appropriate test reagent to the water.
9. Record your results and determine whether your prediction was correct. Compare your results with other groups in your class and record the results for the two solutions that you did not test.
10. Cleanup and Disposal Wash and return all reusable materials. Dispose of test solutions and used dialysis tubing as directed by your teacher. Wash your hands thoroughly after using any chemical reagent.
Analyze and Conclude

1. **Evaluate**  Did your test molecules pass through the dialysis tubing? Explain.

2. **Think Critically**  What characteristics of a plasma membrane give it more control over the movement of molecules than the dialysis membrane?

3. **Error Analysis**  How could failing to rinse the dialysis tube bags with distilled water prior to placing them in the beaker cause a false positive test for the presence of a dissolved molecule? What other sources of error might lead to inaccurate results?
In the 1600s, modern science was just beginning. Many people believed that Earth was at the center of the universe and that diseases were caused by evil spirits. Anton van Leeuwenhoek was born in the Netherlands in 1632. He had no higher education and made a living as a fabric merchant, a janitor, and a lens grinder. After reading a book about Robert Hooke’s discoveries, van Leeuwenhoek made his own microscope and used it to examine pond water and other substances. With his microscopes, he succeeded in making some of the most important discoveries in the history of biology.

Early compound microscopes did not magnify objects more than 20 or 30 times their natural size. However, van Leeuwenhoek’s microscopes magnified more than 200 times, with clearer and brighter images than any of his colleagues could achieve. Among the things he discovered with his microscopes were bacteria, sperm cells, and blood cells.

Part A: Microscope Parts and Functions

Van Leeuwenhoek’s simple microscope consisted of one lens mounted in a tiny hole in a metal plate. The specimen was mounted on a sharp point in front of the lens. Its position and focus could be adjusted by turning two screws that moved up and down. The entire instrument was only 5 to 7.6 cm long and had to be held close to sunlight or candlelight.

Figure 1 is a picture of a compound microscope like the ones used in school laboratories today. This type of microscope incorporates more than one lens so that the image magnified by one lens can be further magnified by another.

Analyze and Conclude

Use Figure 1 to respond to the following statement.

1. Calculate the microscope’s magnifying power if using the eyepiece and the 40× objective.

2. Compare The table below lists functions of parts of the microscope. In the second and third columns, list descriptions of the microscope parts that perform each function.

<table>
<thead>
<tr>
<th>Function</th>
<th>Van Leeuwenhoek’s Microscope</th>
<th>Modern Compound Microscope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specimen mounting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position/focus of specimen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light source</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part B: Using Microscopes to Examine Evidence

The Student Council room at Central High has been set up for a crime scene investigation. Three weeks ago, Mrs. Sarah Roberts, the biology teacher, was writing a test in the lab. Her lunch was on the table where she was working. Suddenly, the fire alarm rang. Mrs. Roberts promptly left the building and, in her haste, left the lab door open. She was surprised to see a large group of people outside the building, most of them with animals. She thought this was a little unusual but soon forgot about it. When Mrs. Roberts returned to the lab, she found that her lunch was missing.

She looked around the room and saw some things that had not been there when she left. There was some kind of debris on the floor. A small piece of human skin was stuck to a broken beaker. Nearby was a trail of blood. The security chief arrived, collected the three pieces of evidence, and ordered laboratory reports on each. The laboratory used microscopes to examine the skin and blood samples. The security chief then apprehended four suspects. All were in the vicinity of the building on the day of the theft. The following information is listed on the evidence bulletin board. You must use this information to determine who stole the lunch bag.

### Background Information

| Red blood cells of mammals do not have nuclei. |
| Red blood cells of nonmammals have nuclei. |
| Cancer cells lack contact inhibition. They continue to grow, forming layers of cells. The cells grow randomly in culture. |
| Normal skin cells grow in culture until they physically come in contact with each other. Growth then stops. This is called contact inhibition. The cells do not grow randomly, but are oriented in a particular direction. |

### Laboratory Test Results

| Debris from the floor: sand and hay |
| Blood sample: Red blood cells have nuclei. |
| Skin sample: Was cultured; cells were found to have contact inhibition and be oriented in a particular direction. |

<table>
<thead>
<tr>
<th>Suspects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Suspect 1</strong></td>
</tr>
<tr>
<td>- Spends weekends on the beach</td>
</tr>
<tr>
<td>- Works as a dishwasher</td>
</tr>
<tr>
<td>- Is being treated for skin cancer</td>
</tr>
<tr>
<td>- Has a poodle named Fifi with a bandaged leg</td>
</tr>
</tbody>
</table>

| **Suspect 2**  |
| - Works in a stone quarry  |
| - Doesn’t go anywhere without his pet frog, Croak, last seen with a bandaged webbed foot  |

| **Suspect 3**  |
| - Lives on a farm  |
| - Recently spent a week at the shore  |
| - Never goes anywhere without her bird, Polly, last seen nursing a hurt wing  |

| **Suspect 4**  |
| - Lives on Main Street above the bagel shop  |
| - Said he shaves hourly  |
| - Has a pet iguana that he recently took to the vet  |

(Adapted from Surmacz, C., Association for Biology Laboratory Education)

### Analyze and Conclude

*Respond to the following statement.*

1. **Deduce** After reviewing the evidence information, deduce the identity of the thief. Explain how you arrived at your answer.

---

**Careers in Biology**

**Cell Biology** Visit biologygmh.com for information on cell biologists.

What are the responsibilities of a cell biologist?
Osmosis is a process that occurs naturally any time two solutions of different concentrations are separated from each other by a semipermeable membrane. For example, the watery solution inside the root cells of a growing plant normally has a higher concentration than the groundwater that surrounds the roots. The solution inside the cell is hypertonic in comparison to the groundwater. Water passes more rapidly across the cell membrane into the cell than it does out of the cell. This process makes possible the movement of water from the base of a plant upward through its trunk and branches into upper parts of the plant.

Differentiate  Humans use the principle of osmosis in a number of practical applications. The table below lists some of those applications. In each case, tell how osmosis explains the process that takes place. If needed, use text resources to research explanations. Then tell whether the solution in **bold** is isotonic, hypotonic, or hypertonic. Use the abbreviations *iso* for an isotonic solution, *hypo* for a hypotonic solution, and *hyper* for a hypertonic solution.

<table>
<thead>
<tr>
<th>Application</th>
<th>Explanation</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pickles are made by immersing cucumbers in a <strong>concentrated saltwater solution</strong>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spraying plants with a <strong>solution</strong> that contains too high a concentration of fertilizer might cause them to dry out and die.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patients undergoing surgery are given a <strong>0.9% saline (saltwater) solution</strong>.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>One of the oldest methods of preserving foods is to pack them in <strong>saline solutions</strong>, which kill the bacteria that cause foods to spoil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organisms that live in <strong>seawater</strong> have specialized mechanisms that prevent them from becoming dehydrated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Florists store fresh flowers in <strong>cold water</strong> to help the flowers keep their original appearance . . .</td>
<td></td>
<td></td>
</tr>
<tr>
<td>. . . although the flowers begin to wilt as soon as they are taken out of the water for a period of time.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Complete the network tree about cellular structure. These terms may be used more than once: animals, bacteria, chloroplasts, eukaryotes, a large central vacuole, plants, plasma membrane, prokaryotes.

1. All cells have a

and are grouped into two broad categories:

2.

which are mainly

4.

3.

which include

5. 6. some yeast and algae

which contain unique structures such as

7. 8.

cell walls
In your textbook, read about the history of the cell theory and microscope technology. 

Respond to each statement.

1. **Name** the invention that helped scientists discover the cell.

2. **Tell** why Hooke called the structures he saw in the cork *cellulae* (“small rooms”).

3. **Name** the type of microscope that uses a series of magnifying lenses.

Write the term or phrase that best completes each statement. Use these choices:

- cell theory
- cells
- daughter cells
- genetic material
- organisms

The (4) ________________________ includes the following three principles:

1. All living organisms are composed of one or more (5) ________________________ .

2. Cells are the basic unit of structure and organization of all living (6) ________________________ .

3. Cells arise only from previously existing cells, with cells passing copies of their (7) ________________________ on to their (8) ________________________ .

In your textbook, read about basic cell types.

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Prokaryotes</th>
<th>Eukaryotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Organisms that break down molecules to generate energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Organisms that have cells lacking internal membrane-bound organelles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Organisms whose cells do not have nuclei</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Organisms that are either unicellular or multicellular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Organisms that are generally unicellular</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Organisms that have cells containing organelles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Organisms that have plasma membranes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In your textbook, read about the function of the plasma membrane.

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Selective Permeability</th>
<th>Homeostasis</th>
<th>Plasma Membrane</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The process of maintaining balance inside a cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. A boundary between a cell and its environment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The feature of the plasma membrane that keeps some substances out</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Separates prokaryotic and eukaryotic cells from the watery environment in which they exist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The quality of a plasma membrane that allows oxygen and glucose to move in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Maintained by the plasma membrane</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In your textbook, read about the structure of the plasma membrane.

Label the diagram of the plasma membrane. Use these choices:

- carbohydrate chain
- nonpolar tails
- polar head
- transport protein

7. ____________________________
8. ____________________________
9. ____________________________
10. ____________________________

Match the definition or description in Column A with the term in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>_____ 11. make up most of the molecules in the plasma membrane</td>
<td>A. transport proteins</td>
</tr>
<tr>
<td>_____ 12. a molecule that has a glycerol backbone, two fatty acid chains, and a phosphate-containing compound</td>
<td>B. lipids</td>
</tr>
<tr>
<td>_____ 13. move substances through the plasma membrane</td>
<td>C. phospholipid</td>
</tr>
<tr>
<td>_____ 14. two layers of phospholipids arranged tail-to-tail</td>
<td>D. fluid mosaic model</td>
</tr>
<tr>
<td>_____ 15. the phospholipid “sea” in which embedded substances float</td>
<td>E. phospholipid bilayer</td>
</tr>
</tbody>
</table>
In your textbook, read about structures and organelles.

Label the diagram of a typical animal cell. Use these choices:

cytoplasm
mitochondrion
endoplasmic reticulum
nucleus

1.
2.
3.
4.
5.
6.
7.

If the statement is true, write true. If the statement is false, replace the italicized word or phrase to make it true.

8. Microtubules are long, hollow protein cylinders that form a rigid skeleton for the cell.

9. The Golgi apparatus contains most of the cell’s DNA.

10. The nucleolus is the structure that produces sugars.

11. The endoplasmic reticulum is a stack of membranes that packages proteins into sacs called vesicles.

12. The cytoplasm is the semifluid internal environment of the cell.
In your textbook, read about cellular transport.

Match the definition in Column A with the term in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. moves small molecules across the plasma membrane using transport proteins</td>
<td>A. osmosis</td>
</tr>
<tr>
<td>2. involves water moving across the plasma membrane to the side with the greater solute concentration</td>
<td>B. exocytosis</td>
</tr>
<tr>
<td>3. occurs when substances move against the concentration gradient; requires energy and the aid of carrier proteins</td>
<td>C. facilitated diffusion</td>
</tr>
<tr>
<td>4. occurs when the plasma membrane surrounds a large substance inside the cell and moves it outside the cell</td>
<td>D. dynamic equilibrium</td>
</tr>
<tr>
<td>5. the condition that results when diffusion continues until the concentrations are the same in all areas</td>
<td>E. active transport</td>
</tr>
<tr>
<td>6. occurs when the plasma membrane surrounds a large substance outside the cell and moves it inside the cell</td>
<td>F. endocytosis</td>
</tr>
</tbody>
</table>

In your textbook, read about osmosis.

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Isotonic Solution</th>
<th>Hypotonic Solution</th>
<th>Hypertonic Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. A solution that has the same osmotic concentration as a cell’s cytoplasm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. A solution that causes a cell to shrivel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. A solution that causes a cell to swell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. A solution that neither shrinks nor swells a cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. A solution in which there is more water outside the cell than inside the cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. A solution that causes water to move out of a cell</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guía de estudio
CAPÍTULO 7
Sección 1: Descubrimiento y teoría de la célula

En tu libro de texto, lee acerca de la historia de la teoría de la célula y la tecnología del microscopio.

Responde a cada afirmación.

1. **Nombra** el invento que ayudó a los científicos a descubrir la célula.

2. **Indica** por qué Hooke denominó las estructuras que observó en el corcho con el nombre de *cellulae* (“celdillas”).

3. **Nombra** el tipo de microscopio que utiliza una serie de lentes de aumento.

Escribe el término o la frase que mejor completa cada afirmación. Usa estas opciones:

- células
- células hijas
- material genético
- organismos
- teoría de la célula

La (4) se define por los siguientes tres principios:

1. Todos los organismos vivos están compuestos por una o más (5) .

2. Las células son la unidad básica de estructura y organización de todos los (6) vivos.

3. Las células surgen únicamente de células anteriormente existentes, que pasan copias del (7) a sus (8) .

En tu libro de texto, lee acerca de los tipos básicos de células.

Completa la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Procariotas</th>
<th>Eucariotas</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Organismos que descomponen moléculas para generar energía</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Organismos que tienen células que carecen de organelos internos unidos a membranas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Organismos cuyas células no tienen núcleo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Organismos que son unicelulares o multicelulares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Organismos que son generalmente unicelulares</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Organismos que tienen células con organelos</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Organismos que tienen membranas de plasma</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guía de estudio

Sección 2: La membrana de plasma

En tu libro de texto, lee acerca de la función de la membrana de plasma.

Completa la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Permeabilidad selectiva</th>
<th>Homeostasis</th>
<th>Membrana de plasma</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. El proceso de mantener el balance al interior de una célula</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Una división entre una célula y su ambiente</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. La característica de la membrana de plasma que mantiene ciertas substancias por fuera</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Separa las células procariotas y las eucariotas del ambiente acuoso en el que existen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. La calidad de una membrana de plasma que permite que el oxígeno y la glucosa entren</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Se mantiene gracias a la membrana de plasma</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

En tu libro de texto, lee acerca de la estructura de la membrana de plasma.

Identifica en el diagrama las partes de la membrana de plasma. Usa estas opciones:
- cabeza polar
- cadena de carbohidratos
- colas apolares
- proteínas de transporte

<table>
<thead>
<tr>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
</tr>
</thead>
</table>

Relaciona la definición o descripción de la columna A con el término de la columna B.

**Columna A**

11. constituyen la mayoría de las moléculas en la membrana de plasma
12. una molécula que tiene una estructura de glicerol, dos cadenas de ácidos grasos y un compuesto que contiene fosfato
13. mueve substancias a través de la membrana de plasma
14. dos capas de fosfolípidos organizadas de cola a cola
15. el “mar” de fosfolípidos en el cual flotan las sustancias incrustadas

**Columna B**

A. proteínas de transporte
B. lípidos
C. fosfolípidos
D. modelo del mosaico fluido
E. capa doble de fosfolípidos
En tu libro de texto, lee acerca de las estructuras y los organelos.

Identifica en el diagrama las partes de una célula animal común. Usa estas opciones:

- aparato de Golgi
- núcleo
- citoplasma
- nucleolo
- microtúbulos
- retículo endoplásmico
- mitocondrias

1. 
2. 
3. 
4. 
5. 
6. 
7.  

8. Los microtúbulos son cilindros de proteína largos y huecos que forman un esqueleto rígido para la célula.

9. El aparato de Golgi contiene la mayor parte del ADN de la célula.

10. El nucleolo es la estructura que produce azúcares.

11. El retículo endoplásmico es un grupo de membranas que empaca proteínas en bolsas llamadas vesículas.

12. El citoplasma es el ambiente interno semifluído de la célula.
Guía de estudio

Sección 4: Transporte celular

En tu libro de texto, lee acerca del transporte celular.

Relaciona la definición de la columna A con el término de la columna B.

<table>
<thead>
<tr>
<th>Columna A</th>
<th>Columna B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. mueve pequeñas moléculas por la membrana de plasma mediante las proteínas de transporte</td>
<td>A. ósmosis</td>
</tr>
<tr>
<td>2. implica mover agua por la membrana de plasma hacia el lado con la mayor concentración soluble</td>
<td>B. exocitosis</td>
</tr>
<tr>
<td>3. ocurre cuando las substancias se mueven contra el gradiente de concentración; necesita energía y la ayuda de proteínas transportadoras</td>
<td>C. difusión facilitada</td>
</tr>
<tr>
<td>4. ocurre cuando la membrana de plasma rodea una sustancia grande al interior de la célula y la mueve hacia el exterior de la célula</td>
<td>D. equilibrio dinámico</td>
</tr>
<tr>
<td>5. la condición que resulta cuando la difusión continúa hasta que las concentraciones sean las mismas en todas las áreas</td>
<td>E. transporte activo</td>
</tr>
<tr>
<td>6. ocurre cuando la membrana de plasma rodea una sustancia grande al exterior de la célula y la mueve hacia el interior de la célula</td>
<td>F. endocitosis</td>
</tr>
</tbody>
</table>

En tu libro de texto, lee acerca de la ósmosis.

Completa la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Solución isotónica</th>
<th>Solución hipotónica</th>
<th>Solución hipertónica</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Una solución que tiene la misma concentración osmótica que el citoplasma de una célula</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Una solución que causa que una célula se contraiga</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Una solución que causa que una célula se hinche</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Una solución que ni contrae ni hinche una célula</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Una solución en la cual hay más agua por fuera de la célula que al interior de la misma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Una solución que causa que el agua salga de una célula</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quick Check

CHAPTER 7
Section 1: Cell Discovery and Theory

After reading the section in your textbook, respond to each statement.

1. **Describe** the discovery of the cell. Mention Robert Hooke and Anton van Leeuwenhoek in your answer.

   ____________________________________________________________
   ____________________________________________________________

2. **Summarize** the three parts of the cell theory.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. **List** three characteristics or structures that all cells share.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

4. **Evaluate** the impact of microscope technology on the modern study of cells.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

5. **Differentiate** between prokaryotic cells and eukaryotic cells.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Section 2: The Plasma Membrane

After reading the section in your textbook, respond to each statement.

1. **Identify** three components of the plasma membrane other than phospholipids.
   
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

2. **Describe** the structure of the phospholipid bilayer.
   
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

3. **State** the function of the plasma membrane as it relates to homeostasis.
   
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

4. **Predict** what would happen to a cell if its plasma membrane lost its selective permeability. Explain.
   
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________

5. **Clarify** why the surface of the plasma membrane can be described as a mosaic.
   
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
Quick Check

Section 3: Structures and Organelles

After reading the section in your textbook, respond to each statement.

1. **List** the two major components of the cytoskeleton of a cell.

2. **Identify** a structure other than a cell wall or a vacuole that might be found in a plant cell but not in an animal cell. Explain why an animal cell would not have the structure you identify.

3. **Cite** the essential cell processes that organelles perform.

4. **Infer** why muscle cells contain more mitochondria than do skin cells.

5. **Depict** the role of lysosomes within a cell, using the metaphor of a factory. Explain.
1. **Name** the two transport processes that allow large substances to cross the plasma membrane.

2. **Identify** three transport processes in cells that do not require energy.

3. **Evaluate** the relative environments inside and outside the cell when a cell is said to be in dynamic equilibrium with its environment.

4. **Predict** the appearance of an egg after the following procedure is performed:
   An egg is soaked in a vinegar solution to remove the hard shell, leaving the inner membrane intact. The egg is then placed in a solution of salt water overnight. As part of your answer, explain what kind of solution the salt water is, relative to the egg’s interior.

5. **Distinguish** between diffusion and active transport.
CHAPTER 7
Assessment
Student Recording Sheet

Section 7.1
Vocabulary Review
Write the vocabulary term that makes each sentence true.

1. ___________________  2. ___________________  3. ___________________

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.


Constructed Response
7. ___________________________________________________________

8. ___________________________________________________________

Think Critically
9. ___________________________________________________________

10. ___________________________________________________________

Section 7.2
Vocabulary Review
Write the vocabulary term that best completes each sentence.

11. ___________________  12. ___________________  13. ___________________

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.


Constructed Response
16. ___________________________________________________________

17. ___________________________________________________________
Assessment

Section 7.3
Vocabulary Review
Write the vocabulary term that best matches each definition.
21. ____________________________ 22. ____________________________

Understand Key Concepts
Select the best answer from the choices given, and fill in the corresponding circle.

Constructed Response
28. ____________________________

29. ____________________________

30. ____________________________

Think Critically
31. ____________________________

32. ____________________________

Section 7.4
Vocabulary Review
Write sentences to compare and contrast each pair of terms.
33.–35. Record your answers for questions 33, 34, and 35 on a separate sheet of paper.
CHAPTER 7

Assessment

Student Recording Sheet

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

36.  

37.  

Constructed Response

38.  

39.  

40.  

Think Critically

41.  

42.  

Additional Assessment

43.  Writing in Biology  Record your answer for question 43 on a separate sheet of paper.

Document-Based Questions

44.  

45.  Record your answer for question 45 on a separate sheet of paper.

Cumulative Review

46.  

47.
CHAPTER 7
Assessment  Student Recording Sheet

Standardized Test Practice

Multiple Choice
Select the best answer from the choices given, and fill in the corresponding circle.

1. [ ] A [ ] B [ ] C [ ] D
2. [ ] A [ ] B [ ] C [ ] D
3. [ ] A [ ] B [ ] C [ ] D
4. [ ] A [ ] B [ ] C [ ] D
5. [ ] A [ ] B [ ] C [ ] D
6. [ ] A [ ] B [ ] C [ ] D
7. [ ] A [ ] B [ ] C [ ] D
8. [ ] A [ ] B [ ] C [ ] D

Short Answer
Answer each question with complete sentences.

9. Record your answer for question 9 on a separate sheet of paper.

10. ____________________________

11. ____________________________

12. ____________________________

13. ____________________________

14. Record your answer for question 14 on a separate sheet of paper.

15. ____________________________

Extended Response
Answer each question with complete sentences.

16. ____________________________

17. Record your answer for question 17 on a separate sheet of paper.

18. ____________________________

19. ____________________________

Essay Question

20. Record your answer for question 20 on a separate sheet of paper.
## Chapter 8  Cellular Energy

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<th>Section</th>
<th>Page</th>
</tr>
</thead>
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<td>Launch Lab</td>
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<td>81</td>
</tr>
<tr>
<td>MiniLab (2)</td>
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<tr>
<td>Section Quick Check 3</td>
<td>99</td>
</tr>
<tr>
<td>Chapter Test A</td>
<td>100</td>
</tr>
<tr>
<td>Chapter Test B</td>
<td>103</td>
</tr>
<tr>
<td>Chapter Test C</td>
<td>106</td>
</tr>
<tr>
<td>Student Recording Sheet</td>
<td>109</td>
</tr>
</tbody>
</table>
1. Sam is building a campfire while camping with his family. Sam’s younger brother asks how energy is generated from the burning log to make fire and heat. Sam studied thermodynamics in science class the month before and is able to answer his brother’s question. Which answer does he give?

A. Chemical energy in the log is converted to heat and light energy.
B. Energy is continually generated by the fire’s high temperature.
C. The increasing entropy in the system creates usable energy.
D. The matter in the log is destroyed to generate excess energy.

Explain.

2. Elena is taking a guided hike through a New Hampshire forest in October to enjoy the changing colors of autumn leaves. Her guide explains that the leaves change color as the green pigment chlorophyll used in photosynthesis decomposes. Another hiker asks the guide to explain photosynthesis. Which is the guide’s answer?

A. Photosynthesis is the process autotrophs use to make energy.
B. Photosynthesis is the process autotrophs use to make sugar.
C. Photosynthesis is the process heterotrophs use to make energy.
D. Photosynthesis is the process heterotrophs use to make sugar.

Explain.

3. Zina is applying to be a volunteer in a nutrition program at the local hospital. For her application essay, she must research the topic of cellular respiration. What does she learn about cellular respiration?
Launch Lab
CHAPTER 8
How is energy transformed?

The flow of energy in living systems is driven by a variety of chemical reactions and chemical processes. Energy is transformed from the Sun’s radiant energy to chemical energy to other forms of energy along the way. In this lab, you will observe two processes in which energy is transformed.

Procedure
1. Read and complete the lab safety form.
2. Measure 100 mL of water using a graduated cylinder; pour into a 250-mL beaker. Use a thermometer to record the water temperature.
3. Measure 40 g of anhydrous calcium chloride (CaCl₂). Use a stirring rod to dissolve CaCl₂ in the water. Record the solution temperature every fifteen seconds for three minutes.
4. Repeat steps 2 and 3 using 40 g of Epsom salts instead of CaCl₂.
5. Graph your data using a different color for each process.

Data and Observations

Analysis
1. Describe the graph of your data.

________________________________________________________________________________________

________________________________________________________________________________________

2. Predict what energy transformations occurred in the two processes.

________________________________________________________________________________________

________________________________________________________________________________________
How do photosynthesis and cellular respiration work together in an ecosystem? Use a chemical indicator to examine how carbon dioxide is transferred in photosynthesis and cellular respiration.

**Procedure**

1. Read and complete the lab safety form.
2. Prepare a data table to record the contents, treatment, initial color, and final color for two experimental test tubes.
3. Pour 100 mL bromothymol blue (BTB) solution into a beaker. Using a straw, exhale gently into the solution until it just turns yellow. **WARNING:** Do not blow so hard that the solution bubbles over or that you get a headache. Do not suck on the straw.

4. Fill two large test tubes three-quarters full with the yellow BTB solution.
5. Cover one test tube with aluminum foil. Place a 6-cm sprig of an aquatic plant into both of the tubes, tightly stopper the tubes, and place them in a rack in bright light.
6. Record your observations in your data table.

**Data and Observations**

**Analysis**

1. Infer the purpose of the tube covered in aluminum foil.

2. Explain how your results demonstrate that photosynthesis and cellular respiration depend on one another.
MiniLab
CHAPTER 8
Observe Chloroplasts

What do chloroplasts look like? Most ecosystems and organisms in the world depend on tiny organelles called chloroplasts. Discover what chloroplasts look like in this investigation.

Procedure
1. Read and complete the lab safety form.
2. Observe the slides of plant and algae cells with a microscope.
3. Identify the chloroplasts in the cells you observe.
4. Make a data table to record your observations and sketch the chloroplasts in the cell.

Data and Observations

Analysis
1. Compare and contrast the physical features of the chloroplasts you observed in the different cells.

2. Hypothesize why green plant leaves vary in color.
**BioLab**

**Design Your Own**

**CHAPTER 8**

Do different wavelengths of light affect the rate of photosynthesis?

**Background:** Photosynthesizing organisms need light to complete photosynthesis. White light is composed of the different colors of light found in the visible light spectrum, and each color of light has a specific wavelength. During this lab, you will design an experiment to test the effect of different light wavelengths on the rate of photosynthesis.

**Question:** How do different wavelengths of light affect photosynthesis rates?

**Materials**

Choose materials that would be appropriate to this lab. Possible materials include:

- aquatic plant material
- Erlenmeyer flasks
- test tubes (15 mL)
- graduated cylinder (10 mL)
- metric ruler
- colored cellophane (assorted colors)
- aluminum foil
- lamp with reflector and 150-W bulb
- baking soda solution (0.25%)
- watch with a second hand

**Safety Precautions**

**Plan and Perform the Experiment**

1. Read and complete the lab safety form.
2. Predict how different wavelengths of light will affect the rate of photosynthesis in your plant.
3. Design an experiment to test your prediction. Write a list of steps you will follow and identify the controls and variable you will use.
4. Explain how you will generate light with different wavelengths, supply the plant with carbon dioxide, and measure the oxygen production of the plants.
5. Create a data table for recording your observations and measurements.
6. Make sure your teacher approves your plan before you begin.
7. Conduct your experiment as approved.
8. **Cleanup and Disposal** Clean up all equipment as instructed by your teacher, and return everything to its proper place. Dispose of plant material as instructed by your teacher. Wash your hands thoroughly with soap and water.

**Data and Observations**
Design Your Own BioLab, Do different wavelengths of light affect the rate of photosynthesis? continued

Analyze and Conclude

1. **Identify** the controls and variables in your experiment.

2. **Explain** how you measured the rate of photosynthesis.

3. **Graph** your data.

4. **Describe** how the rate of photosynthesis is affected by different wavelengths of light based on your data.

5. **Discuss** whether or not your data supported your prediction.

6. **Error Analysis** Identify possible sources of error in your experimental design, procedure, and data collection.

7. **Suggest** how you would reduce these sources of error if repeating the experiment.
You have probably enjoyed the blinking lights of fireflies on a summer evening. Fireflies are not the only species that can glow in the dark. Glowing in the dark is common in species that live in the oceans. Some species contain body cells that produce light. Other species contain bacteria that produce light. The process by which organisms produce light is called bioluminescence.

Scientists study bioluminescent organisms for a variety of reasons. Marine biologists study bioluminescent species to understand marine populations, ecosystems, and evolutionary relationships. Other scientists study bioluminescence to develop technological uses, such as screening for medical conditions, detecting organic pollutants in lakes and rivers, and testing for contamination in the food and drug industry.

In this activity, you will explore the chemistry of bioluminescence and write a hypothesis about bioluminescence and animal behavior.

**Part A: Producing Light**

Researchers interested in bioluminescence conducted a series of experiments to study several species that are able to produce their own light. **Figure 1** shows the conclusions the researchers formed in four of the experiments.

As the researchers worked, it became clear that an additional substance is essential for the chemical reaction that produces bioluminescent light. **Figure 2** shows data collected in a fifth experiment in which the scientists explored the role of ATP (adenosine triphosphate). ATP is present in every cell of every living organism and supplies the energy needed for many metabolic processes.

**Analyze and Conclude**

*Respond to each question and statement.*

1. **Identify** Based on the information in **Figure 1**, what three substances are needed for bioluminescence to occur?

2. **Hypothesize** about the cause of the variance in color of the bioluminescent light produced.

3. **Conclude** From the data in **Figure 2**, what conclusion can you draw about the relationship between ATP and bioluminescence?
Part B: Using Light

All organisms produce bioluminescent light by a similar chemical reaction, but the role of bioluminescence in the adaptive behavior of different species varies. Study the data collected in Figure 3 about three different bioluminescent marine organisms and some of their behaviors involving bioluminescence.

<table>
<thead>
<tr>
<th>Lanternfish</th>
<th>Firefly squid</th>
<th>Colobonema</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Pattern of distribution of light organs is different for each species.</td>
<td>· Organism can shoot out a luminescent cloud.</td>
<td>· Tentacles light up when it is disturbed.</td>
</tr>
<tr>
<td>· Males have patterns that differ from those of females within the same species.</td>
<td>· Clouds appear to be related to the presence of potential predators.</td>
<td>· Brightly colored tentacles can break off.</td>
</tr>
</tbody>
</table>

Figure 3

Analyze and Conclude

Respond to each question and statement.

1. **Hypothesize**  Choose one organism from Figure 3. Suggest a testable hypothesis that explains the use of bioluminescence by that organism.

2. **Plan**  How could you test your hypothesis? What information would you want to gather?

---

**CAREERS IN BIOLOGY**

**Biochemistry**  Visit biologygmh.com for information on biochemical technicians. What are the responsibilities of a biochemical technician?
Chlorophyll was first discovered in 1817 by two French chemists, Pierre-Joseph Pelletier (1788–1842) and Joseph-Bienaimé Caventou (1795–1877). Pelletier and Caventou did not pursue their discovery, however, as they were more interested at the time in learning more about a variety of drugs, including quinine, strychnine, and brucine. In fact, it was not until a half century later, in 1865, that German botanist Julius von Sachs (1832–1897) discovered the role of chlorophyll in photosynthesis.

The next step in unraveling the mysteries of chlorophyll occurred in 1912 when German chemist Richard Willstätter (1872–1942) discovered that chlorophyll exists in two forms: chlorophyll a and chlorophyll b. In 1943, a team of three researchers, Harold H. Strain, Winston M. Manning, and Garrett Hardin, announced that they had found a third type of chlorophyll, which they called chlorophyll c. Later the same year, the same researchers found a fourth kind of chlorophyll, which they called chlorophyll d. In addition to the four naturally occurring forms of chlorophyll, scientists have produced a semisynthetic form of chlorophyll, which is known as chlorophyllin.

Distinguish How are these forms of chlorophyll and chlorophyllin different from one another chemically and biologically? Choose one of these compounds to study in detail. Consult references in your local library to find the chemical structure of the form of chlorophyll or chlorophyllin you have chosen to research. Find the organisms in which your type of chlorophyll occurs or the commercial use of the chlorophyllin. In the space below, draw the chemical structure of the chlorophyll or chlorophyllin and add a caption that briefly describes its occurrence in the natural world or its use by humans.

Compare After completing your study of one type of chlorophyll or chlorophyllin, compare your results with those of other members of the class. How are the chemical structures of the chlorophyll and chlorophyllin molecules alike and different? How are their functions in living organisms alike and different? What are the practical applications of chlorophyllin? Prepare a chart that summarizes the similarities and differences in chemical structure and biological function of the types of chlorophyll and chlorophyllin.
Complete the Venn diagram about photosynthesis and respiration. These terms may be used more than once: absorbs, Calvin cycle, chlorophyll, CO₂, H₂O, Krebs cycle, mitochondria, releases.

**Photosynthesis**

(1) ________________
energy using
(2) ________________
occurs in chloroplasts
(3) ________________
produces glucose

**Both**

(4) ________________
NADPH
(5) ________________
ATP

**Respiration**

(6) ________________
energy
(7) ________________
occurs in
(8) ________________
breaks pyruvate down into carbon dioxide

---

O₂
glucose
FADH₂
In your textbook, read about how organisms obtain energy.

Match the definition in Column A with the term in Column B.

**Column A**

1. the idea that energy cannot be created or destroyed
2. all the chemical reactions in a cell
3. anabolic pathway that converts energy from the Sun to chemical energy for use by cells
4. ability to do work
5. series of chemical reactions in which the product of one reaction is the substrate for the next reaction
6. biological molecule that provides chemical energy
7. study of the flow and transformation of energy
8. source of nearly all energy for life
9. catabolic pathway that breaks down organic molecules
10. spontaneous increase in disorder, or entropy

**Column B**

A. energy
B. thermodynamics
C. first law of thermodynamics
D. second law of thermodynamics
E. metabolism
F. photosynthesis
G. cellular respiration
H. metabolic pathway
I. adenosine triphosphate (ATP)
J. sunlight

In your textbook, read about autotrophs and heterotrophs.

Refer to the illustrations. Use each of the terms below only once to complete the passage.

autotrophs  chemoautotrophs  Group A  Group B  heterotrophs

**Group A**

- Mice
- Seed-eating birds
- Deer

**Group B**

- Grass
- Shrubs
- Trees

The group that makes their own food is (11) ________________________ . The organisms in this group are called (12) ________________________ . The group that must eat other organisms for food is (13) ________________________ . The organisms in this group are called (14) ________________________ . Some organisms get their energy from inorganic substances, such as hydrogen sulfide. These organisms are called (15) ________________________ .
In your textbook, read about light reactions.

Number the following steps of light reactions in the order in which they occur.

1. The energy lost by electrons as they pass through the electron transport chain is used to make ATP.
2. The electrons pass from the chlorophyll to an electron transport chain.
3. Sunlight strikes the chlorophyll molecules in the thylakoid membranes.
4. NADP⁺ molecules change to NADPH as they carry the electrons to the stroma of the chloroplast.
5. Light energy is transferred to the chlorophyll’s electrons.
6. The electrons are passed down a second electron transport chain.

Refer to the graph. Respond to each statement.

7. Explain why there are usually several types of pigments present in chloroplasts.

8. State the name of the pigment that absorbs the most light at about 450 nm.

In your textbook, read about the Calvin cycle and alternative photosynthesis pathways.

Complete the table by checking the correct column(s) for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Calvin</th>
<th>C₄</th>
<th>CAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. The second phase of photosynthesis, in which energy is stored in glucose</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Pathway(s) that help(s) plants photosynthesize while minimizing water loss</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Pathway that allows carbon dioxide to enter leaves only at night</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Light-independent reactions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Uses the enzyme rubisco to convert carbon dioxide into molecules that can be used by the cell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Type of plant found in hot, dry environments</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In your textbook, read about cellular respiration and glycolysis.
Use each of the terms below only once to complete the passage.

<table>
<thead>
<tr>
<th>aerobic</th>
<th>anaerobic</th>
<th>ATP</th>
<th>cellular respiration</th>
<th>cytoplasm</th>
<th>energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucose</td>
<td>glycolysis</td>
<td>mitochondria</td>
<td>NADH</td>
<td>oxygen</td>
<td></td>
</tr>
</tbody>
</table>

Organisms obtain energy in a process called (1) _______________________. This process harvests electrons from carbon compounds, such as (2) _______________________, and uses that energy to make (3) _______________________. ATP is used to provide (4) ________________________ for cells to do work. In (5) ________________________, glucose is broken down into pyruvate.

Glycolysis is a(n) (6) ________________________ process because it does not require oxygen. Glycolysis takes place in the (7) ________________________. Two molecules of ATP and two molecules of (8) ________________________ are formed for every glucose molecule that is broken down.

(9) ________________________ respiration takes place in the (10) ________________________.

It is aerobic because the process requires (11) ________________________.

Refer to the diagram of glycolysis. Label the steps in the description to match the diagram.

12. Step _____ . Each three-carbon compound is converted into a three-carbon pyruvate.
13. Step _____ . A six-carbon compound is broken down into two three-carbon compounds.
14. Step _____ . Phosphate groups from two ATP molecules are transferred to a glucose molecule.
15. Step _____ . Two NADH molecules and four ATP molecules are produced.

Respond to each question.

16. Interpret How many total ATP molecules are produced from the glycolysis of one six-carbon glucose?

__________________________________________

17. Explain Why is there a net gain of only two ATP molecules in the glycolysis of one six-carbon glucose?

__________________________________________

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In your textbook, read about the Krebs cycle, electron transport, and anaerobic respiration.

Refer to the diagram of cellular respiration. Respond to each question and statement.

18. Recall What is the net yield of ATP produced by each of the circled processes in the diagram?
   - Glycolysis = _____ ATP
   - Krebs cycle = _____ ATP
   - Electron transport chain = _____ ATP

19. Find the total net yield of ATP from one molecule of glucose.

20. Specify Based on the diagram and your calculations, which process produces more energy—the anaerobic pathway or the aerobic pathway?

   _______________________________________________________________________

For each statement below, write true or false.

21. The anaerobic pathway that follows glycolysis in the absence of oxygen is fermentation.

22. The hydrogen necessary in the electron transport chain comes from the splitting of carbon dioxide molecules.

23. Cellular respiration in eukaryotes is slightly more efficient than in prokaryotes.

24. The Krebs cycle is sometimes called the TCA cycle or the citric acid cycle.

25. Fermentation occurs in the mitochondria.

26. Skeletal muscle produces lactic acid when the body cannot supply enough oxygen.

27. Alcohol fermentation is found in some bacteria and in humans.

28. The two pyruvate molecules formed during glycolysis result in two Krebs cycles.

29. Electron transport is the first step in the breakdown of glucose.
En tu libro de texto, lee acerca de cómo los organismos obtienen energía.

Relaciona la definición de la columna A con el término de la columna B.

<table>
<thead>
<tr>
<th>Columna A</th>
<th>Columna B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. la idea de que la energía no se puede crear ni destruir</td>
<td>A. energía</td>
</tr>
<tr>
<td>2. todas las reacciones químicas en una célula</td>
<td>B. termodinámica</td>
</tr>
<tr>
<td>3. la ruta anabólica que convierte energía del sol en energía química</td>
<td>C. primera ley de</td>
</tr>
<tr>
<td></td>
<td>termodinámica</td>
</tr>
<tr>
<td>4. la capacidad de trabajar</td>
<td>D. segunda ley de</td>
</tr>
<tr>
<td></td>
<td>termodinámica</td>
</tr>
<tr>
<td>5. una serie de reacciones químicas en las cuales el producto de</td>
<td>E. metabolismo</td>
</tr>
<tr>
<td>una reacción es el sustrato de la siguiente reacción</td>
<td>F. fotosíntesis</td>
</tr>
<tr>
<td>6. la molécula biológica que ofrece energía química</td>
<td>G. respiración celular</td>
</tr>
<tr>
<td>7. el estudio del flujo y la transformación de energía</td>
<td>H. ruta metabólica</td>
</tr>
<tr>
<td>8. la fuente de prácticamente toda la energía para la vida</td>
<td>I. adenosina trifosfato (ATP)</td>
</tr>
<tr>
<td>9. la ruta catabólica que descompone las moléculas orgánicas</td>
<td>J. luz solar</td>
</tr>
<tr>
<td>10. el aumento espontáneo en desorden, o entropía</td>
<td></td>
</tr>
</tbody>
</table>

En tu libro de texto, lee acerca de los autótrofos y heterótrofos.

Consulta las ilustraciones. Usa los siguientes términos sólo una vez para completar el párrafo.

autótrofos  grupo A  grupo B  heterótrofos  quimioautótrofos

El grupo que produce su propia comida es el (11) __________________________. Los organismos en este grupo se llaman (12) __________________________. El grupo que debe comer otros organismos para alimentarse es el (13) __________________________. Los organismos en este grupo se llaman (14) __________________________. Algunos organismos obtienen energía a partir de sustancias inorgánicas, tales como sulfito de hidrógeno. Estos organismos se llaman (15) __________________________.
Guía de estudio

CAPÍTULO 8
Sección 2: La fotosíntesis

En tu libro de texto, lee acerca de las reacciones a la luz.

Enumera los siguientes pasos de las reacciones a la luz en el orden en el cual ocurren.

1. La energía perdida por los electrones a medida que pasan a través de la cadena de transporte de electrones se usa para producir ATP.
2. Los electrones pasan de la clorofila a una cadena de transporte de electrones.
3. La luz solar golpea las moléculas de clorofila en las membranas tilacoides.
4. Las moléculas NADP⁺ cambian a NADPH a medida que transportan los electrones hacia el estroma del cloroplasto.
5. La energía de luz se traslada a los electrones de la clorofila.
6. Los electrones se pasan a una segunda cadena de transporte de electrones.

Consulta la gráfica. Responde a cada afirmación.

7. Explica porqué generalmente hay varios tipos de pigmentos presentes en los cloroplastos.

8. Indica el nombre del pigmento que absorbe la mayor cantidad de luz aproximadamente a 450 nm.

En tu libro de texto, lee acerca del ciclo de Calvin y las rutas alternas de la fotosíntesis.

Completa la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Calvin</th>
<th>C₄</th>
<th>CAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. La segunda fase de la fotosíntesis, en la cual la energía se almacena en glucosa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. La(s) ruta(s) que ayuda(n) a las plantas a completar la fotosíntesis mientras se reduce la pérdida de agua</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. La ruta que permite que el dióxido de carbono entre a las hojas únicamente durante la noche</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Las reacciones independientes a la luz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Utiliza la enzima rubisco para convertir el dióxido de carbono en moléculas que la célula puede usar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Tipo de planta que se encuentra en ambientes calientes y secos</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Guía de estudio

Sección 3: La respiración celular

En tu libro de texto, lee acerca de la respiración celular y la glicólisis.

Usa los siguientes términos sólo una vez para completar el párrafo.

<table>
<thead>
<tr>
<th>ATP</th>
<th>aeróbico</th>
<th>anaeróbico</th>
<th>citoplasma</th>
<th>energía</th>
<th>glicólisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucosa</td>
<td>mitocondria</td>
<td>NADH</td>
<td>oxígeno</td>
<td>respiración celular</td>
<td></td>
</tr>
</tbody>
</table>

Los organismos obtienen energía mediante un proceso llamado (1) ________________. 

Este proceso produce electrones a partir de compuestos de carbono, tales como la (2) ________________, y usa esa energía para producir (3) ________________. 

La ATP sirve para brindar (4) ________________ a las células para trabajar. Durante la (5) ________________, la glucosa se descompone en piruvato. La glicólisis es un proceso (6) ________________ debido a que no requiere oxígeno. La glicólisis se realiza en el (7) _________________. Dos moléculas de ATP y dos moléculas de (8) ________________ se forman para cada molécula de glucosa que se descompone. 

La respiración (9) ________________ se lleva a cabo en el (10) _________________. Es aeróbica debido a que el proceso requiere (11) _________________.

Consulta el diagrama de la glicólisis. Identifica los pasos en la descripción según el diagrama.

12. Paso ____. Cada compuesto de tres carbonos se convierte en un piruvato de tres carbonos.
13. Paso ____. Un compuesto de seis carbonos se descompone en dos compuestos de tres carbonos.
14. Paso ____. Los grupos de fosfato de dos moléculas de ATP se transfieren a una molécula de glucosa.
15. Paso ____. Se producen dos moléculas de NADH y cuatro moléculas de ATP.

Responde a cada pregunta.

16. Interpreta ¿Cuántas moléculas de ATP en total se producen en la glicólisis de una glucosa de seis carbonos?

17. Explica ¿Por qué hay una ganancia neta de sólo dos moléculas de ATP en la glicólisis de una glucosa de seis carbonos?
Guía de estudio, Sección 3: La respiración celular continuación

En tu libro de texto, lee acerca del ciclo de Krebs, el transporte de electrones y la respiración anaeróbica.

Consulta el diagrama de la respiración celular. Responde a cada pregunta y afirmación.

18. Recuerda ¿Cuál es el rendimiento neto de ATP producido por cada uno de los procesos encerrados en un círculo en el diagrama?

   Glicólisis = _______ ATP
   Ciclo de Krebs = _______ ATP
   Cadena de transporte de electrones = _______ ATP

19. Encuentra el rendimiento total neto de ATP de una molécula de glucosa.

20. Específica Con base en el diagrama y tus cálculos, ¿qué proceso produce más energía: la ruta anaeróbica o la ruta aeróbica?

Para cada afirmación a continuación, escribe «verdadero» o «falso».

21. La ruta anaeróbica que sigue a la glicólisis en la ausencia de oxígeno es la fermentación.
22. El hidrógeno necesario en la cadena de transporte de electrones viene de la división de las moléculas de dióxido de carbono.
23. La respiración celular en las eucariotas es ligeramente más eficiente que en las procariotas.
24. El ciclo de Krebs algunas veces se llama el ciclo TCA o el ciclo del ácido cítrico.
25. La fermentación ocurre en la mitocondria.
26. El músculo esquelético produce ácido láctico cuando el cuerpo no puede suministrar suficiente oxígeno.
27. La fermentación del alcohol se encuentra en algunas bacterias y en humanos.
28. Las dos moléculas de piruvato formadas durante la glicólisis resultan en dos ciclos de Krebs.
29. El transporte de electrones es el primer paso en la descomposición de glucosa.
Section 1: How Organisms Obtain Energy

After reading the section in your textbook, respond to each statement.

1. **Recall** the basic components of ATP.

2. **Paraphrase** the first law of thermodynamics.

3. **Contrast** catabolic pathways and anabolic pathways.

4. **Examine** how nearly all energy for life comes directly or indirectly from the Sun, given that heterotrophs get their energy from the food they eat.

5. **Classify** the synthesis of a protein from amino acids as anabolic or catabolic. Explain.
Quick Check

Section 2: Photosynthesis

After reading the section in your textbook, respond to each statement.

1. State the process of photosynthesis as a chemical reaction.

2. Summarize briefly the process of photosynthesis from absorption of light to production of glucose.

3. Discuss what pigments are. Give two examples.

4. Clarify why the reactions of the Calvin cycle are also referred to as light-independent reactions.

5. Deduce how you can tell if an organism carries out photosynthesis just by looking at its cells under a microscope.
Quick Check
Section 3: Cellular Respiration

After reading the section in your textbook, respond to each question and statement.

1. **List** the stages of cellular respiration.

2. **Express** the process of cellular respiration as a chemical equation.

3. **Clarify** the relationship between photosynthesis and cellular respiration.

4. **Arrange** Write the following steps in the order in which they occur during glycolysis.
   - A six-carbon molecule is broken down into two three-carbon molecules.
   - Two NADP⁺ molecules are converted into two NADH molecules.
   - Two phosphate groups from two ATP molecules are joined to glucose.
   - Two three-carbon molecules are converted into two molecules of pyruvate as four molecules of ATP are produced.

5. **Infer** After you have been exercising for a while, why do you start breathing hard?
CHAPTER 8
Assessment

Section 8.1
Vocabulary Review

Replace the italicized words with the correct vocabulary terms.

1. ________________  3. ________________  5. ________________
2. ________________  4. ________________

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.


Constructed Response

10. ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________

11. ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________

Think Critically

12. ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________

13. ___________________________________________________________
    ___________________________________________________________
    ___________________________________________________________

Section 8.2
Vocabulary Review

Write the vocabulary term that best matches each definition.

14. ________________  16. ________________
15. ________________  17. ________________

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

CHAPTER 8
Assessment
Student Recording Sheet

Name __________________________ Date __________________ Class __________________

CHAPTER 8
Assessment
Student Recording Sheet

Constructed Response

22. _____________________________________________________________

23. _____________________________________________________________

24. _____________________________________________________________

Think Critically

25. _____________________________________________________________

26. _____________________________________________________________

27. _____________________________________________________________

Section 8.3
Vocabulary Review

Write a sentence defining each vocabulary term.

28. _____________________________________________________________

29. _____________________________________________________________

30. _____________________________________________________________

31. _____________________________________________________________

32. _____________________________________________________________
CHAPTER 8 Assessment

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

33. A B C D
34. A B C D
35. A B C D
36. A B C D
37. A B C D

Constructed Response

38. 

39. 

40. 

Think Critically

41. 

42. 

43. 

Additional Assessment

44. Writing in Biology Record your answer for question 44 on a separate sheet of paper.

Document-Based Questions

45. 

46. 

47. 

Cumulative Review

48. 

Name ______________________ Date __________ Class __________
CHAPTER 8
Assessment  Student Recording Sheet

Standardized Test Practice

Multiple Choice
Select the best answer from the choices given, and fill in the corresponding circle.

3. A B C D  6. A B C D

Short Answer
Answer each question with complete sentences.

10. __________________________________________
11. __________________________________________
12. __________________________________________
13. __________________________________________
14. __________________________________________
15. __________________________________________
16. __________________________________________

Extended Response
Answer each question with complete sentences.

17. __________________________________________
18. __________________________________________

Essay Question
19. Record your answer for question 19 on a separate sheet of paper.
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<tr>
<td>MiniLab (1)</td>
<td>117</td>
</tr>
<tr>
<td>MiniLab (2)</td>
<td>118</td>
</tr>
<tr>
<td>BioLab</td>
<td>119</td>
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<td>145</td>
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</table>
Before reading Chapter 9, predict answers to questions about the chapter content based on what you already know. Circle the letter of the correct answer, and then explain your reasoning.

1. Carlos is studying human skin cells under a microscope during science class. He asks his teacher why cells are small. Which response does his teacher give him?
   A. A large cell rapidly becomes a dangerous cancer cell.
   B. Cells divide too rapidly to grow much larger in size.
   C. Larger cells could not efficiently transport nutrients.
   D. Small cells place fewer energy demands on an organism.

   Explain.

2. Scott learns that his aunt has a form of cancer. Scott’s science teacher explains to Scott what cancer is. Which is part of the teacher’s explanation?
   A. A cancer patient can pass the disease to other people.
   B. A pathogen, such as a virus, infects a cell with cancer.
   C. Cancer is caused when body cells divide out of control.
   D. Some cancer cells perform normal functions in the body.

   Explain.

3. Keshia is watching a news broadcast story that features the controversy over stem cell research. She does not know what stem cells are, and she looks up the term in a dictionary. What definition does she find?

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Launch Lab
CHAPTER 9
From where do healthy cells come?

All living things are composed of cells. The only way an organism can grow or heal itself is by cellular reproduction. Healthy cells perform vital life functions, and they reproduce to form more cells. In this lab you will investigate the appearance of different cell types.

Procedure  
1. Read and complete the lab safety form.
2. Observe slides of human cells under high magnification using a light microscope.
3. Observe onion root tip cells under the microscope.
4. Observe other cells on the prepared slides your teacher will give you.
5. Draw diagrams of the sample cells you observed. Identify and label any of the structures you recognize.

Data and Observations

Analysis
1. Compare and contrast the different cells you observed.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

2. Hypothesize why the cells you observed had different appearances and structures. How could you identify diseased cells?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________
Could a cell grow large enough to engulf your school? What would happen if the size of an elephant were doubled? At the organism level, an elephant cannot grow significantly larger, because its legs would not support the increase in mass. Do the same principles and limitations apply at the cellular level? Do the math!

**Procedure**
1. Read and complete the lab safety form.
2. Prepare a data table for surface area and volume data calculated for five hypothetical cells. Assume the cell is a cube. (Dimensions given are for one face of a cube.)
   - Cell 1: 0.00002 m (the average diameter of most eukaryotic cells)
   - Cell 2: 0.001 m (the diameter of a squid’s giant nerve cell)
   - Cell 3: 2.5 cm
   - Cell 4: 30 cm
   - Cell 5: 15 m

3. Calculate the surface area for each cell using this formula: length × width × number of sides (6).
4. Calculate the volume for each cell using this formula: length × width × height.

**Data and Observations**

**Analysis**
1. **Cause and Effect** Based on your calculations, confirm why cells do not become very large.

2. **Infer** Are large organisms, such as redwood trees and elephants, large because they contain extra-large cells or just more standard-sized cells? Explain.
Do sunscreens really block sunlight? Sunscreens contain a variety of different compounds that absorb UVB from sunlight. UVB is linked to mutations in DNA that can lead to skin cancer. Find out how effective at blocking sunlight various sunscreens are.

**Procedure**

1. Read and complete the lab safety form.
2. Choose one of the sunscren products provided by your teacher. Record the active ingredients and the sun protection factor (SPF) in the space below.
3. Obtain two sheets of plastic wrap. On one sheet use a permanent marker to draw two widely spaced circles. Place a drop of sunscreen in the middle of one circle and a drop of zinc oxide in the middle of the other.
4. Lay the second sheet on top of both circles. Spread the drops by pressing with a book.
5. Take a covered piece of sun-sensitive paper and two pieces of plastic wrap to a sunny area. Quickly uncover the paper, lay the two pieces of plastic wrap on top, and place in the sunlight.
6. After the paper is fully exposed, remove it from the sunlight and develop according to instructions.

**Data and Observations**

**Analysis**

1. **Think Critically** Why did you compare the sunscreens to zinc oxide?

2. **Draw Conclusions** After examining the developed sun-sensitive papers from your class, which sunscreens do you think would be most likely to prevent DNA mutations?
Background: Ultraviolet (UV) radiation is a component of sunlight that can damage DNA and interrupt the cell cycle.

Question: Can sunscreens prevent damage to UV-sensitive yeast?

Materials
sterile pipettes (10)
aluminum foil
test-tube rack
sterile spreaders (10)
dilution of UV-sensitive yeast
yeast extract dextrose (YED) agar plates (10)
sunscreens with various amounts of SPF

Safety Precautions

Procedure
1. Read and complete the lab safety form.
2. Obtain a test tube containing a diluted broth culture of the UV-sensitive yeast.
3. Formulate a hypothesis, then choose a sunscreen and predict how it will affect the yeast when exposed to sunlight.
4. Label ten YED agar plates with your group name. Label two plates as control. The control plates will not be placed in the sunlight. Label four of the experimental plates as “no sunscreen” and four as “sunscreen.”
5. Spread a 0.1 mL sample of the yeast dilution on all ten YED agar plates. Wrap the control plates in foil and give them to your teacher for incubation.
6. With direction from your teacher, decide how long to expose each of the experimental plates and label each plate accordingly. Prepare a table in which to collect your data.
7. Wrap the “no sunscreen” plates in foil. Apply sunscreen to the lids of the four sunscreen plates and wrap them in foil.
8. Remove the covers from all experimental plates, and expose the plates for the planned times. Re-cover the plates after exposure and give them to your teacher for incubation.
9. After incubation, count and record the number of yeast colonies on each plate.
10. Cleanup and Disposal Wash and return all reusable materials. Dispose of the YED plates as described by your teacher. Disinfect your work area. Wash your hands thoroughly with soap and water.

Data and Observations
BioLab, Does sunlight affect mitosis in yeast? continued

Analyze and Conclude

1. Estimate Assume that each yeast colony on a YED plate grew from one yeast cell in the dilution. Use the number of yeast colonies on your control plate to determine the percent of yeast that survived on each exposed plate.

2. Graph Data Draw a graph with the percent survival on the y-axis and the exposure time on the x-axis. Use a different color to graph the data from the plates with and without sunscreen.

3. Evaluate Was your hypothesis supported by your data? Explain.

4. Error Analysis Describe several possible sources of error.
Most of your body cells undergo mitosis and make more cells to replace cells that are damaged, diseased, or worn out. Some cells divide rapidly to replace dead cells. Millions of cells in your body die every day. For example, blood cells and skin cells constantly need to be replaced. A red blood cell might live for only a few months. New blood cells are made by stem cells in your bone marrow. Dead cells in the outer layer of your skin are replaced every few days by new cells made in a lower layer of the skin.

Sometimes, cells continue to make more cells even when they are not needed, or cells might not die when they should. This uncontrolled, unregulated growth and division of cells is cancer. Cancer cells can crowd out and kill healthy cells. Cancer can affect different parts of the body, such as the stomach, lungs, and brain. Cancer is the second leading cause of death in the United States. In this activity, you will examine some cancer risks and lifestyle choices that can help reduce those risks.

**Part A: Examining the Risks**

Cancer is caused by changes in parts of a cell that control the growth and death of the cell. Certain substances, called carcinogens, can cause these changes. Scientists do research and collect evidence to determine what substances are carcinogens. Some research takes place in laboratories. Other research involves studying the lifestyles of people with different types of cancer. Scientists have identified some substances as known carcinogens; other substances have been identified as possible carcinogens. The table lists the cancer risks of three known carcinogens.

### Analyze and Conclude

**Respond to each question.**

1. **Explain** Why are tobacco, alcohol, and ultraviolet radiation listed as carcinogens in the table?

2. **Identify** What carcinogens in the table are known to cause cancer of the esophagus, the tube leading from the mouth to the stomach?

---

<table>
<thead>
<tr>
<th>Carcinogen</th>
<th>Risks of Cancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>• Tobacco use accounts for at least 30 percent of all cancer deaths.</td>
</tr>
<tr>
<td></td>
<td>• Smoking causes nearly 87 percent of all lung cancers. Smokeless tobacco, pipe</td>
</tr>
<tr>
<td></td>
<td>tobacco, pipe tobacco, cigars, and secondhand smoke also cause cancer.</td>
</tr>
<tr>
<td></td>
<td>• Tobacco use causes lung, stomach, mouth, nasal cavity, esophagus, pancreas,</td>
</tr>
<tr>
<td></td>
<td>kidney, and bladder cancer, as well as other cancers.</td>
</tr>
<tr>
<td>Alcohol</td>
<td>• Alcohol is the primary cause of liver cancer, but it can also cause mouth</td>
</tr>
<tr>
<td></td>
<td>cancer, esophagus cancer, and other cancers.</td>
</tr>
<tr>
<td></td>
<td>• The cancer risk increases as the amount of alcohol consumed increases.</td>
</tr>
<tr>
<td>Ultraviolet</td>
<td>• UV radiation is the primary cause of skin cancer.</td>
</tr>
<tr>
<td>radiation</td>
<td>• People are at greater risk if they live in an area with year-round bright</td>
</tr>
<tr>
<td></td>
<td>sunlight. For example, the risk of skin cancer is twice as high in Arizona</td>
</tr>
<tr>
<td></td>
<td>as it is in Minnesota.</td>
</tr>
<tr>
<td></td>
<td>• People are at greater risk if they use tanning booths or sunlamps.</td>
</tr>
</tbody>
</table>
3. Apply Why are people who work outdoors at greater risk of getting skin cancer?

Part B: Reducing the Risks
Carcinogens can cause changes in cells that result in cancer, but that does not mean everyone exposed to carcinogens will get cancer. Some people inherit a tendency to develop cancer. For people who have a family history of cancer, regular checkups are important. Many kinds of cancer can be treated successfully if they are detected early enough.

Avoiding or reducing exposure to known carcinogens reduces a person’s risk of getting cancer. In addition, numerous studies indicate that a healthy diet and exercise might protect people from cancer. Steps that people can take to reduce their risks of developing cancer are listed below.

Lifestyle Choices for Reducing Cancer Risks
- Avoid smoking and secondhand smoke.
- Avoid alcohol.
- Avoid exposure to UV radiation, use sunscreen, and wear protective clothing.
- Choose foods with less fat and eat more vegetables, fruits, and whole grains.
- Exercise regularly and maintain a healthy weight.

Analyze and Conclude
Respond to each question.

1. Explain How do the lifestyle choices listed above help reduce a person’s risk of cancer?

2. Identify In addition to following the lifestyle choices above, what should a person who has a family history of cancer do to reduce his or her risk of dying from cancer? How does this help?

3. Compare Which diet would give a person a higher risk of cancer—one with lots of fat and few vegetables, fruits, and whole grains, or one with little fat and lots of vegetables, fruits, and whole grains?

CAREERS IN BIOLOGY
Cancer Research Visit biologygmh.com for information on cancer research. What are the responsibilities of a scientist who works in cancer research?
Enrichment

CHAPTER 9

Group Project: Protecting Against Carcinogens

Carcinogens are substances known to cause cancer in humans or other animals. Scientists have identified hundreds of carcinogens, ranging from X rays and sunlight to industrial chemicals and once-popular food additives. Some carcinogens cannot always be avoided in one’s daily life. For example, the only way to avoid ultraviolet radiation, a carcinogen, is to stay out of sunlight. But other carcinogens can be avoided if one knows where they are to be found.

Scrutinize  Lists of known carcinogens are available from a number of library reference books. Locate some of those sources and find out the kind of information available in each one. Notice that some substances are known to be carcinogenic, while others are suspected of being carcinogenic. Decide whether suspected carcinogens or known carcinogens pose greater health risks to the public.

Organize  Form a committee of five classmates to serve as a carcinogen study group for your community. Search the lists of carcinogens that you are able to find and select ten items from those lists on which to focus your research. Find out where in your community each carcinogen is most likely to be found. For each carcinogen, prepare a carcinogen profile listing its source and its possible health effects on humans.

Depict  Summarize the information you have found in a poster, a newsletter, a short newspaper article or television news story, or some other method for informing the community. Your presentation should be interesting enough to attract someone’s attention, while providing information on the ten carcinogens you have studied and the dangers they pose to people living in the community.
Complete the cycle map about the cell cycle. These terms may be used more than once: cell, cytoplasm, metaphase, nuclear membrane, nucleoli, poles.

Interphase

(1) The _______________ grows. DNA is duplicated.

Cytokinesis

(6) _______________ divides.
Two cells are formed.

Prophase

Chromosomes condense.

(2) The _______________
and nucleolus disappear.
Spindle apparatus forms.

Telophase

Chromosomes arrive at poles.

Nuclear membranes and
(5) _______________ reappear.
Chromosomes decondense.

(3) _______________
Sister chromatids line up at equator.

Anaphase

Chromatids are pulled apart toward
(4) _______________.
In your textbook, read about cell size limitations.

List two alternative futures for cells when they reach their size limitations.

1. 
2. 

In your textbook, read about the cell cycle.

Draw the cell cycle in the space below. Include the following labels: cytokinesis, G₁, G₂, interphase, mitosis, S.

3.

Match the definition in Column A with the term in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. stage in which the cell divides into two daughter cells with identical nuclei</td>
<td>A. S phase</td>
</tr>
<tr>
<td>5. substage of interphase immediately after a cell divides</td>
<td>B. cytokinesis</td>
</tr>
<tr>
<td>6. substage of interphase in which the cell copies its DNA in preparation for cell division</td>
<td>C. G₁</td>
</tr>
<tr>
<td>7. stage in which the cell’s nuclear material divides and separates</td>
<td>D. G₂</td>
</tr>
<tr>
<td>8. main stage in which the cell grows, carries out normal functions, and duplicates its DNA</td>
<td>E. interphase</td>
</tr>
<tr>
<td>9. substage in which the cell prepares for nuclear division and a protein that makes microtubules for cell division is synthesized</td>
<td>F. mitosis</td>
</tr>
</tbody>
</table>
In your textbook, read about the stages of mitosis.

For each statement below, write true or false.

1. The nuclear membrane disintegrates during prophase.  

2. Microtubules move chromatids to the poles of the cell during anaphase.  

3. Chromosomes reach the poles of the cell during metaphase.  

4. The cell’s chromatin condenses into chromosomes during prophase.  

5. The nuclear envelope re-forms during anaphase.  

6. Chromosomes attach to spindle fibers and line up along the equator of the cell during metaphase.  

7. The nucleus reappears during prophase.  

8. Centrioles migrate to the poles of the cell during telophase.  

9. Chromatids are pulled apart during anaphase.  

10. The first stage of mitosis is telophase.  

11. The chromosomes decondense or unwind during telophase.  

12. The shortest stage of mitosis is metaphase.

Label the diagram of the stages of mitosis using lines 13–16. Use these choices:

- anaphase  
- metaphase  
- prophase  
- telophase

13. 

14. 

15. 

16. 

Label the diagrams above using lines 17–20. Use these choices:

- centrioles  
- centromere  
- sister chromatids  
- spindle fibers
In your textbook, read about cytokinesis.

Refer to the diagrams above. Respond to each statement.

21. **Discuss** the role of microfilaments in cytokinesis.

22. **Summarize** cell division in prokaryotes.

**Draw the formation of two genetically identical cells in plants in the space below. Include the following labels:** cell plate, identical daughter cells, new cell wall.

23.
In your textbook, read about the abnormal cell cycle and cancer.

Complete the graphic organizer about the causes and prevention of cancer. These terms may be used more than once: carcinogens, cell cycle, cells, DNA damage, genetic changes, spindle fiber failure, the Sun’s ultraviolet rays, tobacco.

Complete the table by checking the correct column for each description.

<table>
<thead>
<tr>
<th>Description</th>
<th>Apoptosis</th>
<th>Stem Cells</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. After a sperm fertilizes an egg, the resulting mass of cells divides until there are about 100 to 150 cells.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Some cells go through a programmed death.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Embryonic cells shrivel and die, resulting in the formation of fingers and toes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Unspecialized cells are either embryonic or adult.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. This event occurs in cells that are damaged beyond repair.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Guía de estudio**

**Sección 1: El crecimiento celular**

En tu libro de texto, lee acerca de las limitaciones en el tamaño de las células.

*Enumera dos futuros alternativos para las células cuando alcanzan sus limitaciones de tamaño.*

1. 
2. 

En tu libro de texto, lee acerca del ciclo celular.

*Dibuja el ciclo celular en el siguiente espacio. Identifica lo siguiente: citoquinesis, G₁, G₂, interfase, mitosis, S.*

3. 

Relaciona la definición de la columna A con el término de la columna B.

<table>
<thead>
<tr>
<th>Columna A</th>
<th>Columna B</th>
</tr>
</thead>
<tbody>
<tr>
<td>etapa en la cual la célula se divide en dos células hijas con núcleos idénticos</td>
<td>A. fase S</td>
</tr>
<tr>
<td>sub-etapa de la interfase inmediatamente después de que una célula se divide</td>
<td>B. citoquinesis</td>
</tr>
<tr>
<td>sub-etapa de la interfase en la cual la célula copia su ADN preparándose para la división celular</td>
<td>C. G₁</td>
</tr>
<tr>
<td>etapa en la cual el material nuclear de la célula se divide y se separa</td>
<td>D. G₂</td>
</tr>
<tr>
<td>etapa principal en la cual la célula crece, realiza funciones normales y duplica su ADN</td>
<td>E. interfase</td>
</tr>
<tr>
<td>sub-etapa en la cual la célula se prepara para la división nuclear y se sintetiza una proteína que produce microtúbulos para la división celular</td>
<td>F. mitosis</td>
</tr>
</tbody>
</table>
En tu libro de texto, lee acerca de las etapas de la mitosis.
Para cada afirmación a continuación, escribe «verdadero» o «falso».

1. La membrana nuclear se desintegra durante la profase.  
2. Los microtúbulos mueven cromátidas hacia los polos de la célula durante la anafase.  
3. Los cromosomas alcanzan los polos de la célula durante la metafase.  
4. La cromatina de la célula se condensa en cromosomas durante la profase.  
5. La envoltura nuclear se vuelve a formar durante la anafase.  
6. Los cromosomas se unen a las fibras del huso y se alinean a lo largo del ecuador de la célula durante la metafase.  
7. El núcleo vuelve a aparecer durante la profase.  
8. Los centriolos migran hacia los polos de la célula durante la telofase.  
9. Los cromátidas se separan durante la anafase.  
10. La primera etapa de la mitosis es la telofase.  
11. Los cromosomas se descondensan o se desenrollan durante la telofase.  
12. La etapa más corta de la mitosis es la metafase.

Identifica el diagrama de las etapas de la mitosis en las líneas 13–16. Usa estas opciones:

13. _____________ 14. _____________ 15. _____________ 16. _____________

17. _____________ 18. _____________ 19. _____________ 20. _____________

Identifica los diagramas anteriores en las líneas 17–20. Usa estas opciones:

130 La reproducción celular CAPÍTULO 9

Unidad 2
En tu libro de texto, lee acerca de la citoquinesis.

Consulta el diagrama anterior. Responde a cada afirmación.

21. **Comenta** la función de los microfilamentos en la citoquinesis.

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

22. **Resume** la división celular en las procariotas.

   ______________________________________________________
   ______________________________________________________
   ______________________________________________________

En el siguiente espacio, dibuja la formación de dos células de plantas genéticamente idénticas. 
Identifica lo siguiente: células hijas idénticas, nueva pared celular, placa celular.

23.
En tu libro de texto, lee acerca del ciclo celular anormal y del cáncer.

Completa el organizador gráfico acerca de las causas y de la prevención del cáncer. Estos términos se pueden usar más de una vez: cambios genéticos, carcinógenos, células, ciclo celular, daño al ADN, el tabaco, falla de las fibras del huso, los rayos ultravioletas del sol.

Completar la tabla marcando la(s) columna(s) correcta(s) para cada descripción.

<table>
<thead>
<tr>
<th>Descripción</th>
<th>Apóptosis</th>
<th>Células madre</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Después de que un esperma fertiliza un huevo, la masa resultante de células se divide hasta que haya alrededor de 100 a 150 células.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Algunas células pasan por una muerte programada.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Las células embriónicas se arrugan y mueren, lo que resulta en la formación de los dedos de las manos y de los pies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Las células no especializadas son embriónicas o adultas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Este evento ocurre en las células que se han dañado sin posibilidad de reparación.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quick Check

Section 1: Cellular Growth

After reading the section in your textbook, respond to each statement.

1. Define mitosis.

2. Summarize the stages of interphase.

3. Clarify the difference between chromatin and chromosomes.

4. Distinguish between mitosis and cytokinesis.

5. The unicellular spores of the fern Ceratopteris richardii are about 100 µm in diameter. Calculate the surface-area-to-volume ratio of a cube whose sides are 100 µm in length to approximate the surface-area-to-volume ratio of the fern spore cell. Show your work.
Quick Check

Section 2: Mitosis and Cytokinesis

After reading the section in your textbook, respond to each statement.

1. **Recount** the major events that happen during prophase.
   
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

2. **Describe** the structure of chromosomes during prophase.
   
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

3. **Summarize** how cytokinesis occurs in plant cells.
   
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

4. **Contrast** the spindle apparatus of an animal cell with that of a plant cell.
   
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

5. **Devise** a way to remember each stage of mitosis. **Propose** one word or a short phrase that describes each stage and also starts with the same letter as the name of that stage, for example, telophase—two nuclei.
   
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Section 3: Cell Cycle Regulation

After reading the section in your textbook, respond to each statement.

1. **Relate** apoptosis to cancer.

2. **Explain** how cancerous cell growth differs from normal cell growth.

3. **Identify** the protein and enzyme complex that is important in controlling the cell cycle and three of the processes it controls.

4. **Determine** the significance of stem cells.

5. **Deduce** what would happen if there were no spindle checkpoints.
CHAPTER 9
Assessment
Student Recording Sheet

Section 9.1
Vocabulary Review

Write the vocabulary term that best matches each definition.

1. ____________________  2. ____________________  3. ____________________

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

4. A   B   C   D
5. A   B   C   D
6. A   B   C   D
7. A   B   C   D
8. A   B   C   D

Constructed Response

9. __________________________________________________________

10. _________________________________________________________

11. _________________________________________________________

12. _________________________________________________________

13. _________________________________________________________

Think Critically

12. _________________________________________________________

13. _________________________________________________________

Section 9.2
Vocabulary Review

Use vocabulary terms to complete the concept map.

14. ____________________  17. ____________________
15. ____________________  18. ____________________
16. ____________________

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CHAPTER 9
Assessment

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

19. A B C D
20. A B C D

21. A B C D
22. A B C D

Constructed Response

23.

24.

25.

Think Critically

26.

27. Math in Biology

Section 9.3

Vocabulary Review

Write the vocabulary term that makes each sentence true.

28. 29. 30.

Understand Key Concepts

Select the best answer from the choices given, and fill in the corresponding circle.

31. A B C D
32. A B C D
33. A B C D

34. A B C D
35. A B C D
Assessment

CHAPTER 9

Student Recording Sheet

Constructed Response

36. 

37. 

Think Critically

38. 

39. 

40. Record your answer for question 40 on a separate sheet of paper.

Additional Assessment

41. Writing in Biology  Record your answer for question 41 on a separate sheet of paper.

42. Record your answer for question 42 on a separate sheet of paper.

Document-Based Questions

43. 

44. 

45. 

Cumulative Review

46. 

47. 

CHAPTER 9
Assessment

Student Recording Sheet

Standardized Test Practice

Multiple Choice

Select the best answer from the choices given, and fill in the corresponding circle.

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D

Short Answer

Answer each question with complete sentences.

11.

12.

13.

14.

15.

16.

17.

Extended Response

Answer each question with complete sentences.

18.

19.

Essay Question

20. Record your answer for question 20 on a separate sheet of paper.