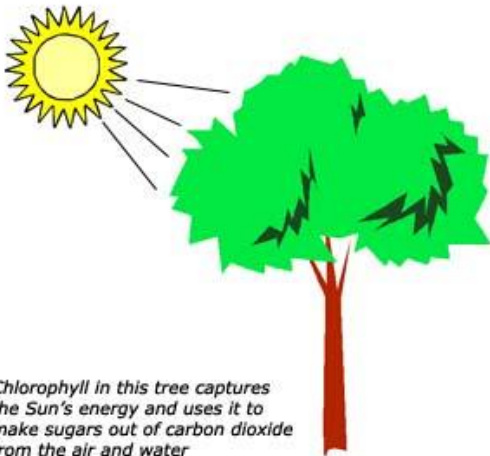


Chapter 3

Cell Processes and Energy



Chlorophyll in this tree captures the Sun's energy and uses it to make sugars out of carbon dioxide from the air and water

Chapter 3 Objectives

Section 1: Chemical Compounds in Cells

1. Define elements and compounds
2. Explain how water is important to the function of cells
3. Identify the four main kinds of organic compounds in living things

Section 2: The Cell in its Environment

1. Describe how most small molecules cross the cell membrane
2. Explain why osmosis is important to cells
3. Tell the difference between passive and active transport

Section 3: Photosynthesis

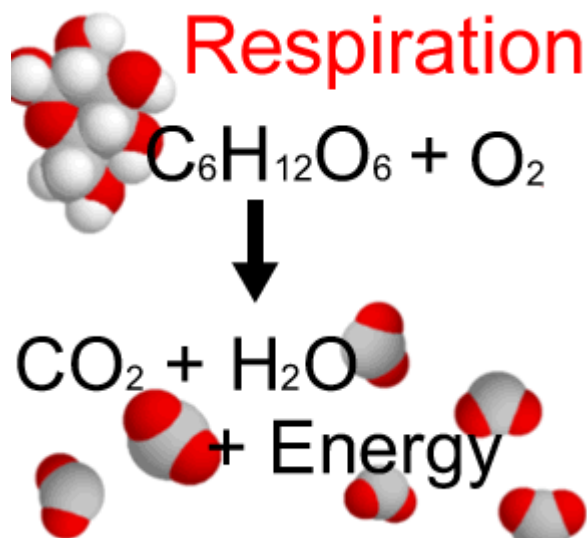
1. Explain how the sun supplies living things with the energy they need
2. Describe what happens during the process of photosynthesis

Section 4: Respiration

1. Describe the events that occur during respiration
2. Define fermentation and understand its importance

Section 5: Cell Division

1. Identify the events that take place during the three stages of the cell cycle
2. Explain how the structure of DNA helps account for the way in which DNA copies itself



Chemical Compounds in Cells

Directions: Fill in the table below.

Organic Compounds		
Type of Compound	Example	Major Roles in Living Things
Carbohydrates	_____/_____ _____	Help form cell walls and membranes; provide energy
_____	Fats	Help form cell membranes; _____
_____	Enzymes	Help form cell membranes and organelles speed up chemical reactions
_____	DNA/ _____	Direct all cell's functions; _____

Directions: Match each term with its proper definition

- | | |
|-----------------------|---|
| 1. ____ Element | a. type of nucleic acid that plays an important role in the production of proteins |
| 2. ____ Compound | b. type of nucleic acid that passes from parent to offspring and directs all the cell's functions |
| 3. ____ Carbohydrate | c. very large organic molecules made of carbon, oxygen, hydrogen, nitrogen, and phosphorus |
| 4. ____ Proteins | d. large organic molecules made of carbon, hydrogen, oxygen, nitrogen, and, in some cases, sulfur |
| 5. ____ Amino Acids | e. small molecules that make up proteins |
| 6. ____ Enzyme | f. the chemical combination of two or more elements |
| 7. ____ Lipid | g. type of protein that speeds up chemical reactions in living things |
| 8. ____ Nucleic Acids | h. any substance that cannot be broken down into simpler substances |
| 9. ____ DNA | i. an energy-rich organic compound such as sugar |
| 10. ____ RNA | j. an energy-rich organic compound such as fat |

Amino Acids and Proteins

Though there are only 20 common amino acids, they can be combined in different ways to produce thousands of unique proteins. Proteins that differ in the order or type of amino acids they contain have very different structures and functions. In fact, a change in even a single amino acid can sometimes affect the way a protein works.

Suppose that proteins could consist of just two amino acids. To see how many unique proteins, each composed of just two amino acids, can be formed from five different amino acids, fill in the spaces in the table below. Some of the spaces have been filled in for you. Assume that each letter represents a different amino acid.

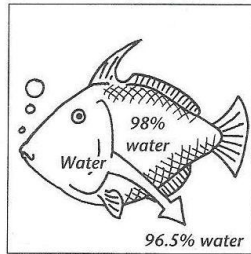
<i>Amino Acids</i>	A	B	C	D	E
A	AA	AB			
B	BA				
C					
D					
E					

Directions: Answer the following questions about amino acids.

1. What does each letter pair in the table represent?
2. Based on your completed table, how many unique proteins, each composed of just 2 amino acids, can be formed from 5 different amino acids?
3. How many unique proteins, each made up of just 2 amino acids, could be formed from 6 different amino acids?
4. How many unique proteins, each made up of just 2 amino acids, could be formed from 20 different amino acids?
5. Most proteins are made up of not just two, but hundreds of even thousands of amino acids. How does this affect the number of unique proteins that could be formed from just a few amino acids?

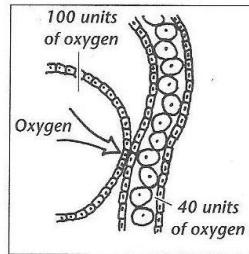
The Cell in Its Environment

Directions: Fill in the blank to identify the processes illustrated in each of the following figures.



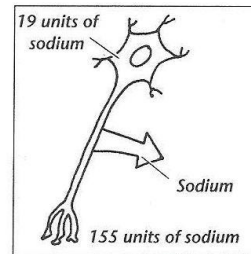
Water moves out of the cells of a saltwater fish and into the ocean.

1. _____



Oxygen moves from the lungs into the bloodstream.

2. _____



Sodium is pumped out of a nerve cell.

3. _____

Directions: Answer the following questions in complete sentences.

1. What is the difference between osmosis and diffusion?
2. What are the differences and similarities between active and passive transport?
3. What are two methods of active transport?
4. What is one reason that cells are so small?

Directions: Decide whether the statement is true or false. If it is false, change the underlined word to make the statement true.

1. _____ Selectively permeable means letting some but not all substances pass through.
2. _____ Osmosis is the process by which molecules tend to move from an area of higher concentration to an area of lower concentration.
3. _____ The process by which water moves across a selectively permeable membrane is called diffusion.
4. _____ Diffusion and osmosis are types of active transport.
5. _____ Passive transport requires the cell's own energy.

Moving through a membrane

Introduction:

The common chicken egg is actually one cell. The largest single cell is the egg of an ostrich. The shell of an egg is a protective layer of calcium carbonate that is deposited around the cell membrane. This activity is a two part process in that we must remove the shell first and then observe osmosis through the semi permeable membrane of the chicken egg.

Purpose: To demonstrate osmosis by observing a chicken egg with a removed shell

Materials

One egg vinegar salt food coloring
Water 1 small bowl
Triple beam balance corn syrup

PART I- Dissolving the Eggshell (Acid/Base reaction)

Procedure:

1. Record how a chicken egg feels when holding it. Describe the shell. Record your qualitative observations in the table.
2. Use the triple beam balance to measure the mass of the egg. Record mass in grams in the table.
3. Carefully place the egg, without cracks, into a small bowl. Cover it completely with vinegar.
4. Take a photo with your iPad and insert it in the table below (section 1).
5. Keep the eggs in the vinegar for 24 hours. Take another photo and insert it in the table below (section 2).
6. Describe your observations of the solution and the egg in the table. Carefully rinse the egg in clean water and prepare for procedure Part II.

Section 1. Egg with Shell	Section 2. Egg after soaked in Vinegar
Mass of Egg = _____ grams	Mass of Egg= _____ grams
Qualitative Observations & photo:	Qualitative Observations & photo:

*Percent change can be calculated from Part I mass changes.

PART II- Observing Osmosis

Procedure:

1. Lightly cover the egg in the corn syrup mixture provided by your teacher.
2. Observe what happens to the egg during the next 24 hours. Describe how the egg looks and draw your observations in the table below (section 3).
3. Measure the mass of the egg using your triple beam balance. Wash your hands.

PART III- Observing Diffusion

Procedure:

1. Fill a bowl about two-thirds full with a color water solution provided by your teacher. Be careful! Food coloring can stain your clothes.
2. Observe what happens to the egg during the next 24 hours. Describe how the egg looks and record your observations in the table below.
3. Empty the solution in the sink and be sure to measure the mass of the egg using the triple beam balance. Put the egg & bowl in the trash and Wash your hands!

Section 3. Sugar Water Mass = _____	Color Water Solution Mass = _____
Qualitative Observations & photo:	Qualitative Observations & photo:

Graph: Create a graph for the effect of solution on mass of the egg.



ANALYSIS

Directions: Answer the questions below

1. The egg is surrounded by a membrane without any smaller divisions. What is the term that describes this unit building block of life?
2. Which Part (I, II, III) demonstrates that material can move into a cell?
3. Which Part demonstrates that a material can move out of a cell?
4. Describe the movement of molecules in terms of diffusion and osmosis based on your egg experiment. **HINT**-look at your observation chart to determine when **osmosis** occurred and when simple **diffusion** occurred.

Accelerated Learning:

Directions: Consider your observations during the egg lab to answer the following questions.

In this *acid-base reaction*, the vinegar reacted with the egg shell to produce a salt, water and carbon dioxide:



5. Which is the Acid? Which is the Base?

6. Underline the organic compound(s).
7. Circle the inorganic compound(s).
8. What formed the bubbles?

Photosynthesis

Photosynthesis is a process unique to the plant world. *Photo* means "light" and *synthesis* means "putting together." *Photosynthesis*, therefore, means "putting together with light." Through this process, plants are able to make their own food. Use the terms in the word box to complete each sentence.

photosynthesis
heterotrophs
chloroplasts
autotrophs

oxygen
carbon dioxide
glucose

carbohydrates
sunlight
cellulose

water
chlorophyll
leaves

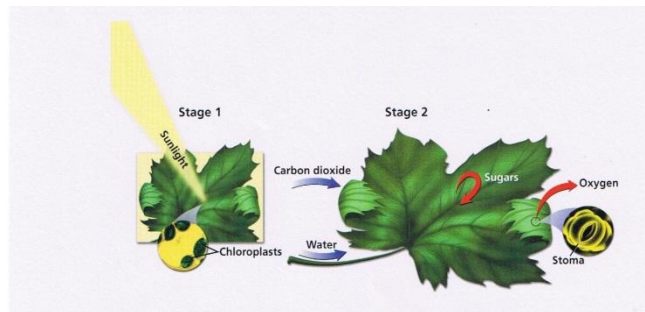
- 1 Water, carbon dioxide, and _____ are the three ingredients needed for photosynthesis to occur.
- 2 Through photosynthesis, plants convert these ingredients into _____, a food used by the plant.
- 3 _____ is the material in green plant cells that traps energy from the sun.
- 4 The plant takes in a gas called _____ from the air.
- 5 Chlorophyll is found in the _____, structures within the cell where photosynthesis will take place.
- 6 _____ is a material the plant takes up through its roots and stems.
- 7 During photosynthesis, _____ is a waste product released by the plant into the air.
- 8 Plants produce more glucose than they need. The excess glucose is stored by the plant as _____ or starches.
- 9 Plants also change glucose into _____, the structural material used in their cell walls.
- 10 While chlorophyll is found in most aboveground parts of green plants, most photosynthesis takes place in a plant's _____.
- 11 In many regions, there is not enough sunlight or water during winter for _____ to occur.
- 12 Most plants are also called _____ because they are able to produce their own food.
- 13 Most animals are called _____ because they obtain energy from other plants or animals.

NUTRIENTS

Directions: Answer the following questions.

1. What is a nutrient?
2. Name the 5 essential nutrients needed by all living things in order to survive.

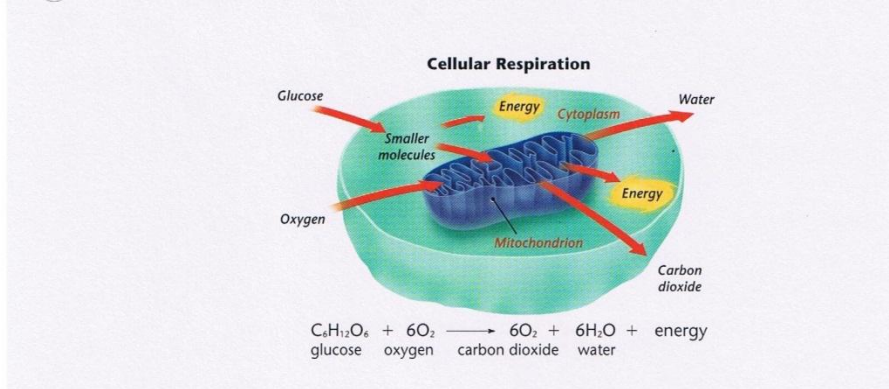
Figure 1



Directions: Use Figure 1 to answer the following questions.

3. What is the source of carbon used to form sugar molecules during photosynthesis?
 - a. Carbon in the soil
 - b. Carbon dioxide gas from the air
 - c. Nutrients from the soil
 - d. Water from the soil
4. From where do plants obtain the water for photosynthesis? _____

Figure 2



Directions: Use Figure 2 to answer the following questions.

5. What is cellular respiration?
6. Do animal cells carry out photosynthesis? Do plant cells carry out cellular respiration?
7. Which nutrients are required for cellular respiration? _____

Figure 4

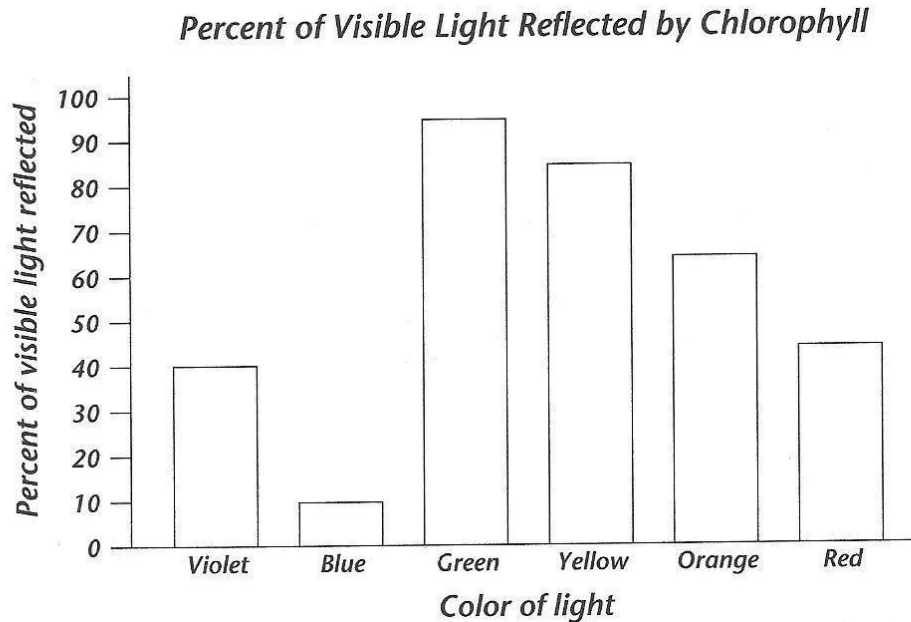


Directions: Use Figure 4 to answer the following questions.

8. Producers, such as plants convert energy from the sun into which nutrient?
 - a. Fats
 - b. Proteins
 - c. sugars
 - d. Vitamins
9. Explain this statement: The ultimate source of energy for all living things, directly or indirectly, is the sun.

Chlorophyll and the Color of Light

A pigment is a colored chemical compound that absorbs light. You can think of a pigment as a kind of sponge that absorbs light of all colors except the ones that it transmits and reflects. The colors that you see are the colors of the light that the pigment reflects. The bar graph below shows the percentages of light of different colors that are reflected by the plant pigment chlorophyll.



Directions: Answer the following questions about the data in the graph.

1. Which color of light does chlorophyll reflect most? About what percent of light of this color does chlorophyll reflect?
2. Which color of light does chlorophyll absorb most? About what percent of light of this color does chlorophyll absorb?
3. The colors that are reflected less than 50% contribute very little to what the eye sees. Which colors does your eye respond to when you look at a "green" leaf?
4. Which colors of light do you not see when you look at a "green" leaf?
5. Explain in your own words how chlorophyll makes a leaf look green.

The Carbon Dioxide-Oxygen Cycle

Matter is continuously cycled between the living and nonliving parts of an ecosystem and between ecosystems. Matter is recycled, no new matter is added to the earth and none is lost. One example of this is in the carbon dioxide-oxygen cycle. Match each term in the word box with its description.

carbon dioxide
producers

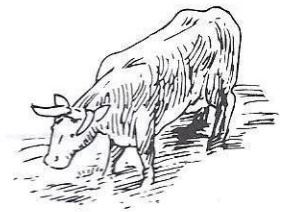
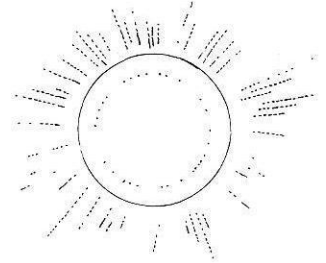
oxygen
consumers

photosynthesis
aerobic

marine algae
geologic activity

decomposers
fossil fuels

- 1 _____ Carbon is present in Earth's atmosphere in the form of this gas.
- 2 _____ The world's oceans hold most of the carbon in a dissolved form. These organisms use the carbon and release oxygen back into the atmosphere.
- 3 _____ Plants, also called this, use carbon dioxide to make their own food.
- 4 _____ This process, used by producers, releases oxygen into the atmosphere as a byproduct.
- 5 _____ These organisms cycle carbon through their bodies through the foods they eat. After they die and decompose, carbon is released back into the soil and atmosphere.
- 6 _____ The burning of these has put more carbon back into the atmosphere than can be cycled naturally.
- 7 _____ These organisms feed off of dead material and release the carbon back into the cycle.
- 8 _____ This type of respiration uses oxygen and produces carbon dioxide as a byproduct.
- 9 _____ Examples of this include volcanic eruptions and weathering of limestone rock, both of which release carbon into the atmosphere.
- 10 _____ The respiration of consumers uses this gas and releases carbon dioxide as a byproduct.



REVIEW: Photosynthesis + Respiration

Directions: Fill in the blanks with the appropriate **photosynthesis** terms.

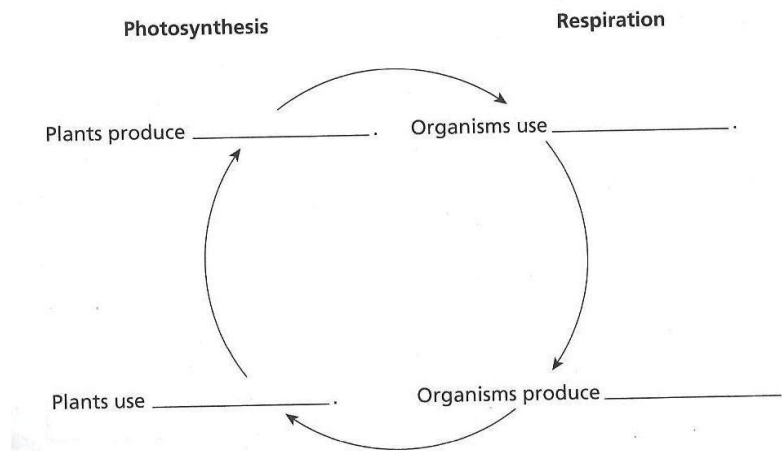
sunlight

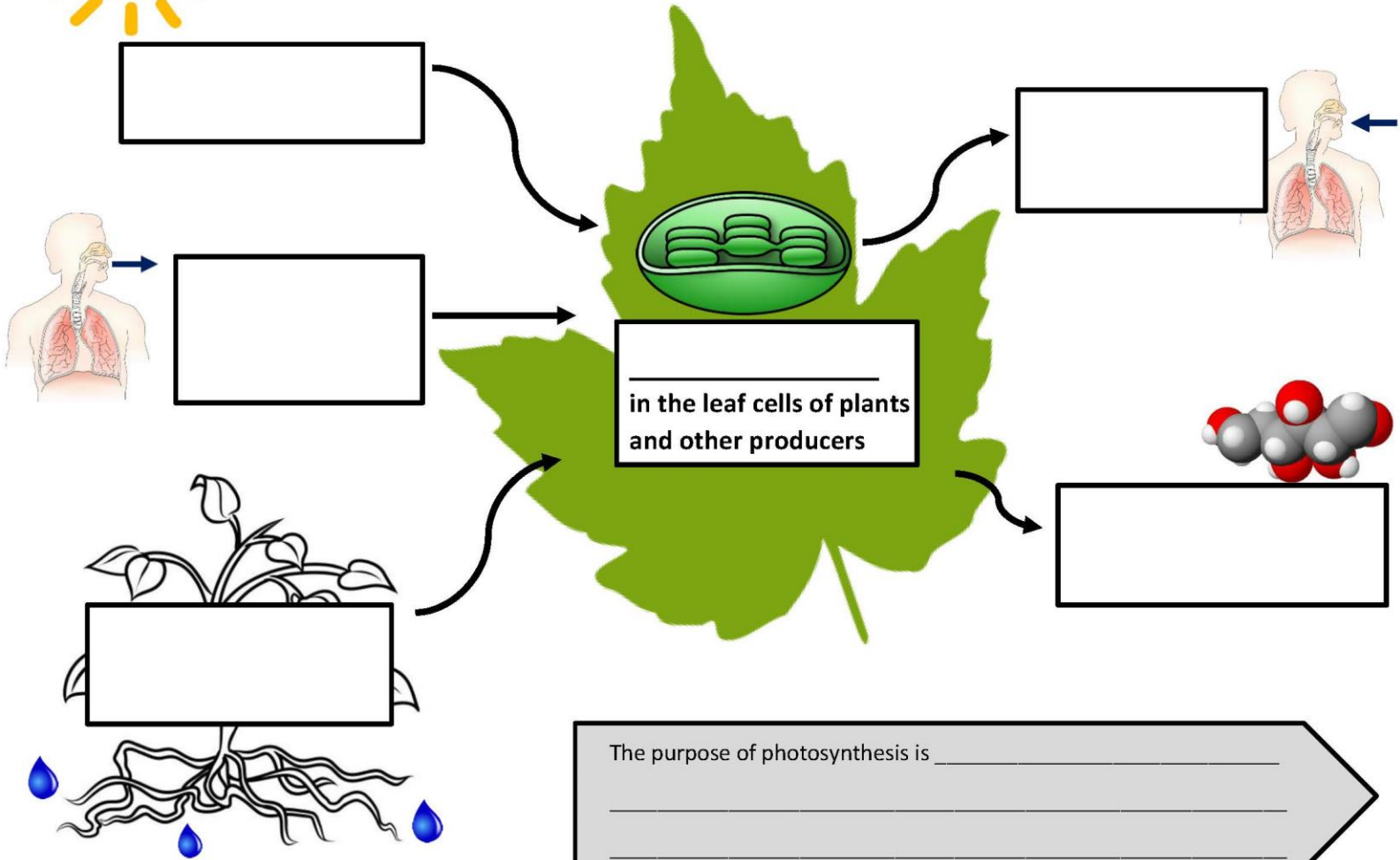
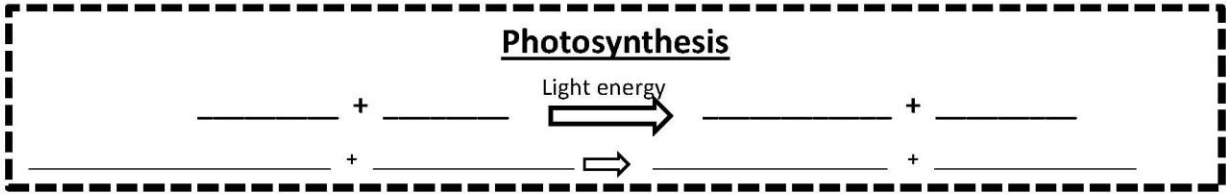
1. _____ + _____ → _____ + _____
2. The process by which a cell captures the energy in sunlight and uses it to make food is called _____.
3. _____ are colored chemical compounds that absorb light.
4. The main pigment found in the chloroplasts of plants is _____.
5. _____ are small openings on the undersides of leaves through which carbon dioxide enters a plant.
6. An organism that makes its own food is a(n) _____.
7. A(n) _____ is an organism that cannot make its own food.

Directions: Fill in the blanks with the appropriate **respiration** terms.

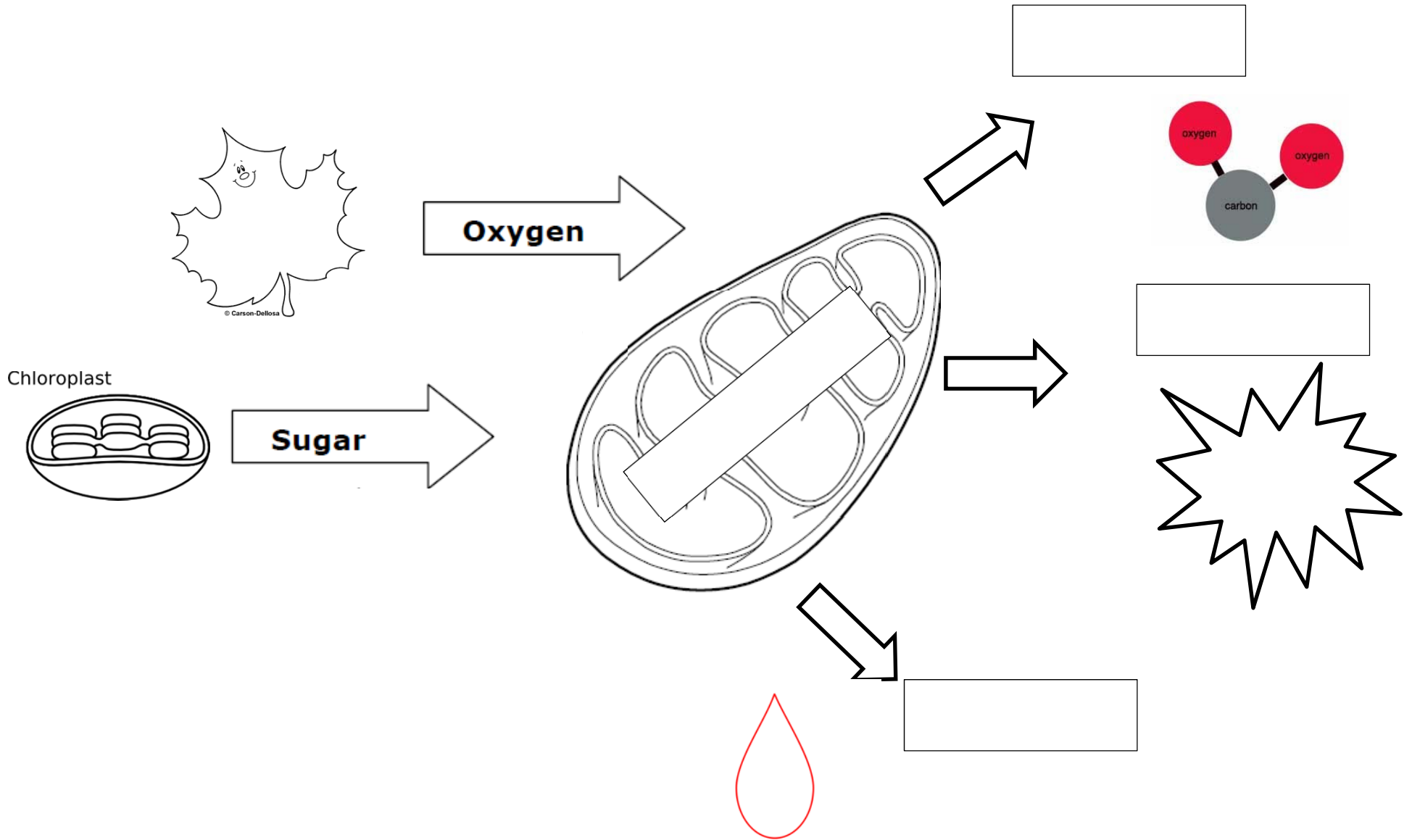
1. _____ + _____ → _____ + _____
2. Cells store energy in the form of _____.
3. What is the definition for Respiration?

Directions: Complete the cycle below, which describes the relationship between photosynthesis and respiration





Cellular Respiration



REVIEW: Chapter 3 SUDOKU

Directions: Match each definition on the left with the vocabulary term on the right. Then write the number of each term in the appropriate box on the table. When you are finished, add up the columns, rows and diagonals separately. Each one should have the same sum if your answers are correct.

- | | |
|--|---|
| <ul style="list-style-type: none"> A. The process by which a cell captures energy in sunlight and uses it to make food B. The division of a nucleus into two new nuclei C. The movement of materials through a cell membrane without using cellular energy D. An energy-rich compound such as sugar E. Process by which cells obtain energy from glucose F. Process by which molecules moves from an area of higher concentration to one of lower concentration G. Colored chemical compound that absorbs light H. First stage of the cell cycle I. Protein that speeds up chemical reactions | <ul style="list-style-type: none"> 1. Mitosis 2. Active transport 3. Pigment 4. Enzyme 5. Diffusion 6. Respiration 7. Carbohydrate 8. Photosynthesis 9. Passive transport 10. Chromosome 11. Interphase 12. Lipid |
|--|---|

A	B	C	=
—	—	—	=
D	E	F	=
—	—	—	=
G	H	I	=
—	—	—	=
=	=	=	=
—	—	—	=

CHAPTER REVIEW

Directions: Fill in the following table about how living things use the sun's energy.

How Living Things Obtain Energy From the Sun		
Living Thing	Autotroph or Heterotroph?	Obtains Energy from the Sun Directly or Indirectly?
Grass		
Zebra		
Lion		

Directions: Use the table below to list the raw materials and products of photosynthesis.

PHOTOSYNTHESIS	
Raw materials	Products

Directions: Use the table below to list the raw materials and products of respiration.

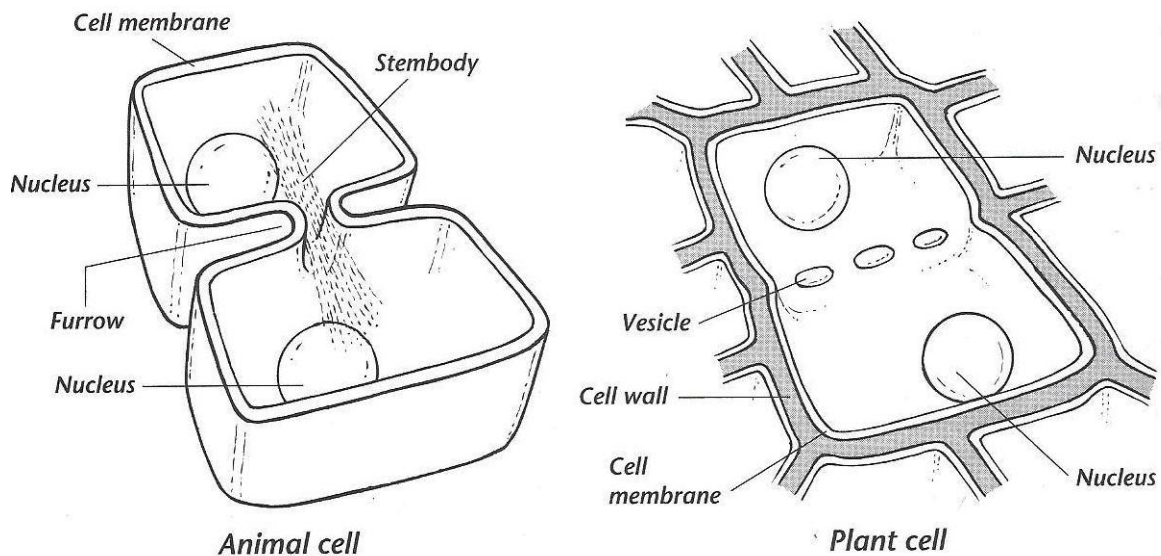
RESPIRATION	
Raw Materials	Products

Directions: Match the following term with its definition.

- | | |
|--|----------------|
| 1. _____ Regular sequence of growth and division that cells undergo | a. Interphase |
| 2. _____ First stage of the cell cycle | b. Mitosis |
| 3. _____ Process in which DNA is copied | c. Cell cycle |
| 4. _____ Stage of the cell cycle during which the cell's nucleus divides | d. Cytokinesis |
| 5. _____ Double rod of condensed chromatin | e. Replication |
| 6. _____ Final stage of the cell cycle | f. Chromosome |

CYTOKINESIS IN PLANT CELLS AND ANIMAL CELLS

Recall that all plant cells have a rigid cell wall. Because of this rigid cell wall, cytokinesis in plant cells is different from cytokinesis in animal cells. Study the figures below to see how cytokinesis differs in plant cells and animal cells.



In animal cells, as daughter cells pinch into two cells, there is a space between the cells called a furrow. As the furrow gets increasingly narrower, the spindle fibers are pressed into a tight bundle, called a stem body. The stem body eventually is cut in two as the new cell membranes fuse together.

In plant cells, pockets of cell-wall material, called vesicles, line up across the middle of the cell. The vesicles fuse together in two sheets to form new cell walls and cell membranes between the daughter cells.

Directions: Answer the following questions about cytokinesis.

1. How does the furrow form in an animal cell? What is the furrow's role in cell division?
2. What causes the stem body to form in an animal cell? What happens to the stem body when the cell divides?
3. What are vesicles? Which parts of the plant cell do vesicles develop into?
4. If you observed a cell under a microscope during cytokinesis, how could you tell whether it was a plant cell or an animal cell?