Chapters 3 , 4 and 5
UNIT TWO: ENERGY AND CELLS

1. Identify and explain the parts of a compound light microscope.

2. Properly use the compound light microscope to view specimens.

3. Explain the Cell Theory.

4. Compare and contrast eukaryotic cells and prokaryotic cells.

5. Identify and explain the function of the following cell parts: cell membrane, cytoplasm, nucleus, mitochondria, ribosome, endoplasmic reticulum, lysosome, golgi body, vacuole, centrioles, cell wall, and chloroplasts.

6. Compare and contrast animal cells and plant cells.

7. Explain how semi-permeable membranes work with respect to active and passive transport.

8. Describe the process of diffusion in terms of concentration gradients.

9. Explain how hypertonic, isotonic, and hypotonic solutions affect cells.

10. Explain the relationship between ATP and chemical bonds.

11. Explain the purpose of photosynthesis and its reactants and products.

12. Explain the purpose of cellular respiration and its reactants and products.

13. Describe a relationship between photosynthesis and cellular respiration.

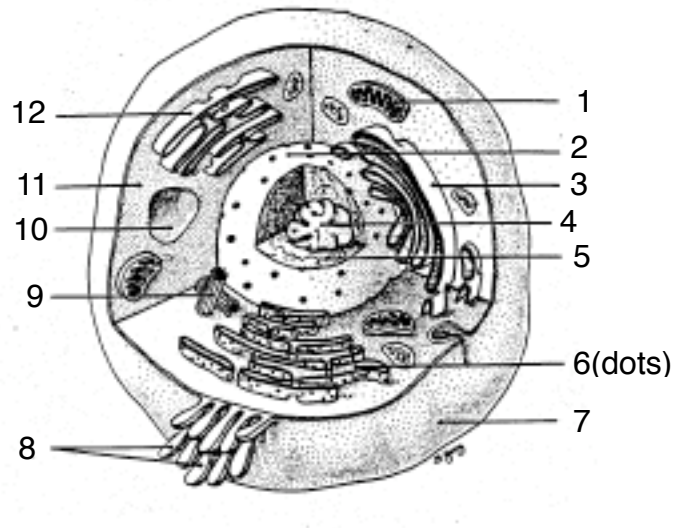
14. Compare the processes of aerobic respiration and anaerobic respiration.

KEY TERMS:

light microscope	magnification	field of view
cell theory	organelle	cytoskeleton
vessicle	cilia	
prokaryote	eukaryote	phospholipid bilayer
centriole (p. 128)		
passive transport	isotonic solution	carrier protein
osmosis	concentration gradient	equilibrium
diffusion	endocytosis	exocytosis
hypertonic solution	hypotonic solution	active transport
facilitated diffusion	sodium-potassium pump	cellular respiration
photosynthesis	autotroph	heterotroph
chlorophyll	ATP	fermentation
pigment	aerobic	anaerobic
light reactions	dark reactions	glycolysis

Animal Cell Diagram

Label all the organelles of the animal cell below and state the function of each organelle in your own words on the corresponding line underneath the diagram.



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

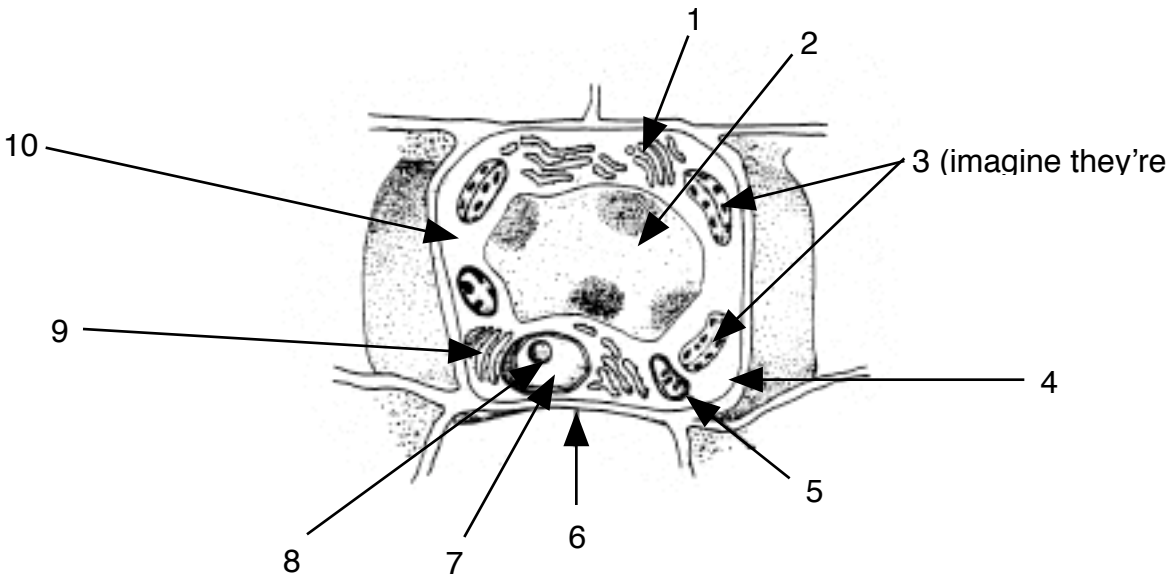
10. _____

11. _____

12. _____

Plant Cell Diagram

Label all the organelles of the plant cell below and state the function of each organelle in your own words on the corresponding line underneath the diagram.



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

Cell Structures Comparison

The cells of all living things are fundamentally alike and their structures perform the same important functions. The structures of a cell are listed in the left column of the table below. Indicate whether they are present in plant, animal cells, or both by placing check marks in the middle columns. Then state the functions of each structure in the right hand column.

STRUCTURE	PLANT	ANIMAL	FUNCTION
Cell Wall			
Cell Membrane			
Vacuole			
Nucleus			
Nucleolus			
Ribosome			
Endoplasmic Reticulum			
Mitochondrion			
Golgi Body			
Nucleoplasm			
Cytoplasm			
Lysosome			
Centriole			
Chromosomes			
Chloroplast			

Create another chart in notebook to compare and contrast prokaryotes and eukaryotes. Determine the key characteristics used to compare the two types of cells.

PRE-LAB: Microscopes and Cell Structures NAME: _____

Directions: Read the lab on packet pages 8-12. THEN, answer the questions below. This page must be completed in order for you to participate in lab.

1. Identify three purposes for this lab.

2. Label the parts of the microscope on packet page 8. Use information in the lab as well as textbook page 52 to help you. You may also use the following website: http://www.geocities.com/thesciencefiles/microscope/usingamike.html

3. What two numbers are used to calculate the total magnification of the microscope?

4. How is total magnification calculated?

5. Why do the onion and check cell specimens have to be stained with iodine?

6. At what magnification should you record (draw) what each cell looks like? Why?

7. How should slides and objective lenses be cleaned?

THE LAB REPORT WILL CONSIST OF THE FOLLOWING PARTS:
Lab Report is due two days after we complete the lab activity in class: _____

I. **Title** (Effect of _____ on _____)
II. **Purpose:** Why did we do this lab? What should you learn from doing lab? (see prelab!)
III. **Safety**: state and explain three safety precautions associated with this lab
IV. **Data**: Include drawings from packet page 11. You may cut the pictures out of the packet and attach to report. Be sure to label all parts. Coloring of cell drawings is encouraged!
V. **Analysis**: Answer all the questions from pkt p. 11 and write your answers using complete sentences and include the answers in the lab report.
VI. **Conclusion**: Use words listed on page 11, follow directions, and include your paragraph in lab report

INTRODUCTION TO THE COMPOUND MICROSCOPE
& COMPARISON OF CELL STRUCTURE

This lab has two parts. The first is an introduction to the microscope. The second uses the skills acquired in the first lab to identify structures in plant and animal cells.

Many of the organisms and parts of organisms that biologists study are not clearly visible to the naked eye. They become visible only through the use of the microscope. In this investigation, you will learn the parts of the microscope and their functions. You will practice some skills needed for using the microscope to study living things.

The cell is a basic unit of all living things. All organisms are made up of at least one cell. Large organisms, such as humans, are made up of trillions of cells. In this lab you are going to examine under the microscope three different kinds of cells: elodea cells, onion cells, and your own cheek cells.

Objectives

Learn the name and function of each of the major parts of a microscope.
Prepare a slide and observe it under low and high power magnification.
Compare orientation, magnification, area observed, and light intensity under low and high power.
Examine the structures found in several types of cells and describe their functions.

Materials

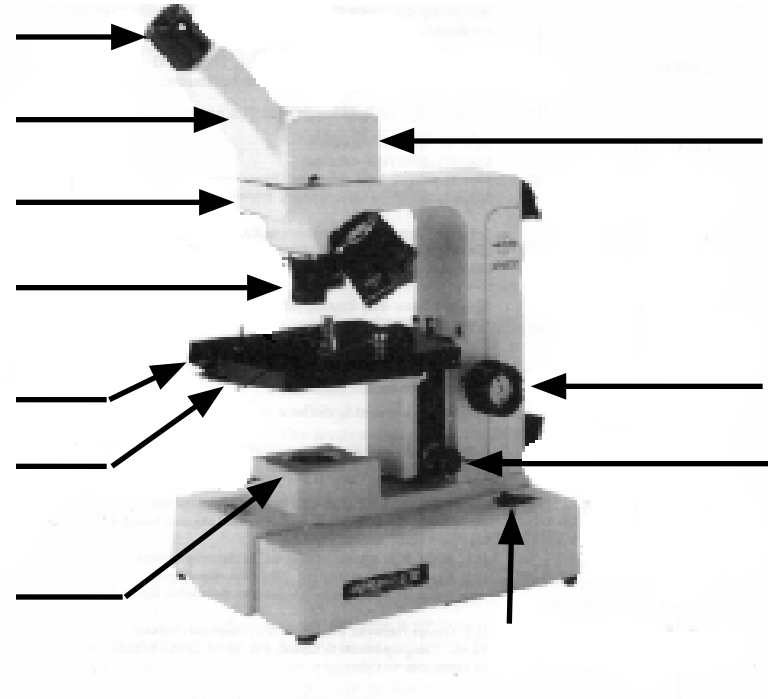
Iodine, toothpick, newsprint, onion piece, elodea leaf, slides, cover slips, compound microscope.

Part I: Procedure and Observations

1. Get a microscope from the storage cabinet as directed by your instructor. Carry it with one hand grasping the arm and the other hand under the base and put it on your work area.

2. Identify the following parts of the microscope and remember their functions Label the parts on Figure 1 on page 9.

arm – the vertical support for the lenses and focusing gears.
body tube – the part through which light passes from one set of lenses to the next.
objectives – the parts that contain the lenses closest to the specimen. You may have two, three, or four objectives, with different degrees of magnification. One of these is probably labeled "DIN10" and another "DIN40." These numbers tell you how many times that objective magnifies an image of your specimen. Each lens is named for its function. The **4X lens is called the Wide Field lens**, **10X is Low power**, **40X is High Power**, and 100X is oil immersion.
nose piece – the circular part that supports two or three objectives with different magnification.
ocular or ***eyepiece*** – the part nearest your eye when you are looking through the microscope. It contains lenses that magnify the image already magnified by the objective. An ocular usually magnifies 10 times.
stage – the flat platform on which you place the specimen. The specimen is usually on a glass slide. The stage on some microscopes has a pair of *stage clips*. Others have a *mechanical stage*. Your instructor will show you how to use the device on your microscope.
diaphragm – a device located beneath the stage and used to control the amount of light passing through the specimen. It may be a disc with holes of various sizes, or it may be an iris diaphragm. Our microscopes typically have a disk diaphragm.
coarse adjustment – moves the specimen and objective lenses closer together or farther apart. It is used to bring the specimen into focus. In some microscopes the nosepiece moves up and down; in others the stage moves up and down. Your instructor will explain how your microscope is focused.
fine adjustment – performs the same function as the coarse adjustment, but moves only a very small distance. It is used to sharpen the image of your specimen.
light source – our microscopes have a light mounted below the stage. Others have a mirror mounted there. The mirror and the light lamp are used to reflect light through the opening in the stage, and through the sample.



3. Turn on the light under the stage of your microscope.

4. From the smallest print in a newspaper, cut a lower-case (non-capital) “e”. In most newspapers, the smallest type is in the classified advertisements.

5. Put a drop of water in the center of the slide. Place your letter “e” in the drop of water in such a position that you can read it without the lenses. (See Fig. 2 below)

6. Lower a cover slip onto the wet “e” with a needle, as shown in Fig. 2e. This allows air bubbles to escape. You have just prepared a wet mount. In this course you will prepare many wet mounts. You will also use some permanent mounts or prepared slides.

7. Place the slide on the stage with the letter “e” over the center of the hole in the stage.

8. Rotate the nosepiece so that the shortest, or wide field, objective is in place.

9. While looking at your slide from the side, move the coarse adjustment so that the objective and slide are nearly touching. Why should you always look from the side, instead of through the ocular, when moving the objective and slide together?

_____

_____

10. While looking through the ocular, move the coarse adjustment back down slowly, until the letter e comes into view. **Keep both eyes open**, to avoid eye strain. This method may be distracting at first, but with a little practice, you will learn to concentrate on what the eye looking through the ocular is seeing.

11. Use the fine adjustment to sharpen the image.

12. The total magnification of your microscope is determined by multiplying the power of the objective times the power of the ocular. Determine how many times your microscope magnifies when you use the wide field objective. Show your calculations.

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13. Gently rotate the nosepiece so that the high power objective clicks into place. Bring it into sharp focus with the fine adjustment. Be careful not to move the slide. On most microscopes the objectives are made so that when a specimen is in focus under one objective, it will also be in focus under another objective. Such a microscope is said to be parfocal.

14. Calculate the magnification under high power. Show your calculations.

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15. Bring it into focus using the wide field objective. What do you notice about the letter's position?

If the letter is upside down and backward, you have followed the instructions well. The lenses in the microscope reverse the image as the light passes through them.

16. While looking through the microscope, gently move the slide away from you toward the front of the stage. In which direction does the letter appear to move? _____
Now move the slide to the right. In which directions does the letter appear to move?

Remembering these things will help you to move things about under your microscope without losing sight of your specimen.

17. Center the "e" in the low power field. Turn the nosepiece until the high power objective clicks into place. With the fine adjustment, bring the image into clear focus.

18. Do you see more or less of the letter than you did under low power? _____
Does the field of view (the bright circle you see when looking into a microscope) appear brighter or less bright than it did under low power? _____

19. Use the fine adjustment to focus up and down on the letter. Can you tell which side of the newspaper the ink is on? Each level at which you focus is called a focal plane. By looking at several focal planes in a specimen, you can construct in your mind a three-dimensional image of the whole object.

20. Remove the cover slip and the letter "e" from your slide. Dry the slide and cover slip with a facial tissue or paper towel.

Part II: Procedure and Observations

A. ONION CELLS

The bulb of an onion is really an underground stem. The stem is completely covered by leaves, which take the form of succulent (full of juice) scales.

1. Obtain a piece of scale of an onion bulb. You will use the outer layer (the epidermal cells) from the scale. Bend the scale until it cracks, then gently pull the two pieces apart; the outer layer of epidermal tissue should peel off easily. This tissue will be about as thin and flexible as plastic wrap. If you aren't sure what to do, ask your teacher for help.

2. Put a drop of water in the center of a clean slide. Cut off a small piece of the epidermal tissue and place it in the drop of water. Make sure that the tissue is flat. If it is folded, straighten it with a corner of the cover slip. Put one drop of iodine stain directly on top of the onion tissue. Wait one minute, then place a cover slip over the tissue. Next, remove the stain from under the cover slip and replace it with clear water. To do this, place a paper towel at the edge of one side of the coverslip. Place a drop of water at the edge of the cover slip on the other side.

3. Observe the slide under low power (100X) and then high power (400X). You will see that certain portions of the cell absorbed the stain well, while others did not. The stained parts of the cell are more visible under the microscope. Try to identify the parts of the onion cell. Look for the nucleus, cytoplasm, and cell wall. Draw a few cells. Label the cell wall, nucleus, and cytoplasm as well as the power of magnification of your sketch. **THESE WILL BE INCLUDED IN YOUR LAB WRITEUP.**

B. ELODEA

1. Remove a young piece of leaf near the growing tip of an ***Elodea*** sprig. Put the leaf on a slide and add a drop of water. Add a cover slip to make a wet mount.

2. Observe the leaf with low power (100X) and then high power (400X). Observe the cells along the margin and those directly in the middle of the leaf. Look for movement of chloroplasts within the cells. A large fluid filled central vacuole (invisible) may be outlined by a high number of chloroplasts.

3. The nucleus may be difficult to see. It may be covered by the chloroplasts.

4. Draw several *Elodea* leaf cells. Label the following: cell wall, nucleus, chloroplasts, and cytoplasm as well as the power of magnification of your sketch. **THESE WILL BE INCLUDED IN YOUR LAB WRITEUP.**

C. HUMAN CHEEK CELLS

1. You will now observe some of your own cells. The epithelial cells lining your mouth are constantly being replaced. The old cells that are ready to slough off can easily be collected.

2. Put a drop of iodine on a clean slide. Using the flat end of a toothpick, gently scrape the inside of your cheek. **You will not be able to see anything on the toothpick, but the cells are there!** Do not damage your check, gently rub toothpick inside mouth.

3. Stir the iodine on the slide with the end of the toothpick to mix the cells with the stain. Remove the stain from the slide as instructed by step #2 of Part A: Onion.

4. Observe the slide under the microscope at low power (100X) and high power (400X). Try to identify the parts of the cheek cell. Look for the cell membrane, the nucleus, and the cytoplasm.

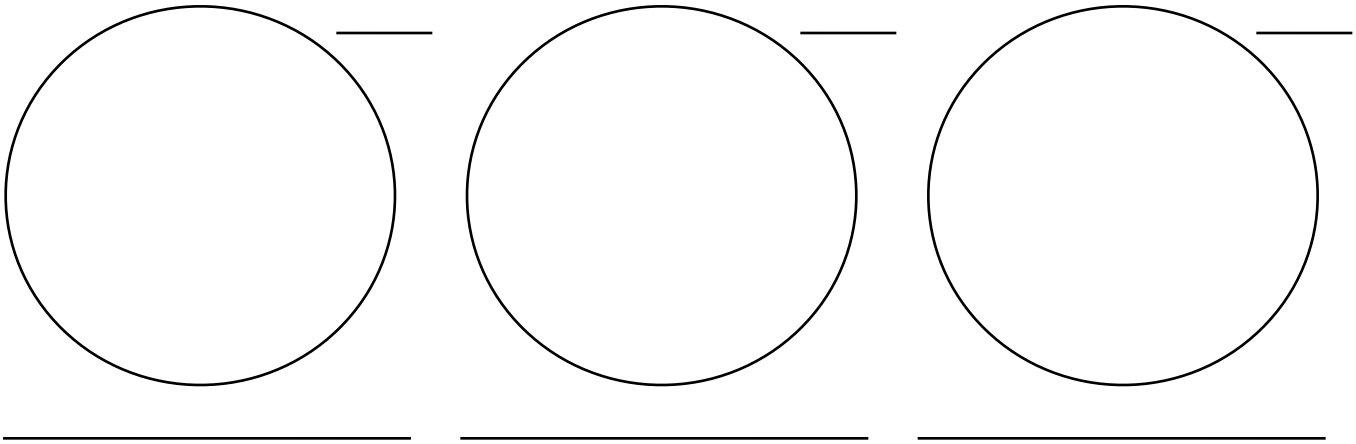
5. Draw and label a cheek cell that has a nucleus, cytoplasm, and cell membrane as well as the power of magnification of your sketch. **THESE WILL BE INCLUDED IN YOUR LAB WRITEUP.**

D. CLEANING UP

When you finish using your microscope, there are several things you must do to care for it.
Turn the nosepiece to the wide field objective.
Remove the slide if one is left on the stage. Remove specimen and thoroughly wash and dry slide.
Use lens tissue to clean the lenses carefully. Do not use facial tissue or paper towels, because lenses are made of soft glass that is easily scratched. Use facial tissue or a paper towel to dry the stage if you have gotten water on it.

Use the coarse adjustment to put the low power objective and stage as close together as they will go.
Turn off the lamp and wind up the cord neatly around the microscope below the stage.
Put the dust cover on the microscope.
Carefully return the microscope to its proper storage place, carrying the microscope close to you and using two hands!**Data and Analysis**

Draw the cells you observed. **Include the type of cell, total magnification, labeled parts.** Draw the cells neatly and show their actual size as seen in **high power**. **THESE WILL BE INCLUDED IN YOUR LAB WRITEUP.**



<u>ANALYSIS</u>: Answer the following using complete sentences and logical thoughts on a SEPARATE PIECE OF PAPER FOR YOU LAB WRITEUP.

1. What powers of magnification can you get with your microscope? Identify each power of magnification as either wide field, low power, and high power.

2. Why should you always locate objects first with low power, even if you want to observe them with high power? HINT: use the term "field of view" in your explanation!

3. What structure gives the plant cells their regular shape?

4. What organelles are seen in the *Elodea* leaf tissues that are not seen in the onion tissue? Why are they not present?

5. How does the shape of a cheek cell differ from an onion or *elodea* cell? Why?

6. What is the purpose of adding iodine stain to the onion and cheek cells? Why were the *Elodea* cells not stained with iodine?

7. What organelles would vary in human tissues. Give two specific examples.

8. What organelles are found in almost all human tissues. Why?

<u>CONCLUSION</u>: Use the terms below to create a concept generalization summarizing the lab. Include this as the conclusion section of your lab report. Prove to me you understand the concepts practiced in the lab and the relationships between terms. You may want to divide your conclusion into two paragraphs: one paragraph about microscopes and one paragraph about cells and organelles.

<u>underline all terms within your concept generalization paragraphs</u>

microscope	focus	light	magnification	slide movement
image movement	field of view	plant cells	animal cells	similarities
differences	organelles	specialized functions.		

Cells and Cell Organelles THINKING QUESTIONS (we *love* to think...)

Directions: Answer the following questions in the space provided. Work cooperatively in your group and let all members participate in the discussion. **DO IN YOUR NOTEBOOK.**

1. The pancreas and small intestine digest polymers and absorb monomers. What cell organelles are important in each of these organ's cells? Explain your answer.

2. Organ function is related to the number of specific organelles. Cite two examples of organs where there is an abundance of one kind of organelle and explain why they are in abundance. **OR** What kinds of cells might lack particular organelles? Identify cells (of tissues and organs) lacking organelles and explain why some cells may be lacking particular organelles.

3. Why don't animal cells have a cell wall, but plant cells *must* have one?

4. Explain how the following organelles work together to accomplish a cellular task:

   a. cell membrane & nuclear membrane

   b. endoplasmic reticulum & lysosome

   c. ribosome & golgi bodies

5. Explain how the following organelles work together to accomplish a cellular task:

   a. mitochondria & ribosome

   b. nucleus & ribosome

   c. ribosome & cell membrane

6. Organelles work together to make a cell function as a viable unit in living things. Explain **two** examples of how ***three*** (or more) organelles work together to accomplish a particular job within a cell. Do NOT use an example that's already in your textbook... **THINK!**

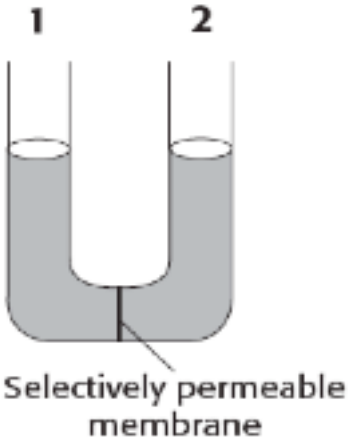
7. Compare a cell to a city. Choose five organelles and assign each organelle a "role" in the city. Explain why you chose each role for a particular organelle.

8. Cells are limited in the size they can be. Use math to compare the surface area to volume ratio of a cell(cube) that is 1 cm x 1 cm x 1cm to a cell cube with dimensions 2 cm x 2 cm x 2 cm. Which is more important to the survival of a cell: surface area or volume? Why?

HINT: surface area = L x W volume = L x W x H

Chapter 4: Predicting
Use the information below and the figure at right to answer questions 1–3.

EXPERIMENT A
A selectively permeable membrane separates the solutions



in the arms of the U-tube shown at right. The membrane is permeable to water and to substance A but not to substance B. Forty grams of substance A and 20 g of substance B have been added to the water on side 1 of the U-tube. Twenty grams of substance A and 40 g of substance B have been added to the water on side 2 of the U-tube. Assume that after a period of time, the solutions on either side of the membrane have reached equilibrium.

Read each question, and write your answer in the space provided.
1. How many grams of substance A will be in solution on side 1 of the U-tube? How many grams of substance A will be in solution on side 2? Explain.

2. How many grams of substance B will be in solution on side 1 of the U-tube? How many grams of substance B will be in solution on side 2? Explain.

3. What has happened to the water level in the U-tube? Explain.

Use the information below to answer questions 4–6.
EXPERIMENT B
The cell membrane of red blood cells is permeable to water but not to sodium chloride, NaCl. Suppose that you have three flasks:
- Flask X contains a solution that is 0.5 percent NaCl.
- Flask Y contains a solution that is 0.9 percent NaCl.
- Flask Z contains a solution that is 1.5 percent NaCl.

To each flask, you add red blood cells, which contain a solution that is 0.9 percent NaCl.

Read each question, and write your answer in the space provided.

4. Predict what will happen to the red blood cells in flask X.

5. Predict what will happen to the red blood cells in flask Y.

6. Predict what will happen to the red blood cells in flask Z.

Egg Lab Pre-Lab Worksheet NAME: _____

DIRECTIONS: Read the lab on pages 18-19 in your packet. After reading the lab, answer the following questions using complete sentences. If you have thoroughly read the lab, you should not have to refer back to the lab to answer the questions. It is important that you spend quality time thinking about this lab before entering the classroom so you understand what is expected of you and so you obtain accurate data.

1. Osmosis is the movement of water from and area of _____ concentration of water to

   an area of _____ concentration of water.

2. Define the following words in terms of the **movement of water molecules** between the solution and a cell:

   a. ISOTONIC SOLUTION

   b. HYPOTONIC SOLUTION

   c. HYPERTONIC SOLUTION

3. Define the following words in terms of **concentration of solutes** compared to a cell:

   a. ISOTONIC SOLUTION

   b. HYPOTONIC SOLUTION

   c. HYPERTONIC SOLUTION

4. Write your hypotheses for what you think will happen when the egg is placed in a hypertonic solution and a hypotonic solution. (Procedure steps #2 and #5)

5. Why do you have to mass the egg before and after placing it in the two solutions?

THE EGG LAB: Diffusion and Osmosis in Cells

Water is the most abundant substance in any cell. Water actually makes up about 99% of a cell by molecular count. All the chemical processes of the cell involve water in some way. Water passes into and out of the cell by the process of osmosis. **Osmosis** is the diffusion of water through a semi permeable membrane from an area where the concentration of water is high to an area where the concentration is low.

The cell membrane is **semi-permeable**. It allows some substances to pass through, while preventing the movement of others. Because water molecules are relatively small, they easily pass through the cell membrane. If the cell is in an environment where the concentration of water molecules is greater outside the cell than it is inside, water will move through the membrane into the cell by osmosis. If the concentration of water is greater inside than it is outside the cell, the water will move out of the cell by osmosis.

The amount of water in the cell changes as the cell's environment changes. If too much water enters the cell by osmosis, the cell may burst. If too much water leaves the cell, the cell will shrink. In the normal environment of a cell, however, the water concentration does not undergo such radical changes.

In this lab, you will use a raw chicken egg with the shell removed as a model of the cell to demonstrate the process of osmosis. The egg membrane is semi permeable, as is the membrane of a smaller cell. Actually, the egg is a large, single cell!

PURPOSE: Demonstrate and quantify the process of osmosis.

MATERIALS:
A raw chicken egg with the shell removed
A hypertonic salt solution (very salty water)
A hypotonic solution (distilled water)
An electronic balance

PROCEDURE: The eggshell was removed by placing the egg in vinegar (acetic acid) for three days. The vinegar dissolved the shell, but left intact the membrane surrounding the yolk and white of the egg. If any shell remains on your egg, do not remove it! Small pieces of shell will not affect your experiment.

1. GENTLY pick up an egg and carefully rinse it under tap water. Place it on a paper towel on the table and gently blot it dry with a second paper towel.

2. Write a hypothesis which predicts the results for the egg which is ina hypertonic (15% salt) environment.

If _____

_____.

3. Determine the mass of the egg on the electronic balance (make sure the balance is measuring mass in grams) and record the mass of your egg in the appropriate place in your data chart.

4. Place the egg ina beaker containing the hypertonic solution. Make sure there is enough liquid to cover the egg. Leave it in the solution for about 10 minutes. After 10 minutes, carefully remove your egg from the beaker, pat it dry as in step #1 and determine its mass as in step #3. Record this mass in the appropriate location in your data table.

5. Write an hypothesis which predicts results for the egg which is in the hypotonic solution.

If _____

_____

6. The starting mass for the egg in the hypotonic solution is the same as the ending mass for the egg in the hypertonic solution. Place the egg gently into the hypotonic solution for about 10 minutes. After 10 minutes, remove the egg carefully, blot it dry, determine its mass, and record the mass on the appropriate location in the data table.

7. Be sure your lab station is as clean as you found it at the start of class. Return your egg to the bin in the front of the room.

8. Egg lab rough table: **Effect of _____ on _____**

Solution	Start Mass (g)	End Mass (g)	% Change in Mass	Class % Change
Hypertonic				
Hypotonic				

% Change is calculated by the following formula $\frac{\text{(end mass) - (start mass)}}{\text{(start mass)}} \times 100$

ANALYSIS: **Answer these questions in a separate section in your lab report using complete sentences.**

1. How does osmosis differ from diffusion?
2. How did your data compare to the class data?
3. **Why** did your egg lose or gain mass in the 15% salt solution?
4. Explain what occurred when your egg was placed in the distilled water (hypotonic) solution. **Why did this change occur?**
5. What would occur if you put an egg in distilled water for 10 minutes, then placed the same egg in a solution of 20% salt for 10 minutes? **WHY?**
6. If a cell that contains 97% water is placed inot a 30% sugar solution, what will happen to the cell? **Why?**
7. Pioneers used to pack meat in salt to preserve it for long periods of time. The salt prevented bacteria from growing on the meat and spoiling the meat. How did the salt affect the bacteria? **Why?**
8. Why does road salt applied during winter months adversely effect plants growing along the side of the road? **WHY?**

CONCLUSION: Write a paragraph of about 6 sentences including and underlining the following terms to *demonstrate your understanding* of the concepts associated with this lab:

hypertonic	diffusion	osmosis	high concentration	selectively permeable
hypotonic	change in mass	water	salt(solute)	cell membrane

EGG LAB REPORT REQUIREMENTS:

I. **TItle**: Effect of _____ on _____ for _____
II. **Purpose**: Question(s) answered by doing the lab
III. **Hypothesis**: Recopy them from packet page 22!
IV. **Data**: Neatly recopy table from pkt p. 23; include units for every column and title
V. **Analysis**: Answer all ?'s from packet p. 23 using complete sentences and thoughts
VI. **Conclusion**: Follow directions and use terms listed on packet p. 23

Introduction to Photosynthesis and Cellular Respiration

I. The Basics

A. All organisms, plants and animals, break down molecules to make ATP.
B. This process is called **Cellular Respiration**
C. Cellular respiration requires oxygen and glucose
D. ATP is cellular energy that is "cashed in" to do work in a cell.
E. Work for a cell includes:
   1. 2.
   3. 4.

$C_6H_{12}O_6 + 6O_2 \text{ ---> } 6H_2O + 6CO_2 + 36ATP$

F. Plants not only break down macromolecules, they also MAKE monomer units and build macromolecules.
G. This process is called **Photosynthesis**.
H. Photosynthesis REQUIRES energy from the sun, water, and carbon dioxide.

$\text{Light energy} + 6CO_2 + 6H_2O \text{ ---> } C_6H_{12}O_6 + 6O_2$

Consider the information above to answer the following questions:

1. What is *required* for cellular respiration? photosynthesis?
2. Which reaction requires energy?
3. Which reaction produces energy?
4. Which reaction(s) occurs in plant cells? Which reaction(s) occurs in animal cells?
5. What cell organelles are necessary for photosynthesis? What cell organelles are necessary for cellular respiration?

Consider the chart on the next page to answer the following questions:

1. What are the reactants for photosynthesis?
2. What are the reactants for cell respiration?
3. How do you know that carbon cycles?
4. What molecule is essential to both of these reactions occuring at a rapid rate.
5. What would happen if the rate at which cellular respiration occurred exceeded the rate of photosynthesis? What is this called?

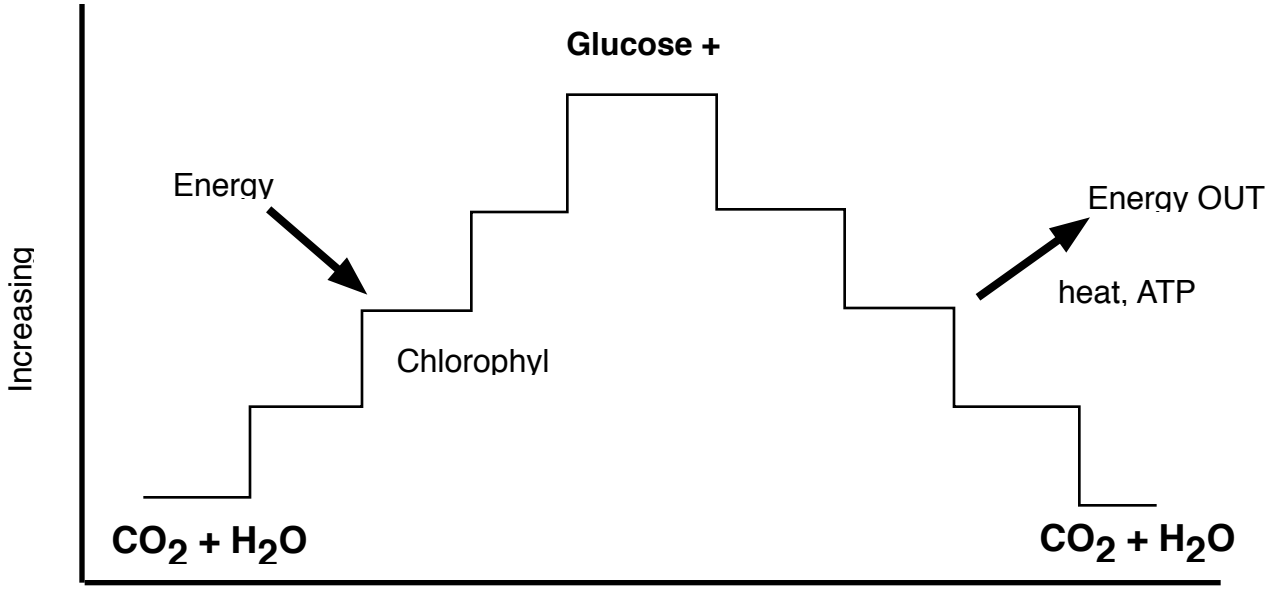
6. Fill in the blanks:

   a.) CO_2 + _____ + light energy -------> _____ + O_2

   b.) glucose + _____ ---------> _____ + H_2O + _____

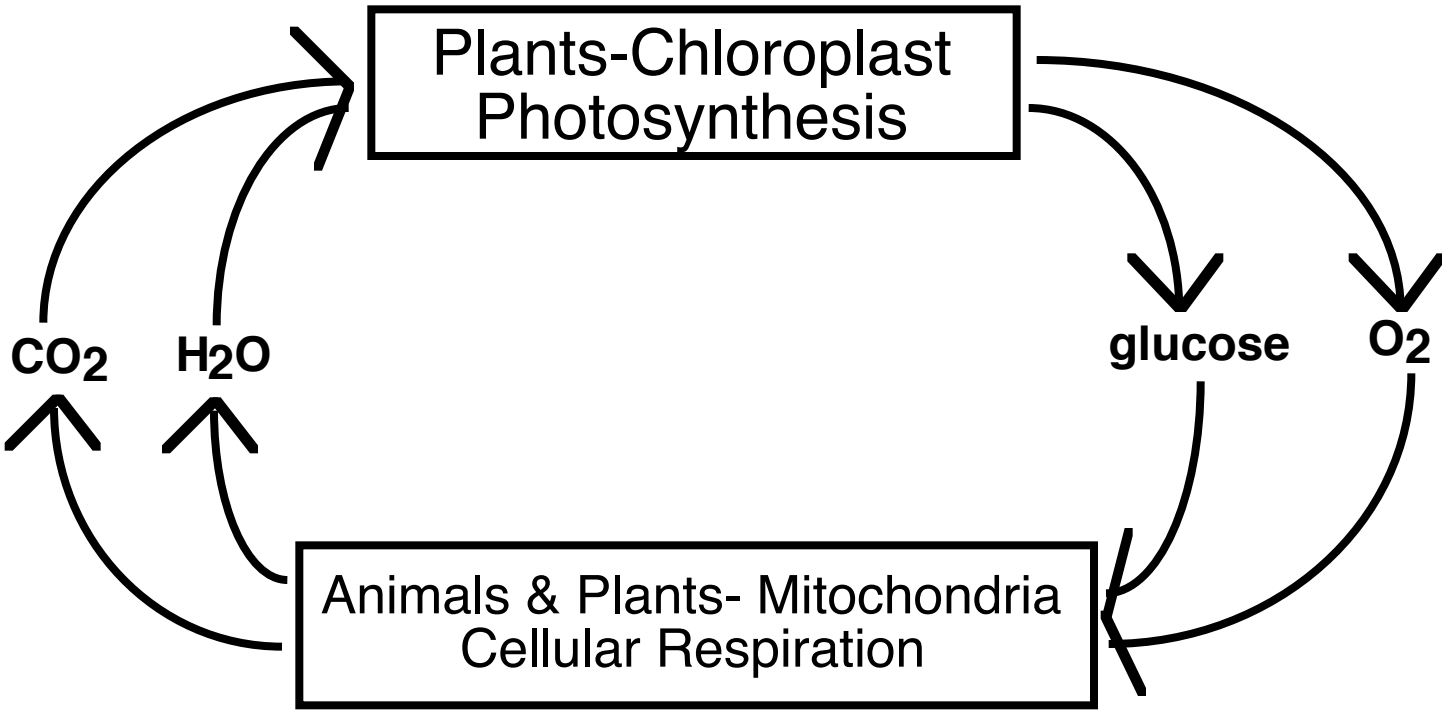
7. Which of the above reactions is cellular respiration? How do you know?

8. Which of the above reactions is photosynthesis? How do you know?II. The Relationship Between Photosynthesis and Cellular Respiration



ENZYMES CONTROL ALL REACTIONS!!

III. The Carbon Cycle



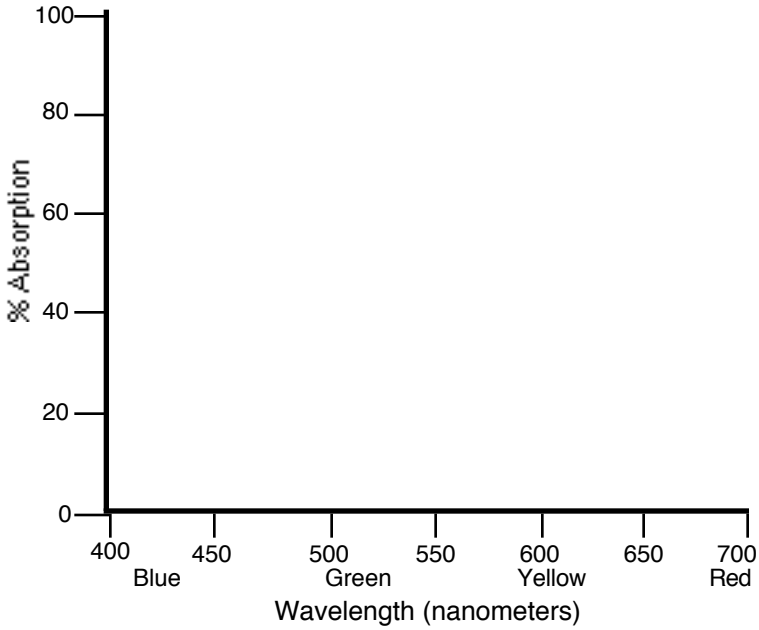
Characteristic	Photosynthesis	Cellular Respiration
Location within Cell		
Anatomy of Organelle		
Raw Materials (reactants)		
Products		
Energy Storage Molecules		
ATP Production ?		
Balanced Reaction		

Cells and Energy Extension
The Absorption of Light by Pigments

Photosynthesis is the process by which green plants convert the energy of sunlight into chemical energy. This process requires special pigments that have hte ability to absorb the energy in light.

Study the chart below that shows the amount and kind of light absorbed by two kinds of chlorophyll common to green plants. Plot these data on the graph on the right. Then, answer the questions below the data chart and graph.

Wavelength (nm)	Chlorophyll A % Absorption	Chlorophyll B % Absorption
400	30	0
450	65	40
500	0	85
550	0	0
600	10	10
650	45	25
700	10	10



1. Chlorophyll A absorbs the greatest amount of light at a wavelength of _____ nanometers.

2. Chlorophyll B absorbs the greatest amount of light at a wavelength of _____ nanometers.

3. Why do artificial plant grow lights have a light spectrum that favors the blue and red portions of the spectrum?

_____

_____

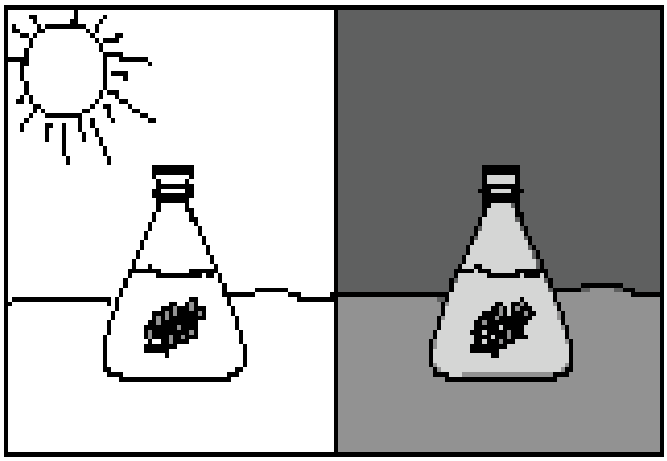
4. Using the graph above, explain why the leaves of trees are green in summer.

_____

_____

5. The plant pigment xanthophyll absorbs light in the range of 400-500 nanometers and reflects all other light. What colors are tissues that contain only xanthophylls? Why?

_____



Analyzing a process involves breaking down the process into its smaller components. The role of each part in the overall process is identified. The relationships that exist among the various parts are also examined. Developing an understanding of the function of each part leads to an improved understanding of the process as a whole. You can read more about analyzing processes by reading page 950 of your text.

THE EXPERIMENT:
Bromthymol blue is a pH indicator that turns yellow in the presence of carbon dioxide. In a particular experiment, a scientist filled two flasks with bromthymol blue. She then placed a sprig of Elodea, an aquatic autotroph, in each flask. One flask was put inside a dark cabinet, while the other was put in direct sunlight. After 24 hours, the scientist compared the contents of the flasks. The flask that had been put in the dark contained a yellow liquid. The flask that had been put in sunlight contained a blue liquid. What caused these results?

APPLICATION: Write a complete answer to each question.

1. What processes associated with energy occur within the Elodea? Explain your answer.

_____
_____
_____

2. Identify the products of the processes described above.

_____
_____
_____

3. Describe the processes that occurred in each flask. What evidence do you have that these processes occurred?

_____
_____
_____

4. In another experiment, the scientist exhaled through a tube that led into a flask containing bromthymol blue. She then placed a sprig of Elodea in the flask, put the stopper in it, and placed it on a sunny windowsill. Predict what she observed.

_____

_____

Section 3.1: Looking at Cells

In the space provided, write the letter of the measurement that best matches the term or phrase.

_____ **1.** height of a human	**a.** 2 cm
_____ **2.** diameter of a penny	**b.** 2 m
_____ **3.** diameter of a blood cell	**c.** 2 m
_____ **4.** length of a bacterium	**d.** 20 cm
_____ **5.** length of a human hand	**e.** 10 m

In the space provided, explain how the terms in each pair differ in meaning.

6. magnification, resolution

7. light microscope, electron microscope

Read each question, and write your answer in the space provided.

8. What is the difference between a magnifying glass and a compound light microscope?

9. What is the difference between a transmission electron microscope and a scanning electron microscope?

Section 3.2: Cell Features

Read each question, and write your answer in the space provided.

1. What is the cell theory?

2. Why can small cells exchange substances more readily than large cells?

3. What are prokaryotes?

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **6.** eukaryote	**a.** short hairlike structures
_____ **7.** organelles	**b.** cell structures that carry out specific activities
_____ **8.** nucleus	**c.** houses the cell's DNA
_____ **9.** cilia	**d.** cells contain nuclei

Complete each statement by writing the correct term or phrase in the space provided.

10. The _____ is made of a double layer of phospholipids.

Section 3.3: Cell Organelles
Read each question, and write your answer in the space provided.
1. What two substances are made in the nucleus and move into the cytoplasm?

2. What substance is stored in the nucleus?

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **3.** endoplasmic reticulum	**a.** packages and distributes proteins
_____ **4.** Golgi apparatus	**b.** small membrane-bound sac
_____ **5.** vesicle	**c.** internal membranes that move substances through the cell
_____ **6.** lysosomes	**d.** small organelles that contain digestive enzymes

Read each question, and write your answer in the space provided.
7. What is ATP?

8. What function do mitochondria perform?

In the space provided, write *Plants* if the structure is found in plant cells only.
Write *Both* if the structure is found in both plant cells(P) and animal cells(A).

_____ **9.** cell membrane	_____**12.** cell wall
_____**10.** ribosomes	_____**13.** mitochondria
_____**11.** nucleus	_____**14.** chloroplasts

Critical Thinking: Work-Alikes
In the space provided, write the letter of the term or phrase that best describes how each numbered item functions.

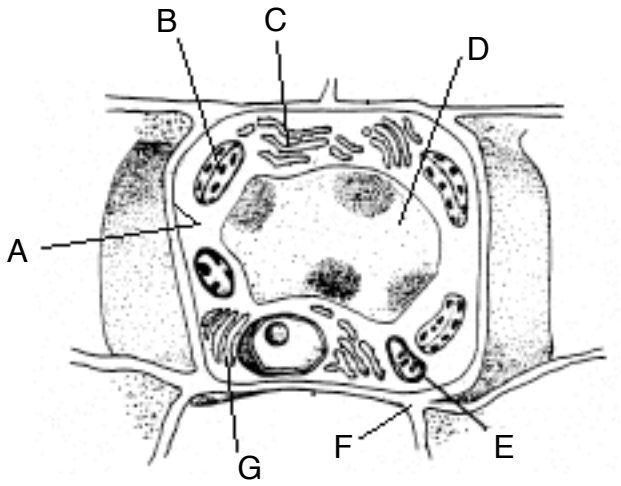
_____ **11.** cilia	**a.** welcoming committee
_____ **12.** cell membrane	**b.** boat oars
_____13. ribosome	**c.** gate keepers
_____ **14.** receptor proteins	**d.** protein factories
_____**15.** transport proteins	**e.** security guard

Chapter 3 Practice Test

Complete each statement by writing the correct term or phrase in the space provided.

7. A cell's boundary is called the _____ _____.
8. In a bacterium, the _____ _____ provides structure and support.
9. In the cell membrane, _____ _____aid the movement of substances into and out of a cell.
10. In plant cells, rigidity is provided by a large, membrane-bound sac called the _____ _____.
11. Nuclear _____ allow certain substances to pass into and out of the nucleus of a cell.
12. Vesicles that contain a cell's digestive enzymes are called _____.
13. The "head" of a phospholipid is _____ , so it is attracted to water, while the "tails" are_____ , so they are repelled by water.
14. The cytoskeleton is a network of protein fibers that support the shape of a cell and may be involved in the movement of_____ .
15. If a compound microscope has a 50 X objective lens and a 10 X ocular lens, a viewed image appears _____ times larger than its actual size.
16. Mitochondria contain their own _____ , so they can produce their own proteins.

Questions 17–23 refer to the figure below.



17. The structure labeled *A* is the _____ _____.
18. The organelle labeled *B* is a _____.
19. The structure labeled *C* is the _____ _____.
20. The structure labeled *D* is the _____ _____.
21. The organelle labeled *E* is a _____.
22. The structure labeled *F* is the _____ _____.
23. The organelle labeled *G* is the _____ _____.

Read each question, and write your answer in the space provided.
24. List the three parts of the cell theory.

25. List the primary differences between prokaryotic cells and eukaryotic cells.

26. **Section 4.1: Passive Transport**

Read each question, and write your answer in the space provided.

1. What is passive transport? Why is diffusion an example of passive transport?

2. How does the cell membrane help cells maintain homeostasis?

3. What determines the direction in which a substance diffuses across a membrane?

4. Describe the state of equilibrium.

In the space provided, explain how the terms in each pair differ in meaning.

5. osmosis, diffusion

6. hypertonic solution, hypotonic solution

7. isotonic solution, equilibrium

In the space provided, write the letter of the description that best matches the term or phrase.

____ **8.** hypertonic solution	**a.** difference in the concentration of a substance across space
____ **9.** selective permeability	**b.** the inside of a typical cell
____**10.** osmosis	**c.** diffusion of water through a cell membrane
____**11.** negatively charged	**d.** allows charged molecules to pass through the cell membrane
____**12.** facilitated diffusion	**e.** enables a cell to control what enters and leaves
____**13.** concentration gradient	**f.** will cause a cell to shrivel up
____**14.** ion channel	**g.** involves carrier proteins

Active Reading Skills Worksheet

Read the passage below. Notice that the sentences are numbered. Then answer the questions that follow.

[1] The diffusion of water through a selectively permeable membrane is called **osmosis**. [2]Like other forms of diffusion, osmosis involves the movement of a substance—water—down its concentration gradient. [3] Osmosis is a type of passive transport. [4]If the solutions on either side of the cell membrane have different concentrations of dissolved particles, they will also have different concentrations of "free" water molecules. [5]Osmosis will occur as water molecules diffuse into the solution with the lower concentration of free water molecules.

Read each question, and write your answer in the space provided.

1. What key term is defined in this passage? What does this term mean?

2. How are diffusion and osmosis related?

3. What does the word *water* in Sentence 2 tell you about osmosis?

Section 4.2: Active Transport

Complete each statement by writing the correct term or phrase in the spaceprovided.

1. The transport of a substance across the cell membrane against its concentration gradient is called _____ _____.

2. Active transport requires the cell to use _____.

3. The energy needed for active transport is usually supplied by _____.

4. The sodium-potassium pump is a(n) _____ protein.

5. The concentration of sodium ions inside the cell is usually _____ than the concentration of sodium ions outside the cell.

6. The concentration of potassium ions inside the cell is usually _____ than the concentration of potassium ions outside the cell.

7. The sodium-potassium pump picks up _____ ions outside the cell.

8. The sodium-potassium pump releases _____ ions inside the cell.

Read each question, and write your answer in the space provided.

9. Explain why proteins and polysaccharides cannot diffuse through the membrane like water does.

10. What is the difference between endocytosis and exocytosis?

11. How do sodium-potassium pumps support the efficient functioning of cells?

Analogies: In the space provided, write the letter of the pair of terms or phrases that best completes the analogy shown.

_____**12.** active transport : ATP ::

a. carbon : fuel
b. passive transport : sodium
c. facilitated diffusion : concentration
d. campfire : wood

_____13. exocytosis : vesicles out ::

a. endocytosis : exocytosis **c.** exocytosis : ATP

b. endocytosis : vesicles in **d.** vesicles : ATP

_Vocabulary Review: Skills Worksheet

Match the words on the left with the statements on the right.

_____ **1.** passive transport **a.** difference in the concentration of a substance across a space

_____ **2.** concentration gradient **b.** does not require energy from a cell

_____ **3.** equilibrium **c.** molecules move from an area of high concentration to a lower concentration

_____ **4.** diffusion **d.** concentration of a substance is equal throughout a space

Match the words on the left with the statements on the right.

_____ **5.** osmosis **a.** causes a cell to shrink because of osmosis

_____ **6.** hypertonic solution **b.** produces no change in cell volume because of osmosis

_____ **7.** hypotonic solution **c.** diffusion of water through a semi permeable membrane

_____ **8.** isotonic solution **d.** causes a cell to swell because of osmosis

Match the words on the left with the statements on the right.

_____ **9.** ion channel **a.** movement of a substance against substance's concentration gradient

_____**10.**carrier protein **b.** passive transport using carrier proteins

_____**11.** facilitated diffusion **c.** protein used to transport specific substances

_____**12.** active transport **d.** transport protein through which ions can pass

Pretest

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ **1.** When a cell uses energy to transport a particle through the cell membrane to an area of higher concentration, the cell is using

a. diffusion. **c.**osmosis.

b. active transport. **d.** facilitated diffusion.

_____ **2.** The excretion of materials to the outside of a cell by discharging them from vesicles is called

a. exocytosis. **c.** osmosis.

b. endocytosis. **d.** diffusion.

Questions 13–15 refer to the figures below.

A B C

13. Figure *A* illustrates a cell in a(n) _____ solution.

14. Figure *B* illustrates a cell in a(n) _____ solution.

15. Figure *C* illustrates a cell in a(n) _____ solution.

Suppose you want to explain a concentration gradient to someone. Create a scenario that illustrates passive transport down the concentration gradient.

Using your understanding of osmosis, describe why putting salt on a pork chop before cooking it on a grill is likely to result in a dry, tough piece of meat.

How is facilitated diffusion different from the other passive transport processes?

How does a cell consume a food particle that is too large to pass through a protein channel?

Section 5.1: Energy and Living Things

In the space provided, write the letter of the description that best matches the term or phrase.

_____ **1.** photosynthesis	**a.**building molecules that can be used as an energy source, or breaking down molecules in which energy is stored
_____ **2.** autotroph	**b. T**he process by which light energy is converted to chemical energy
_____ **3.** heterotroph	**c.** an organism that uses sunlight or inorganic substances to make organic compounds
_____ **4.** cellular respiration	**d.** an organism that consumes food to get energy
	e. the process of getting energy from food
_____ **5.** metabolism	

Read each question, and write your answer in the space provided.

11. What is the difference between cellular respiration and getting energy from a log by burning it?

12. Why is ATP called an "energy currency"?

13. How is energy released from ATP?

14. How is ATP important to cell metabolism?

Read each question, and write your answer in the space provided.

4. Where does the energy for human metabolism come from?

5. Write the chemical equation that is used to summarize photosynthesis.

Complete each statement by writing the correct term or phrase in the space provided.

6. Light-absorbing substances are called _____.

7. Pigments found in plants include chlorophyll *a*, chlorophyll *b*, and _____.

8. ATP is made from ADP by adding a(n) _____ group to a molecule of ADP.

he role of fermentation in cellular respiration is to recycle _____.

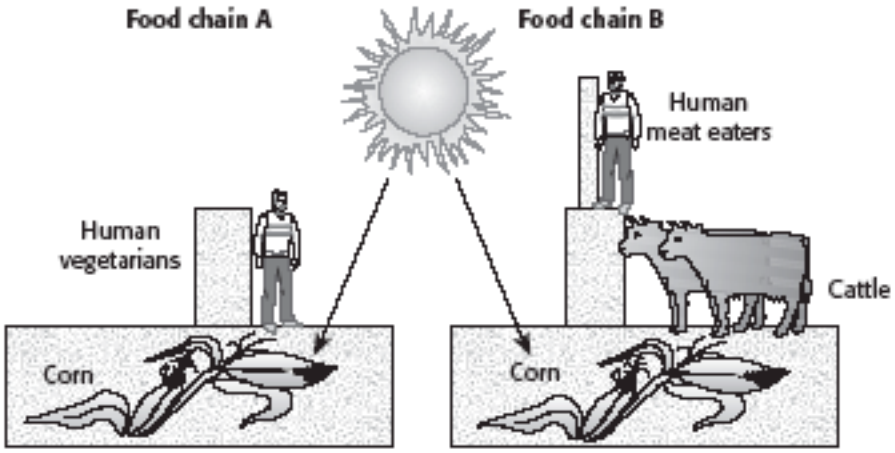
Read each question, and write your answer in the space provided.

11. Explain what causes muscle soreness during exercise?

12. Why do cells produce more ATP under aerobic conditions than under anaerobic conditions?

Science Skills: Interpreting Data

Scientists estimate that only 10 percent of the energy present at each level of the food chain is available to the next level. Scientists also estimate that only 1 percent of the light energy from the sun that reaches photosynthetic organisms is converted to chemical energy during photosynthesis. Use this information and the two food chains below to answer the questions that follow.



Read each question, and write your answer in the space provided

1. Assume that 1 million kilocalories (kcal) of energy from the sun is available to the autotrophs in the food chains above. Determine the amount of energy that will be available at every level of each food chain. Show your work.

2. Explain why most food chains consist of no more than three or four levels.

3. What happens to the stored energy that does not advance from one level of the food chain to the next?

4. A 55 kg person at rest requires an average of 54 kcal/hour. The same person engaged in activity requires an average of 87.5 kcal/hour. What is the percent increase in required kcal/hour between rest and activity? Which would be a more efficient diet for an active person—plant foods or meat? Explain.

5. Earth's population is increasing at a rate that may outpace our ability to produce enough food. Why are some people promoting vegetarianism as an answer to this problem?