BIOLOGY NOTEBOOK MP1

NAME_____

SCI#_____

HOLT USER NAME_____

LAB PARTNER_____

1.Using the Microscope

Procedures

1. Review the parts of the compound microscope
2. Place the slide on the stage. Secure the slide so that the slide is flat against the stage.
3. Move the slide so that the light is shining through the area to be viewed.
4. Turn the low power objective (10X) in place until you hear it click. Lower the objective using the coarse focus knob until it is almost touching the slide.
5. Look through the eyepiece and adjust the diaphragm until you see a bright light.
6. Using the coarse adjustment, raise the objective until the object comes into focus.
7. Use the fine adjustment to bring the object into sharp focus.
8. When you find the object to be viewed, center it in the field. Then you may switch to high power (40X) by carefully rotating the objective until you hear a click. Be sure not to crack the slide! You will need to readjust the focus using ONLY the fine adjustment knob.

Troubleshooting:

Problem: object can't be seen clearly or found under low power.

Solution: make sure the eyepiece, objective and slide are clean. Make sure the diaphragm is open.You may need to adjust the diaphragm so that not as much light is coming through- transparent objects can be washed out by too much light. When unsure if the object is centered, move the slide so the edge of the coverslip is directly under the objective. Focus on the seam of the coverslip and adjust the focus. Then move the slide using your eyes (not the eyepiece) so that the center of the slide is under the objective.

Problem: Object can't be found under high power.

Solution: Check to be sure that the object is centered over the stage opening. You may need to return to low power.

2. Calculating Magnification

Objects viewed under the microscope appear larger than normal because they are magnified. You can calculate total magnification by

1. Look for the number marked with an X on the
    a. Eyepiece
    b. Low power objective
    c. High power objective
2. Multiply the number on the eyepiece by the number on the objective.

Ex- eyepiece is 10X and the objective is 40X. the total magnification is 400X

3.Making a Wetmount

1. Add a drop of water to the center of a clean microscope slide.
2. Place the object to be viewed in the drop of water.
3. Pick up a coverslip by its edges. Do not touch the surface of the coverslip. Stand the coverslip on its edge next to the drop of water
4. Slowly lower the coverslip over the drop of water and the object to be viewed.

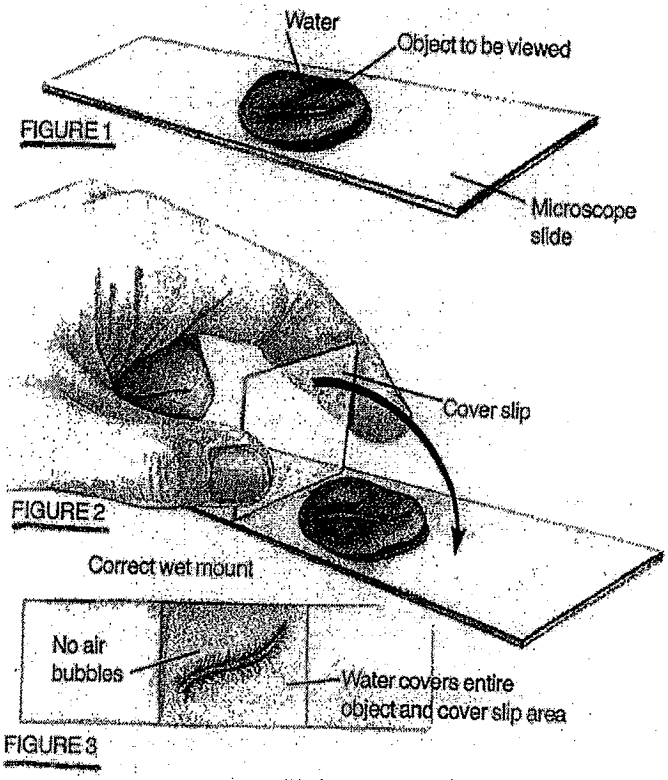


FIGURE 1
FIGURE 2
FIGURE 3

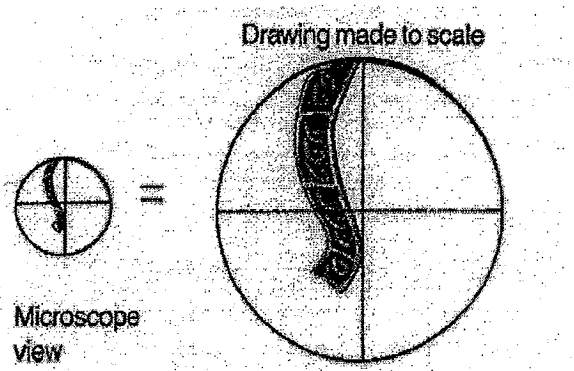
Troubleshooting

1. Not enough water: air bubbles will form. Air does not refract light in the same way as water- therefore you will not be able to see an object in or near an air bubble. Air bubbles will appear as dark black dots or lines
2. Too much water: water will come out from under coverslip and coverslip will be floating and moving. Take a paper towel and touch the edge of the paper towel to the edge of the coverslip. This is also how you pull stain across a specimen.

4.Making Scale Drawings

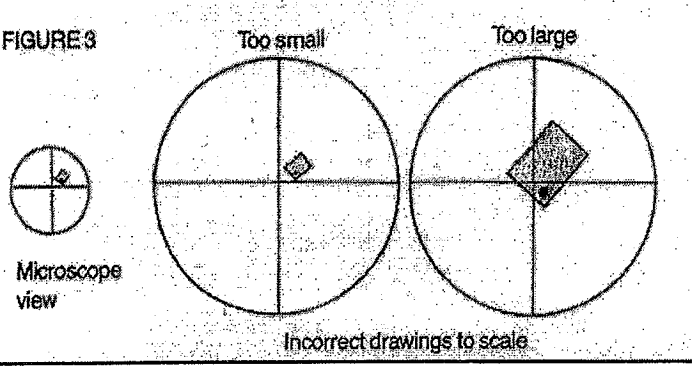
When you draw objects seen through the microscope, the size that you make your drawing is important. Your drawing should be in proportion to the size the object appears to be when viewed through the microscope. This is called drawing to scale. This allows you to compare the sizes of different objects.

1. Draw a circle on the paper
2. Imagine the circle divided into 4 equal sections
3. When looking through the eyepiece, imagine the same 4 equal sections
4. Note how much of the object takes up each quadrant. Draw each quarter exactly as it appears in the eyepiece.



Correct

FIGURE 3



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6.Writing a Hypothesis

A hypothesis is a possible or tentative explanation for a question or problem. A properly written hypothesis has a dependent and independent variable.

Dependent Variable- this is what may happen because of the independent variable. In other words it depends on the independent variable.

Independent Variable- this is what is having an effect on the dependent variable

Here are some Examples to help clear this up!

Problem: Does the amount of air in a basket ball determine how high it will bounce?

Hypothesis:

The amount of air in a basketball affects how high it will bounce.
(I.V.) (D.V.)

Problem: Does the temperature affect how active the lizard is?

Hypothesis:

Warmer temperatures increase the activity level of a lizard.
(I.V.) (D.V.)

Problem: IS the speed that a boy walks affected by how baggy his pants are?

Hypothesis:

The speed that boy walks is affected by how baggy his pants are

(D.V.) (I.V.)

Listed below are some already written hypotheses. Underline the independent variable and **circle** the dependent variable in each one. Basically, the dependent variable is something that can be measured like speed, height, odor, etc. and the independent variable is something that is causing different amounts of the thing being measured.

1. The amount of sunlight a plant gets affects how tall the plant will grow.

2. Female elks with higher level of hormones will migrate faster

3. A teacher's attitude is affected by the number of students in her class

4. The amount of sleep a students gets before a test affects the score he or she earns on a the test

5. A person's sex determines how fast they can learn.

6. The amount of hairspray a girl uses affects the number of boys who ask her out.

7. Eating broccoli increases the number of correct answers on a math test

8. Applying fertilizer affects the number of weeds growing in a yard

9. The amount of rainfall affects how many flowers a cactus produces

10. A rougher road increases the number of times you fall when rollerblading.

11. Telling your mother that she is a good cook increases the hour of your curfew.

12. Washing the dishes for your mother increases the amount of money she gives you on the weekend.

13. Coaches with more years of experience will have a higher percentage of wins.

14. The amount of food that a bird eats is affected by the temperature.

15. Eating chocolate affects the number of zits you get.

Here is something a little different to try. Now I am going to give you the problem and you have to write a hypothesis. Underline the independent variable and **circle** the dependent variable for each hypothesis you create.

1. Does the number of holes in your pants affect the number of detentions you get?

2. Does the color of a person's hair affect the scores they get on tests?

3. Does the color of a T-shirt you wear affect the number of people who smile at you?

4. Does the type of music you listen to affect your grades?

5. What affect does the temperature have on the length of an animal's hair?

6. Does the amount of salt in water affect how fast it will boil?

7. Does the way a boy's hair is cut affect how many girl's like him?

8. Does music have an affect on the number of eggs a chicken will lay?

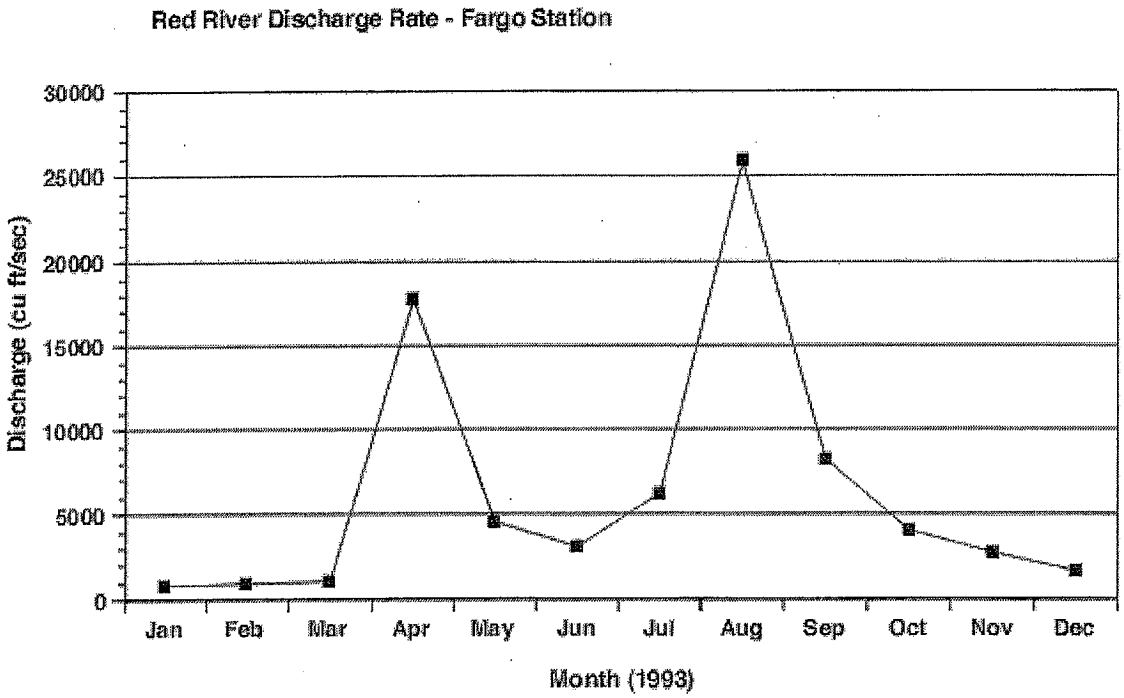
9. What effect does the price of a pair of jeans have on how good they fit?

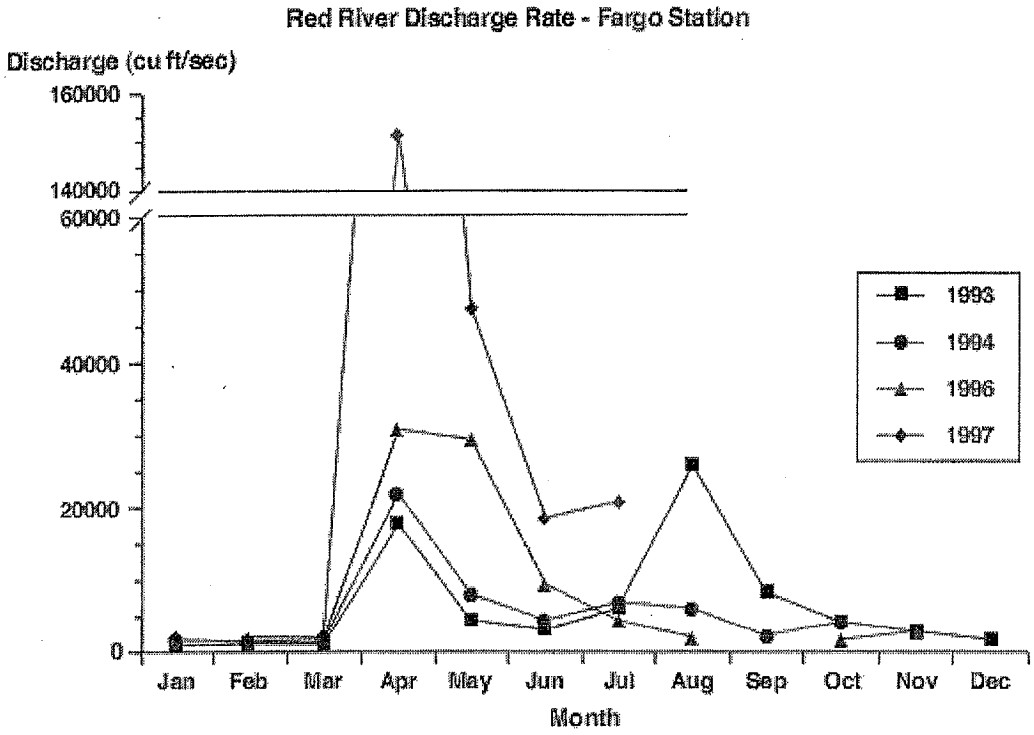
10. What affect does cockroach poison have on the number of cockroaches in a house?

7. Graphing

Line Graphs

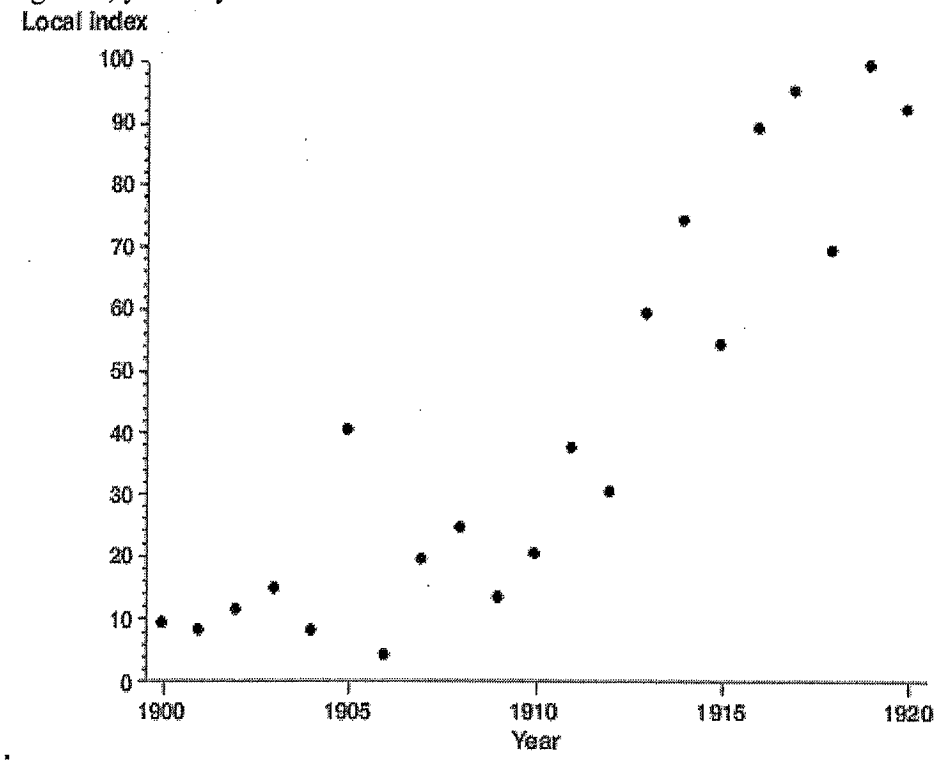
Line graphs are very useful to plot a value over time. Line graphs are useful when both variables are quantitative (numerical). The line can be studied to find the slope, which can be useful for studying certain properties. The slope is a tool used to mathematically express a trend in the data.

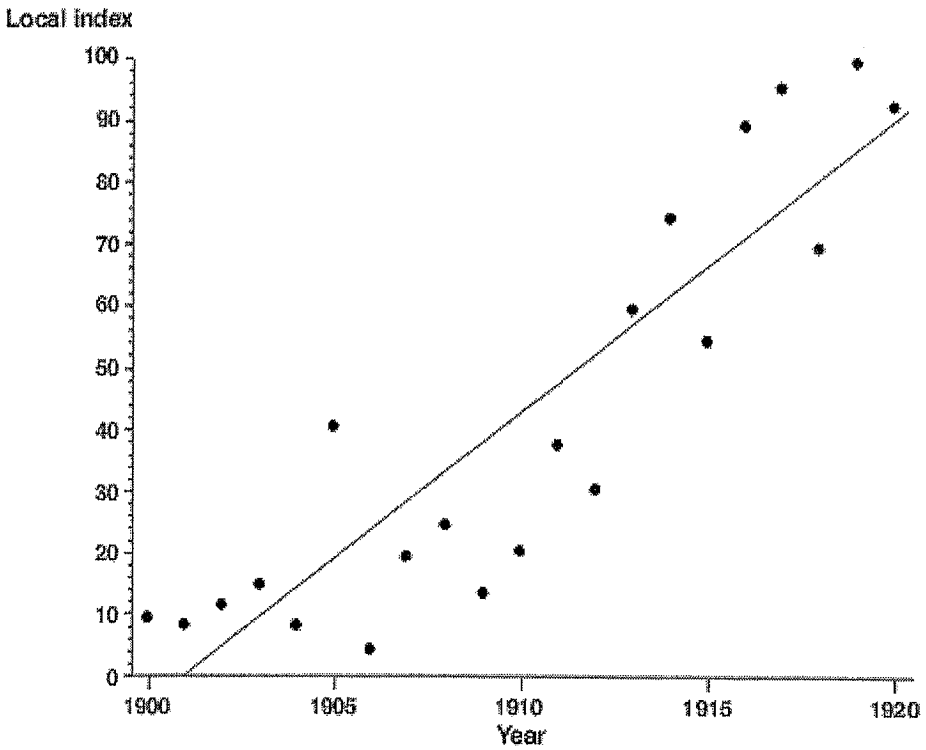




Scatter Plot

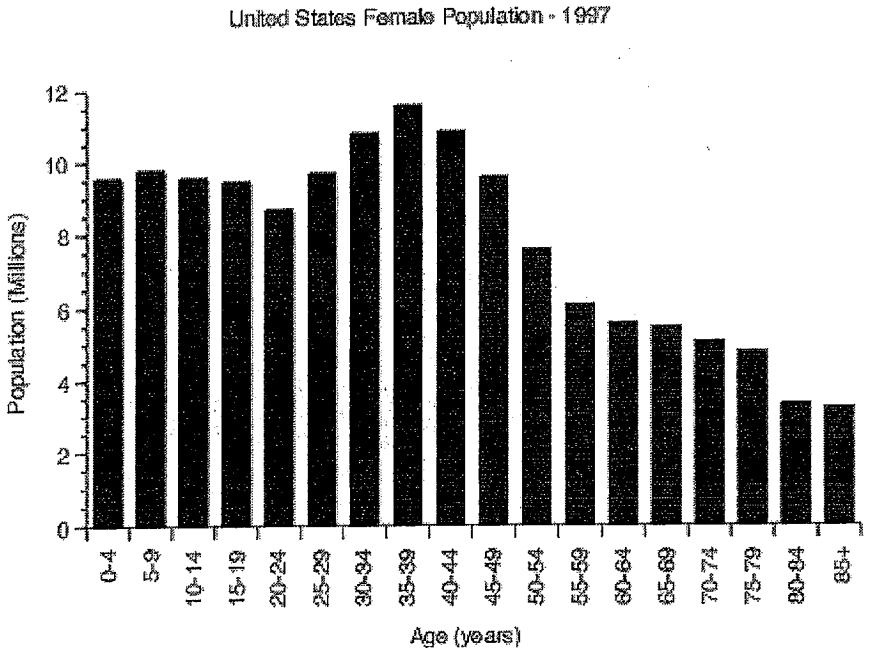
With a scatter plot a mark, usually a dot or small circle, represents a single data point. With one mark (point) for every data point a visual distribution of the data can be seen. Depending on how tightly the Points cluster together, you may be able to discern a clear trend in the information





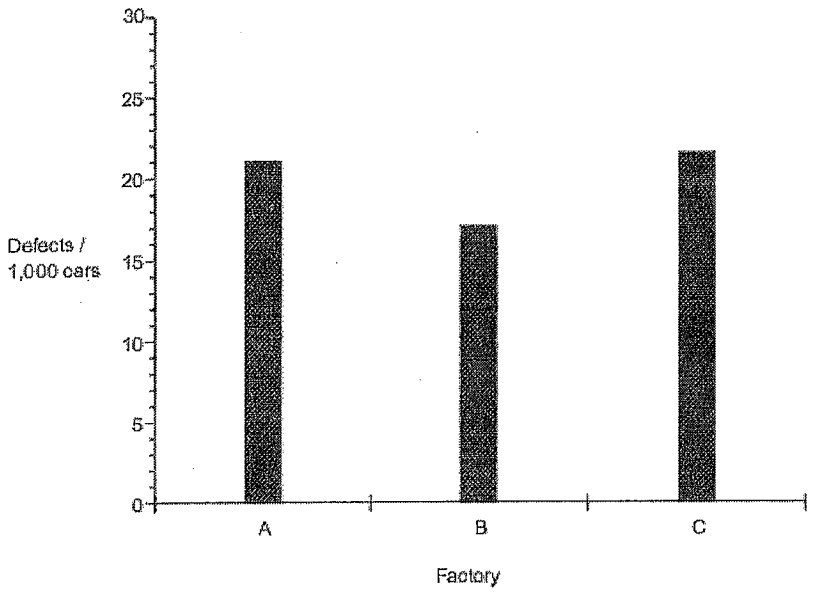
Histogram

A histogram is a graphic display of frequencies of a value. It is the graphical equivalent of the table of how many of each cateogory fall into the range... The histogram differs from a bar chart in that it is the *area* of the bar that denotes the value, not the height, a crucial distinction when the categories are not of uniform width.



Bar Graphs

Bar graphs are a coomon type of graph that are best suited for qualitative information, such as name or group. there is no unbiform distance between the bars- due to qualitative nature- and a slope can NOT be derived from the information presented.



Measuring with a Microscope

Pre-Lab Discussion

The microscope, developed more than three hundred years ago, is the basic tool of the biologist. The microscope enables biologists to investigate living things and objects that are too small to be seen with the unaided eye. The microscope is able to magnify these tiny specimens by means of lenses located in the eyepiece and objectives. The light microscope is also capable of revealing fine detail. This ability to reveal fine detail is known as resolving power. The type of microscope that you will be using throughout your study of biology is the compound light microscope.

Although it is interesting and informative to observe specimens under the microscope, it is often difficult to know the actual size of the object being observed. Magnification causes us to lose the idea of actual size. You cannot hold up a ruler to a paramecium or a plant cell while it is under the microscope. Therefore size must be measured indirectly—that is, it must be compared with the size of something you already know. The diameter of the microscope field seen through the eyepiece is a convenient standard to use. To measure objects under the microscope, a unit called the micrometer (μm) is used. One micrometer equals 0.001 millimeter.

In this investigation, you will develop skill in using the compound light microscope. You will also learn how to estimate the sizes of objects under the microscope.

Problem

How is the compound microscope used to make measurements of microscopic specimens?

Materials *(per group)*

Microscope	Transparent metric ruler
Lens paper	Prepared slides

Safety

Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling glass slides as they can break easily and cut you. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

1. Take a microscope from the storage area and place it about 10 centimeters from the edge of the laboratory table.
2. Carefully clean the eyepiece and objective lenses with lens paper.
3. Examine the markings on a metric ruler. Decide which marks indicate millimeter lengths. Place the ruler on the stage so that it covers half of the stage opening, as shown in Figure 1.

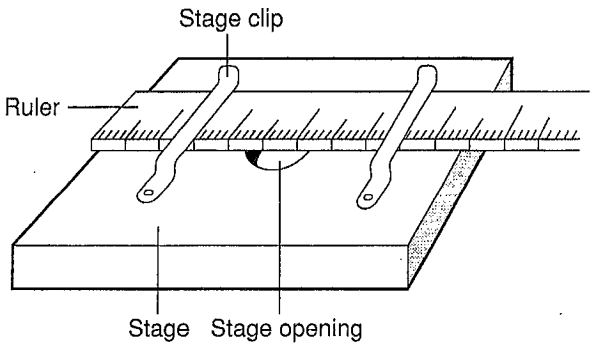


Figure 1

4. Prepare your microscope for low-power observation of the ruler.
5. Look through the eyepiece. Focus on the edge of the ruler using the coarse adjustment. Adjust the position of the ruler so that the view in the low-power field is similar to Figure 2.
6. Place the center of one mark at the left side of the field of view. Make sure that the edge of the ruler is exactly across the center of the field. If the ruler sticks to your fingers, use the eraser end of a pencil to arrange it.

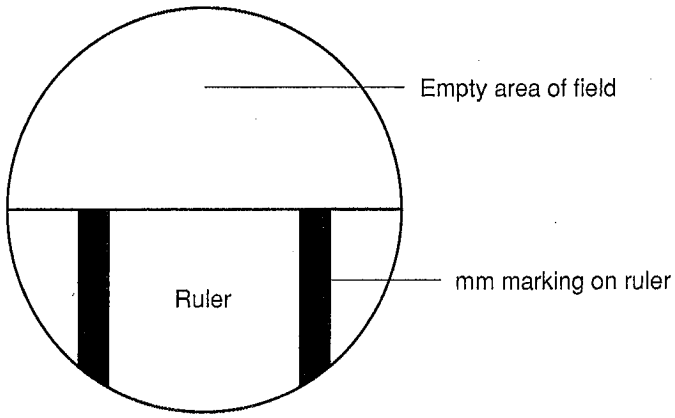


Figure 2

7. Note that 1 millimeter is the distance from the middle of one mark to the middle of the next mark. The diameter of the low-power field measures 1 millimeter plus a fraction of another. In Observations, record the measurement of the low-power field diameter in millimeters, expressing the length to the nearest tenth of a millimeter.
8. In Observations, record the measurement of the low-power field diameter in micrometers.
9. You cannot measure the diameter of the high-power field using the process you have just completed. Viewing a ruler under high power presents problems with light and focusing. Also, the high-power field diameter is less than 1 millimeter. But you can obtain the high-power field diameter indirectly. You know the low-power field diameter and the magnifying power of both objectives. Since the magnification of the objectives is inversely proportional to the field size, you can use this formula:

$$\text{high-power field diameter} = \frac{\text{low-power field diameter} \times \text{low-power magnification}}{\text{high-power magnification}}$$

   In Observations, record the high-power field diameter in micrometers. Show your calculations.
10. Now that you know the diameter of your field size under both low and high power, you can estimate the sizes of the objects you view under the microscope by comparing them with the diameter of the field of vision. For example, if a tiny organism takes up approximately one-half of a field of view that is 1000 micrometers in diameter, then its size is about one-half of 1000 micrometers, or 500 micrometers.

11. Obtain prepared slides of various organisms and practice estimating their lengths. Write the name of the organism or part you examine and its estimated size in micrometers in the Data Table.
12. When you have finished examining the organisms in step 11, return your microscope to the storage area.

Observations

1. Measurement of the low-power field diameter = _____
2. Measurement of the low-power field diameter = _____ micrometers.
3. Low-power magnification = _____
4. High-power magnification = _____
5. Use the formula shown in step 9 of Procedure to calculate the high-power field diameter. Show your calculations.

Data Table

Name of Object	Measurement of Object (μm)

Analysis and Conclusions

1. How many micrometers are in 1 millimeter? _____
2. How many micrometers are in 1 meter? _____
3. What happens to the field of view when you change from low-power magnification to high-power magnification? _____

4. How many times is the magnification increased when you change from low-power to high-power magnification? _____

5. How many times is the diameter of a field decreased when you change from low-power to high-power magnification? _____

Critical Thinking and Application

1. Approximately 500 of a certain type of bacteria can fit across your low-power field of vision. What is the approximate size of 1 bacterium? _____

2. Approximately 7 of a certain type of protist can fit across your high-power field of vision. What is the approximate size of 1 protist? _____

3. If a microscope has a low-power magnification of 100X, a high-power magnification of 600X, and a low-power field diameter of 1800 micrometers, what is the high-power field diameter in micrometers? _____

4. If 20 objects fit across a low-power field of view whose field diameter is 3000 micrometers, what is the approximate size of each object? _____

1–1 How Is the Light Microscope Used?

A microscope is a tool used to look at very small things. "Micro" means small and "scope" means to look at. The microscopes that you will use in class have two or more lenses. A lens is a curved piece of glass. The lenses inside your microscope make the objects you look at appear larger. They are located in the eyepiece and in the objectives.

You may wonder how much larger your microscope can make something look. The magnifying power of a microscope is how many times larger a microscope makes something look. The eyepiece of your microscope probably makes things look ten times larger. If so, it has 10× written on it. Each objective lens also has a power written on it. To find the magnification for your microscope, multiply the eyepiece power by the power of the objective lens you are using.

OBJECTIVES

In this exercise, you will:

a. learn the names and jobs of microscope parts.
b. learn how to use and care for the microscope.
c. determine the magnification of your microscope.

KEYWORDS

Define the following keywords:

compound light microscope _____

field of view _____

lens _____

stage _____

MATERIALS

light microscope
lens paper
prepared slide of insect leg

PROCEDURE

1. The microscope should always be handled with care. Use one hand to hold the arm. Place the other hand under the base. Move the microscope to your table and gently set it down. (The arm should be toward you.)
2. Use of the microscope is easy if you know the parts. Find the parts listed in Table 1 on page 2 on your microscope.

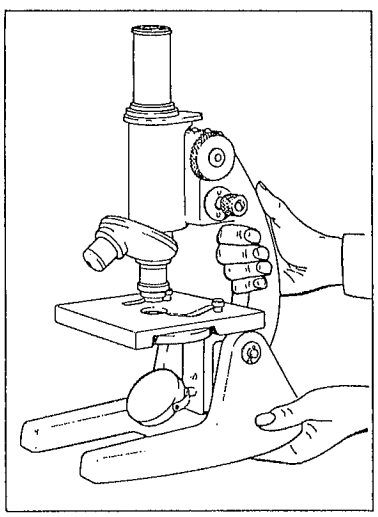


FIGURE 1. Carrying a microscope

Table 1. Microscope Parts and Their Jobs

Part	Name	Job
A	Eyepiece	Holds top lens, usually 10×
B	Body tube	Holds top lens certain distance from lower lenses
C	Arm	Supports body tube
D	Nosepiece	Holds lower lenses, turns to change objectives
E	High power objective	Contains 43× lens
F	Low power objective	Contains 10× lens
G	Coarse adjustment	Moves body tube up and down, brings objects into focus
H	Fine adjustment	Moves body tube up and down slightly, brings objects into focus
I	Stage	Supports slide
J	Stage clips	Holds slide in place
K	Diaphragm	Controls amount of light entering microscope
L	Light or mirror	Sends light through microscope
M	Base	Supports microscope

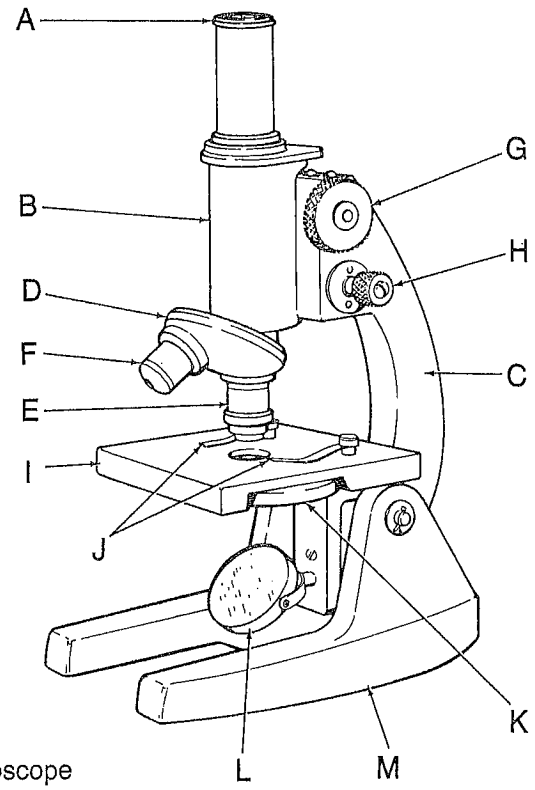


FIGURE 2. Parts of the microscope

3. Before using the microscope, make sure the lenses are clean. Use lens paper *only*. Any other kind of paper may scratch the lenses. Wipe the eyepiece and objective lenses gently.
4. Look through the eyepiece. Turn the diaphragm so that the most light comes through the opening in the stage. The circle of light that you see through the microscope is called the field of view.
5. Turn the nosepiece so that the low power (10×) objective is in place. Put a prepared slide of an insect leg on the stage under the clips. A prepared slide is a slide made to last a long time. Keep the slide clean by holding it by the edges.

6. Always find an object first on low power. Move the slide until the leg is directly over the hole in the stage. Then use the coarse adjustment knob to make what you see clear. Look to the side of your microscope when turning the coarse adjustment to keep from hitting the slide with the objective. Turn the coarse adjustment slowly. When the object is clear, we say it is in focus.
7. Move the slide to the left. Which way does the leg move as you look through the microscope?

_____

8. Move the slide away from you. Which way does the leg move as you look through the microscope? _____

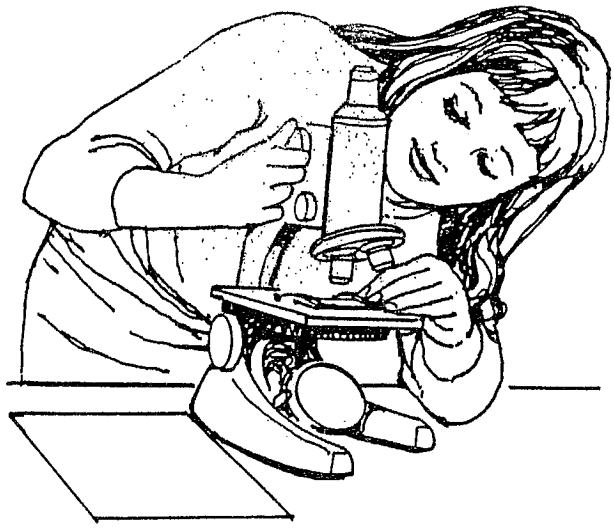
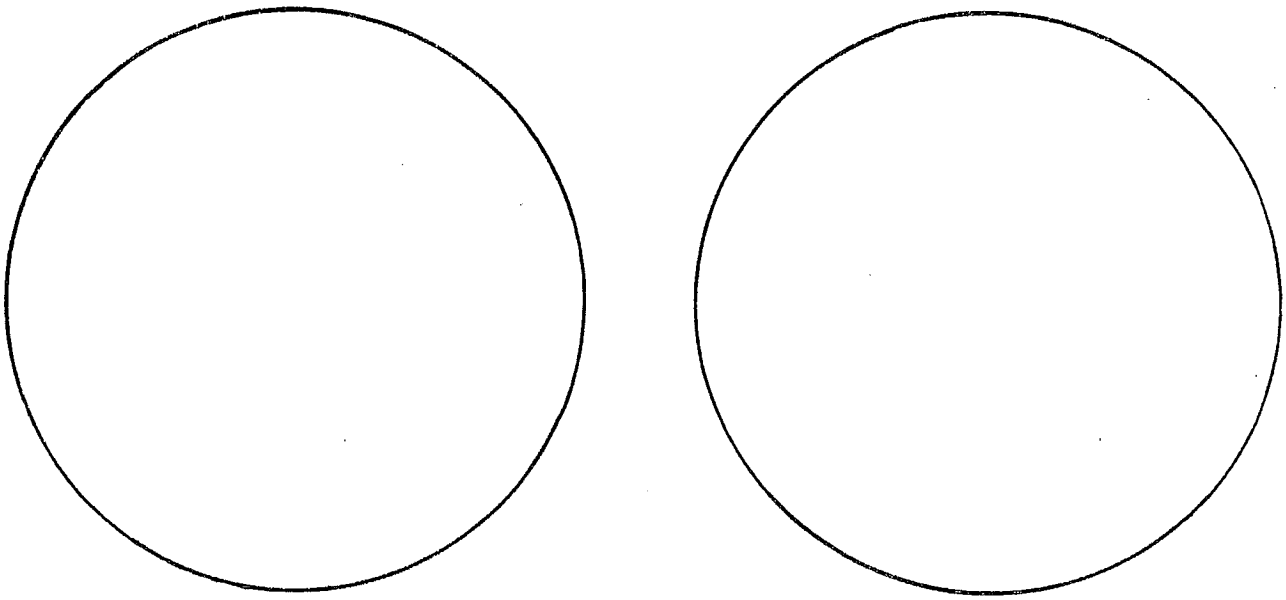


FIGURE 3. Using coarse adjustment

9. Draw the insect leg in the circle in Figure 4 as it appears under low power. Then turn the nosepiece carefully until the high power objective clicks into place. Bring the object into focus by turning *only* the fine adjustment. Observe and draw the leg in the circle in Figure 4 as it appears under high power.



Low power **High power**

FIGURE 4.

10. Switch back to low power. Remove the slide and put it away. Answer the questions on the next page. Then put your microscope away.

QUESTIONS

1. Fill in the chart below to show the total magnification of your microscope on low and high power.

	Eyepiece magnification	×	Objective magnification	=	Total magnification
Low power					
High power					

2. How does the leg look under high power that differs from how it looks under low power?_____

3. When you moved the slide to the right, which way did the insect leg move?_____

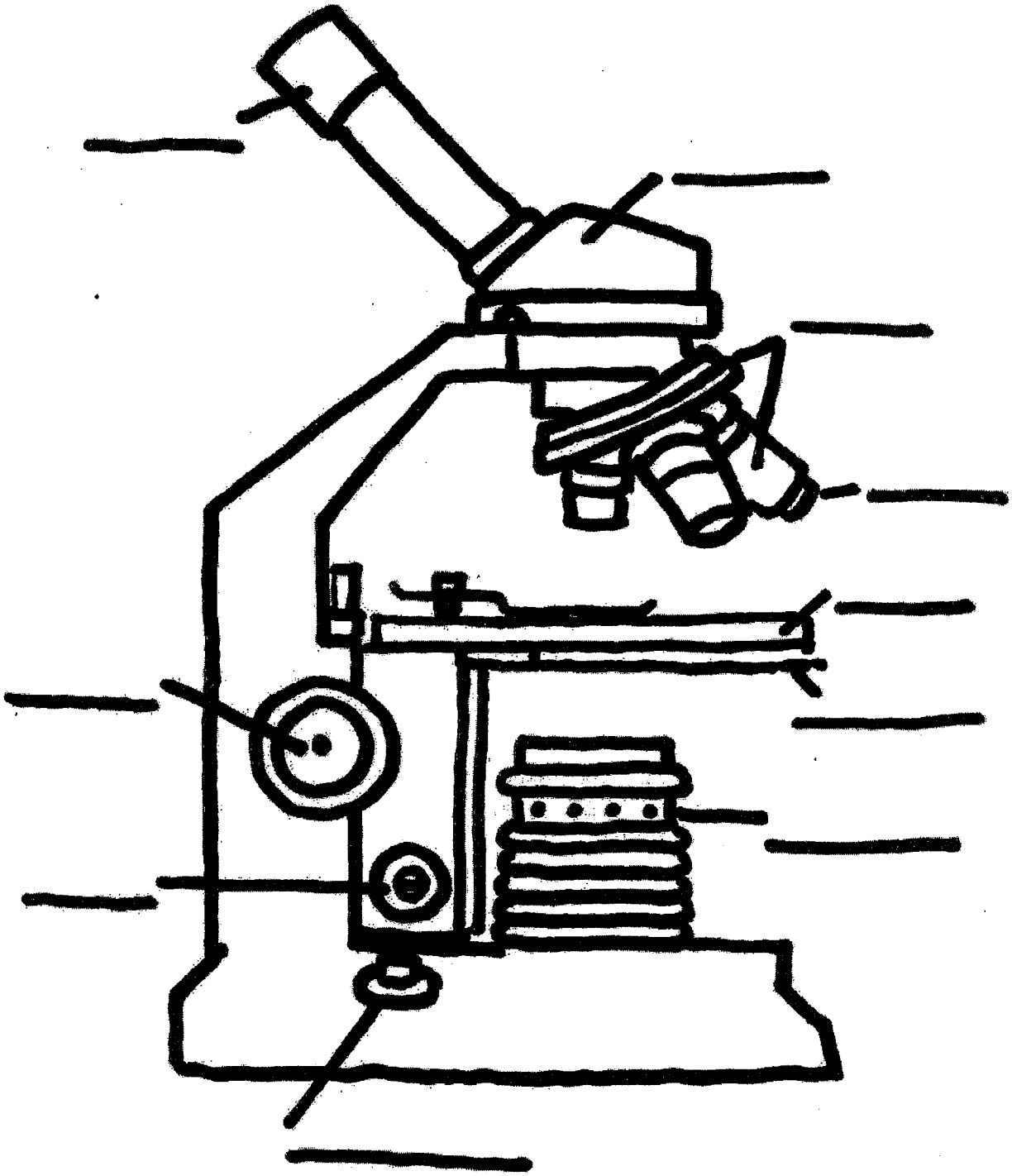
4. Is the field of view brighter or dimmer under high power? _____

5. How should you carry a microscope?_____

6. Why should lenses be cleaned only with lens paper?_____

7. A compound microscope has two or more lenses. Is the light microscope you used in class a compound light microscope?_____
   Explain._____

8. When using any piece of laboratory equipment, what should you always do?_____



ACTIVITY #1

"HOW TO MAKE A WET MOUNT SLIDE"

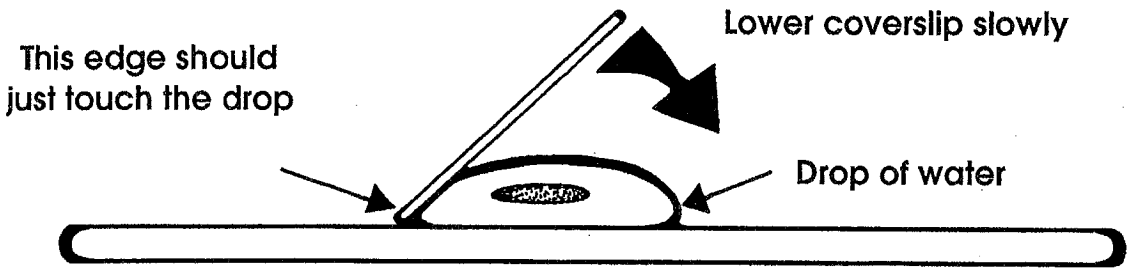
In order to observe cells, you will have to become good at the technique of making a slide. This requires patience and careful handling of equipment. Take your time.

STEP 1 You will need a microscope slide and a coverslip.

STEP 2 Put a *drop* of water on the slide.

STEP 3 Put the object into the drop of water. The object must be *very* thin. You will see the importance of this when you make a wet mount of onion cells.

STEP 4 Place the coverslip over the object by first placing one edge down, and then slowly lowering the other side so that you don't trap air bubbles. Air bubbles will look like discarded tires, and are actually quite interesting in appearance, but they will interfere with your view of the object you really want to see.



SIDE VIEW OF SLIDE

Whenever you make a slide of something during this semester, you should use the wet mount method. It is the very best way to get a clear view of the object, and it prevents the specimen from drying out.

Human Epidermal Cells

Introduction

What do your skin cells look like? It is easy to remove some and look at them with a microscope.

Biological Concepts

- Cell structure
- Epidermis

Materials

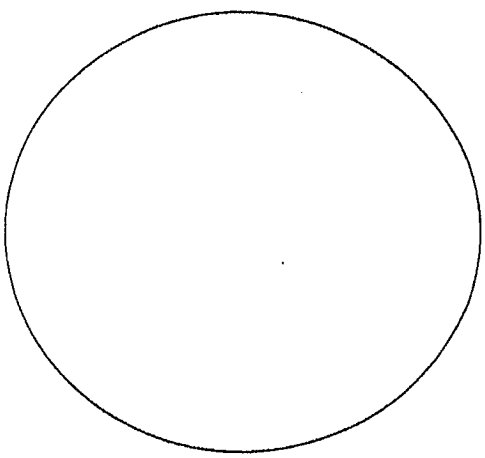
- Methylene blue stain, 1% aqueous
- Clear tape, 1.0 cm × 1.0 cm
- Dissecting needle
- Forceps
- Microscope
- Microscope slide
- Slide cover slip
- Soap/water

Safety Precautions

Methylene blue is a vital stain—it stains nearly everything, and it is difficult to remove. Prevention is the key when working with vital stains. Wear chemical-resistant gloves and avoid contact with eyes and skin. Wear safety glasses or chemical splash goggles whenever working with chemicals, heat or glassware in the lab.

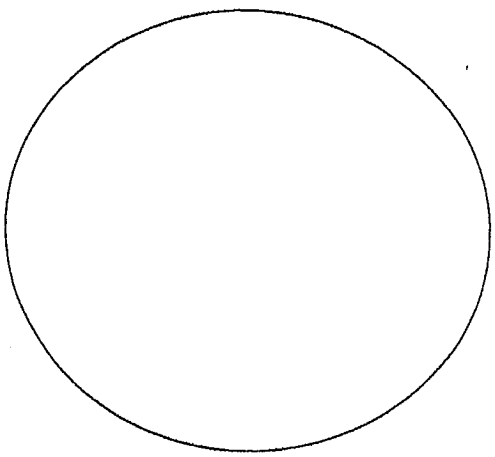
Procedure

1. Wash the underside of a wrist that will be sampled for epidermal cells with soap and water.
2. Stick a clean piece of clear tape on the underside of the washed wrist.
3. Gently remove the piece of tape from the wrist being careful to avoid getting fingerprints on the tape. A forceps might help to remove the tape and avoid fingerprinting the tape.
4. Place the tape, sticky-side up, on a clean microscope slide.
5. Stain the top, sticky side of the tape with 2 or 3 drops of 1% methylene blue solution.
6. Use a dissecting needle to gently place a cover slip over the sticky tape. Lower the coverslip down onto the tape and then remove the dissecting needle. This should help prevent staining your fingers. *Caution:* Use methylene blue carefully. It will stain most items including skin, clothing, and table tops.
7. Examine the slide under a microscope. Look for cells with low power first, and then switch to high power for details.
8. Record your observations of epidermal cells by making drawings. Label your drawings with appropriate magnifications. Use your knowledge of the size of the microscopic field to estimate the size of the cells.



OBJECT_____

MAGNIFICATION_____



OBJECT_____

MAGNIFICATION_____

Name _____ Class _____ Date _____

LABORATORY SKILLS

Using Graphing Skills

Pre-Lab Discussion

Recorded data can be plotted on a graph. A graph is a pictorial representation of information recorded in a data table. It is used to show a relationship between two or more different factors. Two common types of graphs are line graphs and bar graphs.

In this investigation, you will interpret and construct a bar graph and a line graph.

Problem

How do you correctly interpret and construct a line graph and a bar graph?

Materials

No special materials needed

Procedure

Part A. Interpreting Graphs

1. The type of graph that best shows the relationship between two variables is the line graph. A line graph has one or more lines connecting a series of points. See Figure 1. Along the horizontal axis, or x–axis, you will find the most consistent variable in the experiment. Along the vertical axis, or y-axis, you will find the other variable.

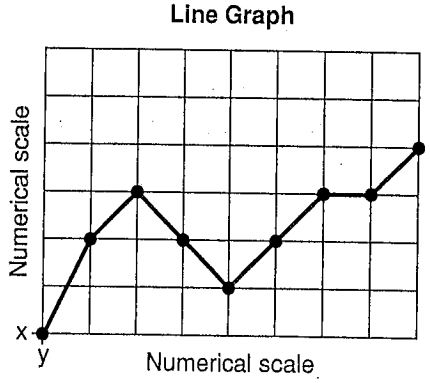


Figure 1

2. Use the line graph in Figure 2 to answer questions 1 through 6 in Observations.

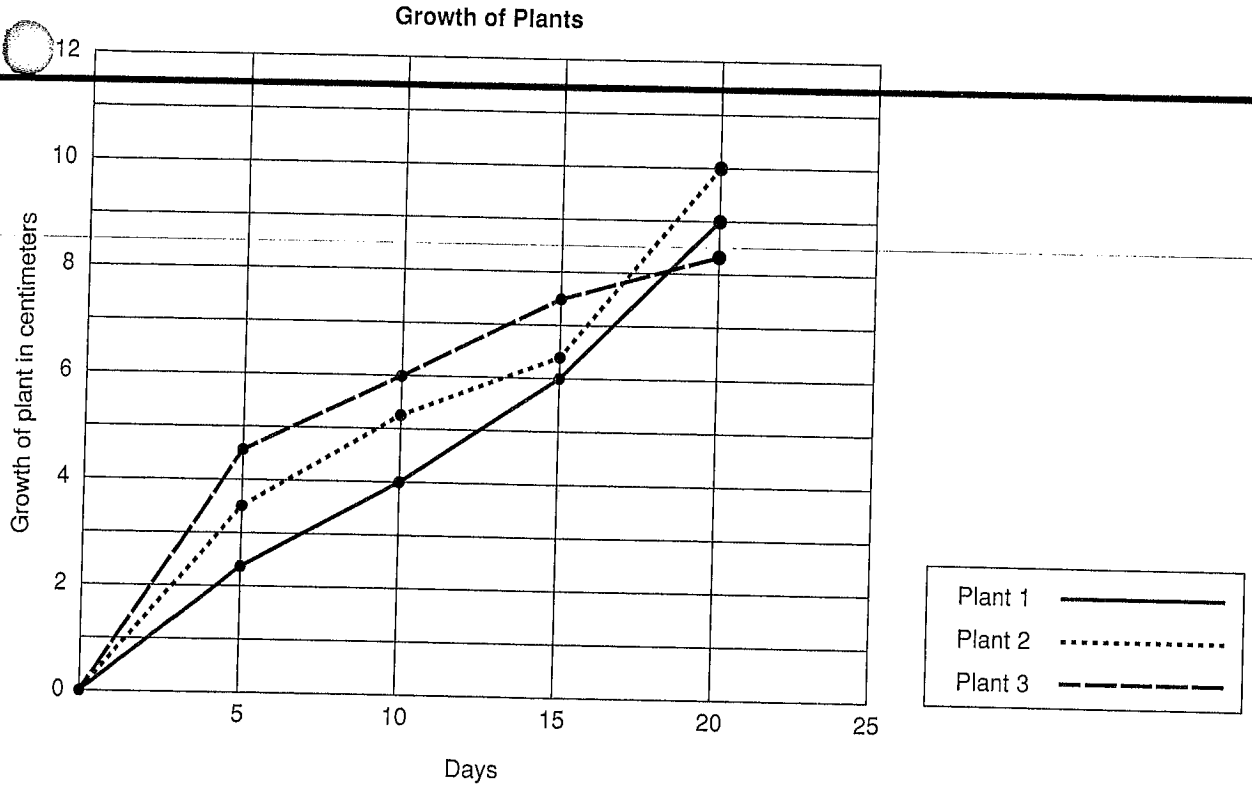


Figure 2

3. A bar graph is another way of showing relationships between variables. A bar graph also contains an x-axis and a y-axis. But instead of points, a bar graph uses a series of columns to display data. See Figure 3. On some bar graphs, the x-axis has labels rather than a numerical scale. This type of bar graph is used only to show comparisons.

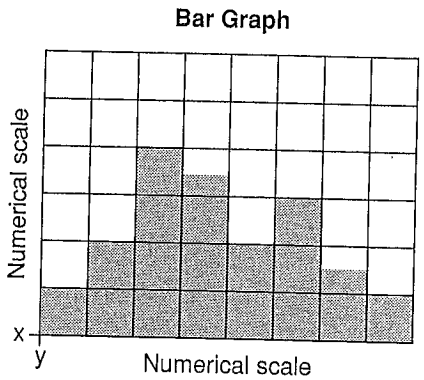


Figure 3

Name _____ Class _____ Date _____

4. Use the bar graph in Figure 4 to answer questions 7 through 11 in Observations.

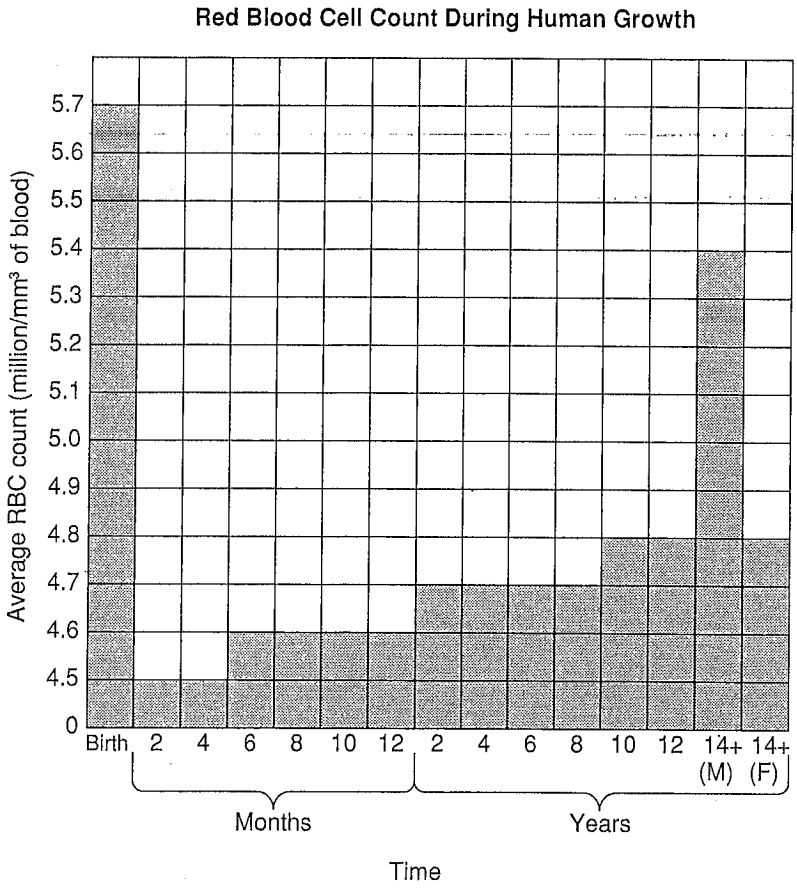


Figure 4

Part B. Constructing Graphs

1. When plotting data on a graph, you must decide which variable to place along the x-axis and which variable to place along the y-axis. Label the axes of your graph accordingly. Then you must decide on the scale of each axis; that is, how much each unit along the axis represents. Scales should be chosen to make the graph as large as possible within the limits of the paper and still include the largest item of data. If the scale unit is too large, your graph will be cramped into a small area and will be hard to read and interpret. If the scale unit is too small, the graph will run off the paper. Scale units should also be selected for ease of locating points on the graph. Multiples of 1, 2, 5, or 10 are easiest to work with.
2. Use the information recorded in Data Table 1 to construct a line graph on the grid provided in number 12 of Observations. You should label each axis, mark an appropriate scale on each axis, plot the data, connect the points, and give your graph a title.
3. Use the information recorded in Data Table 2 to construct a bar graph on the grid provided in number 13 of Observations. You should label each axis, mark an appropriate scale on each axis, plot the data, darken the columns of the graph, and give your graph a title.

Observations

Part A. Interpreting Graphs

Use the line graph in Figure 2 to answer questions 1 through 6.

1. Which plant grew the tallest? _____

2. How many plants grew to be at least 6 cm tall? _____

3. Which plant grew the fastest in the first five days? _____

4. Which line represents plant 2? _____

5. After 10 days, how much had plant 3 grown? _____

6. How long did it take for plant 1 to grow 6 cm? _____

Use the bar graph in Figure 4 to answer questions 7 through 11.

7. At birth, what is the average number of red blood cells per mm^3 of blood?

_____

8. What appears to happen to the number of red blood cells between birth and 2 months?

_____

9. What happens to the number of red blood cells between the ages of 6 and 8 years?

_____

10. Between what ages is a human likely to have 4.6 million red blood cells?

_____

11. After 14 years of age, do males or females have a higher red blood cell count?

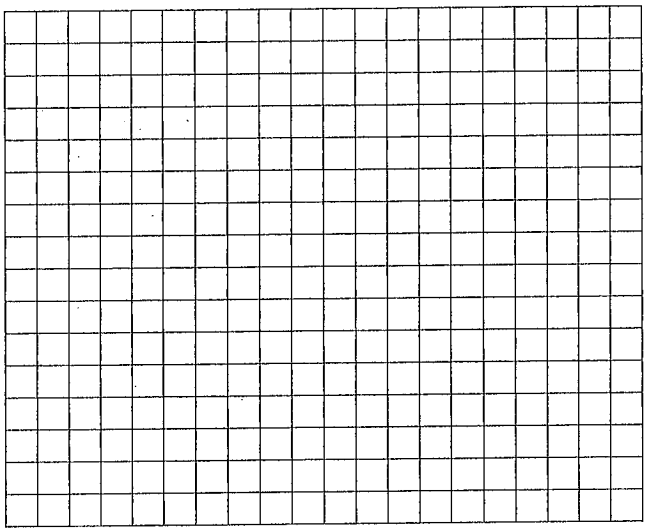
_____

Part B. Constructing Graphs

Data Table 1 Breathing Rate of the Freshwater Sunfish

Temperature (°C)	Breathing Rate (per minute)
10	15
15	25
18	30
20	38
23	60
25	57
27	25

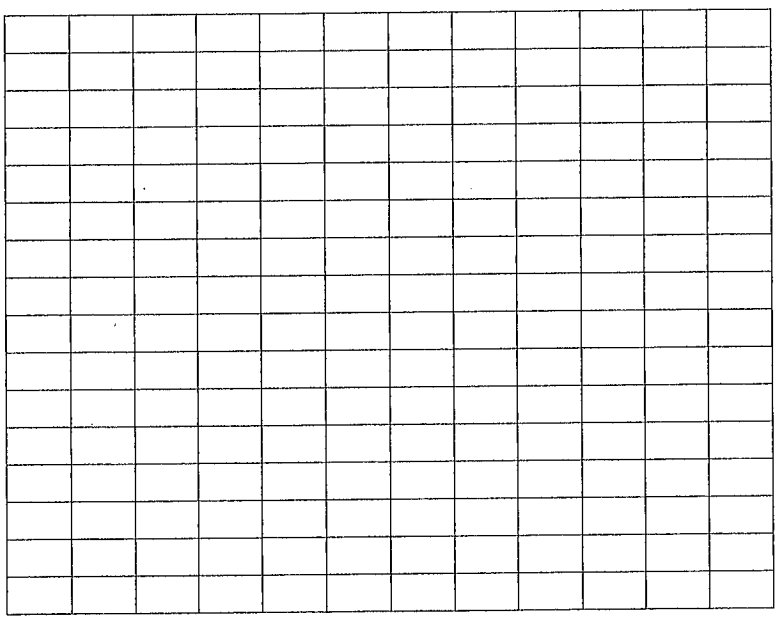
12. Use the grid below to construct a line graph for the information shown in Data Table 1.



Data Table 2 Average Rainfall in Willamette Valley

Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rainfall (mL)	15	21	28	24	16	8	2	1	2	3	5	10

13. Use the grid below to construct a bar graph for the information shown in Data Table 2.



Analysis and Conclusions

1. How is a graph similar to a data table? _____

2. How is a line graph different from a bar graph? _____

3. Does a steep curve on a line graph indicate a rapid or a slow rate of change?

Critical Thinking and Application

1. You are conducting an experiment to measure the gain in mass of a young mouse over a ten-week period. In constructing a graph to represent your data, which variable should you place along the x-axis and which variable should you place along the y-axis? Explain your answer.

2. What is an advantage of using multiple lines on a line graph? (See Figure 2.)

3. Why is it important to have all parts of a graph clearly labeled and drawn?

Pre-Lab Questions

Where should you read the volume in a graduated cylinder?

What will you use to add water to the cylinder?

What object will you find the volume of?What is this method called?

What is volumes will you be taking from the beakers of red, blue and yellow?

What are your predictions for this lab? Reading what colors you will be mixing, can you tell what the final colors will be, in order?.

Volume Lab

SCI #

Part A: Count your drops!

Take a guess - How many drops of water will it take to equal 1 milliliter? _____ *drops*

Follow the directions to find the number of drops in 1 milliliter of water, then answer the questions. You will need a small graduated cylinder (25 ml), a beaker of water, and an eyedropper for this section.
(1) Fill a small graduated cylinder with 10 ml of water.
(2) Count the number of drops it takes to raise the water to 11 ml. Record the number in the chart.
(3) Leave the water in the graduated cylinder and count the number of drops it takes to raise the water to 12 ml. Record the number in the chart.
(4) Leave the water in the graduated cylinder and count the number of drops it takes to raise the water to 13 ml. Record the number in the chart.
(5) Calculate your average and round to the nearest tenth.

# of drops to 11 ml	# of drops to 12 ml	# of drops to 13 ml	Average

Based on your average, how close were you to your guess? _____

Based on your average, how many drops would it take to make 1 liter? _____

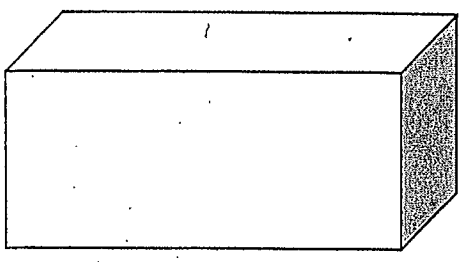
Part B: Water Displacement

Follow the directions to find the volume of three marbles using water displacement.
(1) Add 20 ml of water to a 100 ml graduated cylinder. Record this amount in the chart.
(2) Add three marbles to the cylinder and measure the volume. Record this amount in the chart.
(3) Find the difference between the two measurements and record in the chart. The difference between the two measurements will be the volume of the three marbles.

Volume of water before adding marbles	Volume of water after adding marbles	Difference in volume	Volume of 3 marbles

Part C: Volume by Formula

Use the formula to find the volume of the box. Measure to the nearest centimeter (no decimals) before calculating your answer.



Volume = length x width x height

_____ x _____ x _____ = _____

Part D: Color Challenge

1. Obtain the following items from your teacher:

   3 beakers with colored water- 25 ml of each color (red, blue, and yellow)
   1 graduated cylinder (25 ml - 50 ml)
   1 eyedropper
   6 test tubes labeled A, B, C, D, E, and F

2. Perform each step outlined below using accurate measurements.

   (1) Measure 17 ml of RED water from the beaker and pour into test tube A.
   (2) Measure 21 ml of YELLOW water from the beaker and pour into test tube C.
   (3) Measure 22 ml of BLUE water from the beaker and pour into test tube E.
   (4) Measure 5 ml of water from test tube A and pour it into test tube B.
   (5) Measure 6 ml of water from test tube C and pour it into test tube D.
   (6) Measure 8 ml of water from test tube E and pour it into test tube F.
   (7) Measure 5 ml of water from test tube C and pour it into test tube B.
   (8) Measure 2 ml of water from test tube A and pour it into test tube F.
   (9) Measure 4 ml of water from test tube E and pour it into test tube D.

3. Complete the chart.

Test Tube	Color	Final Amount (ml)
A		
B		
C		
D		
E		
F		

Pre-Lab Questions

1. What liquids will you be mixing?

2. What is the formula of density?

3. What will you be taking the temperature of?

4. What must you do to the material you are measuring the temperature of?

5. What are the SI units for
   a. Temperature
   b. Mass
   c. Density
   d. Volume

6. What are your predictions for this lab? Be specific.

SI Units

OBJECTIVES

- **Express** measurements in SI units.
- **Read** a thermometer.
- **Measure** liquid volume by using a graduated cylinder.
- **Measure** mass by using a balance.
- **Determine** the density (mass-to-volume ratio) of two liquids.

MATERIALS

- graduated cylinder, 100 mL
- cups, plastic, (2)
- thermometers, Celsius, alcohol-filled (2)
- ring stand or lamp support
- stopwatch or clock
- corn oil, 25 mL
- cup, clear plastic
- sand, light-colored, 75 mL
- sand, dark-colored, 75 mL
- gloves, heat-resistant
- light source
- balance
- water, 25 mL
- graph paper

Procedure

MEASURE SAND TEMPERATURE

1. Use the data table on the next page to record your results.
2. Put on safety goggles, gloves, and a lab apron. Using a graduated cylinder, measure 75 mL of light-colored sand. Pour the sand into one of the small plastic cups. Do the same thing with the dark-colored sand and another plastic cup.
3. Make sure the sand is level. You can do this by placing the cup on your desk and sliding it back and forth. Insert one thermometer into each cup.
4. Using a ring stand or lamp support, position the lamp approximately 9 cm from the top of the sand, as shown in the picture on page 20. Make sure that the lamp is evenly positioned between the two cups.

5. Before turning on the lamp, record the initial temperature of each cup of sand in the data table.

Sand Temperature

	Temperature (degrees C)	
Time (min)	Dark-colored sand	Light-colored sand
Start		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

6.  **CAUTION: Wear heat-resistant gloves when handling the lamp. The lamp will get very hot and may burn you.** Start the stopwatch when you turn on the lamp. The lamp will get hot and warm the sand. Check the temperature of the sand in each container every minute for 10 minutes. In your data table, write down the temperature of the sand after each minute.

COMPARE THE DENSITY OF OIL AND WATER

7. Use the data table on the next page to record the results from this section.
8. Label one clean plastic cup "Oil." Label a second cup "Water." Using a balance, measure the mass of each plastic cup. Record the weight in your data table.

Density of Two Liquids	
a. Mass of empty oil cup	g
b. Mass of empty water cup	g
c. Mass of cup and oil	g
d. Mass of cup and water	g
e. Volume of oil	25 mL
f. Volume of water	25 mL
Calculating Actual Mass	
Oil Item c – Item a =	g
Water Item d – Item b =	g
g. Density of oil	g/mL
h. Density of water	g/mL

9. Put on an apron. Using a clean graduated cylinder, measure 25 mL of corn oil, and pour it into the plastic cup labeled "Oil." Using a balance, measure the mass of the plastic cup containing the corn oil. Record the mass in your data table.
10. Repeat step 9 with water instead of oil. Use the plastic cup labeled "Water."
11. To find the mass of the oil, subtract the mass of the empty cup from the mass of the cup and the oil together.
12. To find the density of the oil, divide the mass of the oil by the volume of the oil, as shown in the operation below.

$$\textit{Density of oil} = \frac{\textit{mass of oil}}{\textit{volume of oil}} = \_\_\_\_\_ \text{ g/mL}$$

13. Repeat steps 11 and 12 to find the mass and density of water.
14. Combine the oil and water in the clear cup. What happens?

_____

_____

_____

15.  Clean up your materials. Put everything back where you found it. Wash your hands or use the GERM-X by door before leaving the lab.

NAME_____ SCI#_____ POINTS:_____

SI UNITS LAB SHEET

1. Use graph paper to graph the data that you collected in the first part of the lab. Remember to use the correct variables (use notes) and label the graph correctly! Staple behind this sheet with your name on it.

2. Based on your graph, how are color and heat absorption related?

_____

_____

3. How might the color of the clothes that you wear affect you on a sunny day? (Hint: Think of typical summer clothes.)

_____

_____

4. In the second part of the lab, you combined the oil and water. How are your observations related to the densities of the liquids?

_____

_____

5. What could you infer about the value for the density of ice if you observe it floating in water?

_____

_____

6. How would your calculated density values be affected if you misread the volume measurement on the graduated cylinder?

_____

_____

_____

7. Pumice is a volcanic rock that has a density less than 1.00 g/cm^3. How would you prove this density if you did not have a balance to weigh the pumice? (Hint: The density of water is 1.00 g/cm^3.)

_____

_____

_____

_____

Pre-Lab Questions

What magnification is the dissecting lens? The low power? High power?

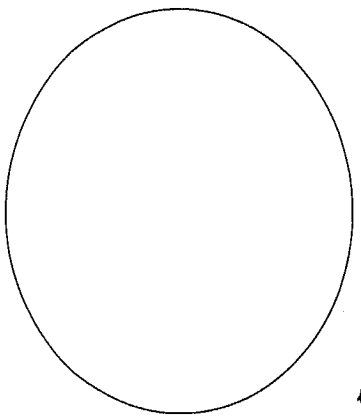
What will you be looking at under the microscope? Why is one object only looked at under low power?

List the steps for focusing under low power.

What is very important when focusing under high power?

What are your predictions for this lab? How many microns will the field of view be under low power?

Draw what you believe an human skin cell will look like under high power



Scale Drawings

OBJECTIVES

- Use the microscope to view prepared slides under low and high power

MATERIALS

Slides of tissues

Procedure:

1. You will take one of the prepared slides
2. Using your knowledge of the microscope, you will make 2 scale drawings, one under low power and one under high power
3. Use a clear ruler under the low poer objective only to get a scale, which you MUST include in your drawing under low power.

Questions

1. Complete 2 scale drawings below. Be sure to include a circle and labels as they are not provided for you in this lab.

Pre-Lab Questions

What magnification is the dissecting lens? The low power? High power?

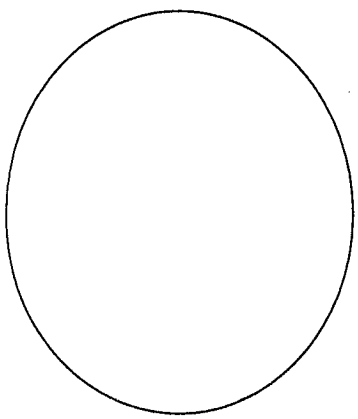
What will you be making a wet mount of? What should you be careful of?

List the steps for focusing under low power.

What is very important when focusing under high power?

What are your predictions for this lab? How do you think the object will appear to in the field of view when you move it right? Up? What do you think will be most difficult to accomplish?.

Draw what you believe an onion cell will look like under high power



Using a Microscope

In almost every type of biological research, the microscope plays a fundamental role. Biologists use it to study the fine structures of cells and tissues, things that are too small to be seen with the unaided eye. The microscope used most often is the *light microscope*, which uses light to form an enlarged image of a specimen. A commonly used type of microscope is the *compound light microscope*. Compound light microscopes are used to view tiny living organisms as well as preserved cells mounted on glass (a *microscope slide*) and covered with a *coverslip*. This type of slide is prepared with water or some other liquid, such as a stain, and is called a *wet mount.*

Under the compound light microscope, most objects and microorganisms are observed in a drop of water. If you think of that drop of water as a pond and the objects and microorganisms as fish in the pond, you will begin to see why it is important to be able to focus at different depths. *Depth-of-field* focusing is always done under high power with the fine adjustment.

In this lab, you will practice using a compound light microscope. You will learn how to make a wet-mount slide and will observe several cell structures.

OBJECTIVES

- **Show** the proper use and care of a compound light microscope.
- **Use** the compound light microscope at low power and at high power.
- **Prepare** a wet-mount slide to examine under the microscope.
- **Compare** the movements of several images seen through a compound light microscope.

MATERIALS

- safety goggles, lab apron, protective gloves
- compound light microscope
- coverslip (5)
- dissecting needle or pencil
- forceps
- glass microscope slide (5)
- *Elodea* leaves
- lens paper
- medicine dropper
- methylene blue
- onion section
- paper towel
- prepared slide
- small plants, such as moss
- threads
- tweezers
- water

Procedure

PART 1: THE COMPOUND LIGHT MICROSCOPE

1. Complete **Table 1** as you do Part 1.

FIGURE 1 THE COMPOUND LIGHT MICROSCOPE

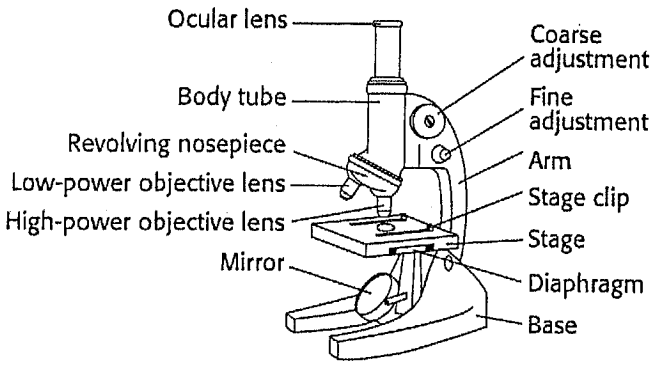


TABLE 1 THE PARTS OF A COMPOUND LIGHT MICROSCOPE

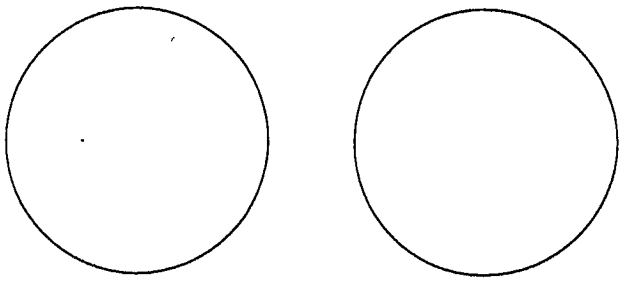
Microscope part	Function
Ocular lens (magnification: _____)	
Body tube	
Arm	
Stage	
Coarse adjustment	
Fine adjustment	
Lamp or mirror	
Revolving nosepiece	
Low-power objective lens (magnification: _____)	
High-power objective lens (magnification: _____)	
Diaphragm	
Base	

2. Carry a microscope to your lab table by holding the microscope arm with one hand and supporting the base with the other hand. **CAUTION: A microscope is expensive and fragile. It is important to use it correctly to avoid damaging it and avoid breaking slides or destroying specimens. When you use a microscope, be sure it rests securely on your lab table away from the edge.**
3. Locate each microscope part listed in **Table 1** and shown in **Figure 1**. Observe the magnification power (a number followed by an ×) of the ocular lenses and the low- and high-power objective lenses. Record these numbers in **Table 1**.
4. If your microscope has a built-in lamp, plug it in and turn it on to reflect light through the hole in the center of the stage.
5. Raise the objectives (or lower the stage) as far as possible by turning the coarse-adjustment knob. Secure a prepared slide to the stage, using the stage clips. Turn the low-power objective into position over the stage. While observing the stage from eye level, use the coarse-adjustment knob to position the objective as close to the slide as it will go without touching the slide.
6. Look through the ocular. Always keep both eyes open as you look into the eyepiece. Keeping both eyes open avoids eye strain. If the lens is dirty, ask your teacher to demonstrate the correct way to clean it. **CAUTION: Never use anything other than lens paper to clean the lenses of the microscope.** Focus with the coarse-adjustment knob only. **CAUTION: Never focus by moving the objectives downward. You may run the objective into the slide and break the slide or damage the objective.**
7. Complete focusing by slowly turning the fine-adjustment knob back and forth. When the object you are viewing is in focus and exactly in the middle of your field of vision, switch to high power. Use the fine-adjustment knob to refocus. **CAUTION: Never use the coarse-adjustment knob at high power.**

PART 2: MAKING A WET MOUNT

8. Use tweezers to strip a thin, transparent section of skin from the inner layer of a piece of onion.
9. Place the section of skin in the center of a clean, dry slide. With a medicine dropper, apply a drop of methylene blue stain to the skin. **CAUTION: Glassware is fragile. Notify your teacher immediately of any broken glass.**
10. Hold a coverslip at a 45° angle to the slide at the edge of the drop of methylene blue. Lower the coverslip slowly to avoid forming air bubbles. Under the microscope, air bubbles look round and have dark edges.

11. Place your wet mount onion cell slide on the microscope stage. Using the low-power objective, center and focus the microscope on the cells that make up the skin. Then switch to high power.
    - Make a drawing of what you see.



LOW POWER HIGH POWER

    - What happens to the image of the cells as you go from low power to high power?

_____

_____

12. As you look through the eyepiece, slowly adjust the diaphragm to obtain the appropriate light for viewing.
    - What happens as you adjust the diaphragm?

_____

13. As you look into the microscope, use your stage adaptor to move the slide to the right and then to the left.
    - What happens to the image as you move the slide to the right?

_____

    - What happens to the image as you move the slide to the left?

_____

_____

14. Observe one cell carefully for several minutes under high power.
    - Locate a vacuole. How many are there?

_____

    - What other cell structures do you see?

_____

_____

15. Obtain a sample of protists. Make a wet mount, and observe it under high power. Observe one cell carefully for several minutes.

- Identify the structures you see.

_____

_____

- What movement do you see?

_____

PART 3: DEPTH-OF-FIELD FOCUSING

16. Make a wet mount slide of two threads by crossing the threads in the center of a clean glass microscope slide. Use a medicine dropper to add a drop of water. Add a coverslip to the slide.
17. Place your wet mount on the stage of the microscope. Under low power, adjust the slide on the microscope stage so that the point where the threads cross is in the center of your field of vision. Bring both threads into focus.
18. Switch to high power.
    - Using the fine adjustment, can you see both threads in focus at the same time? Why or why not? What can you infer about the depth-of-field and the objective used for viewing?

_____

_____

19. Slowly turn the fine-adjustment knob back and forth, and practice focusing on different parts of the two threads.
20. Dispose of your materials according to the instructions from your teacher. Clean up your work area, and wash your hands before leaving the lab.

NAME_____ SCI#_____ POINTS:_____

Questions for Microscope Lab

1. What does the magnification number on the ocular lens mean?

2. Calculate the total magnification of your compound light microscope at low power and at high power. (Multiply the ocular (eyepiece) magnification by the objective magnification.) Show the calculation.

3. Is the largest *field of view* seen under high power or low power?

4. Why is it necessary to be able to focus at different depths?

5. When making a wet mount, why must you always use a coverslip?

6. When the slide is moved to the right, the object through the eyepiece appears to move in which direction? What occurs when the slide is moved away from you?

7. If a microorganism was moving from right to left across your field of view under a compound light microscope, which way would you move the slide to keep the microorganism in view? Why?

8. Which thread from the prepared slide was on the bottom? What color was on top. How did you determine this?

9. In addition to compound light microscopes, there are more powerful ones that scientists use. Research (use book or internet) to determine the differences in

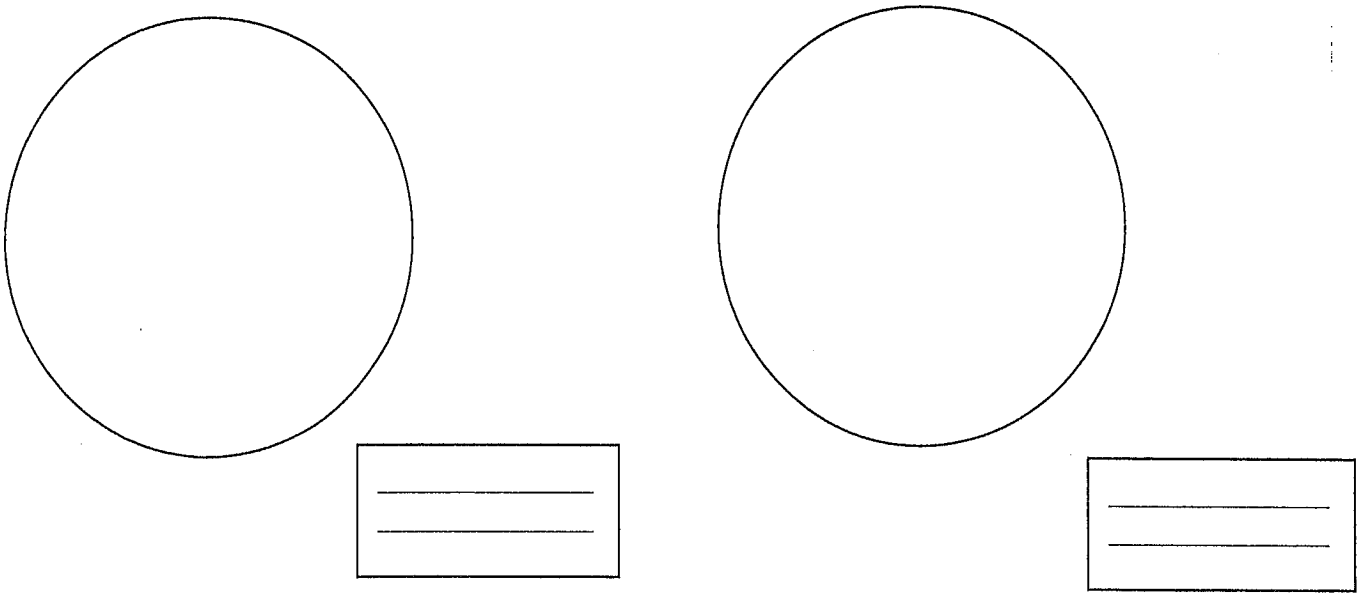
what they use to image an object and the amount of magnification for the following microscopes:

a. scanning electron microscope _____

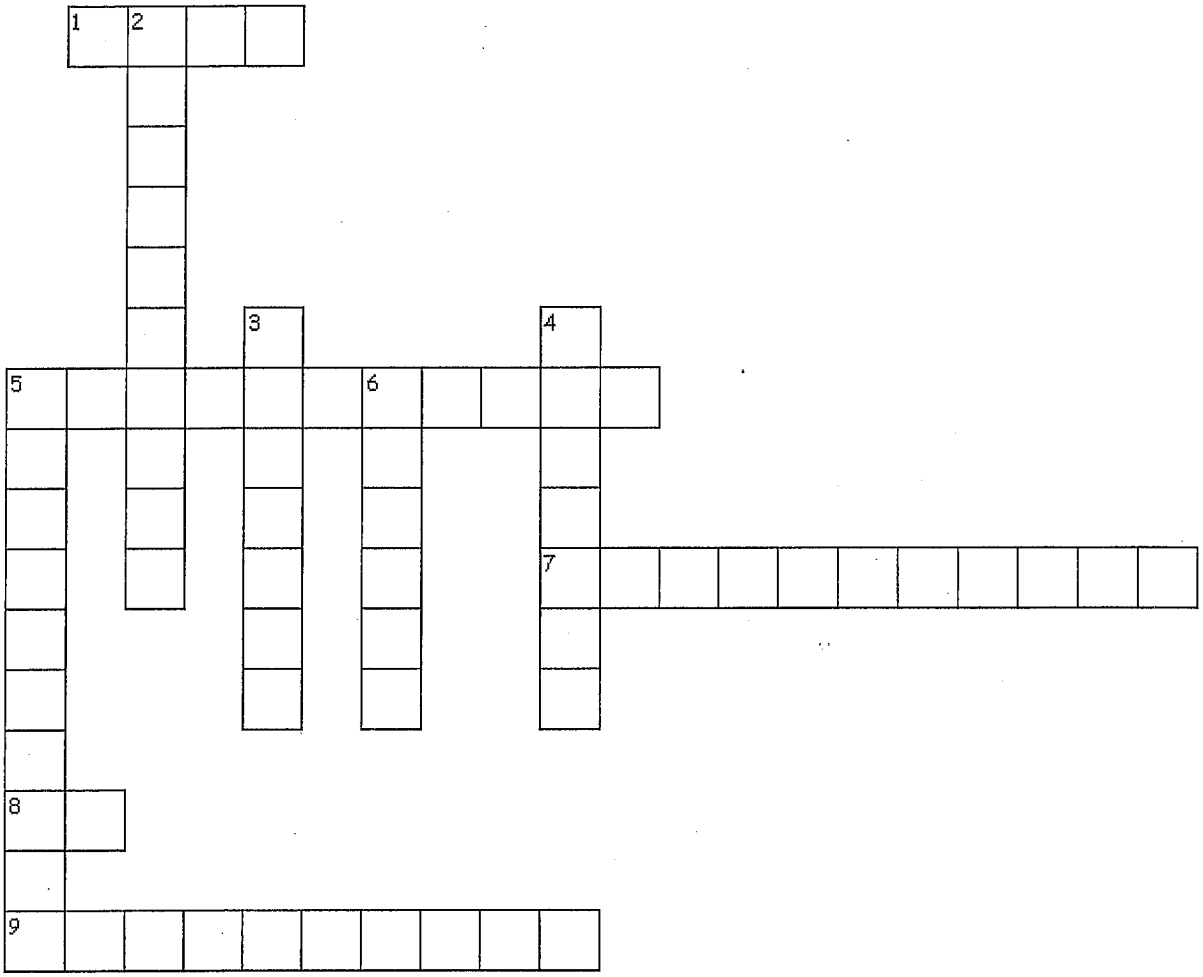
b. transmission electron microscope _____

c. scanning tunneling electron microscope _____

10. Draw the onion cell correctly below under low AND high power. Make sure to use proper labeling and drawing techniques as discussed in class!!



Ch 1 Crossword/ Flashcards- complete the crossword, then make a flashcard (term on one side, definition on the back) for all 10 terms



Across

1. in biology, the smallest unit that can perform all life processes
5. the maintenance of a constant internal state in a changing environment
7. the process of obtaining information by using the senses; the information obtained by using the senses
8. Le Système International d'Unités, or the International System of Units, which is the measurement system that is accepted worldwide
9. a habit of mind in which a person questions the validity of accepted ideas

Down

2. a procedure that is carried out under controlled conditions to discover, demonstrate, or test a fact, theory, or general truth
3. group in an experiment, a group that serves as a standard of comparison with another group to which control group is identical except for one factor
4. the scientific study of living organisms and their interactions with the environment
5. a testable idea or explanation that leads to scientific investigation
6. a system of ideas that explains many related observations and is supported by a large body of evidence acquired through scientific investigation

Skepticism

Observation

Hypothesis

Experiment

control group

theory

SI

Biology

cell

homeostasis

universal laws

correlation data

bias

Homeostasis

Metabolism

Responsivene ss

Heredity

CHAPTER 1 BIOLOGY AND YOU

I. **SCIENTIFIC THOUGHT** involves making observations, using evidence to draw conclusions, being skeptical about ideas, and being open to change when new discoveries are made.

II. **UNIVERSAL LAWS**-Science is governed by truths that are valid everywhere in the universe. These truths are called _____

III. **SCIENCE AND ETHICS** -Scientific experimentation and discovery can have serious ethical implications. Because of this, scientific investigations require ethical behavior. _____ are a system of moral principles and values. Scientists performing investigations must report only accurate data, must allow peers to review their work, and must behave ethically with the people involved in their investigations.

IV. **WHY DO YOU NEED SCIENCE?** An understanding of science can help you take better care of your health, be a wiser consumer, and become a better-informed citizen.

A. The same critical thinking process that scientists use is a tool that you can use in your everyday life- ex deciding which route to work has the least amount of traffic

B. You can use what you learn to increase the quality of your physical life- ex what is the best acne medication, which vitamins help you live better, etc

C. New technologies are around the corner. Understanding biology and science will help you make informed decisions- ex new drugs for obesity, removing the need for sleep. nanotechnology

V. **SCIENTIFIC EXPERIMENTS**-Scientists conduct controlled experiments or perform studies in order to test a _____

A. An experiment is a procedure that is carried out under controlled conditions to test a hypothesis.

B. There are often cases in which experiments are not possible or not ethical. In these cases, researchers perform studies or use correlation data (statistics gathered from subjects that show a relationship)

C. Scientists verify their _____ by conducting their experiments many times and by checking to see if other scientists have found similar results.

D. Every person has his or her own point of view. A point of view is called a _____

E. Scientists try to prevent bias from affecting their work, but bias can still influence an experiment. Sources of funding, personal involvement in a product, and other conflicts of interest can affect an experiment.

F. It is wise to view all scientific claims in their context and think critically about scientific theories. Ex- diet miracles

G. The main difference between a theory and a hypothesis is that a hypothesis is a specific, testable _____ for a limited set of conditions and a theory is a general explanation for a broad range of data that is consistently proven correct by new studies.

VI. **THE STUDY OF LIFE**-Biology is the scientific study of living organisms and their interactions with the environment. Some of the branches of biology are

- biochemistry,
- ecology,
- cell biology,
- genetics,
- evolutionary theory,
- microbiology,
- botany,
- zoology,
- physiology

VII. **PROPERTIES OF LIFE**-The six properties of life are :

1. _____
   i. All living things are made of one or more cells.
   ii. A cell is the smallest unit capable of all life processes.
2. _____
   i. All living organisms must maintain a stable internal environment in order to function properly.
   ii. The maintenance of a stable internal environment in spite of changes in the external environment is called homeostasis.
3. _____
   i. Living organisms carry out different chemical reactions in order to obtain energy.
   ii. The sum of all the chemical reactions carried out in an organism is called metabolism.
   iii. Almost all of the energy used by living things originally comes from the sun.
4. _____
   i. In addition to maintaining a stable internal environment, living organisms respond to their external environment.
   ii. Can you think of a way that you have responded to your environment today • Reproduction
   iii. Most living things can reproduce. Reproduction is the process by which organisms make more of their own kind from one generation to the next.
5. _____
   i. When an organism reproduces, it passes on its own traits to its offspring in a process called heredity.
   ii. Inherited characteristics change over generations. This process is called evolution.
6. _____
   i. All living organisms grow.
   ii. As organisms grow, many change. This process is called development.
   iii. Development differs from evolution because development refers to change in a single individual during that individual's life.

1. Why is skepticism important in science?

2. Describe four ways to practice scientific thought.

3. What is a universal law?

4. Identify two universal laws.

5. Give three examples of ethical scientific behavior.

6. Think about some decisions you make every day. Give two examples of how you can use scientific thought to help you make good decisions.

BELLRINGER: Day *Date* *Question*

Ans

1. How do most scientific investigations begin?

2. What is the difference between a dependent variable and an independent variable?

3. How is a theory different from a hypothesis?

Underline the independent variable and circle the dependent variable in the following.

4. Telling your mother that she is a good cook increases the hour of your curfew.

5. Washing the dishes for your mother increases the amount of money she gives you on the weekend.

6. Coaches with more years of experience will have a higher percentage of wins.

7. The amount of food that a bird eats is affected by the temperature.

8. Eating chocolate affects the number of zits you get.

BELLRINGER: Day____ Date_____ Question

Ans

CHAPTER 1 SEC 3 DUE DATE .

1. Describe two benefits of using the SI system of measurement.

2. How many centimeters are in 1 m?

3. Why might a scientist use a microscope in a laboratory?

4. What is the purpose of using the sterile technique in the laboratory?

5. Why is it important to keep your lab area clean and organized?Give two reasons.

6. What should you do before a lab ? Why?

7. What should you do if an accident occurs in the lab?

BellringerQuestion

ANSWER

CHAPTER 1 REVIEW QUESTIONS

1. What is bias? Why do scientists not use this to support ideas?

2. What is skepticism? Why would making a new discovery be a result of skepticism?

3. What is a universal law? What branches of science do universal laws mostly apply to?

4. Which are some examples of unethical behavior in scientific investigations?

5. How can an understanding of science help you live a better life?

6. Noticing that your heart rate AND respiration increase when you exercise is an example of what? What part of the scientific process is noticing changes? What about writing down your heart rate and respiration?

7. What is a hypothesis?.

8. Most typically, what is the order in which the steps of scientific investigations are applied?

9. If experiments are not possible or ethical, scientists can do what?

10. How are scientific hypotheses tested?

11. What is the definition of an experiment?

12. What are the independent and dependant variable? (definitions)

13. What is a general explanation for a broad range of data called?

14. Is a scientific theory always correct? When can they be revised (updated or changed)?

15. How do scientists build a theory? What do they use to support the theories?

16. What number is the metric system based on? (what are the powers)?

17. How many kilometers is one meter equal to?

18. A specialized tool used to magnify organisms so that they can be observed is a _____

19. What is sterile technique? Give an example of how sterile techniques prevents contamination

20. Know your safety procedures.

21. What is biology the study of?

22. What are the six properties of life?

23. As a characteristic of all living things, homeostasis relates most directly to what biological themes?

24. All living things maintain a balance within their cells and with the environment through the process called what?

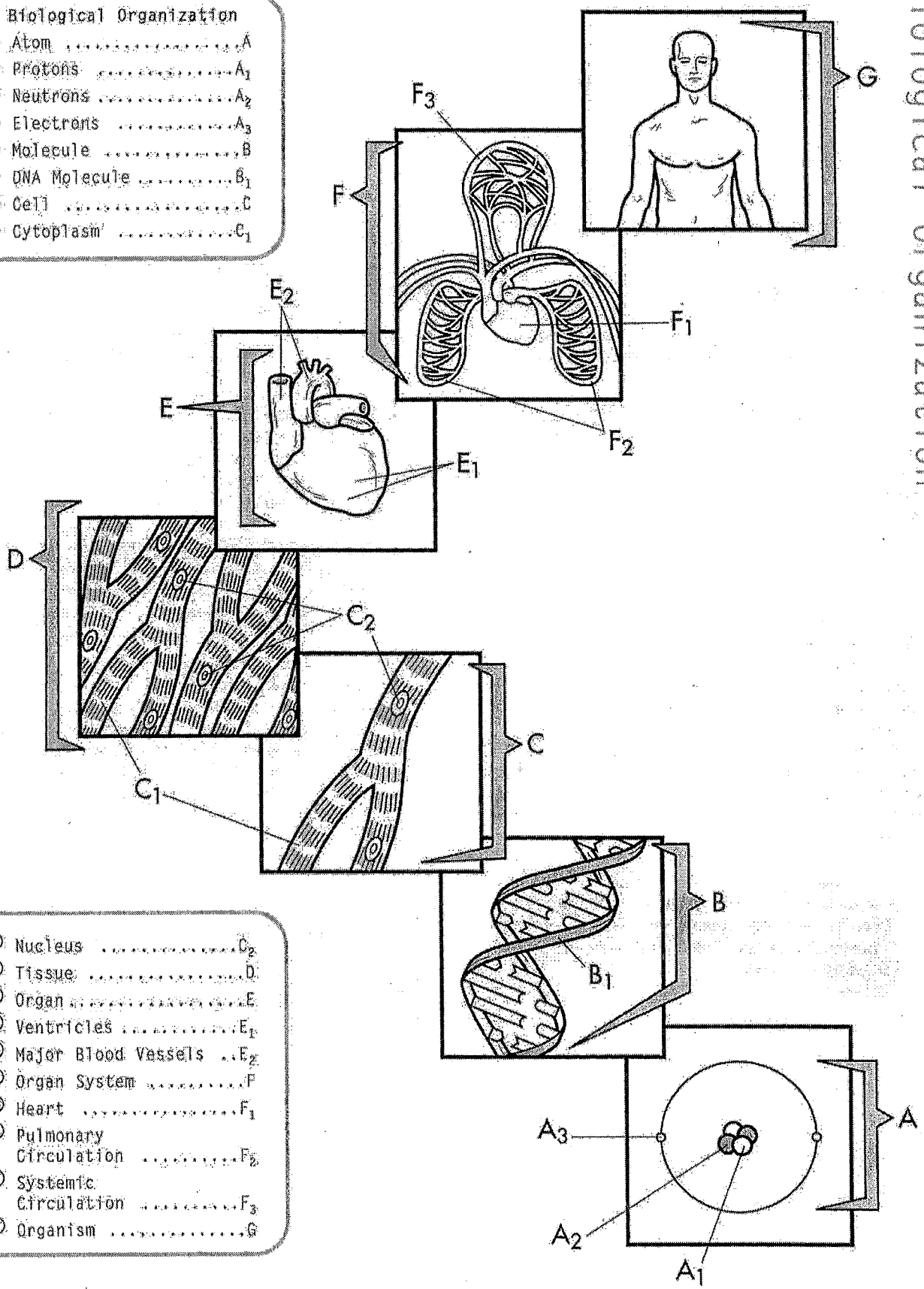
25. What is the process by which organisms make more of their own kind?

26. Children tend to resemble their parents due to what trait of living things?

27. When sunflowers turn their flowers to follow the sun, or you wake up from your alarm clock going off, this is an example of which property of life?

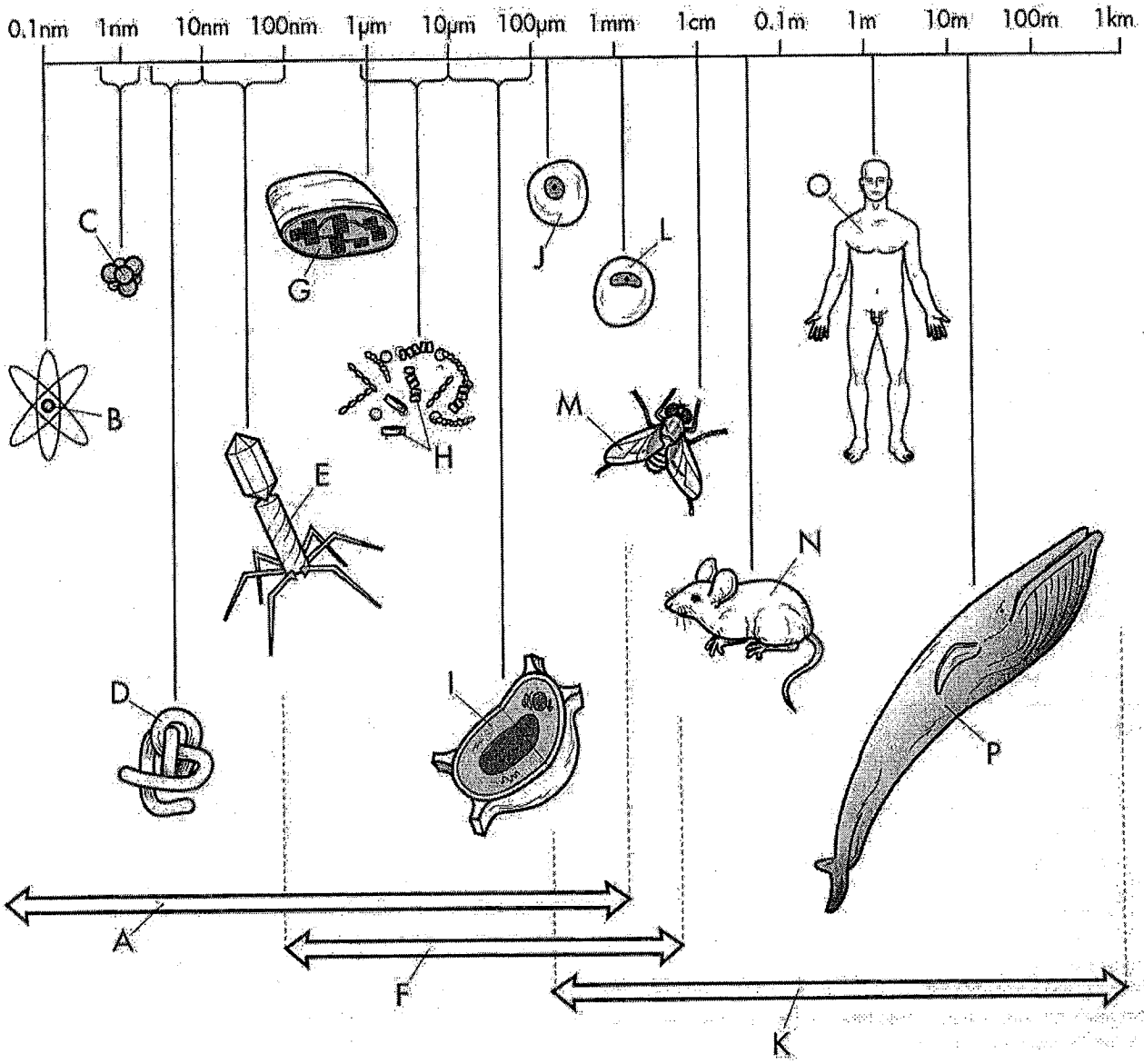
Biological Organization

- Atom ..... A
- Protons ..... A_1
- Neutrons ..... A_2
- Electrons ..... A_3
- Molecule ..... B
- DNA Molecule ..... B_1
- Cell C
- Cytoplasm ..... C_1



- Nucleus ..... C_2
- Tissue ..... D
- Organ ..... E
- Ventricles ..... E_1
- Major Blood Vessels ..... E_2
- Organ System ..... F
- Heart ..... F_1
- Pulmonary Circulation ..... F_2
- Systemic Circulation ..... F_3
- Organism ..... G

Size Relationships in Biology



Size Relationships in Biology

○ Electron Microscope Range ..... A	○ Light Microscope Range ..... F	○ Unaided Eye Range ..... K
○ Atom ..... B	○ Chloroplast ..... G	○ Frog Egg Cell L
○ Small Molecule C	○ Bacteria ..... H	○ Insect ..... M
○ Folded Protein ..... D	○ Plant/Animal Cell I	○ Rodent ..... N
○ Virus ..... E	○ Human Egg Cell ..... J	○ Human ..... O
		○ Whale ..... P

Using the Scientific Process

Scientific Process

- Collecting observations
- Forming hypothesis
- Making predictions
- Verifying predictions
- Performing control experiments
- Forming a theory

To show how each stage of a scientific investigation leads logically to the next, perform the following exercise and identify each stage.

(1) Collecting observations

(a) Measure (for one-minute) your resting respiratory & pulse rate

(b) Record the number of times you breathe during one minute period

(c) Record the number of times your heart beats during one minute period

Resting Respiratory Rate	Resting Pulse Rate

(2) Formulate a hypothesis:

How will exercise affect your resting respiratory & pulse (heart) rate?

(3) Making Predictions:

Note the number of breaths & pulses you think you will take in the same period of time after you have jogged in place for one minute

Predicted Respiratory Rate	Predicted Pulse Rate

(4) Verifying predictions:

Exercise by jogging in place for one minute and then immediately record your respiratory & pulse rate after exercise.

Respiratory Rate After Exercise	Pulse Rate After Exercise

(5) Performing control experiments

How do you know that exercise was the factor that affected your respiratory rate and pulse rate.

(6) Formulate a theory

Suggest a connection between exercise and your respiratory & pulse rates.

Pre-Lab Questions

1. How will you measure head circumference?

_____

_____

2. How will you measure running speed?

_____

_____

3. Who's information will you be recording?

_____

_____

4. How will you measure height?

_____

_____

5. What are the SI units for
   a. Shoe size _____
   b. time _____
   c. height _____
   d. weight _____
6. What are your predictions for this lab? Be specific.

_____

_____

_____

_____

LAB Graphing

OBJECTIVES

- to use observation to record data
- to use data to create a graph that best demonstrates a correlation

MATERIALS

- graph paper
- string
- ruler

Procedure:

1. You will use a string to measure height and head circumference. Mark the string with a marker or pen instead of cutting it and then measure it using a yardstick.
2. To determine how high someone can jump, measure where the tip of their hand is on a wall (use masking tape), then have them place a different piece of tape on the wall as high as they can put it while jumping. The distance between the 2 pieces of tape is the height they jumped.
3. Use 3 attempts for jumping, breath holding, and running. Take the best of the three.
4. Use the materials provided to record the variables of the following:

    a. Does someone's height determine how high they can jump?

    b. The effect a person's age has on their weight. (Use kilograms)

    c. Does a student's head circumference effect the length of time a person can hold their breath? Use class data.

    d. Does a person's shop effect the number of jumping jacks they can complete in 1 minute?

    e. Does a person's shoe size influence how fast a person can run 100 meters?

    f. The favorite types of ice cream in the class.(yes this is a graph)

5. Unless otherwise specified, you will use the people in your lab table. This means there will be a minimum of four people.

6. If there are not enough people in your group, I will combine groups.

7. You must use SI units except for shoe size, which is American shoe size. We will run the 100 meters as a group and you will be required to remember your own time.

8. Create a different graph for each situation. They are not all line graphs. Use what you know about graphs to chose the best type of graph for the information

9. The x and y axes (meaning the independent and dependant variables) must be correct, the labels must be correct,an appropriate title must be chosen, a ruler must be used to draw the graphs and of course graph paper must be used. Your name must be on each page and they must be stapled. Each person must hand in their own set of graphs.

Chapter 3 Word Search/ Flashcards Homework- find

all 30 words in the letters below whose definitions follow the puzzle. Then create flashcards for the terms (30). Remember to put the definition on the opposite side as the term

W N Q O N S P O U D E B E B M E T N E X
X C O H E S I O N N I L U O A V V U N N
P K F R P X H I Z G U P T F B S T C E I
T E V I T C A Y P C S A I E F I E L R E
A O D H O C M D E V A E M L S E B E G T
C Q D I N E E L J C L T C U I J R O Y O
L A X X I P O L T I C T A N T M C T J R
R C R Y M M F I E I A N D M E Z L I L P
P L A B A B V Z E Z M R J A W L E D F V
S Z X S O A A L L B J N V Y U F A E C D
P C Y N T H C D U Q Z J L H J S I V L Z
R T M I B U Y Z H R I K Q L U O S W S F
D W O Z N A A D E E K B X G D L I U L W
Y N Q F A E T A R T S B U S N U Q Q D P
Y O B Y S F C Q A A M I C G U T H J L N
W V C U M T X E Y I T U O M O I M Q K N
Y Q K R A J A J L F J E H N P O G H T F
F I C N A C I D G J I B T Z M N A I N V
T F T I V R D W P H Q K F A O Z O N E T
T N E M E L E P R O D U C T C N D L R M

_____ the smallest unit of an element that maintains the chemical properties of that element

_____ a substance that can not be broken down into simpler substances by chemical means- ex Carbon, hydrogen

_____ an electron that is found in the outermost shell of an atom and determines the atom's chemical properties

_____ a substance that is made of atoms of two or more elements joined by chemical bonds

_____ a group of atoms that are held together by chemical forces

_____ an atom or molecule that has gained or lost one or more electrons and has a net positive or negative charge

_____ the force that holds molecules of a single material together

_____ the attractive force between 2 different substances that touch each other

_____ a homogeneous mixture with 2 or more substances uniformly dispersed

_____ any substance that increases hydronium (hydrogen ions H+)

_____ any substance that increases hydroxide ions (OH-)

_____ a scale that shows acidity or alkalinity (basicness). A logarithmic scale.

_____ a substance that acts as an acid and base and stabilizes a solution's pH

_____ a class of molecules that has carbon, hydrogen and oxygen. Includes sugars, starches and fiber

_____ long hydrocarbon chains that includes fats, waxes and steroids

_____ long chains of amino acids. Main component of everything in cells

_____ a class of molecules that contain a carboxyl group and amino group

_____ long chains of nucleotides. Includes DNA and RNA

_____ contains a sugar, nitrogenous base and phosphate group. In chains, makes DNA and RNA

_____ deoxyribonucleic acid, determines hereditary information

_____ ribonucleic acid, also carries genetic information, but uses info to make proteins

_____ adenosine trisphosphate, the energy currency of ALL cells

_____ capacity to do work

_____ a substance that is part of a chemical reaction

_____ a substance that is formed from a chemical reaction

_____ the minimum amount of energy that is needed to begin a chemical reaction

_____ a molecule, usually made of protein, that helps chemical reactions happen in cells

_____ the reactant (beginning substance) catalyzed by an enzyme

_____ the site on an enzyme where the reaction takes place

Chapter 3 Chemistry of Life

I. **ATOMS** -All matter is made up of atoms. An atom is the smallest unit of matter that cannot be broken down by chemical means.

A. Matter is anything that has _____ and takes up space.

B. The nucleus of an atom is made up of positively charged protons and uncharged neutrons. Negatively charged electrons have very little mass and move around the nucleus in a large region called the _____

C. An element is a substance made up of atoms that have the same number of protons. For example, each atom of the element carbon has six protons.

D. Atoms of an element may have different numbers of neutrons. These atoms are called _____ of elements.

II. **CHEMICAL BONDS** -Chemical bonds form between groups of atoms because most atoms become stable when they have eight electrons in the valence shell.

A. Electrons in the outermost level, or shell, are called _____.

B. Atoms tend to combine with each other such that eight electrons will be in the valence shell. When atoms combine, a force called a chemical bond holds them together.

C. When atoms of different elements combine, a _____ forms. A compound is a substance made of the bonded atoms of two or more elements.

D. Types of bonds-

1. _____- sharing valence electrons forms a covalent bond.

a) A _____is a group of atoms held together by covalent bonds.

b) A water molecule, H_2O, forms when an oxygen atom forms covalent bonds with two hydrogen atoms.

2. _____-Atoms can achieve a stable valence level by losing or gaining electrons, resulting in a positive or negative charge. An ion is an atom or group of atoms that has an electric charge because it has gained or lost electrons. The attractive force between oppositely charged ions is an ionic bond.

III. **POLARITY** – some bonds may have charges that are not distributed equally. Molecules with partial charges on opposite ends are said to be _____

A. In some covalent bonds, the shared electrons are attracted more strongly to one atom than to the other. As a result, one end of the molecule has a partial negative charge, while the opposite end has a partial positive charge.

B. The partially charged ends of polar molecules attract opposite charges. Because of this behavior, polar molecules can dissolve other polar molecules and ionic compounds.

C. Nonpolar substances, such as _____, grease, and _____, do not dissolve well in water.

D. When bonded to an oxygen, nitrogen, or fluorine atom, a hydrogen atom has a partial charge nearly as great as a proton's charge. It attracts the negative pole of other nearby molecules. This attraction, called a _____, is stronger than attractions between other molecules, but not as strong as covalent bonds.

IV. **PROPERTIES OF WATER** -Most of the unique properties of water result because water molecules form hydrogen bonds with each other.

A. When water freezes, the crystal structure formed due to hydrogen bonding makes ice _____ than liquid water.

B. Water can absorb a large amount of heat without changing temperature. This property can help organisms maintain a constant internal temperature.

C. The attraction of particles of the same substance, such as water, is called _____. Cohesion keeps water from evaporating easily; thus, water is a liquid at ordinary temperatures.

D. Water molecules also stick to other polar molecules. This attraction between particles of different substances is called _____.

V. **SOLUTIONS** - A solution is a mixture in which ions or molecules of one or more substances are evenly distributed in another substance.

A. Many substances are transported throughout living things as solutions of water. Dissolved substances can move more easily within and between cells.

B. Some water molecules break apart to form _____(H+) and _____(OH-) ions. In pure water, hydronium and hydroxide ions are present in equal numbers.

VI. **ACIDS/BASES-** Acids and bases are compounds that change the balance of these ions.

A. Acids are compounds that form extra _____(H+) ions when dissolved in water.

B. Bases are compounds that form extra _____(OH-) ions when dissolved in water.

C. When acids and bases are mixed, the extra hydronium and hydroxide ions react to form water.

VII. **pH** is a measure of how acidic or basic a solution is.

A. Each one-point increase in pH represents a _____ decrease in hydronium ion concentration. (logorathmic scale)

B. Pure water has a pH of ___. Acidic solutions have a pH _____ 7, and basic solutions have a pH _____7.

C. The pH of solutions in living things must be stable. For a stable pH to be maintained, the solutions in living things contain buffers.

D. A _____ is a substance that reacts to prevent pH changes in a solution.

VIII. **BUILDING BLOCKS OF CELLS** – biomolecules contain carbon (also called organic). They include carbohydrates, proteins, lipids and nucleic acids

A. _____ - Carbohydrates are molecules made of sugars. A sugar contains carbon, hydrogen, and oxygen in a ratio of _____.

1. Carbohydrates are a major source of energy

2. Chitin and cellulose are complex carbohydrates that provide support.

a) _____ is found in the shells of insects and the cell walls of mushrooms.

b) _____ is found in the cell walls of plants.

B. _____ - Lipids are another class of biomolecules, which includes fats, phospholipids, steroids, and waxes.

1. Lipids consist of chains of carbon atoms bonded to each other and to hydrogen atoms. This structure makes lipids _____water.

2. The main purpose of _____ is to store energy. Fats can store energy even more efficiently than carbohydrates.

3. The cell's boundary(cell membrane) is made of _____. The structure of cell membranes depends on how this molecule interacts with water.

C. _____-Proteins are chains of amino acids that twist and fold into certain shapes that determine what the proteins do. Proteins may be involved in structure, support, movement, communication, transportation, and carrying out chemical reactions.

1. A protein is a molecule made up of amino acids, building blocks that link to form proteins.

a) Every amino acid has an _____group and a _____ group. Units of amino acids can form links called peptide bonds.

b) The _____ group gives an amino acid its unique properties. _____ different amino acids are found in proteins.

2. For each type of protein, there are different levels of structure

a) amino acids are arranged in a specific order, the protein's primary structure. 1

b) The interactions of the various side groups may form coils and folds, the protein's secondary structure. 2

c) The overall shape of a single chain of amino acids is the protein's tertiary structure. 3

d) The quaternary structure is the overall shape that results from combining the chains to form proteins. 4

D. _____ - A nucleic acid is a long chain of nucleotide units. A nucleotide is a molecule made up of three parts: a _____, a _____, and a _____ group.

1. Nucleotides of deoxyribonucleic acid, or _____, contain the sugar deoxyribose. DNA molecules act as "instructions" for the processes of an organism's life

2. Nucleotides of ribonucleic acid, or _____, contain the sugar ribose. RNA also interacts with DNA to help decode the information.

3. Adenosine triphosphate, or _____, is a nucleotide that has three phosphate groups and supplies energy to cells. Energy is released in the reaction that breaks off the third phosphate group.

IX. CHANGING MATTER

A. A _____ change occurs when only the form or shape of the matter changes.

B. A _____change occurs when a substance changes into a different substance.

C. Matter is neither created nor destroyed in any change. This observation is called the _____. Every change in matter requires a change in energy.

D. Energy may change from one form to another, but the total amount of energy does not change. This observation is called the _____

X. **CHEMICAL REACTIONS** -Chemical reactions can only occur when the activation energy is available and the correct atoms are aligned.

A. Changing a substance requires a chemical reaction. During this process, bonds between atoms are broken, and new ones are formed.

B. A _____ is a substance that is changed in a chemical reaction.

C. A _____is a new substance that is formed.

D. Chemical reactions can only occur under the right conditions. The activation energy of a reaction is the _____ kinetic energy required to start a chemical reaction. Even if enough energy is available, the product still may not form. The correct atoms must be brought together in the proper orientation.

XI. **BIOLOGICAL REACTIONS** - By assisting in necessary biochemical reactions, enzymes help organisms maintain homeostasis.

A. In living things, chemical reactions occur between large, complex biomolecules. Many of these reactions require large activation energies.

B. An _____ is a molecule that increases the speed of reactions.

1. Enzymes hold molecules close together and in the correct orientation. An enzyme lowers the activation energy of a reaction.

2. Each enzyme has an _____, the region where the reaction takes place.

3. The shape of the active site determines which reactants, or substrates, will bind to it. Each different enzyme acts only on specific substrates.

4. Most enzymes need a certain range of _____ and _____

1. How are atoms and elements related?

2. Fill in the blank spaces in the table below.

Type of particle	Location within an atom	Charge
	outside the nucleus	
Proton		
	in the nucleus	0 (neutral)

3. Why do atoms form chemical bonds?

4. How is a covalent bond different from an ionic bond?

5. What is a hydrogen bond?

6. Give one reason that hydrogen bonds are important in living things.

7. Why does sodium have a positive charge when it is in solution?.

BellringerDayM T W Th F Date_____Question_____

Answer_____

1. A student empties the water out of a glass. The student observes that small droplets of water remain stuck to the glass. Which two properties of water explain the student's observation?

2. Oceans and other bodies of water warm up more slowly than air or land. Describe how the hydrogen bonds between water molecules cause this effect.

3. When carbon dioxide, CO_2, dissolves in water, some of the CO_2 molecules react with water. This forms carbonate ions and hydronium ions. Will a solution of CO_2 in water be acidic, basic, or neutral? Explain your answer.

4. What is a buffer? Why do the solutions in living things contain buffers?

Bellringer:DayM T W Th F Date_____ Question_____

Answer_____

CHAPTER 3 SEC 3 DUE DATE .

1. What are biomolecules?

2. Fill in the spaces in the table below.

Type of biomolecule	What are the building blocks of this type of biomolecule?	What is one main function of this type of biomolecule?
Carbohydrate		
	chains of carbon and hydrogen atoms	
Protein		
	Nucleotides	

3. Why can proteins perform so many different functions?

4. What is the difference between a nucleic acid and a nucleotide?

Bellringer: Day M T W Th F Date Question

Answer

CHAPTER 3 SEC 4 DUE DATE .

1. Where do living things get the energy they need?

2. How is a physical change different from a chemical change?

3. Give two conditions that must be met for a chemical reaction to occur.

4. Identify the products and the reactants in the chemical reaction shown below. Write only the chemical formulas for the products and reactants.

$$CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$$

5. Why are enzymes important to living things?

6. What is the relationship between an active site and a substrate?

7. Why may an enzyme not work properly if temperature or pH changes?

Bellringer:DayM T W Th F Date Question

Answer

CHAPTER 3 REVIEW

1) Atoms are composed of what?

2) What are ionic bonds? How do they form?

3) What is an element?

4) What is a molecule?

5) What is a covalent bond? How does it form?

6) Why don't oil and water mix?

7) What types of bonds share electrons? Donate electrons?

8) What element is contained in all biomolecules? What are the types of biomolecules?

9) What is a polar molecule? Why is water a polar molecule? What does the polarity do?

10) What is a non-polar molecule? What charges does a non-polar molecule have? What is a polar molecule? What charges do a polar molecule have?

11) What so nonpolar molecules look like? Are the ends charged? How do non-polar molecules behave?

12) What is an electron? Where is an electron cloud found? Where do electrons stay? What is the valence shell?

13) What is the smallest particle of matter that retains the properties of the element? What is the difference between an atom, element and molecule?

14) What are polysaccharides, sugars, chitin and cellulose?

15) What are the unique properties of water?

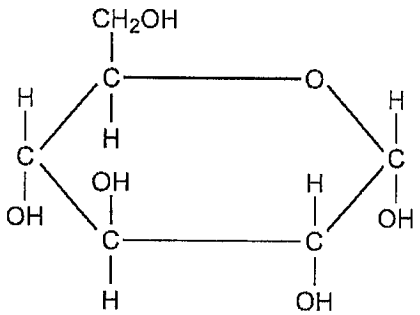
16) If the electrons in the valence shell are shared , what type of bond is it? What does this do to the stability of the molecule?

17) What are hydronium ions? What do excess hydronium ions do to the pH of the substance?
What are hydroxide ions? What do excess hydroxide ions do to the pH of the substance?

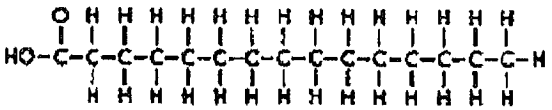
18) What types of molecules are classified as carbohydrates?

19) What types of molecules are classified as lipids?

20) What type of molecule is this?



21) What type of molecule is this?



22) How are lipids and carbohydrates similar? What do they have in common in structure?

23) What are the four levels of protein organization? What are the characteristics of each level?

24) What is cohesion? What is adhesion? What properties of water do each of these influence?

25) What are the attractions between water molecules called? How do they form? Why are they important?

26) Give 3 examples of lipids

27) Why is each amino acid unique? What portion of the structure is responsible for this uniqueness?

28) What is the substrate of an enzyme? What is the reactant of an enzyme? What is the active site of an enzyme?

29) What is matter composed of?

30) What are the two types of nucleic acids?

31) A pH less than seven means that the substance is what?

32) How do you form an electron bond? Are the electrons shared or donated?

33) What are the parts of a DNA molecule?

34) What is the link between a carboxyl group of an amino acid and the amino group of another amino acid called?

35) How do enzymes make reactions proceed? What do they do to the activation energy?

36) Where are long chains of amino acids found?

37) What molecule does an enzyme act on?

38) If a substance has a pH greater than 7 mean the substance is what?

39) How does ATP store energy?

40) What is the force that allows water to climb up a glass tube called? What is the type of bonding that is responsible for it called?

41) What are the charges of a
   a. neutron
   b. proton
   c. electron

42) Where can each subatomic particle be found?

Pre-Lab Questions

What is pH? What foes the p represent? What does the H represent?

What will you be using to test solid surfaces?

What pH is most acidic? What pH is most basic?

What is a buffer? Name a common buffer? What type of water will you be using? Why?

What are your predictions for this lab? What in your shop will be acidic (3 items). What will be basic (3 items). What do you believe will be neutral?

pH of Shop Materials Lab

Materials

- pH test strips
- pH color change guide
- Q tips
- Distilled water

Procedures:

1. You will be exploring your shops to determine the pH of various materials commonly used in your area of interest. You will be working in groups of two. Gloves and eye protection must be worn during this lab!
2. You will determine the pH of substances by using the pH test papers. These papers are designed to test liquids, but you can test pH of solids, although the results are not as accurate. The papers are embedded with a chemical that causes a color change in the presence of hydrogen and hydronium ions.
3. The liquids you test should sampled using the following method. Immerse the cotton portion of the Qtip into the liquid to be tested. The qtip should then be wiped on the test paper. Do not immerse the test strip in any liquids. There are chemicals on the paper that could contaminate the liquids you are testing. Also, avoid smearing any liquid on your gloves or body as this may irritate your skin or contaminate the pH tests of other materials.
4. After placing test liquid on pH test paper, wait 8-10 seconds and then compare the color of the test strip where the liquid was placed to the pH color change guide. The pH of the liquid is the number next to the color that most closely matches the test strip. If the color seems to be between the guide colors, estimate between the pH values.
5. Record the name of the substance that you tested, the chemical name (if known) and the pH value that you determined using the test strips in the data table below.
6. **DO NOT** wait longer than 12 seconds to read your test tape because some materials oxidize and will give you inaccurate pH results.
7. **DO NOT** try to remember the values- the strips will change with time, and may even return to the original color when dry. Record your readings as soon as you complete the reading.
8. The pH test strips can not accurately determine the pH of strongly colored dyes. If you have a material that is colored, wipe the liquid on the test tape and then with the other side of the Qtip (dipped in distilled water) remove any excess liquid. This prevents staining of the tape and allows more accurate pH measurement.
9. If you chose to sample a solid object (only 25% of the total number of objects tested may be solid), saturate a clean Qtip in distilled water, wipe the Qtip on the solid object for 30 seconds, then rub the Qtip on the test tape and read as described above. Remember to record your results immediately!
10. Throw all used Qtips and pH test strips away in a proper trash receptacle immediately following testing.

	Substance Tested	**Chemical Name** (if chemical name is not known, state the function of the substance-ex Fantastik=cleaner)	Room number	pH
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

NAME_____SCI#_____ POINTS:____

Questions:

Include with this lab sheet a list of the materials your LAB TABLE tested in order or pH from MOST ACIDIC to MOST BASIC. Include the substance tested, the pH and where it was tested. This must be TYPED!!!

1. Why is it important to use *distilled* water to moisten Qtip when sampling materials?

2. What is the pH range of an alkaline solution? Name three alkaline substances.

3. What is the pH range of an acidic substance? Name three acidic substances.

4. What chemical properties does pH actually represent?

5. An increase in the pH from 8 to 9 indicates that the number of hydroxide ions has increased by what amount?

6. A decrease in the pH from 3 to 2 represents an increase or decrease in hydrogen ions? By how much?

7. Why is it important to know the acidity/ alkalinity of the substances you are working with?

8. Does the pH range for acids seem to go against intuition (What you think would be the rule for pH)? If you knew nothing about acids and bases, but were told that the pH range was between 1 and 14, what end would you say acids were on? Does this make it easier or harder to remember specific pH values of common substances? Why?

Measuring Food Energy

Pre-Lab Discussion

All living things need energy to carry out metabolic activities. Animals—unlike many plants, protists, and bacteria—do not have the means to get energy directly from sunlight or simple inorganic chemicals. The energy requirements of animals must be met by taking in food.

The energy content of food can be determined by burning a sample of food in a device called a calorimeter. Heat energy released by combustion is absorbed by a container of water. Any rise in water temperature is measured and then used to determine the value of the heat energy released by the burning food sample. Heat energy is expressed in units called calories. One calorie is the amount of heat needed to raise the temperature of 1 gram of water by 1 degree Celsius. This unit, however, is too small for evaluating food energy. A Calorie, which is equal to 1000 calories, is used to measure food energy.

In this investigation, you will construct a simple calorimeter and use it to measure the amount of heat energy contained in certain foods.

Problem

How is the energy in food measured?

Materials *(per group)*

Ring stand	Four food samples
Test tube clamp	Heat-resistant gloves
Test tube	Triple-beam balance
Paper clip	100-mL graduated cylinder
Cork stopper	Matches
Fireproof pad	Thermometer
Metric ruler	

Safety

Put on a laboratory apron if one is available. Put on safety goggles. Handle all glassware carefully. Use extreme care when working with heated equipment or materials to avoid burns. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

72

1. To assemble a calorimeter, set up a ring stand, test tube clamp, test tube, and fireproof pad as shown in Figure 1.
2. To make a food platform for the calorimeter, bend the outer end of a paper clip straight down so that it is at a right angle to the rest of the clip. Insert the free end of the clip into the middle of the narrow end of the cork stopper. See Figure 2.
3. Place the food platform on the fireproof pad. Adjust the height of the test tube so that the space between the food platform and the bottom of the test tube is 2 cm.
4. Use a graduated cylinder to measure exactly 15 mL of water into the test tube. Record the mass of the water in the appropriate place in the Data Table. **Note:** *Remember that 1 mL of water has a mass of 1 g.*
5. Measure the temperature of the water in the test tube. Record this number in the appropriate place in the Data Table. **Note:** *Be sure to remove the thermometer from the test tube after you record the temperature.*
6. Select a food sample and find its mass using the triple-beam balance. Record the mass in the appropriate place in the Data Table. Also record the name of the food sample used in the appropriate place in the Data Table.
7. Place the food sample on the paper clip platform. Ignite the food sample with a match, and quickly place the platform under the test tube. **CAUTION:** *Wear safety goggles when doing this part of the investigation. Be careful when using matches.* Allow the food to burn completely. Reignite the sample if necessary.

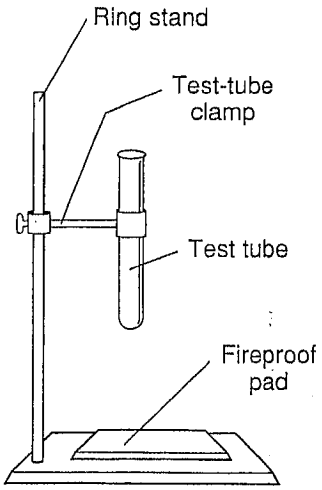


Figure 1

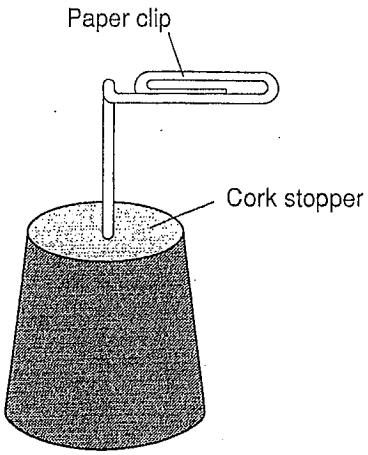


Figure 2

8. After the sample has burned completely, measure the temperature of the water in the test tube. **CAUTION:** *Do not touch the test tube; it may be hot.* Record the temperature of the water.
9. Find the mass of the remainder of the burned food sample. Record the mass.
10. Determine the change in mass of the food sample. Record the result.
11. Determine the change in the temperature of the water in the test tube. Record the result.
12. Repeat steps 3 through 11 using three other food samples. **Note:** *Remember to empty the water out of the test tube and to use cool water for each sample.*
13. Use the formula below to find the energy value, or Calories, per food sample. Record the results in the appropriate place in the Data Table. **Note:** *The specific heat of water is 1 Calorie per kilogram degree Celsius.*

$$\text{Calories per food sample} = \text{Change in water temperature} \times \text{Mass of water} \times \text{Specific heat of water} \times \frac{1\text{ kg}}{1000\text{ g}}$$

14. Use the formula below to find the Calories per gram of food sample. Record the results in the appropriate place in the Data Table.

Calories per gram = Calories per food sample/Change in mass of food sample

Observations

Data Table

Variable	Food Sample			
Mass of food sample before burning (g)				
Mass of food sample after burning (g)				
Change in mass of food sample (g)				
Mass of water (g) (1 mL = 1 g)				
Temperature of water before heating (°C)				
Temperature of water after heating (°C)				
Change in water temperature (°C)				
Calories per food sample				
Calories per gram				

Analysis and Conclusions

1. What is the difference between a calorie and a Calorie? _____

2. Why must the food sample be ignited before placing the platform under the test tube?

3. Why must the thermometer be removed from the test tube when the food sample is burning?

4. How do your results compare to those of other student groups in your class? Give reasons for any variations. _____

_____

5. Fats yield more food energy than proteins or carbohydrates. Which of your food samples most likely contained the greatest amount of fat? _____

_____

Critical Thinking and Application

1. Swimming for one hour burns up 600 Calories. For each food sample you tested, calculate how many grams of food you would have to eat to get this energy. _____

_____

2. Fad diets, which have become popular in the past two decades, involve the consumption of large amounts of a limited variety of foods. Explain why some fad diets may be an unhealthful way to lose weight. _____

_____

_____

3. Although fiber is not officially classified as a nutrient, it is an important component of the American diet today. What is the role of fiber in the human body?

_____

_____

_____

4. Contrast the snacks for a person who is trying to lose weight with those for a person who is growing very rapidly. _____

_____

_____

_____

Going Further

Using the procedure from this investigation, determine the Caloric value of various diet foods and their counterparts. Is there a difference in their Caloric values?

Honors Only

5. In the Data Table, write the name of the type of cell that you examined. Describe the general shape of the cell in the space provided. Estimate the length of the cell and record this figure. Refer to Laboratory Investigation 4 if you need to review how to estimate the size of objects under the microscope. Put a check mark next to the cell structures you are able to observe under low power.
6. Switch to the high-power objective lens. **CAUTION:** *When turning to the high-power objective lens, you should always look at the objective from the side of your microscope so that the objective lens does not hit or damage the slide.* Look for cell structures unobservable under low power. Put a check mark next to these structures in the Data Table. Based on your observations, decide if the cell is prokaryotic or eukaryotic and record this in the Data Table.
7. In the appropriate place in Observations, draw and label what you see using the high-power objective lens. Record the magnification of the microscope.
8. Repeat steps 1 through 7 using other prepared slides provided by your teacher.
9. Repeat steps 1 through 7 using an unidentified prepared slide provided by your teacher.
10. When you have finished examining all of the prepared slides, return the microscope to the storage area.

Observations

Data Table

Cell Type	Shape	Size (μm)	Cell Structures							Prokaryotic or Eukaryotic
			Cell wall	Cell membrane	Nucleus	Nuclear envelope	Cytoplasm	Vacuoles	Plastids	
Unknown										

Prepared Slide 1 High-power objective

Magnification _____

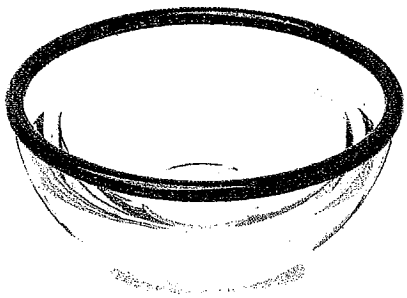
Prepared Slide 2 High-power objective

Magnification _____

Break water's surface tension

9

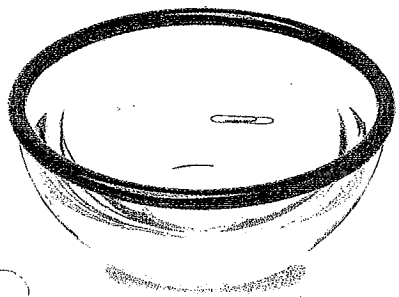
THE SURFACE OF WATER pulls in all directions. This is called surface tension. Try breaking water's surface tension and watch what happens!



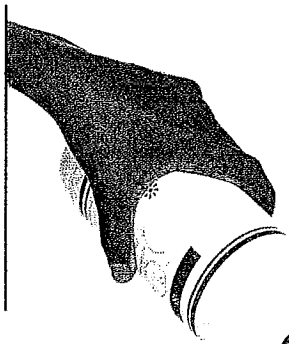
Find in your kit:
- 2 boat shapes
- paper clip

Find around your home:
- dishwashing liquid
- bowl of water

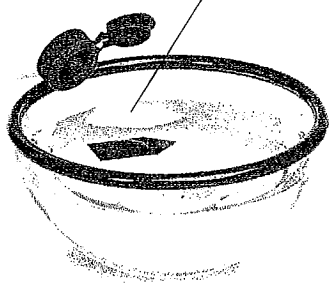
1 Fill up a small bowl with cold water until it is about three-quarters full.



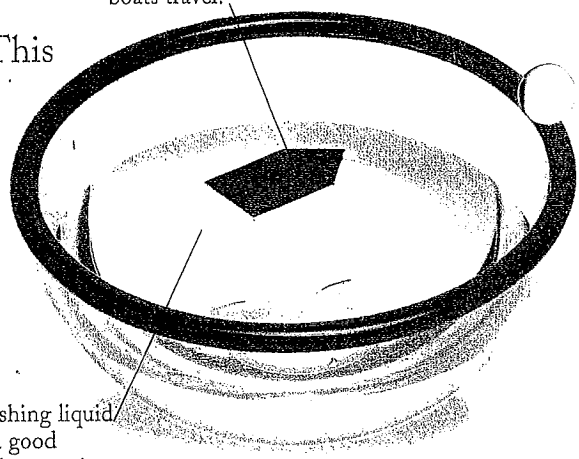
2 Try floating a paper clip on top of the water's surface. Can you see the surface stretching under the weight of the paper clip?



3 Float the two boats on the surface of the water. Gently add a small drop of dishwashing liquid behind the boats and watch what happens.



Float the two boats next to each other on the water's surface.



How far do your boats travel?

Dishwashing liquid makes a good cleaner because it breaks water's surface tension.

4 The dishwashing liquid reduces the water's surface tension. The surface tension at the front of the boats pulls them forward.

More experiments
- Place a different amount of dishwashing liquid behind each boat and race them. Which boat travels farthest?
- What other substances can you use to break water's surface tension?

2 6 7

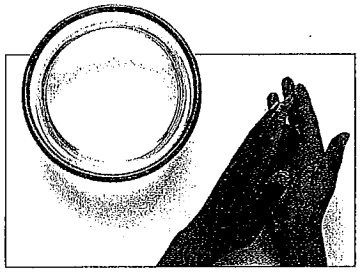
Float a clay boat

Find in your kit:
- modeling clay

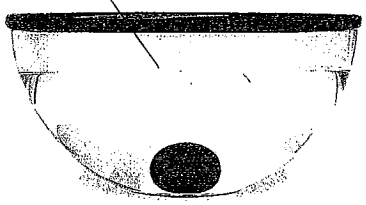
Find around your home:
- small bowl of water

8

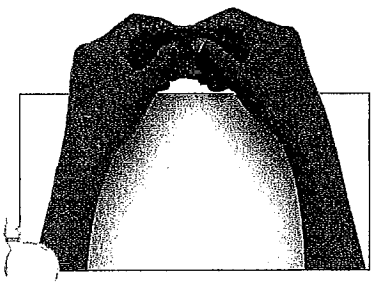
IF BOATS ARE MADE FROM heavy materials, why don't they sink? By simply reshaping a ball of clay, you can learn how boats float on water.



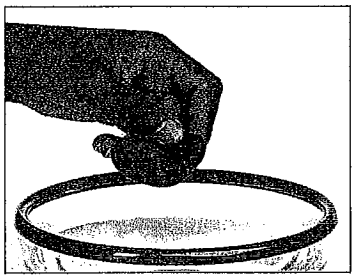
1 Pour some water into a small bowl until it is about three-quarters full. Roll the modeling clay into a ball.



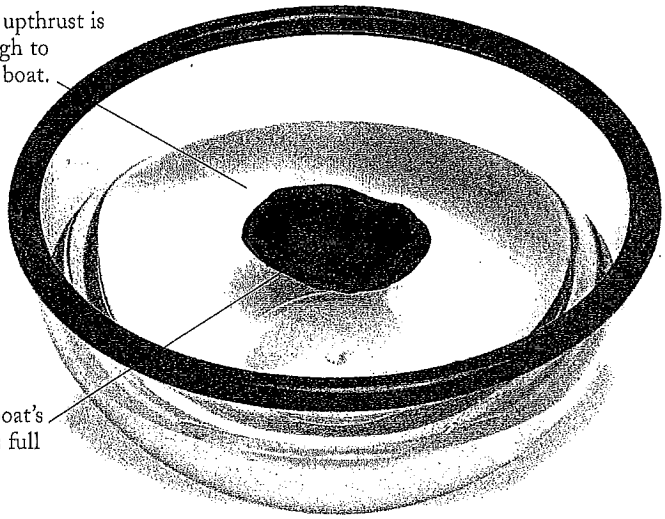
2 Drop the clay ball gently into the water. The clay ball sinks because it is more dense than the water.



3 Remove the ball from the water. Reshape the clay into a boat's hull with a flat bottom and turned-up sides.

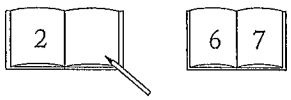


4 Now carefully place the clay boat in the bowl of water. Do you think that the boat will float?



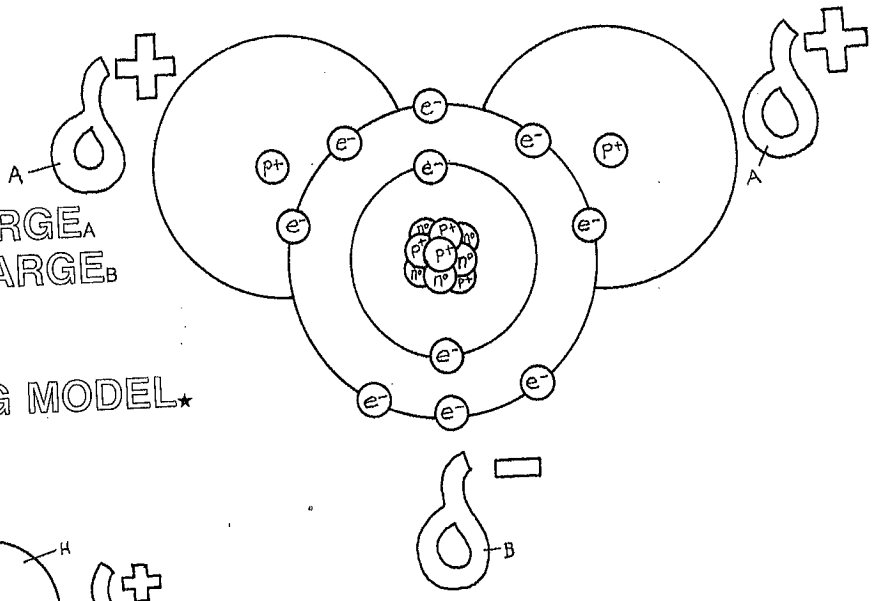
5 The boat shape displaces, or pushes away, more water than the clay ball did. This increases the water's upthrust and makes the boat float on the surface. Try putting a cargo of small marbles in the boat. Does the boat float or sink?

More experiments
- Test whether your clay boat can hold different types of cargo from your kit. Then record the results in your *Scientist's Notebook*.

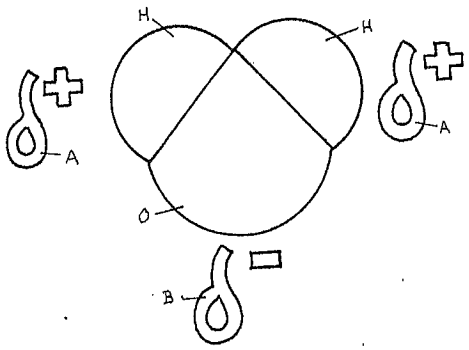


WATER MOLECULES.

ELECTRON DIAGRAM★
PROTON$_{p+}$
NEUTRON$_{n^0}$
ELECTRON$_{e-}$
POSITIVE CHARGE$_A$
NEGATIVE CHARGE$_B$

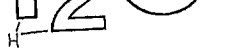


SPACE-FILLING MODEL★
HYDROGEN$_H$
OXYGEN$_O$

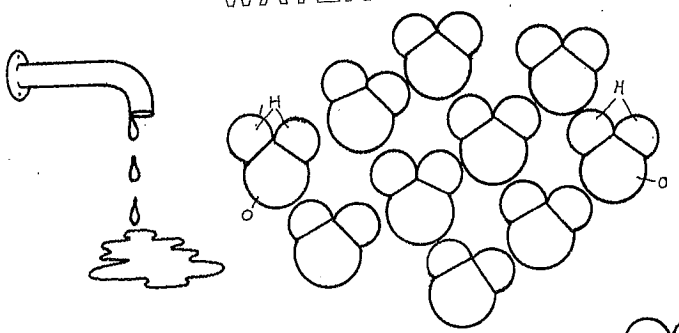


EMPIRICAL FORMULA$_{H_2O}$

H_2O



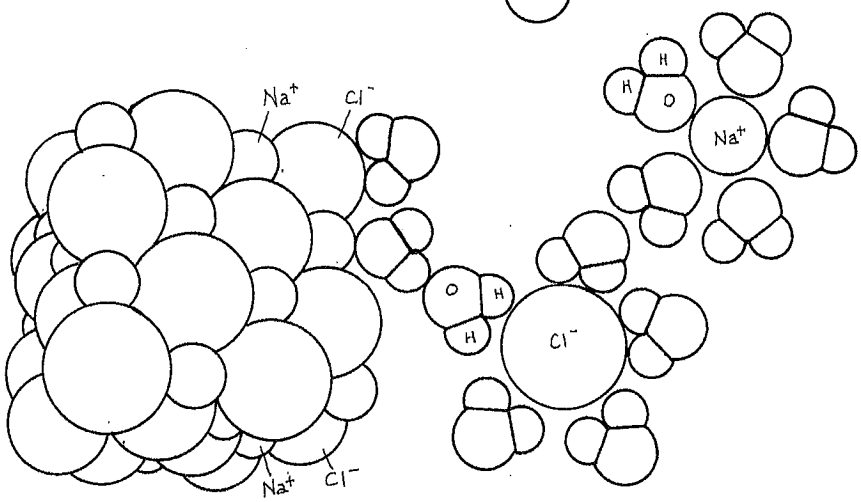
HYDROGEN BONDING OF WATER MOLECULES★



DISSOLVING OF AN IONIC COMPOUND★

SODIUM ION$_{Na^+}$

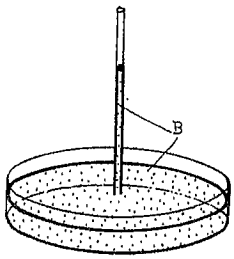
CHLORIDE ION$_{Cl^-}$



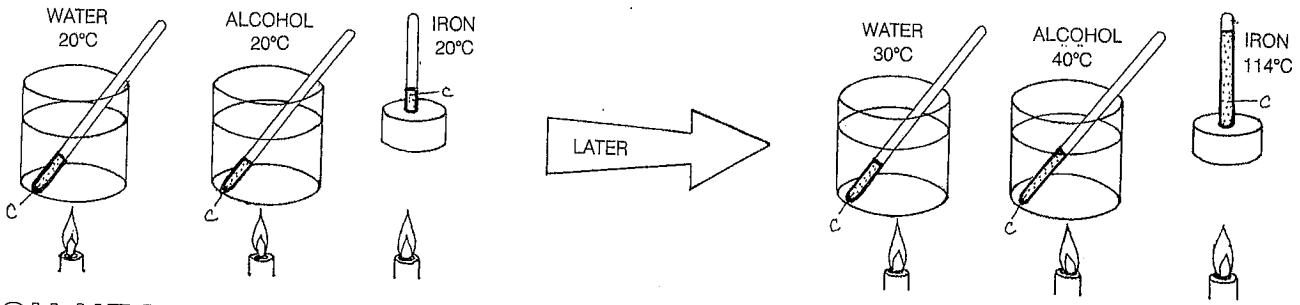
UNUSUAL PROPERTIES OF WATER.

GOOD SOLVENT$_A$

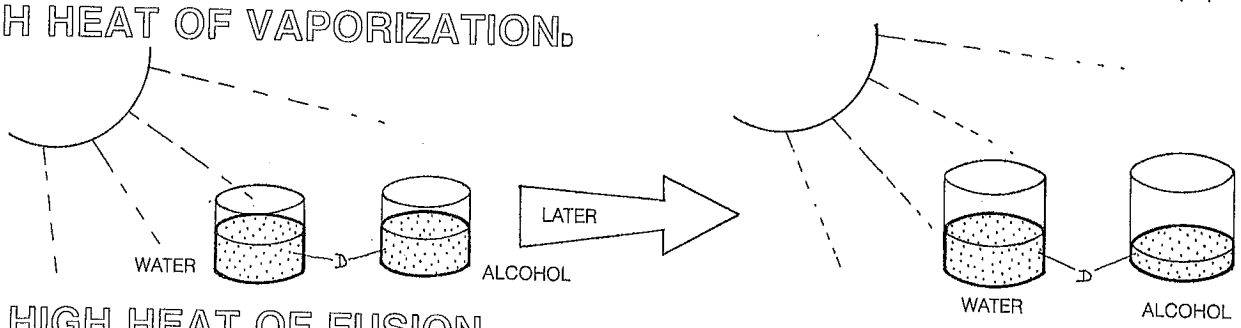
CAPILLARY ACTION$_B$



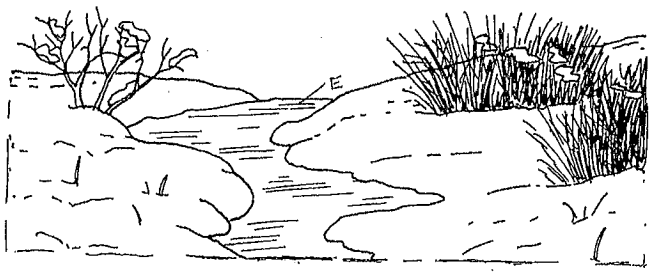
HIGH SPECIFIC HEAT$_C$



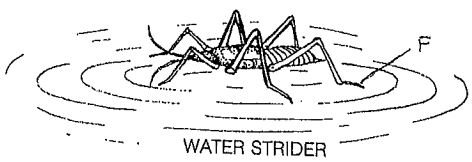
HIGH HEAT OF VAPORIZATION$_D$



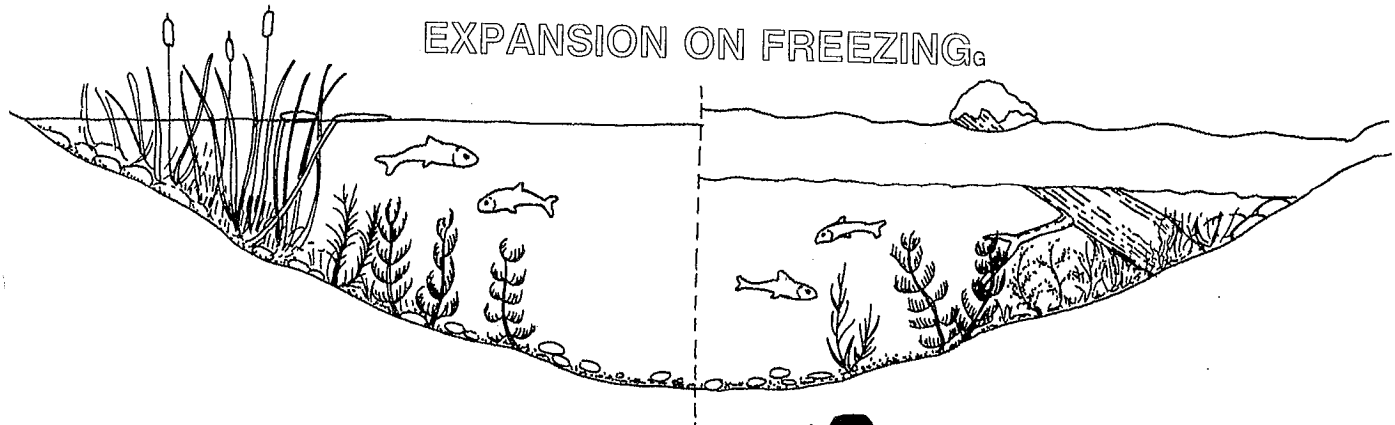
HIGH HEAT OF FUSION$_E$

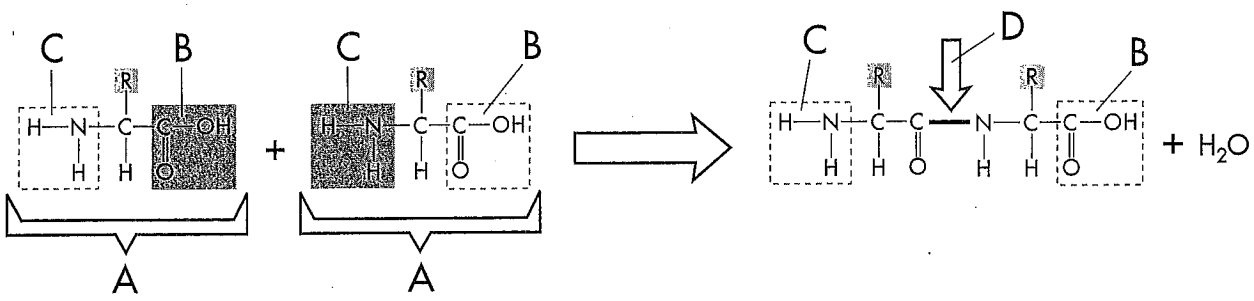


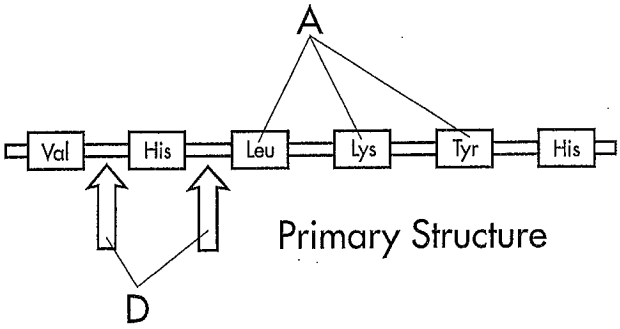
HIGH SURFACE TENSION$_F$



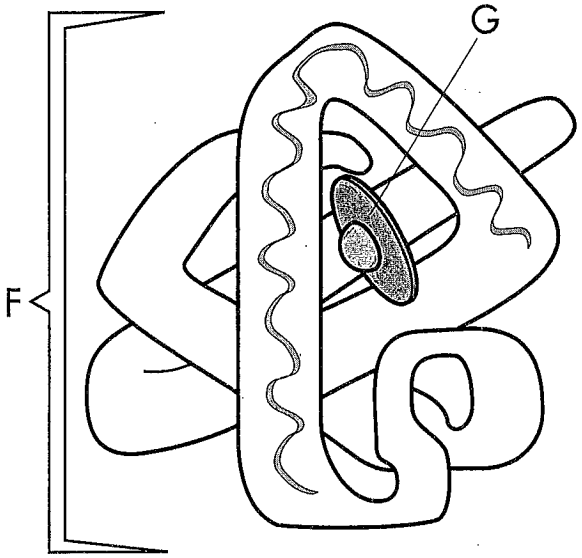
EXPANSION ON FREEZING$_G$



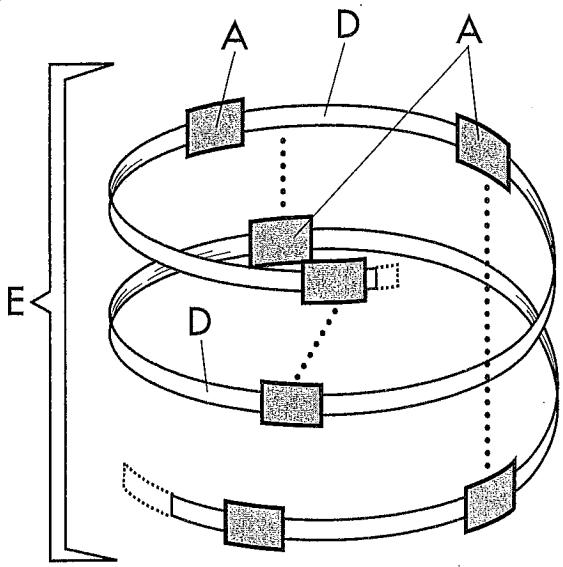




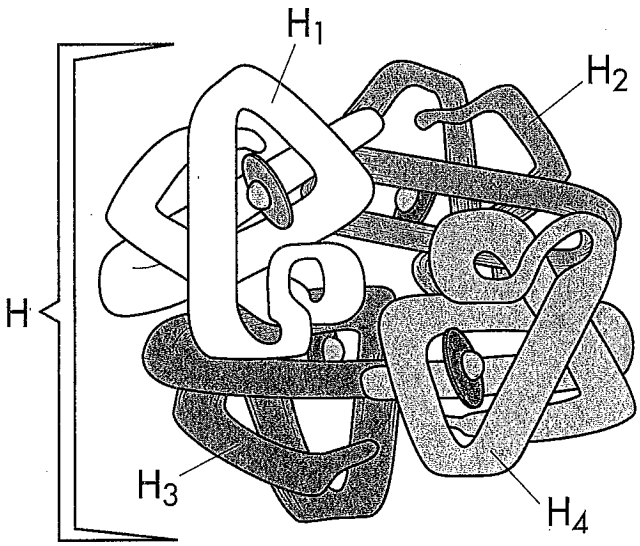
Primary Structure



Tertiary Structure

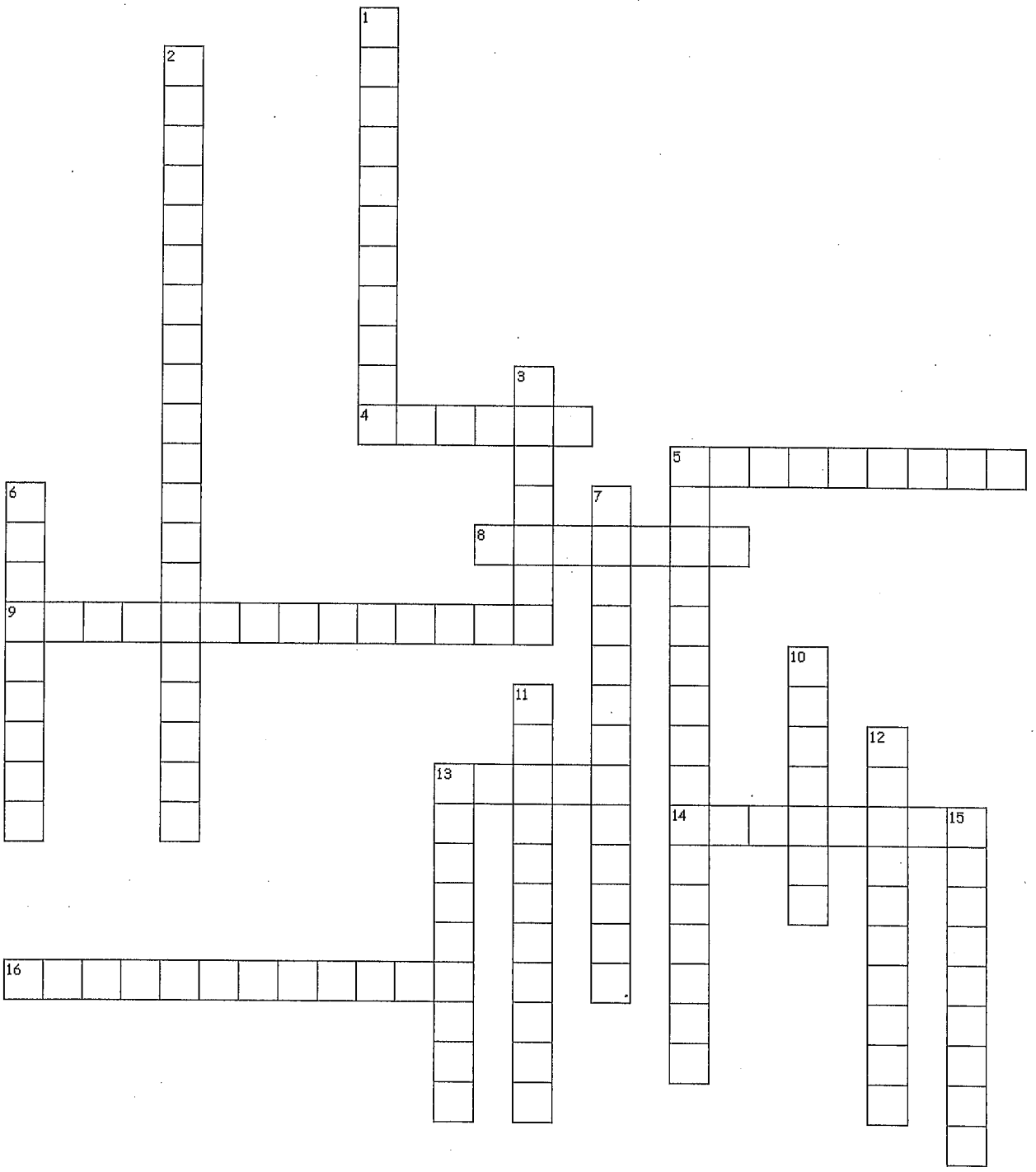


Secondary Structure



Quaternary Structure

Ch 7 Crossword and Flashcards-complete the crossword, then make a flashcard for each term 18 cards



Across

4. a group of similar cells that perform a common function
5. the region of the cell within the membrane
8. a small cavity or sac that contains materials in a eukaryotic cell
9. a cell organelle that helps make and package materials to be transported out of the cell
13. a collection of tissues that carry out a specialized function of the body
14. a cell organelle where protein synthesis occurs
16. a phospholipid layer that covers a cell's surface and acts as a barrier between the inside of a cell and the cell's environment

Down

1. an organelle found in plants and algae cells where photosynthesis occurs
2. a system of membranes that is found in a cell's cytoplasm and that assists in the production, processing, and transport of proteins and in the production of lipids
3. in a eukaryotic cell, a membrane-bound organelle that contains the cell's DNA
5. a collection of genetically identical cells that are permanently associated but in which little or no integration of cell activities occurs
6. a long, hairlike structure that grows out of a cell and enables the cell to move
7. in eukaryotic cells, the cell organelle that is surrounded by two membranes and that is the site of cellular respiration
10. a fluid-filled vesicle found in the cytoplasm of plant cells or protists
11. a group of organs that work together to perform body functions
12. a single-celled organism that does not have a nucleus or membrane-bound organelles
13. one of the small bodies that are found in the cytoplasm of a cell and that are specialized to perform a specific function
15. an organism made up of cells that have a nucleus and membrane-bound organelles

CHAPTER 7 VOCAB

Cell membrane
Cytoplasm
Ribosome
Prokaryote
Eukaryote
Nucleus
Organelle
Vesicle
endoplasmic reticulum
Golgi apparatus
Vacuole
Chloroplast
Mitochondrion
Flagellum
Tissue
Organ
organ system
colonial organism

Chapter 7 Cell Structure

I. **THE DISCOVERY OF CELLS**- Microscope observations of organisms led to the discovery of the basic characteristic common to all living things.

A. Robert Hooke used a microscope to discover cells in _____.

B. Anton van Leeuwenhoek used a more powerful microscope to see single-celled organisms in pond water.

II. **CELL THEORY**-The cell theory states:

A. All living things are made up of one or more _____.

B. Cells are the basic units of structure and function in organisms.

C. All cells arise from _____cells.

III. **CELL FUNCTION**- A cell's shape reflects the cell's function. Cell size is limited by a cell's _____

A. All substances that enter or leave a cell must cross the surface of the cell.

B. A cell's ability to move substances across its surface can be estimated by finding its surface area-to-volume ratio.

C. Cells with _____ surface area-to-volume ratios can exchange substances more efficiently.

D. When comparing cells of the same shape, small cells have greater surface area-to-volume ratios than large cells. Small cells function_____ efficiently than large cells.

IV. **CELL FEATURES**- Because of their complex organization, eukaryotic cells can carry out more specialized functions than prokaryotic cells can. All cells share common structural features, including a cell membrane, cytoplasm, ribosomes, and DNA.

A. The cell membrane is the outer layer that covers a cell's surface and acts as a _____between the outside environment and the inside of the cell.

B. The cytoplasm is the region of the cell within the cell membrane. The _____includes the fluid inside the cell called the cytosol.

C. A _____ is a cellular structure (but does not have a membrane) that makes proteins.

D. The _____ of a cell provides instructions for making proteins, regulates cellular activities, and enables cells to reproduce.

V. DIFFERENCES BETWEEN TYPES OF CELLS

A. _____- A prokaryote is an organism made of a single prokaryotic cell.

1. Prokaryotic cells do not have a nucleus or other internal compartments. The genetic material of a prokaryotic cell is a single loop of DNA.

2. Prokaryotes are more _____ and existed first

B. _____- A eukaryote is an organism made up of one or more eukaryotic cells. All multicellular organisms are made of eukaryotic cells.

1. The DNA of a eukaryotic cell is found in an internal compartment of the cell called the nucleus.

2. All eukaryotic cells have membrane-bound organelles. An organelle is a small structure found in the cytoplasm that carries out specific activities inside the cell.

VI. THE FRAMEWORK OF THE CELL-The cytoskeleton helps the cell move, keep its shape, and organize its parts.Eukaryotic cells have an intricate network of protein fibers called the cytoskeleton which provides the interior framework of the cell.

A. There are three different kinds of cytoskeleton fibers:

1. Microfilaments

2. Microtubules

3. Intermediate fibers.

VII. DIRECTING CELLULAR ACTIVITY- DNA is the "brain" of the cell. It has the instructions for making all proteins. The proteins then go on to complete ALL activities. DNA is like a general, the proteins are the soldiers. The soldiers are actually doing all the work but without the general making the decisions, there would be chaos.

A. DNA contains instructions for making proteins which control most of the activity of the cell.

B. The DNA of eukaryotic cells is stored in the _____.

C. A double membrane called the nuclear _____ surrounds the nucleus. Nuclear pores located on the nuclear envelope act as channels to allow certain molecules to move in and out of the nucleus.

D. The _____ is a structure within the nucleus where ribosome parts are made. These ribosome parts are transported out of the nucleus into the cytoplasm where they are assembled to form a complete ribosome. Ribosomes are the machines that make the proteins.

E. Ribosomes that are suspended in the cytosol are called _____ ribosomes.

F. Free ribosomes make _____that remain inside the cell.

G. Ribosomes that are attached to the endoplasmic reticulum are called _____ribosomes. Bound ribosomes make proteins that are exported from the cell.

H. Ribosomes can switch between being bound or free, depending on what proteins the cell needs to make.

VIII. **PROTEIN PROCESSING**- The endoplasmic reticulum and Golgi apparatus are both involved in protein processing

A. _____ - The endoplasmic reticulum and the Golgi apparatus are organelles that prepare proteins for extracellular export.

1. Proteins that are sent outside the cell are packaged in vesicles. Vesicles are small, membrane envelopes that enclose the proteins and keep them separate from the rest of the cytoplasm.

2. The endoplasmic reticulum, or ER, is a system of membranes that moves proteins and other substances through the cell and make the vesicles.

3. The endoplasmic reticulum is divided into two portions: rough ER and smooth ER.

4. The ribosomes on the rough ER make proteins that are packaged into vesicles.

5. Enzymes of the smooth ER make lipids and break down toxic substances.

B. _____- The Golgi apparatus is a set of flattened, membrane-bound sacs. The Golgi apparatus helps modify, sort, and package cell products for distribution.

1. The ribosomes located on the rough ER make proteins which then cross into the membranes of the ER.

2. The ER membrane then pinches off and forms a vesicle around the proteins.

3. Vesicles move from the rough ER to the Golgi apparatus, where they are modified by enzymes and repackaged in new vesicles then are sent out of the cell or stored.

IX. **STORAGE AND MAINTENANCE**- Vesicles help maintain homeostasis by storing and releasing various substances as the cell needs them. They are Lysosomes and vacuoles

A. _____A lysosome is a vesicle produced by the Golgi apparatus that contains enzymes that break down large molecules. Lysosomes recycle old or damaged organelles and digest food particles to provide nutrients for the cell.

B. _____-A vacuole is a fluid-filled vesicle found in the cytoplasm of many plant cells.

1. Plant cells contain a large compartment called the central vacuole, which stores water, ions, nutrients, and wastes.

2. Some protists have contractile vacuoles which pump excess water out of the cell in order to control the concentration of salts and other substances.

3. A food vacuole is formed when the cell membrane surrounds food particles outside the cell and pinches off to form a vesicle inside the cell.

X. **ENERGY PRODUCTION**- The energy for cellular functions is produced by chemical reactions that occur in the mitochondria and chloroplasts. Cells can only use ATP for energy, much like a car can only use gas. If you put diesel fuel in a car gas tank, it will not run because it can't use the diesel. Cells must convert sugars and fats to ATP to use.

A. _____-A chloroplast is an organelle found in plant and algae cells that uses light energy to make carbohydrates from carbon dioxide and water. Carbohydrates are then used to make ATP.

1. Chloroplasts are surrounded by two membranes and have several stacks of flattened sacs where energy production takes place.

2. Plant cells may have several chloroplasts.

B. _____- mitochondria are cell organelles that use other forms of energy to make ATP. ATP needed by a cell is produced inside mitochondria. Both animal and plant cells contain mitochondria. Even though plants have chloroplasts which make sugars by photosynthesis, the plant cell can not use the photosynthestic sugar as energy- it still needs to be changed into ATP.

XI. **DIVERSITY IN CELLS**- The different organelles and features of cells enable organisms to function in unique ways in different environments. The function of a cell is determined by its shape and the organelles found in the cell.

A. Prokaryotes can vary in shape, the way they obtain and use energy, and their ability to move.

1. Many prokaryotes have a flagellum, a long, hair-like structure that grows out of the cell and enables the cell to move through its environment.

2. Prokaryotes may also have pili, short outgrowths that allow the cell to attach to surfaces or other cells.

B. Eukaryotic cells can vary in shape, external features and internal features. Eukaryotic cells usually have a "specialty"- a specific job they must do for the health of the whole organism. Remember eukaryotes are multicellular.

1. Your skin cells and brain cells do not have the same job and so do not look or function the same.

2. Animal and plant cells are two types of eukaryotic cells. Both have many of the same organelles, but plant cells also have chloroplasts, a large central vacuole, and a cell wall.

XII. **LEVELS OF ORGANIZATION**- Plants and animals have many highly specialized cells that are arranged into tissues, organs, and organ systems.

A. A _____ is a distinct group of similar cells that perform a common function.

B. An _____ is a collection of tissues that work together to form a structure which performs a specific function.

C. An _____ is composed of a group of organs that work together to perform major body functions.

XIII. **BODY TYPES**- organisms can be unicellular or multicellular.

A. _____organisms can thrive independently or live together in groups.

B. Cells that are permanently associated but do not work together or integrate cell activities are called _____ organisms.

C. True multicellularity occurs only in eukaryotes. In a multicellular body, cells are interdependent – they can NOT live alone. Distinct types of cells have specialized functions to help the organism survive. Most multicellular organisms begin as a single cell, which divides to form more cells. These cells then grow and become specialized in a process called differentiation. Once differentiation occurs, the specialized cells can not exist on their own.

CHAPTER 7 SEC 1 DUE DATE

1. Indicate whether each structure or feature below is found in a prokaryotic cell, a eukaryotic cell, or both.

Cell structure or feature	Prokaryotic cell	Eukaryotic cell
Nucleus	no	yes
Cell membrane		
Cytoplasm		
DNA		
Ribosomes		
Membrane bound organelles		

2. What are the three parts of the cell theory?

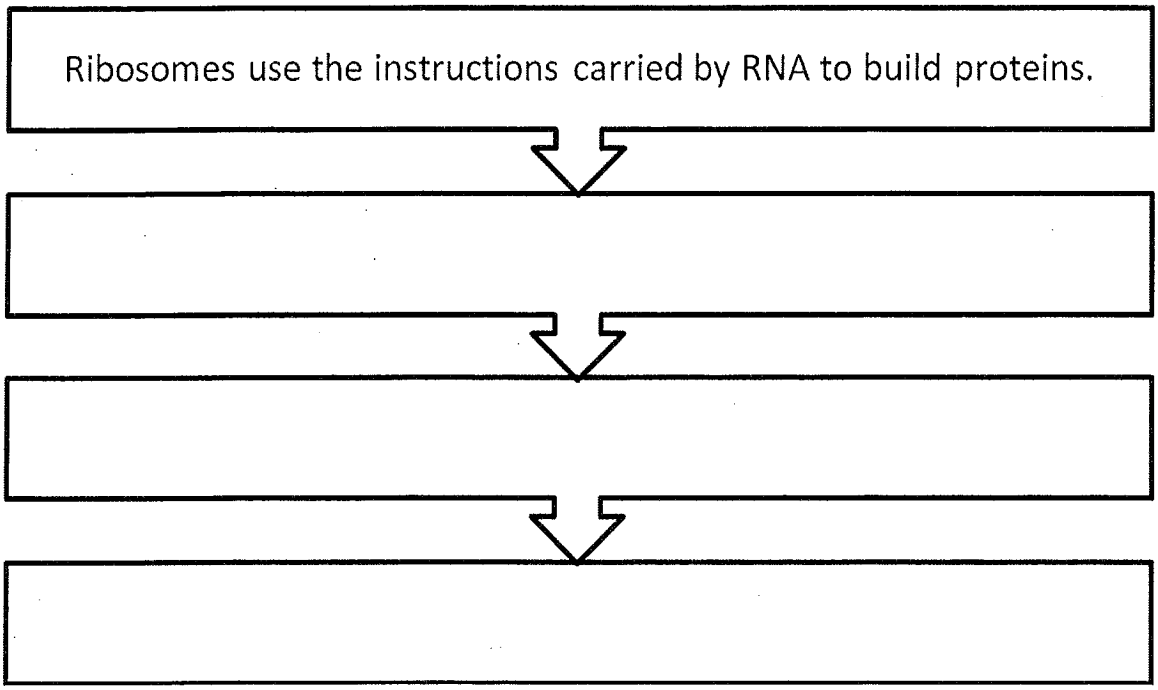
3. Could a cell be the size of an elephant? Explain your answer.

4. How does the location of DNA differ in prokaryotic and eukaryotic cells?

Bellringer: Day M T W Th F Date_____ Question_____

Answer_____

1. Complete the process chart to describe how proteins are made andmoved out of the cell.



2. How does DNA direct the cell's activities, such as making proteins, if DNA stays inside the nucleus?

3. Why do plant cells need both chloroplasts and mitochondria?

Bellringer:Day M T W Th F Date Question

Answer

CHAPTER 7 SEC 3 DUE DATE .

1. Why are specialized cells found only in multicellular organisms?

2. Identify four ways that prokaryotes can differ from one another.

3. Why are colonial organisms not truly multicellular?

4. How would pili be important to colonial bacteria?

5. What are the four levels of organization of complex multicellular organisms?

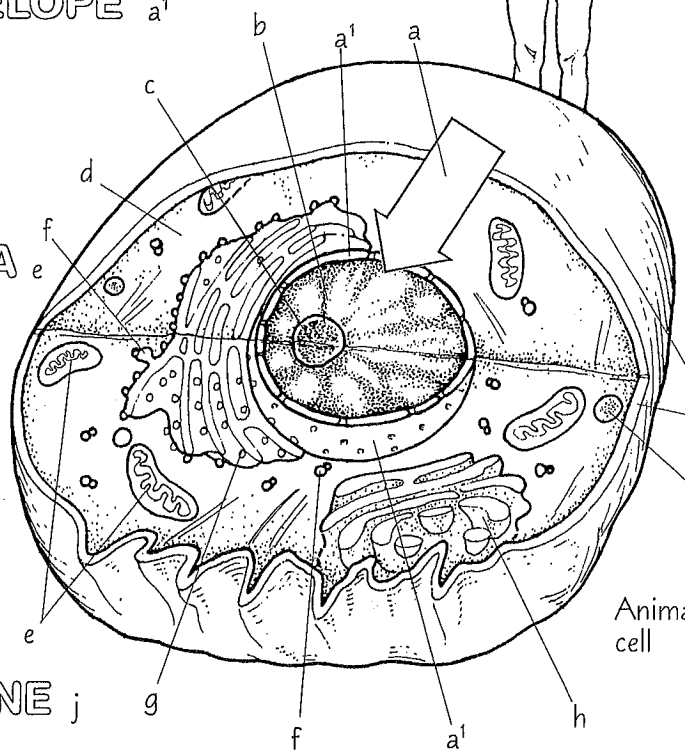
Bellringer: Day M T W Th F Date Question

Answer

EUKARYOTES AND PROKARYOTES

EUKARYOTIC CELL ✿

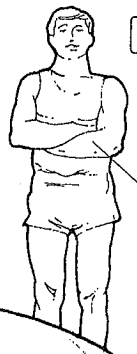
NUCLEUS a
NUCLEAR ENVELOPE a^1
CHROMATIN b
NUCLEOLUS c
CYTOPLASM d
MITOCHONDRIA e
RIBOSOME f
ENDOPLASMIC RETICULUM g
GOLGI APPARATUS h
LYSOSOME i
CELL MEMBRANE j



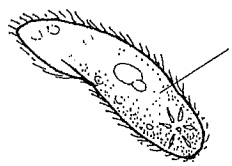
Animal cell

EUKARYOTES ✿

ANIMAL k



PLANT l

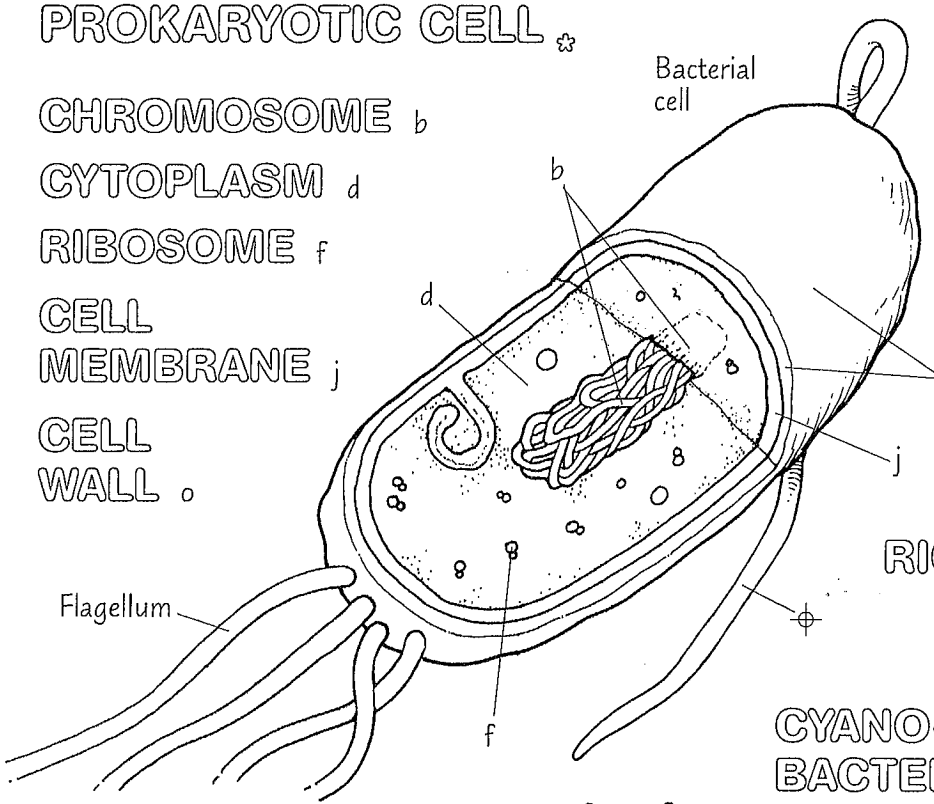


PROTOZOAN m

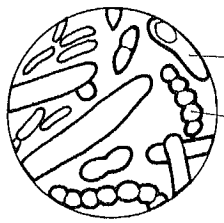
FUNGUS n

PROKARYOTIC CELL ✿

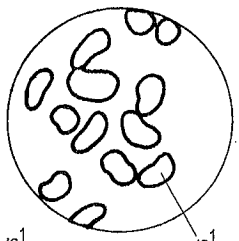
CHROMOSOME b
CYTOPLASM d
RIBOSOME f
CELL MEMBRANE j
CELL WALL o



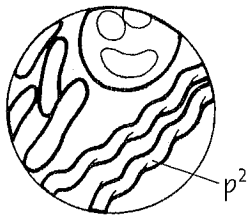
PROKARYOTES ✿



BACTERIUM p



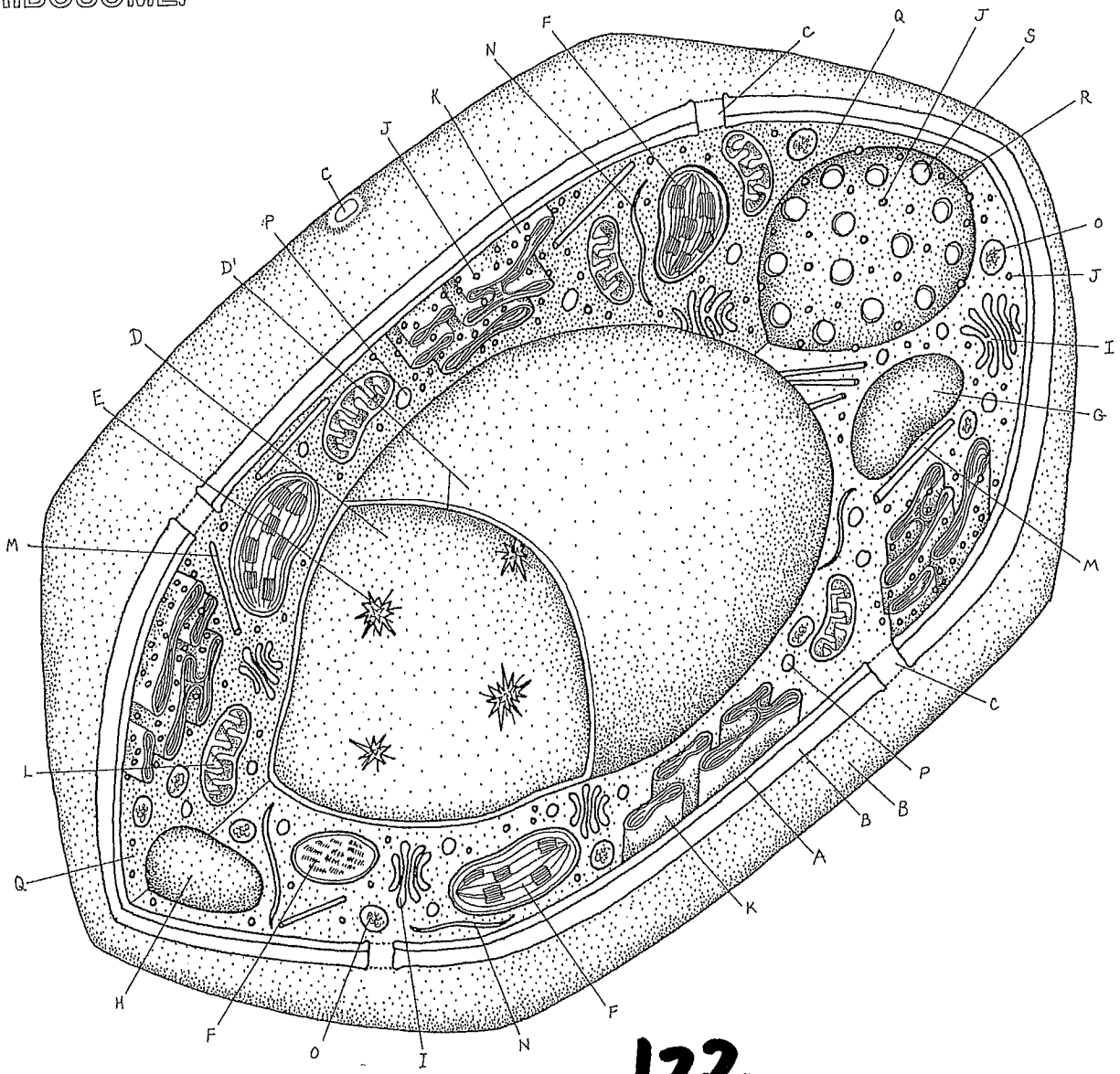
RICKETTSIA p^1



CYANO-BACTERIUM p^2

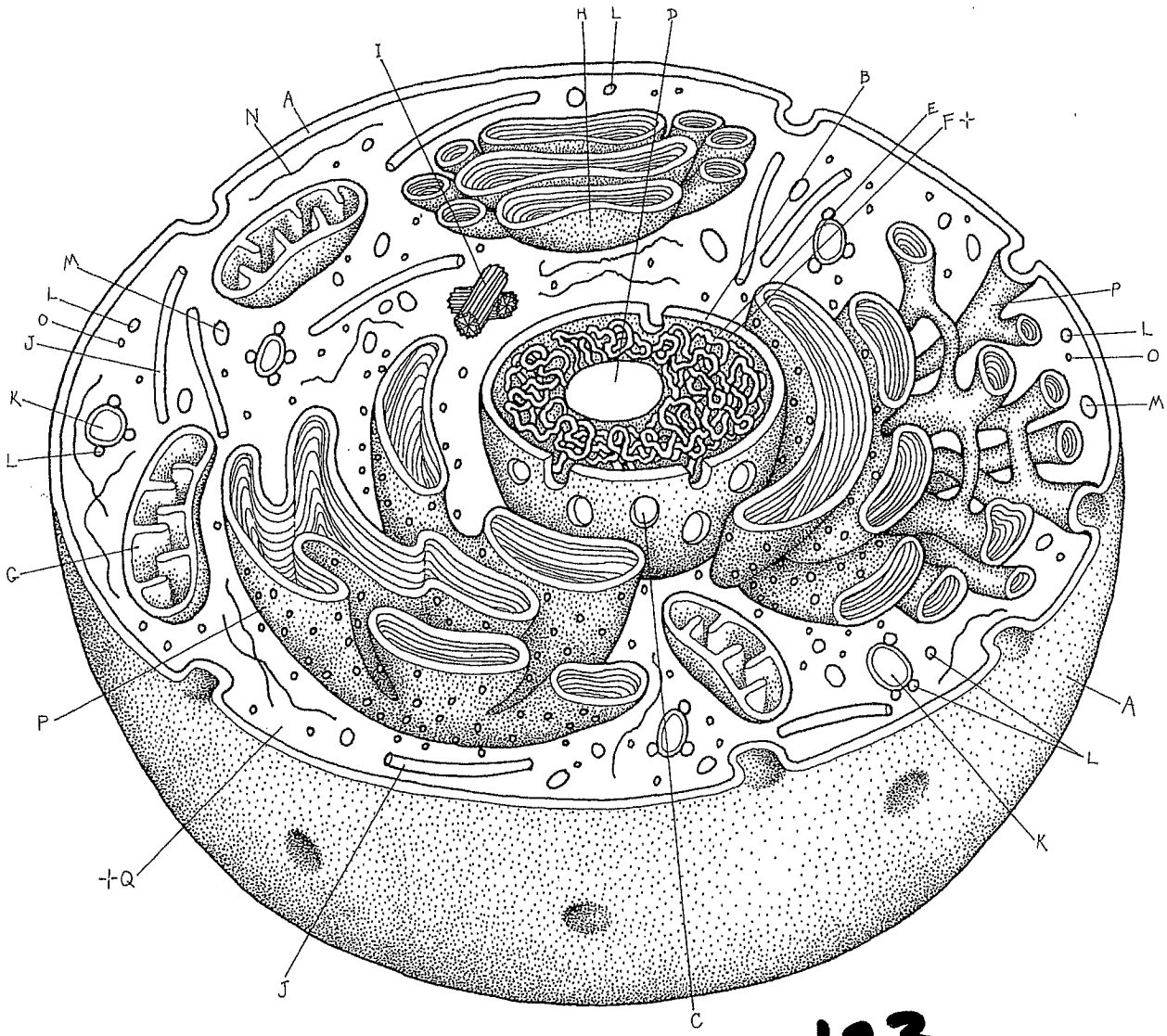
PLANT CELL.

CELL MEMBRANE$_A$
CELL WALL$_B$
PLASMODESMA$_C$
VACUOLE$_D$
  TONOPLAST$_{D'}$
  CRYSTAL$_E$
PLASTIDS$_\star$
  CHLOROPLAST$_F$
  LEUCOPLAST$_G$
  CHROMOPLAST$_H$
GOLGI COMPLEX$_I$
RIBOSOME$_J$
ENDOPLASMIC RETICULUM$_K$
MITOCHONDRION$_L$
MICROTUBULE$_M$
MICROFILAMENT$_N$
LYSOSOME$_O$
MICROBODY$_P$
HYALOPLASM$_Q$
NUCLEUS$_\star$
  NUCLEAR ENVELOPE$_R$
  NUCLEAR PORE$_S$



ANIMAL CELL.

CELL MEMBRANE$_A$
NUCLEUS$_\star$
NUCLEAR ENVELOPE$_B$
NUCLEAR PORE$_C$
NUCLEOLUS$_D$
CHROMATIN$_E$
NUCLEAR SAP$_F$+
CYTOPLASM$_\star$
MITOCHONDRION$_G$
GOLGI COMPLEX$_H$
CENTRIOLE$_I$
MICROTUBULE$_J$
VACUOLE$_K$
LYSOSOME$_L$
MICROBODY$_M$
MICROFILAMENT$_N$
RIBOSOME$_O$
ENDOPLASMIC RETICULUM$_P$
HYALOPLASM$_Q$+

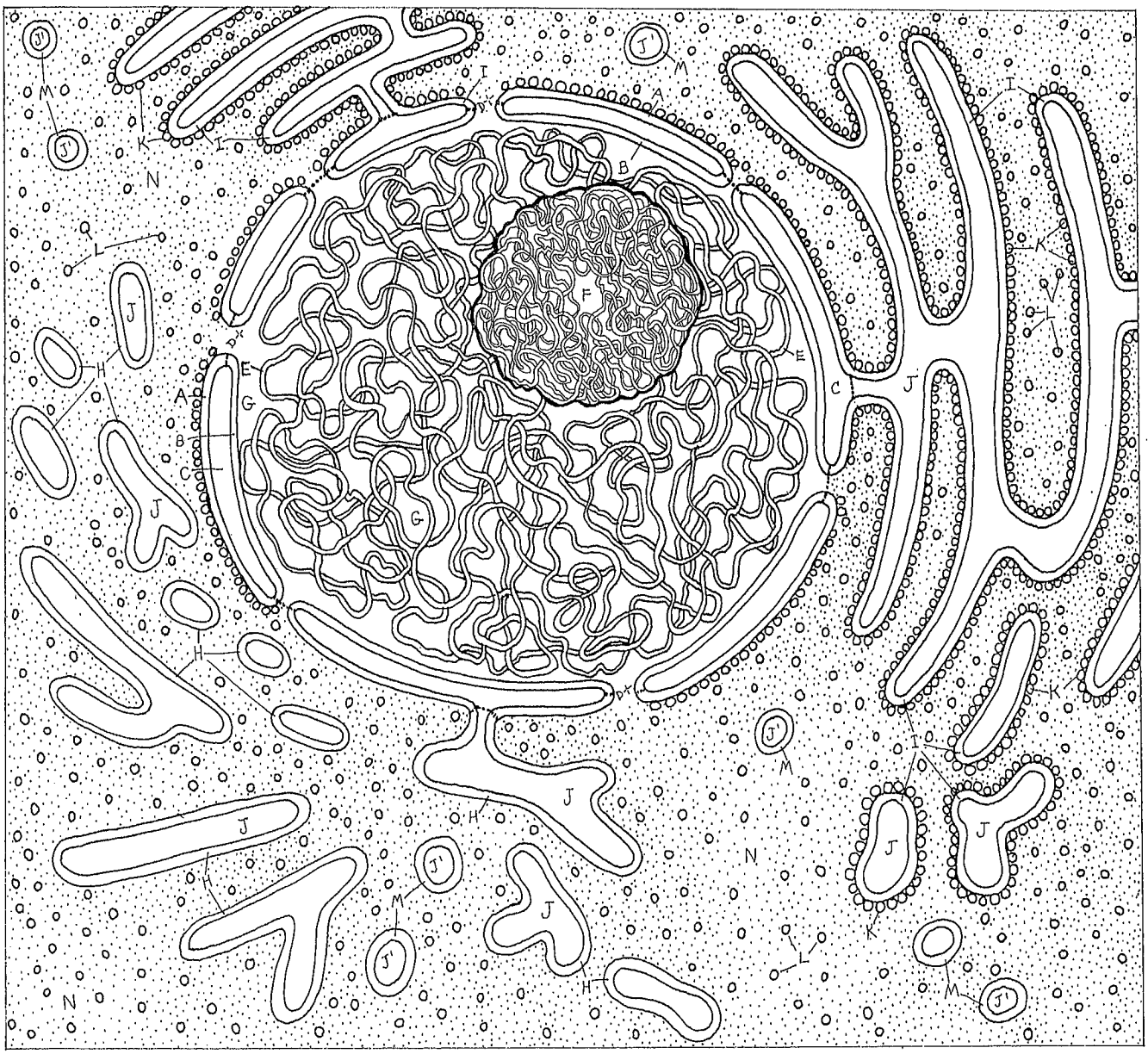


NUCLEUS AND ENDOPLASMIC RETICULUM.

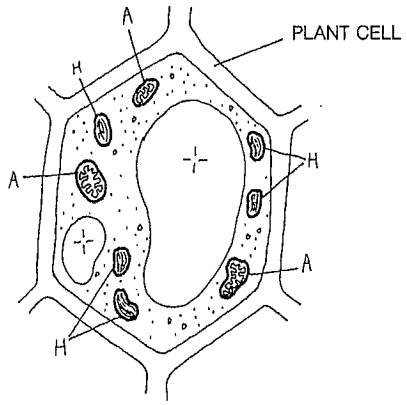
NUCLEAR ENVELOPE★
- OUTER MEMBRANE$_A$
- INNER MEMBRANE$_B$
- PERINUCLEAR SPACE$_C$
- NUCLEAR PORE$_{D+}$

CHROMATIN$_E$
NUCLEOLUS$_F$
NUCLEAR SAP$_G$
SMOOTH ENDOPLASMIC RETICULUM$_H$
ROUGH ENDOPLASMIC RETICULUM$_I$
CISTERNA$_J$
ATTACHED RIBOSOME$_K$
FREE RIBOSOME$_L$
VESICLE$_M$
- CONTENTS$_{J'}$

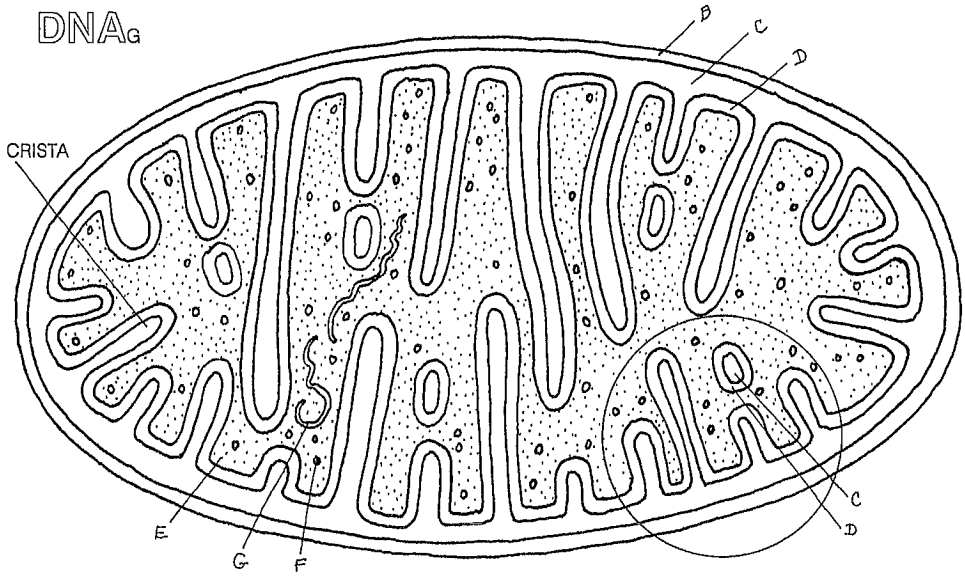
HYALOPLASM$_N$

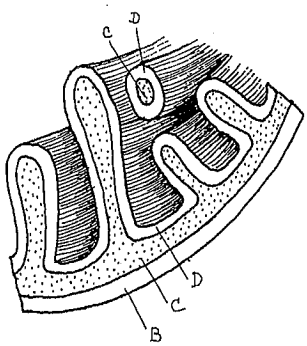


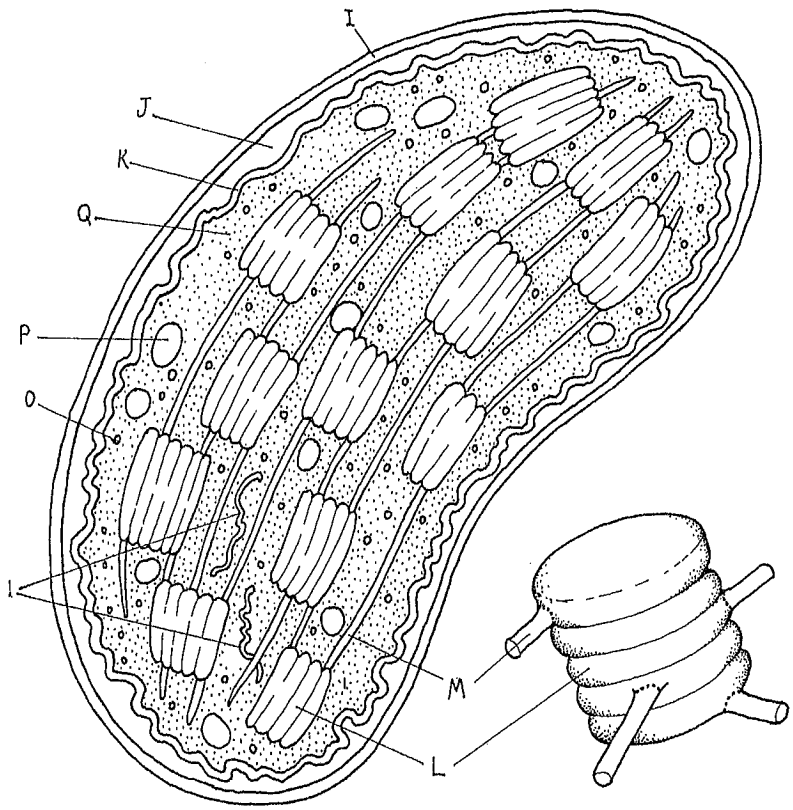
MITOCHONDRION AND CHLOROPLAST.



MITOCHONDRION$_A$
- OUTER MEMBRANE$_B$
- INTERMEMBRANE SPACE$_C$
- INNER MEMBRANE$_D$
- MATRIX$_E$
- RIBOSOME$_F$
- DNA$_G$



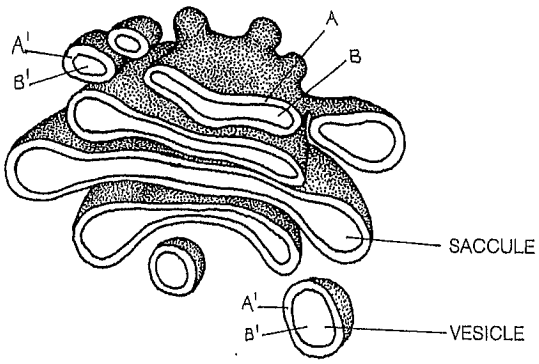




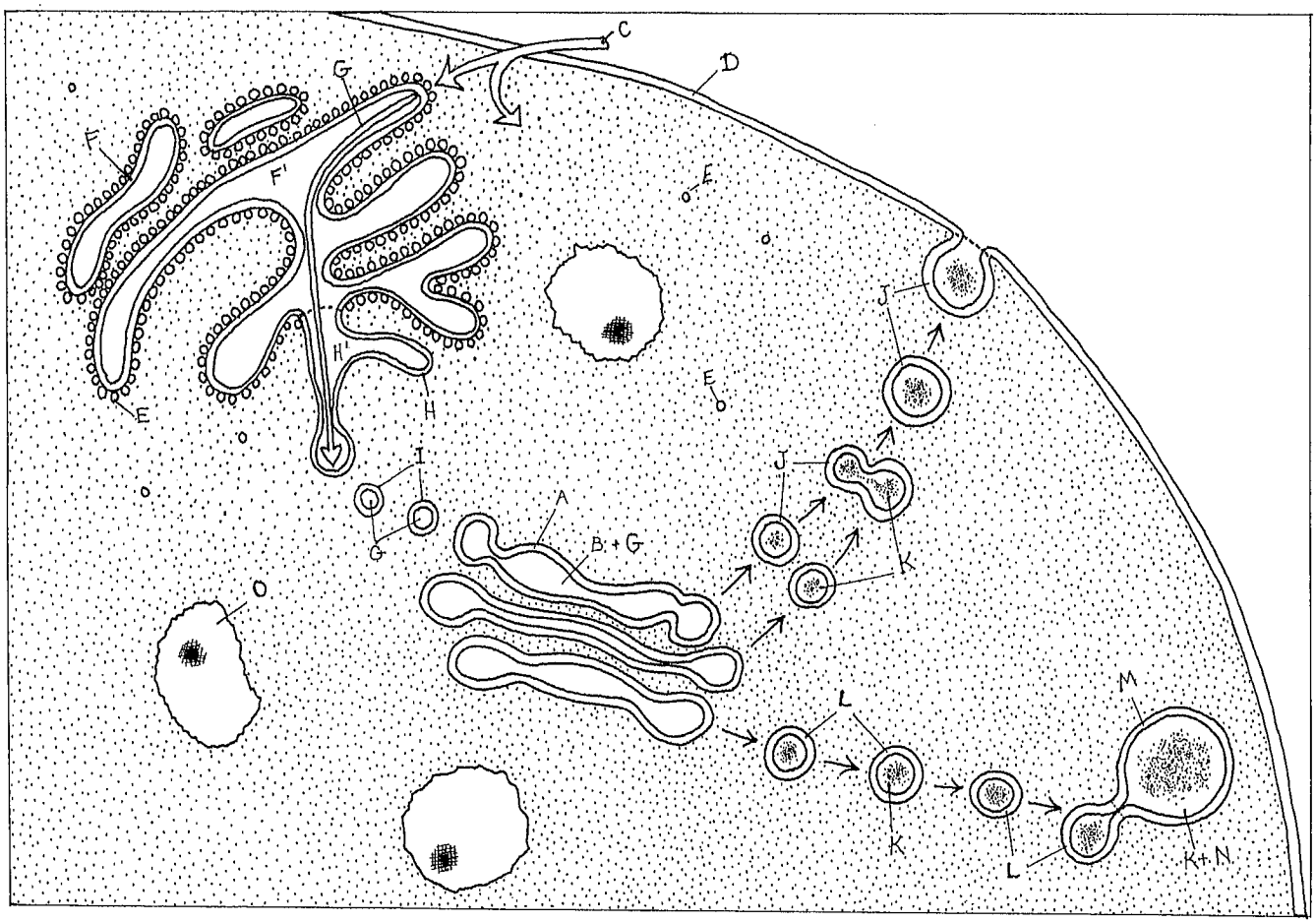
CHLOROPLAST$_H$
- OUTER MEMBRANE$_I$
- INTERMEMBRANE SPACE$_J$
- INNER MEMBRANE$_K$
- GRANUM$_\star$
  - THYLAKOID$_L$
- STROMAL LAMELLA$_M$
- DNA$_N$
- RIBOSOME$_O$
- STARCH GRAIN$_P$
- STROMA$_Q$

GOLGI COMPLEX, LYSOSOMES, MICROBODIES.

GOLGI COMPLEX★
SACCULE/VESICLE★
  MEMBRANE$_{A,A^1}$
  COMPARTMENT$_{B,B^1}$
GOLGI COMPLEX IN ACTION★
AMINO ACID MOLECULES$_C$
CELL MEMBRANE$_D$
RIBOSOME$_E$
ROUGH ER MEMBRANE$_F$
  CISTERNA$_{F^1}$
POLYPEPTIDE CHAINS$_G$
SMOOTH ER MEMBRANE$_H$
  CISTERNA$_{H^1}$
TRANSITION VESICLE$_I$



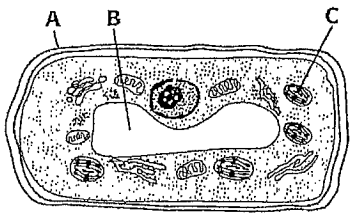
SECRETION VESICLE$_J$
  PROTEIN COMPLEX$_K$
LYSOSOME$_L$
FOOD VACUOLE$_M$
  FOOD$_N$
MICROBODY★
  PEROXISOME$_O$



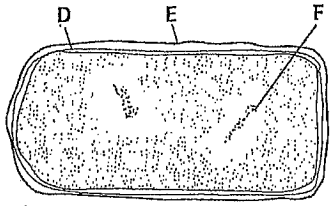
Science Skills

INTERPRETING GRAPHICS

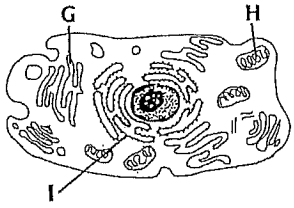
Biology students were working on a class project. They prepared copies of transmission electron micrographs of a bacterium, a plant cell, and an animal cell for display in their classroom. Unfortunately, the pictures were not labeled and got mixed up. Help these students correctly identify the cells and cell structures. Use the figures below to answer questions 1–5.



Cell 1



Cell 2



Cell 3

In the space provided, write the names of each cell's labeled structures (A–I). Using this information, write the identity of each cell—bacterium, plant cell, or animal cell.

1. Cell 1 identity _____

   A. _____

   B. _____

   C. _____

2. Cell 2 identity _____

   D. _____

   E. _____

   F. _____

3. Cell 3 identity _____

   G. _____

   H. _____

   I. _____

Characteristics of Prokaryotic and Eukaryotic Cells

Pre-Lab Discussion

Cells are the basic units of structure and function of all living things. There are two major divisions into which all cells fall—prokaryotic and eukaryotic.

Prokaryotic cells are cells that lack a nucleus and membrane-bound organelles. Bacteria and related microorganisms are prokaryotes. *Eukaryotic cells* are cells that contain a nucleus and membrane-bound organelles. Organisms such as animals, plants, fungi, and protists are all eukaryotes.

In this investigation, you will observe several prepared slides to examine the differences between prokaryotic and eukaryotic cells. You will also use these differences to classify an unknown specimen.

Problem

What are the differences between prokaryotic and eukaryotic cells?

Materials *(per group)*

Microscope
Lens paper
Prepared slides of prokaryotic and eukaryotic cells

Safety

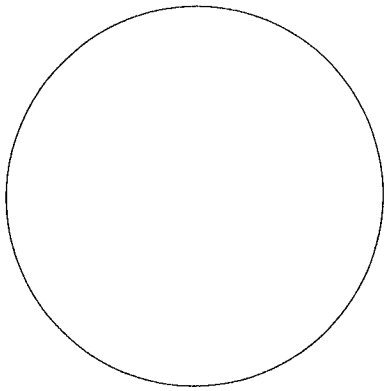
Always handle the microscope with extreme care. You are responsible for its proper care and use. Use caution when handling glass slides as they can break easily and cut you. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to the symbol guide on page 10.

Procedure

1. Take a microscope from the storage area and place it about 10 centimeters from the edge of the laboratory table.
2. Carefully clean the eyepiece and objective lens with lens paper.
3. Place your first prepared slide on the microscope stage so that it is centered over the stage opening. Hold the slide in position with the stage clips.
4. Using the low-power objective lens, locate the cell(s) under the microscope. Turn the coarse adjustment knob until the cell comes into focus.

Prepared Slide 3 High-power objective

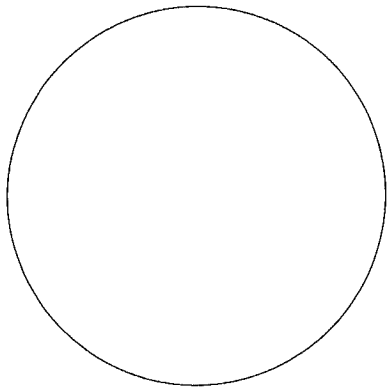
Magnification _____



_____

Prepared Slide 4 High-power objective

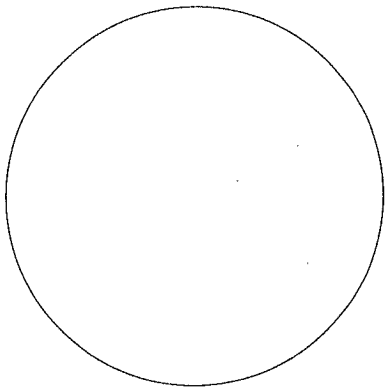
Magnification _____



_____

Prepared Slide 5 High-power objective

Magnification _____



Unknown

_____

Analysis and Conclusions

1. Based on your observations, do all cells have the same shape? Support your answer.

_____

_____

2. Based on your observations, do all cells have the same size? Support your answer.

_____

_____

3. What cell structures are common to all cells? _____

_____

4. What cell structures are found only in eukaryotic cells? _____

_____

5. Are the nuclei always found in the same place within different types of cells? Support your answer. _____

_____

Critical Thinking and Application

1. Skin cells seem to fit together like pieces of a jigsaw puzzle. How is this arrangement of cells helpful to an organism? _____

_____

_____

2. Why do cells have different shapes and sizes? _____

_____

_____

3. What cell structure might you be able to compare to the main (principal's) office in your school? Explain your answer. _____

_____

_____

Going Further

1. Observe characteristics of living cells by making wet-mount slides of plant and animal tissues or protist cultures. Construct a data table to record the shapes and sizes of the cells and the structures they contain.
2. Think about the cell structures that you were unable to see with a compound light microscope. Use resources from your library to locate electron micrographs of these structures.
3. Research the use of some of the stains used in the preparation of wet-mount slides. Some of the stains that might be included in your report are methylene blue, neutral red, acetocarmine, Congo red, Janus green B, and Sudan III. What cell structures do each of these stains make more visible?

PART C - Observation Of Organelles In Living Tissue

We have already mentioned that mitochondria are responsible for breaking down food in the presence of oxygen. The enzymes that the mitochondria use to do this are called *dehydrogenases,* which remove hydrogen atoms from food molecules. We can "fool" the mitochondria by giving it other molecules with hydrogen, and the mitochondrion's enzymes will react the same way. The kit contains a dye called *Janus Green B*. The molecules of this dye are greenish-blue in color, and will be transported to the mitochondria as if they were food. If hydrogen atoms are removed from the dye molecules, though, the dye looses its color. By observing the loss of color in the mitochondria, we can observe mitochondria at work.

Obtain a second piece of celery, the same size as the first, a razor blade, a microscope slide and a cover slip, a pair of forceps, and a microscope.

Cut a piece of celery in the same manner as in Part A, isolating a piece of thin tissue from in between two celery threads. Add a drop of water to the slice, and drop a cover slip on top of it. Place the slide under the microscope as before and focus it, first on low power and then on high power.

Obtain a bottle of Janus Green B stain. Tear off a piece of paper towel, and have it ready next to your lab station. Place a drop of the Janus Green B stain on the slide immediately next to the cover slip. Place the piece of paper towel along the opposite edge of the coverslip. The paper towel will absorb the water underneath the coverslip, and the drop of stain on the other side will be drawn into its place. Observe the cells as they are stained. The stain will congregate in the mitochondrial cells, and will turn them bluish green. Observe the slide for several minutes, alternating with your partner, until you notice a change in the color of the mitochondria. Record and explain your observations:

Discussion Questions

Why do you think that it is important that enzymes be restricted to inside organelles?

What advantage do you think a cell has because of its organization into organelles?

Could the model for an organelle be used as a model for a cell? What are the differences between cells and organelles?

The organelles of a cell have been compared to the parts of the body: each part of the body performs a specific function. In what ways do you think this analogy is correct?

When you observed the living tissue of the celery, you may have noticed that the organelles were flowing around inside the cell. This process is called cytoplasmic streaming. Why do you think that this might be important to the cell?

What Cell Parts Can You See with the Microscope?

Living things are made of cells. All cells have parts that do certain jobs. Cells have an outer covering called the cell membrane. Cell membranes give cells their shapes and control what enters and leaves the cells. The clear, jellylike material inside the cell is the cytoplasm. The nucleus is the control center of the cell. Plant cells have a thick outer covering called the cell wall. It is on the outside of the cell membrane.

Cell parts can be studied by making wet mount slides. A wet mount slide is a temporary slide. It is not made to last a long time. You can make wet mount slides of living and once-living materials to study cell parts.

GOALS

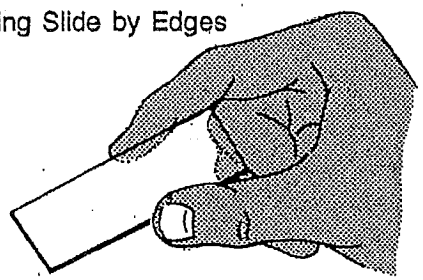
In this exercise, you will:

a. make wet mount slides for examination under the microscope.
b. study four cell parts—the cell wall, cytoplasm, nucleus, and cell membrane.

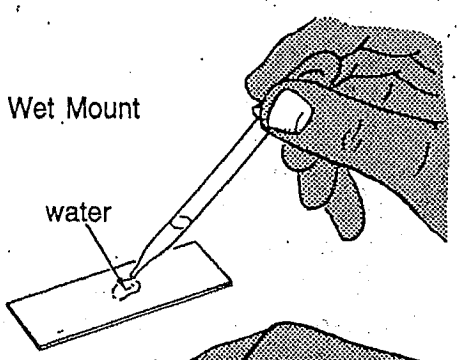
MATERIALS

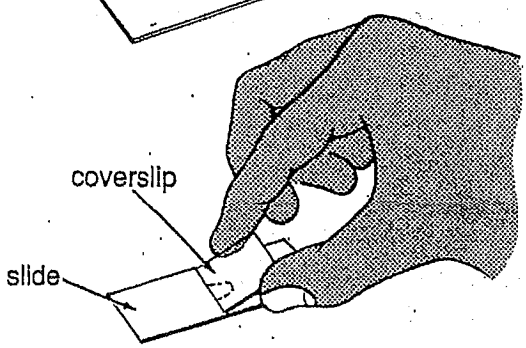
glass slide
coverslip
light microscope
water
dropper
forceps
stain
cork shaving
bamboo shaving
onion skin
prepared slide of frog blood

Holding Slide by Edges



Making Wet Mount





PROCEDURE

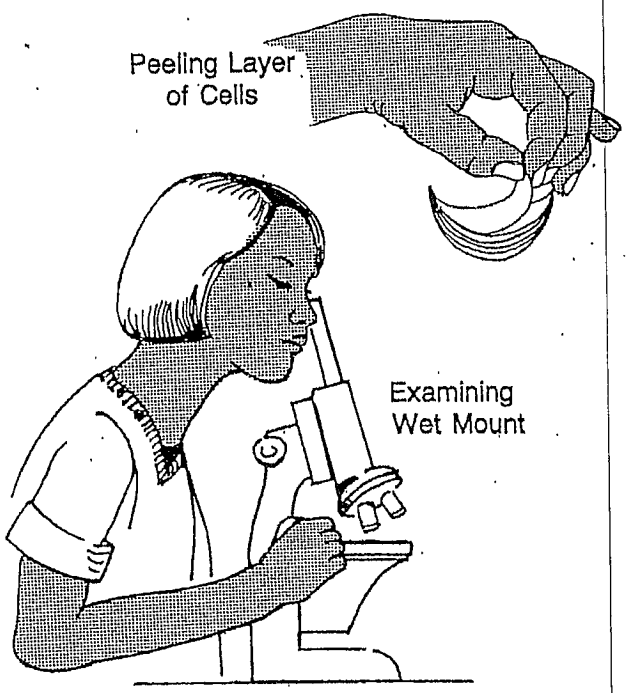
1. Follow the steps below to make a wet mount slide.
   a. Get a clean microscope slide and coverslip. Handle the slide and coverslip by the edges to keep them clean.
   b. Use a dropper to put a drop of water in the center of the slide.
   c. With forceps, place the object to be examined in the drop of water.
   d. Hold the coverslip at an angle. Gently lower it onto the drop of water.

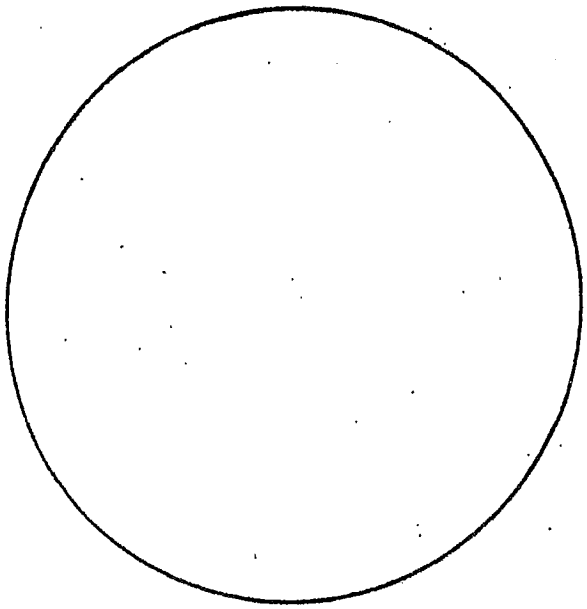
2. Prepare a wet mount of the cork shaving. Follow the steps just given on the last page.
3. Examine the slide of cork under low power of the microscope. Switch to high power. Examine the cork cells under high power. Draw cork cells that you see in the circle below. Label the cell wall.
4. Prepare a wet mount of a bamboo stem shaving. Examine the bamboo under low and then high power of your microscope. Draw the bamboo cells you see. Label the cell wall.

Cork Cells

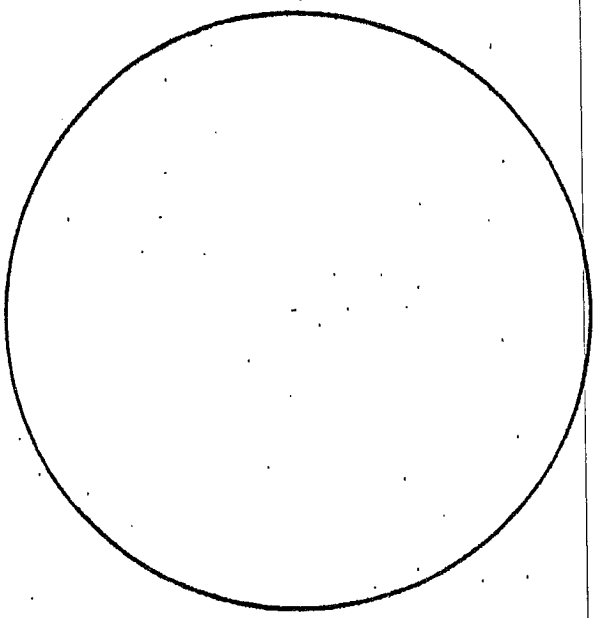
Bamboo Cells

5. Peel the thin layer of cells from the inside of an onion as shown here. Make a wet mount of the onion skin cells. Add one drop of stain in place of water.
6. Examine the onion slide under low and high power of your microscope.
7. Find the cell wall, nucleus, and cytoplasm. Draw onion cells that you see in the circle on page 17. Label the parts.
8. Examine a prepared slide of frog blood with low and then high power. In the circle on page 17, draw frog blood cells that you see. Label the nucleus, cytoplasm, and cell membrane.
9. Complete the table on page 17.





Onion Skin Cells



Frog Blood Cells

Parts of Cells

Cell type	Cell wall present? (yes or no)	Nucleus present? (yes or no)	Cytoplasm present? (yes or no)	Shape of cell?	Cell living or dead?
Cork					
Bamboo					
Onion					
Frog blood					

QUESTIONS

1. What is the name of the small units that make up cork? _____
2. Describe how the small units of cork look. _____
3. Are the cork cells filled with living material or are they empty? _____

4. Are bamboo cells living or dead? _____

5. How are cork cells and bamboo cells alike? _____

_____

_____

6. How are onion cells different from the cork cells? _____

_____

_____

7. Compare the onion skin cells and the frog blood cells. _____

_____

_____

8. What cell parts that you observed are found only in plant cells? _____

_____

APPLICATIONS

1. Why do cells have different shapes? _____

_____

2. Skin cells seem to fit together or overlap. How is this cell arrangement helpful to the organism? _____

_____

3. If blood cells were box-shaped, like onion cells, why would they be unable to do their job as well? _____

_____

VOCABULARY

Fill in the blanks with the proper word or words.

1. Cells have an outer covering called the _____.
2. The jellylike material inside the cell is the _____.
3. The control center of a cell is the _____.
4. Plant cells have a thick outer covering called the _____.
5. When you place an object in a drop of water on a slide and put a coverslip on it, a _____ slide is made.

Pre-Lab Questions

Is a plant a prokaryote or eukaryote? What is a prokaryote?

What is the cell cycle? Is mitosis a part of the cell cycle?

Why does a cell undergo mitosis?

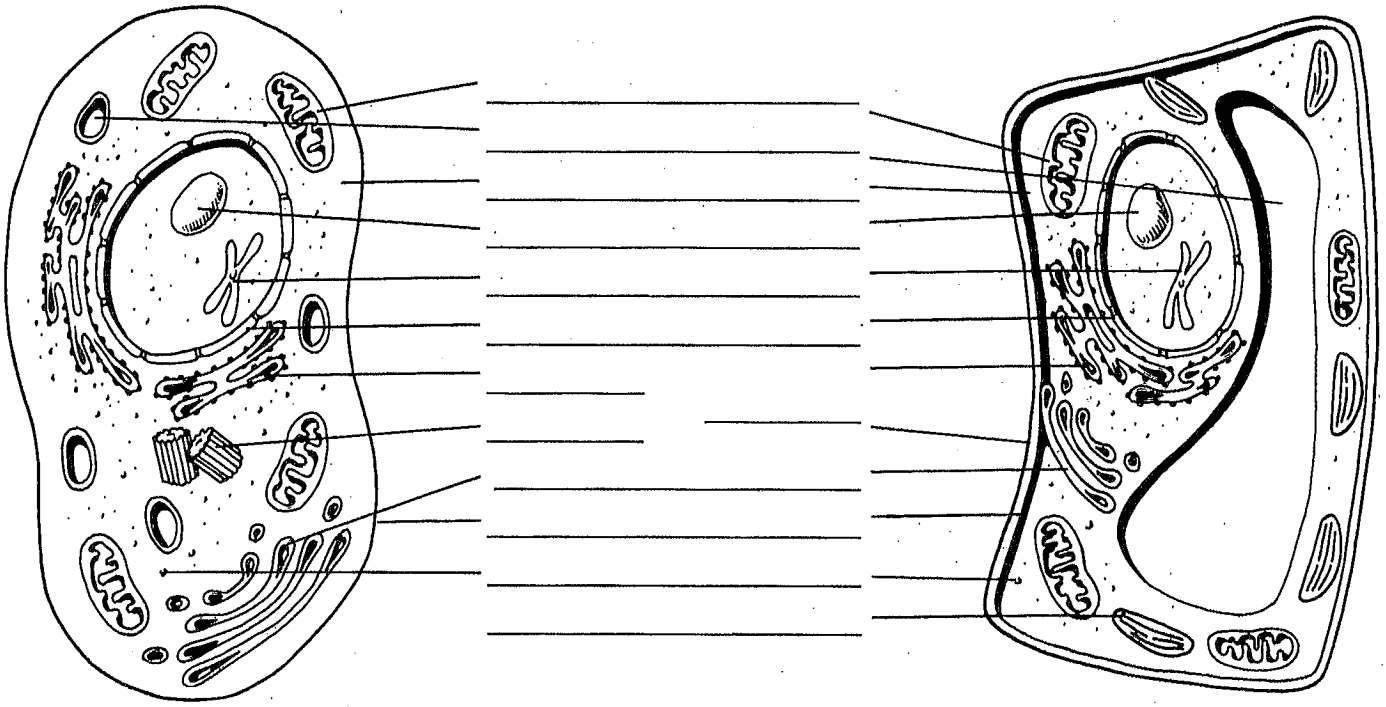
Can you see DNA in all cells under the microscope? Why or why mot.

What are your predictions for this lab? Be specific- what do you think is the longest part of mitosis.

CELL PARTS AND THEIR JOBS

In your textbook, read about cell parts and their jobs in Section 2:2.

1. Label the parts of these two cells in the spaces provided.



Cell A Cell B

2. Read the descriptions of cell parts below and write in the name of the cell part. Use the color indicated to shade the pictures above.

a. Use red for the part that gives the cell shape and holds the cytoplasm. _____

b. Use green for parts that make food. _____

c. Use brown for the thick outer covering that protects and supports the cell. _____

d. Use blue for the part that stores substances. _____

e. Use black for parts that release energy from food. _____

f. Use purple for parts that carry hereditary information. _____

g. Use pink for the cell part that helps with cell reproduction. _____

h. Use orange for the parts that package and store chemicals. _____

3. List two cell parts found only in a plant cell. _____

4. Where in a cell do most chemical reactions take place? _____

NAME_____ SCI #_____

LAB PARTNER_____

Cell Parts Model

No space is wasted inside a cell. Packed into the cell are all parts essential to its survival.

Procedure

1. Fill a sealable plastic sandwich bag halfway with tap water. Add several drops of blue food dye. Before you seal the bag, push out any remaining air.
2. Roll this water-filled bag into a cylindrical shape. Use two long strips of tape to secure this shape.
3. Fill two small plastic jewelry bags with water. Before sealing the bags, add several drops of green food coloring to each bag.
4. Place the water-filled sandwich bag and the two small jewelry bags into a gallon-size plastic bag.
5. Fill this outer bag two-thirds full with water. Push out any remaining air, and seal the bag.

Analysis

1. **State** what each plastic bag in this model represented.

_____

_____

_____

2. **Describe** how the "central vacuole" affects the contents of your cell model.

_____

_____

_____

3. **Critical Thinking** **Predicting Outcomes** Explain how removing water from the model's central bag might affect the tension and shape of the outer plastic bag.

_____

_____

_____

Summary Questions

1. Discuss the Cell Law and explain why it's discovery was so important.

2. How big is a human cheek cell compared to the dot over the letter "i"? (State your answer as a percent of the diameter.)

3. How do you know whether a cell is eukaryotic?

4. How long in mm is a typical onion cell?

5. How many layers of cells are in the Elodea leaf?

6. Which layer of the Elodea leaf has thick-walled cells?

7. Where are color pigments located in the cells of plants? Illustrate your answers.

8. What is the stomata, where are they found, and how are they important?

Gram Stain

Differential stains, which are more complex than simple ones, are used to divide bacteria into groups. Bacteria stain differentially because they differ in cell wall composition. The Gram stain separates almost all bacteria into two large groups: the Gram-positive bacteria, which stain blue (Fig. 6), and the Gram-negative bacteria, which stain pink (Fig. 7). This classification is basic to bacteriological identification.

1. Prepare the smear, air-dry, and heat-fix by following Steps 1 through 8 in the "Simple Stains" staining instructions above.
2. Flood with Hucker ammonium oxalate crystal violet for 60 seconds.
3. Rinse with tap water.
4. Flood with Gram's iodine solution for 60 seconds.
5. Rinse with tap water.
6. Decolorize with 95% ethanol. Allow the ethanol to drip across the slide until the runoff is almost clear.
7. Rinse with tap water.
8. Flood with safranin for 60 seconds.
9. Rinse with tap water.
10. Blot carefully.
11. Observe with an oil immersion lens.

Morphological observations and the Gram stain are the first steps in identifying an unknown bacterium. Differential media are then used for definite identification.

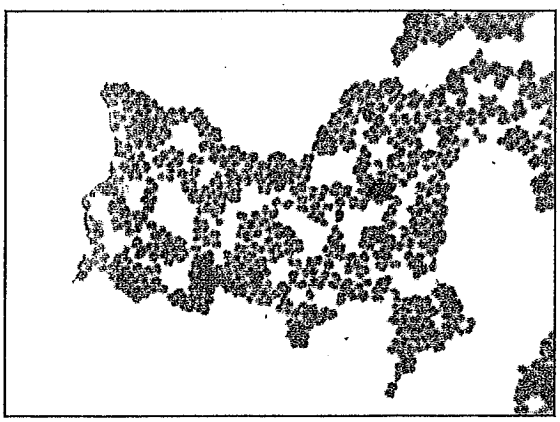
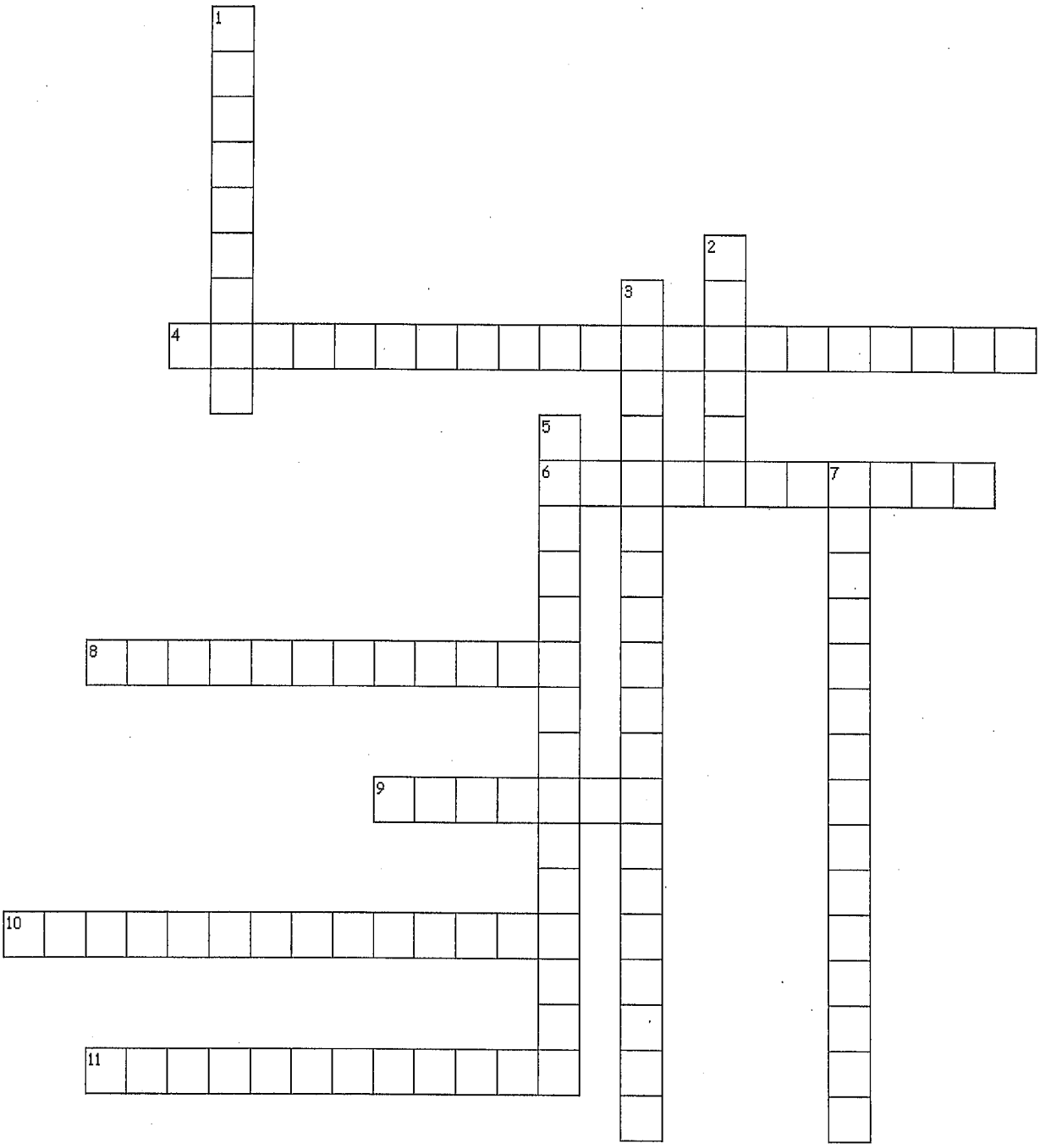


Figure 6. Gram-positive bacteria.

Figure 7. Gram-negative bacteria.

Chapter 8 Flashcards and Crossword- complete the crossword and then complete a flash card for each of the terms (11)



Across

4. a difference in the concentration of a substance across a distance
6. a state that exists when the concentration of a substance is the same throughout a space
8. a lipid that contains phosphorus and that is a structural component in cell membranes
9. the diffusion of water or another solvent from a more dilute solution (of a solute) to a more concentrated solution (of the solute) through a membrane that is permeable to the solvent
10. a protein that transports substances across a cell membrane
11. the basic structure of a biological membrane, composed of two layers of phospholipids

Down

1. the movement of particles from regions of higher density to regions of lower density
2. anything that serves to direct, guide, or warn
3. a carrier protein that uses ATP to actively transport sodium ions out of a cell and potassium ions into the cell
5. a molecule that is generated when a specific substance attaches to a receptor on the outside of a cell membrane, which produces a change in cellular function
7. a protein that binds specific signal molecules, which causes the cell to respond

Chapter 8 Cells and Their Environment

I._____- Homeostasis is the maintenance of stable internal conditions in a changing environment. One way that a cell maintains homeostasis is by controlling the movement of substances across the cell membrane. The cell membrane is a gatekeeper. The cell membrane also provides structural support to the cytoplasm, recognizes foreign material, and communicates with other cells, all of which contribute to maintaining homeostasis.

II. _____- The cell membrane is made of phospholipids. A phospholipid is a specialized lipid made of a phosphate "head" and two fatty acid "tails."

A. The phospholipids form a barrier through which only small, nonpolar substances can pass. Ions and most polar molecules are repelled by the nonpolar interior of the lipid bilayer.

B. The phosphate head is _____ and is attracted to water.

C. The fatty acid tails are _____ and are repelled by water.

D. Because there is water inside and outside the cell, the phospholipids form a double layer called the lipid _____.

1. The nonpolar tails, repelled by water, make up the interior of the lipid bilayer.

2. The polar heads are attracted to the water, so they point toward the surfaces of the lipid bilayer.

III. **MEMBRANE PROTEINS**- Proteins in the cell membrane include cell-surface markers, receptor proteins, enzymes, and transport proteins.

A. Cell-surface markers -act like a name tag. A unique chain of sugars acts as a marker to identify each type of cell. These sugars (carbohydrates) are attached to the cell surface by proteins called glycoproteins. Glycoproteins help cells work together.

B. _____ -enable a cell to sense its surroundings by binding to certain substances outside the cell. When this happens, it causes changes inside the cell.

C. _____ -Many substances that the cell needs cannot pass through the lipid bilayer. Transport proteins aid the movement of these substances into and out of the cell.

D. _____- allow reactions to take place- can break a larger molecule into 2 smaller molecules

IV. **TRANSPORT ACROSS THE MEMBRANE-** There are 2 types of transport- passive and active

A. **PASSIVE TRANSPORT-**In passive transport, substances cross the cell membrane down their concentration gradient. No energy is required for this. Passive transport includes

1. _____ Small, nonpolar molecules can pass directly through the lipid bilayer. This type of movement is called simple diffusion. Oxygen moves down its concentration gradient into the cell. Carbon dioxide diffuses out of the cell. Also,natural steroid hormones, which are nonpolar and fat soluble, can also diffuse across the lipid bilayer.

2. _____- Many ions and polar molecules that are important for cell function do not diffuse easily through the nonpolar lipid bilayer. During facilitated diffusion, transport proteins help these substances diffuse through the cell membrane. Two types of transport proteins are

a) channel proteins –channel proteins, sometimes called pores, serve as tunnels through the lipid bilayer. Each channel allows the diffusion of specific substances that have the right size and charge. Ions, sugars, and amino acids can diffuse through the cell membrane through channel proteins

b) carrier proteins- A carrier protein binds to a specific substance on one side of the cell membrane. This binding causes the protein to change shape. As the protein's shape changes, the substance is moved across the membrane and is released on the other side.Carrier proteins transport substances that fit within their binding site.

3. _____-Water can diffuse across a selectively permeable membrane in a process called osmosis. Osmosis allows cells to maintain water balance as their environment changes. Remember that in osmosis, ONLY the water molecules are free to move.

a) If the solution is hypertonic, or has a higher solute concentration than the cytoplasm does, water moves out of the cell. The cell loses water and shrinks.

b) If the solution is isotonic, or has the same solute concentration that the cytoplasm does, water diffuses into and out of the cell at equal rates. The cell stays the same size.

c) If the solution is hypotonic, or has a lower solute concentration than the cytoplasm does, water moves into the cell. The cell gains water and expands in size. If left unchecked, the swelling caused by a hypotonic solution could cause a cell to burst.

d) The rigid cell walls of plants and fungi prevent the cells of these organisms from expanding too much. In fact, many plants are healthiest in a hypotonic environment.

e) Some unicellular eukaryotes have contractile vacuoles, which collect excess water inside the cell and force the water out of the cell.

f) Animal cells have neither cell walls nor contractile vacuoles. Many animal cells can avoid swelling caused by osmosis by actively removing solutes from the cytoplasm

B. **ACTIVE TRANSPORT**- Active transport requires energy to move substances against their concentration gradients. In order to move substances against their concentration gradients, cells must use energy. Most often, the energy needed for active transport is supplied directly or indirectly by ATP.

1. _____- In active transport, the carrier proteins do require energy to "pump" substances against their concentration gradient.

   a) The sodium-potassium pump is a carrier protein that actively transports three sodium ions out of the cell and two potassium ions into the cell. This pump is one of the most important carrier proteins in animal cells. It prevents sodium ions from building up in the cell, resulting in osmosis into the cell making it burst.

   b) The concentration gradients of sodium ions and potassium ions also help transport other substances, such as glucose, across the cell membrane.

2. _____- Many substances, such as proteins and polysaccharides, are too large to be transported by carrier proteins. Instead, they cross the cell membrane in vesicles, which are membrane-bound sacs made by pinching off of the membrane.

   a) _____- The movement of a large substance <u>into</u> a cell by means of a vesicle. Vesicles that form by endocytosis may fuse with lysosomes or other organelles.

   b) _____- The movement of material <u>out</u> of a cell by means of a vesicle. These vesicles are usually from the Golgi

V. **SENDING SIGNALS**- Cells communicate and coordinate activity by sending chemical signals that carry information to other cells.

A. A signaling cell produces a signal, often a molecule, that is detected by the target cell. Target cells have specific proteins that recognize and respond to the signal. These proteins are usually on the cell membrane (except in steroids)

B. Neighboring cells can communicate through direct contact between their membranes.

C. Long-distance signals are carried by hormones and nerve cells.
_____ are distributed widely in the bloodstream

VI. **RECEIVING SIGNALS**- _____cells have receptor proteins.A receptor protein binds only to signals that match the specific shape of its binding site (the key for your front door will not open your neighbors front door) The outer part of the receptor protein is folded into a unique shape, called the binding site. Only the "right" shape can fit into the receptor protein while the "wrong" shape have no effect on that particular receptor protein. Once it binds the signal molecule, the receptor protein changes

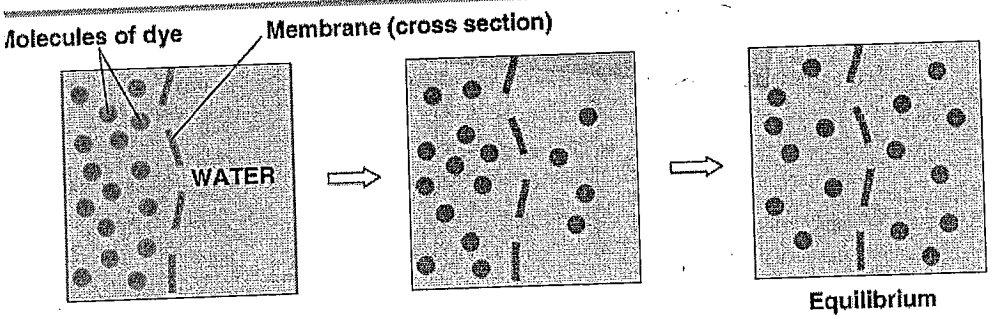
its shape in the membrane. This change in shape relays information into the cytoplasm of the target cell.

VII. **RESPONDING TO SIGNALS**-The cell may respond to a signal by

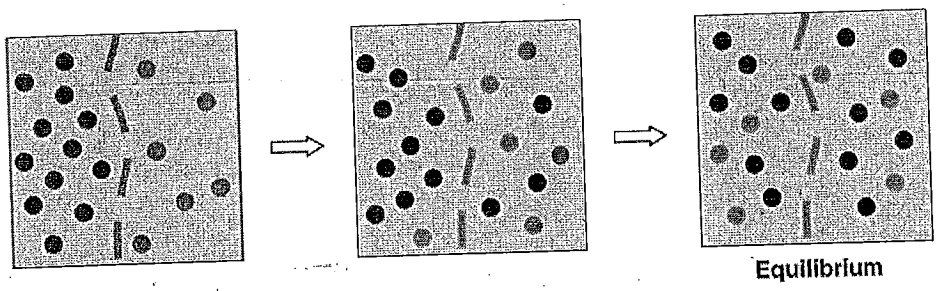
A. changing its membrane permeability

B. activating enzymes

C. forming a second messenger.

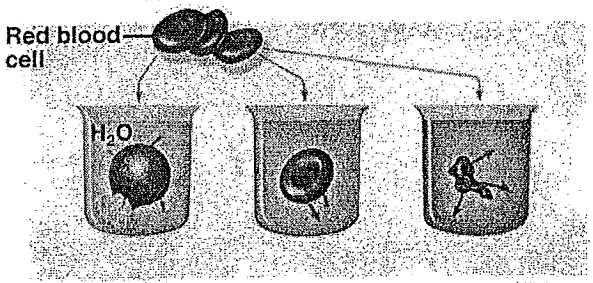


(a) Diffusion of one solute

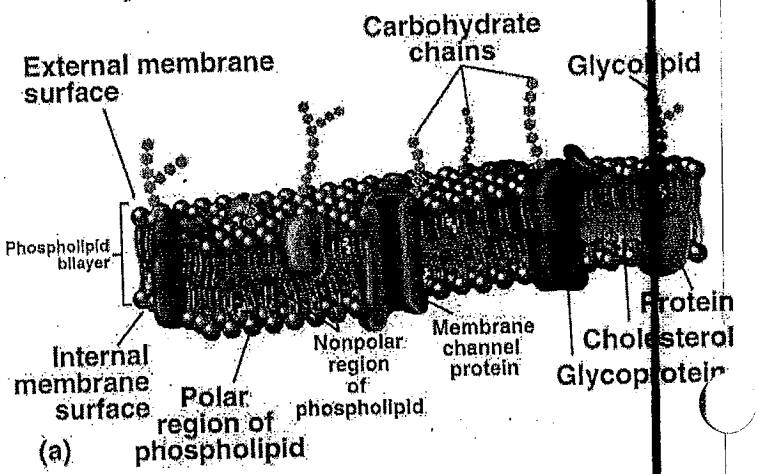


(b) Diffusion of two solutes

Effects of Hypotonic, Isotonic, and Hypertonic Solutions on Red Blood Cells



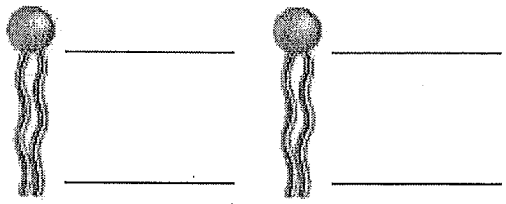
Cell Membrane



CHAPTER 8 SEC 1 DUE DATE .

1. What are four functions of the cell membrane that help a cell maintain homeostasis?

2. Label the two main parts of the structure below. Which of these parts faces the area between the two layers of the lipid bilayer? Which faces out? Why?



3. Why are ions and polar molecules unable to pass easily though the lipid bilayer?

4. What are two functions of cell-surface markers?

5. Suppose a cell were exposed to a drug that caused transport proteins in the cell membrane to stop working. What would happen to the cell?

Bellringer: Day M T W Th F Date Question

Answer

ΔÇ[

CHAPTER 8 **SEC 2** **DUE DATE** .

1. Why does diffusion of water happen when there are dissolved particles on one side of a membrane but not on the other?

2. Complete the following table

TYPE OF SOLUTION	DESCRIPTION
HYPERTONIC	
HYPOTONIC	
	The concentrations of solutes and water in the solution are equal to those in the cell cytoplasm. Water diffuses into and out of the cell at equal rates.

3. If a cell were unable to make ATP, how would the cell's transport processes be affected?

Bellringer:Day M T W Th F Date_____ Question_____

Answer_____

CHAPTER 8 SEC 3 DUE DATE .

1. What are two ways cells can communicate over long distances? What is one way cells can communicate with cells that are nearby?

2. What is the function of receptor proteins?

3. What happens when a receptor protein binds to a signal molecule?

4. What are three ways a cell may respond when a signal molecule binds to a receptor protein?

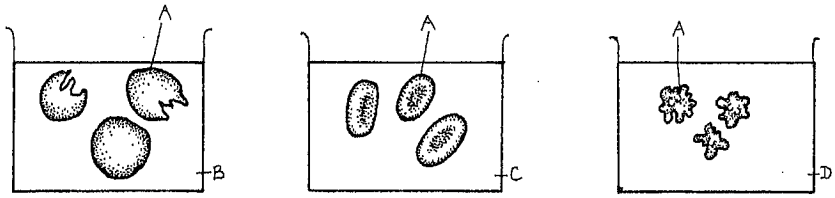
5. Why is it important that each receptor protein binds to only one signal molecule?

Bellringer: Day M T W Th F Date _____ Question _____

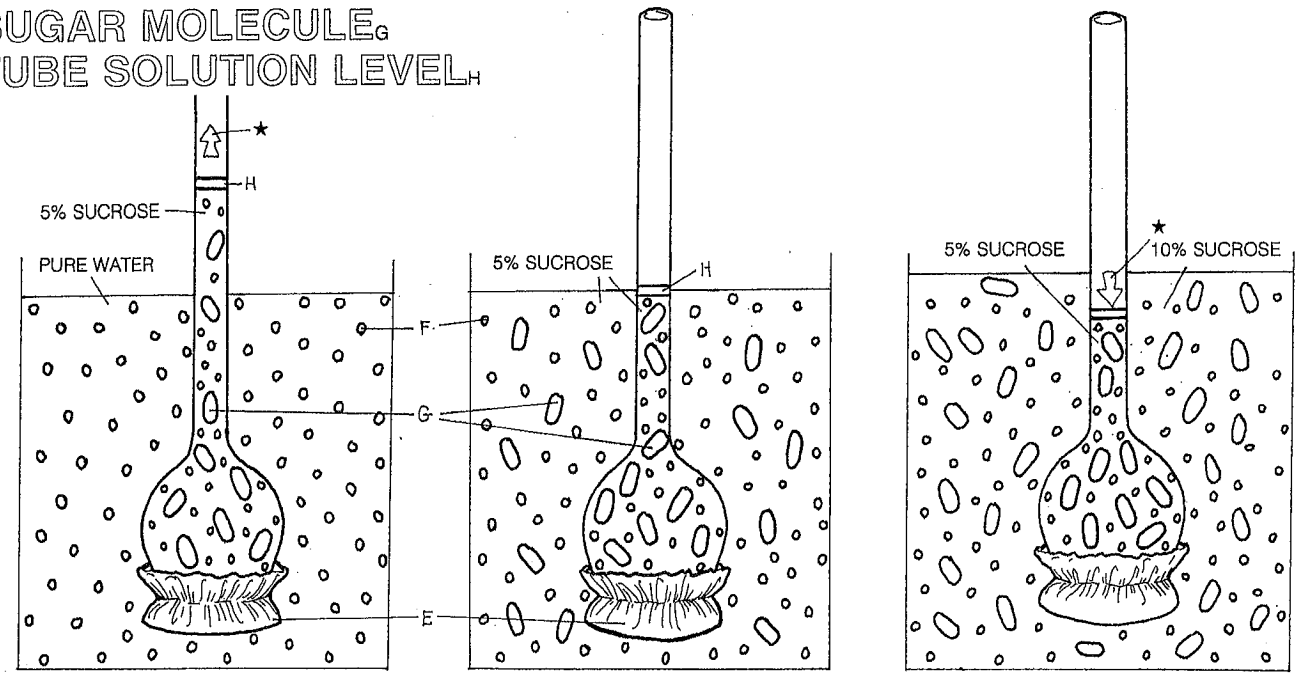
Answer _____

OSMOSIS.

ERYTHROCYTE$_A$
PURE WATER$_B$
0.85% SALT SOLUTION$_C$
2% SALT SOLUTION$_D$

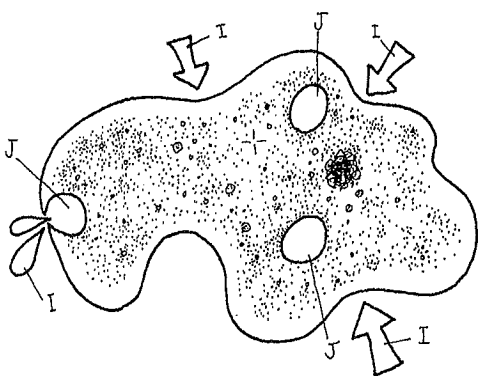


OSMOMETER★
SELECTIVELY PERMEABLE MEMBRANE$_E$
WATER MOLECULE$_F$
SUGAR MOLECULE$_G$
TUBE SOLUTION LEVEL$_H$

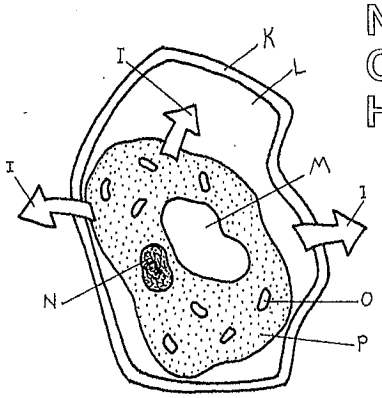


HYPOTONIC★ ISOTONIC★ HYPERTONIC★

AMOEBA★
WATER$_I$
CONTRACTILE VACUOLE$_J$



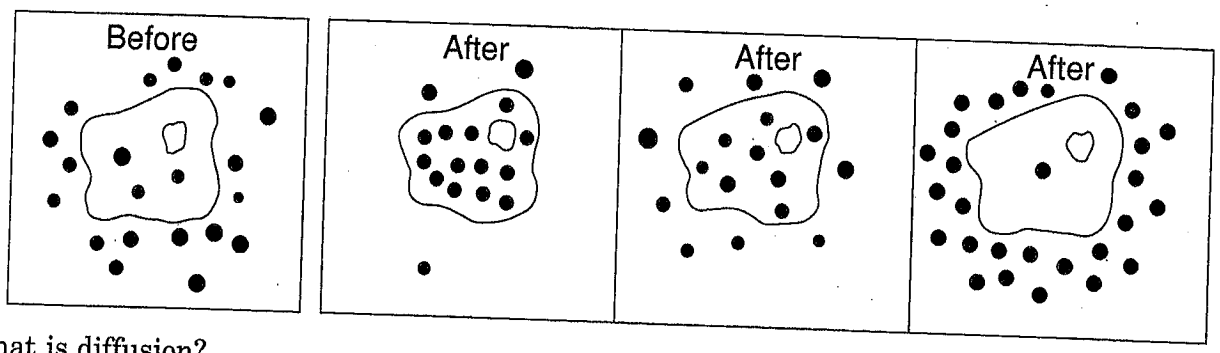
WILTING PLANT CELL★
CELL WALL$_K$
AIR SPACE$_L$
SHRUNKEN VACUOLE$_M$
NUCLEUS$_N$
CHLOROPLAST$_O$
HYALOPLASM$_P$



SPECIAL CELL PROCESSES

In your textbook, read about diffusion and osmosis

1. The first picture below, labeled *Before*, shows a cell surrounded by oxygen molecules before diffusion takes place. Each of the small black dots represents an oxygen molecule. Which of the three pictures labeled *After* shows where these oxygen molecules would be found after diffusion takes place? Circle your answer.



2. What is diffusion? _____

3. How do molecules get through the cell membrane? _____

4. What is osmosis? _____

5. Which way would the water molecules move in the following situations?
   a. cucumber slice is placed in salt water _____
   b. salt is poured on a snail _____
   c. vegetables are sprinkled with water _____
   d. potato slice is placed in pure water _____

6. Circle the letter in front of the sentence that best explains the process of osmosis.
   a. Osmosis is the movement of water into or out of a cell from where it is in large amounts to where it is in small amounts.
   b. Osmosis is the movement of water into or out of a cell from where it is in small amounts to where it is in large amounts.
   c. Osmosis is the movement of salt into or out of a cell from where it is in large amounts to where it is in small amounts.

Pre-Lab Questions

Why must you use 2 beakers?

What is osmosis? If there is no water, can osmosis occur? What is the difference between osmosis and diffusion.

What is the egg white made of? What is corn syrup made of?

Why must you soak the egg in and why are you doing this?

What is a HYPOTONIC solution? _____

What is a HYPERTONIC solution? _____

What is a ISOTONIC solution?_____

What are your predictions for this lab? Be specific.

Observing Osmosis in Eggs

Some chemicals can pass through a cell membrane, but others cannot. Furthermore, not all chemicals can pass through a cell membrane with equal ease. The cell membrane determines which chemicals can diffuse into or out of a cell.

As chemicals pass into and out of a cell, they move from areas of high concentration to areas of low concentration. Cells in *hypertonic* solutions have solute concentrations lower than the solution that bathes them. This concentration difference causes water to move out of the cell into the solution. Cells in *hypotonic* solutions have solute concentrations greater than the solution that bathes them. This concentration difference causes water to move from the solution into the cell. The movement of water into and out of a cell through the cell membrane is called *osmosis.*

In this lab, you will use a model of a living cell to predict the results of an experiment that involves the movement of water through a membrane.

OBJECTIVES

- **Explain** changes that occur in a cell as a result of diffusion.
- **Distinguish** between hypertonic and hypotonic solutions.

MATERIALS

- safety goggles, lab apron, protective gloves
- balance
- beakers, 250 mL (2)
- beakers, 600 mL (2)
- corn syrup
- distilled water
- eggs (2)
- paper towels (2)
- tablespoon or tongs
- vinegar, 400 mL
- wax pencil

Procedure

DAY 1: SOAKING EGGS IN VINEGAR

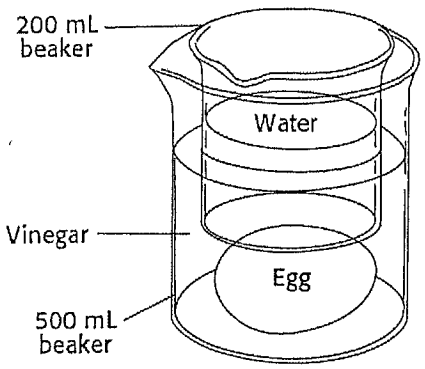
1. Label one 600 mL beaker "Egg 1: water" and the other 600 mL beaker "Egg 2: syrup." Also label the beakers with the initials of each member of your group.
2. Measure the mass of each of two eggs to the nearest 0.1 g, and record your measurements in the second column of **Table 1. CAUTION: Uncooked eggs may contain harmful bacteria. Do not touch your face after you have handled raw eggs. Clean up any material from broken eggs immediately. Wash your hands with soap and water after handling the eggs.**
3. Put on safety goggles and a lab apron. Pour 200 mL of vinegar into each labeled beaker. Using a tablespoon or tongs, place an egg into each beaker. Always return each egg to the same beaker.

TABLE 1 EGGS IN VINEGAR

Egg	Mass of fresh egg with shell	Observations after 24 h	Mass after 24 h in vinegar
1			
2			

4. Place a 250 mL beaker containing 100 mL of water on each egg to keep it submerged, as shown in **Figure 1**. Add more vinegar if the egg is not covered by the vinegar already in the beaker. If some vinegar spills over when the 250 mL beaker is placed on the egg, carry the beaker carefully to the sink and pour out some vinegar. Store the beakers for 24 hours in the area specified by your teacher.

FIGURE 1 EGG IN VINEGAR



5. Clean up your work area and wash your hands before leaving the lab.

DAY 2: SOAKING EGGS IN TWO LIQUIDS

6. After 24 hours, observe the eggs. Record your observations in Table 1.
7. Put on safety goggles and a lab apron. Label two separate sheets of paper towel "Egg 1" and "Egg 2." Pour the vinegar from the beakers into the sink. Using a tablespoon or tongs, remove the eggs and rinse them with water. Place each egg on the appropriately labeled paper towel. Measure the mass of each egg, and record the measurement in the last column of **Table 1**.
8. Return Egg 1 to its beaker, and add water until the egg is covered. Return Egg 2 to its beaker, and add corn syrup until the egg is covered. Store the beakers for 24 hours in the same place as before.
9. Clean up your work area and wash your hands before leaving the lab.

DAY 3: MEASURING CHANGES IN THE EGGS

10. Predict how the mass of each egg has changed after 24 hours in each liquid. (Hint: An egg is surrounded by a membrane. Inside the membrane, the egg white consists mainly of water and dissolved protein. The yolk consists mainly of fat and water. Corn syrup is sugar dissolved in water. The protein, fat, and sugar are solutes.) Record your predictions in **Table 2.**

    • What will have occurred if your egg gains or loses mass?

    _____

11. Observe your eggs. Record your observations in **Table 2.** Measure and record the final masses of the two eggs.

TABLE 2 EGGS SOAKED IN TWO LIQUIDS

Egg	Liquid	Predicted change after 24 h	Observations after 24 h	Final mass of egg
1				
2				

12. Dispose of your materials according to your teacher's instructions.
13. Clean up your work area, and wash your hands before leaving the lab.

Analysis

1. What effect did the vinegar have on the eggs?

    _____

    _____

    _____

2. What caused the change in appearance in Egg 1 after it soaked in water?

    _____

    _____

    _____

3. What caused the mass of the egg to increase after soaking in the vinegar solution?

4. What material seems to have moved through the membrane of Egg 2 after it soaked in the corn syrup? In what direction did the material move?

5. How did your results in step 11 compare with your prediction?

6. Which egg was in a hypertonic solution? Explain what you used for evidence.

7. Which egg was in a hypotonic solution? Explain what you used as evidence.

8. What do you think would happen to a red blood cell placed in a test tube of distilled water? Explain using principles of osmosis why you believe this would occur.

_____

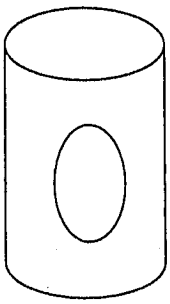
_____

_____

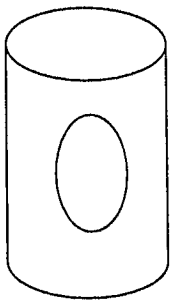
_____

9. Draw a diagram of where water molecules move from a cell in a)hypertonic solution b) hypotonic solution c) isotonic solution.

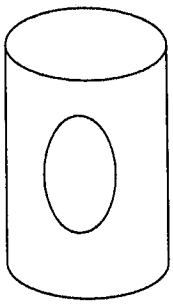
A) hypertonic



B) hypotonic



C) isotonic



Pre-Lab Questions

How many cell models will you be making? What is the difference in them?

What will you use to measure volume of the models?

what is the SI for volume? What is the formula to find the volume of an object?

What is the surface area? What is the surface area of a cube? What is the surface area of a sphere?

What are your predictions for this lab? Which model will have the greatest volume? How does this apply to a cell? Is this an important concept and why.

Modeling Cells: Surface Area to Volume

Are there limits to how large a cell can grow? Everything that enters and exits a cell passes through the cell membrane. As the size of a cell increases, its surface area increases, but so does its volume. Consider how people enter a crowded event at a large stadium. Everyone funnels through a few gates. In a larger stadium, it takes people longer to move in and out. Similarly, in a larger cell, it takes materials longer to reach their destination inside the cell. This means that it is more difficult for a large cell to have its needs met through the cell membrane. In this lab, you will examine surface area-to-volume ratios on a small scale, using model cells. You will use the collected data to draw conclusions about why this ratio might limit the size of a cell.

OBJECTIVES

- **Prepare** and **compare** various cell models.
- **Calculate** surface area and surface area-to-volume ratios.
- **Use** your data to form conclusions about size limitations on cells.

MATERIALS

- calculator (optional)
- cell model patterns (3)
- funnel
- graduated cylinder, large
- metric ruler
- paper, heavy
- safety goggles
- sand
- scissors
- tape

Procedure

1. Put on your safety goggles. Trace and cut out three cell models. Your teacher will provide you with the patterns or dimensions for each model. Fold the models to form three-dimensional shapes, as in **Figure 1**. Use tape to keep each model together.
2. Use the ruler to measure the length, width, and height dimensions of each model. Record the dimensions in **Table 1.**
3. Calculate the total surface area for each model. To do this, find the area of each side (length 3 width), then multiply that number by 6. Enter the data in **Table 1.**

FIGURE 1
CELL MODEL

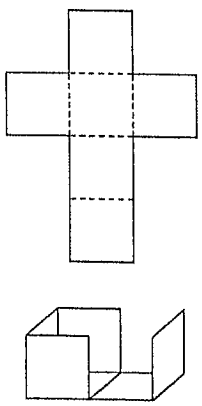


TABLE 1 MODEL CELL CALCULATIONS

Cell	Dimensions (cm)	Surface area (cm^2)	Volume (cm^3)	Surface area-to-volume ratio
A				
B				
C				

4. Use the funnel to fill each model with sand. Use the ruler to level off the sand.
5. Find the volume of sand in each model, and enter the data in **Table 1.** You can do this by using either of two methods.
   a. Measure the amount of sand in each model by pouring the sand through a funnel into a graduated cylinder.
   b. Calculate the volume, using the following formula:
   volume = length × width × height
6. Calculate the surface area-to-volume ratio for each model. Use the following formula:
   surface area ÷ volume = surface area-to-volume ratio
   Record the values in **Table 1.**
7.  Clean up your materials and wash your hands.

NAME_____SCI#_____ POINTS:_____

1. Why do you need to multiply by 6 in step 3?

   _____

   _____

2. Which cell model has the largest surface area? _____

   The largest volume? _____

   The largest surface area-to-volume ratio? _____

   Which of these measurements is the most important for hypothesizing whether a cell would be able to get all the oxygen and food it needs?

   _____

3. Which model cell is likely to be most efficient at getting nutrients to all of the cell parts? Explain your answer in terms of surface area-to-volume ratios.

   _____

   _____

   _____

4. What formula did you use to get the volume? _____
5. What formula did you use for surface area? _____
6. On back of this sheet, create the same table as in lab procedures above. Be sure to use a ruler to make the table and include all the information that is in the table above. Highlight (in yellow) the model that would give you the *MOST EFFICIENT* cell.

Pre-Lab Questions

Why is it important to dry the grapes?

What is osmosis? If there is no water, can osmosis occur? What is the difference between osmosis and diffusion.

What is the major component of grape flesh? What is grape juice made of?

What is distilled water? Is it different than tap water?

What is a HYPOTONIC solution?

What is a HYPERTONIC solution?

What is a ISOTONIC solution?

What are your predictions for this lab? Be specific.

Osmosis

You will observe the movement of water into or out of a grape under various conditions.

Procedure

1. Make a data table with four columns and three rows.
2. Fill one cup with a salt solution. Fill a second cup with grape juice. Fill a third jar with distilled water. Label each cup with the name of the solution that it contains.
3. Use a balance to find the mass of each of three grapes. Place one grape in each cup, and cover the cups with wrap. Place in your period's tray.
4. Predict whether the mass of each grape will increase or decrease over time. Explain your predictions on prelab sheet.
5. After 24 hours, remove each grape from its jar, and dry the grape gently with a paper towel. Using the balance, find each grape's mass again. Record your results.

Analysis

1. **Identify** the solutions in which osmosis occurred.

2. How did you determine whether osmosis occurred in each of the three solutions?

3. Did the mass of each grape change as you had predicted? Why or why not?

4. Which solution was hypotonic? Hypertonic? Isotonic?

	SALT WATER	GRAPE JUICE	DISTILLED WATER
DAY 1			
DAY 2			
CHANGE IN MASS (+ IF IT INCREASED, -,IF DECREASED NO CHANGE)			

Why do cells divide?

When cells grow to a certain size, their rate of growth slows until they stop growing. At this point, they have reached their size limit. A cell that has reached its size limit divides into two smaller cells. In this lab, you will explore one of the factors that limit cell size: the relationship between the size of the cell—specifically, its surface area and volume—and how efficiently substances diffuse across its cell membrane.

Objectives

- Model cells of different sizes with agar cubes.
- Model the diffusion of materials across a cell membrane.
- Calculate the surface area-to-volume ratio for model cells.
- Form a hypothesis about how cell division affects a cell's ability to absorb materials.

Materials

agar
beaker
timer
calculator
plastic ruler
100 mL 0.1*M* solution of hydrochloric acid
kitchen knife
plastic spoons
paper towels

Safety Precautions

WARNING: ***Use caution when handling hydrochloric acid.***

Procedure

Part A. Setting Up the Experiment

1. Read and complete the lab safety form.
2. Obtain a block of agar containing phenolphthalein from your teacher. Recall that phenolphthalein turns pink in the presence of a base. It will become colorless in an acid.
3. Use a ruler to measure and a kitchen knife to cut three blocks out of the agar. One should be 3 cm on each side, one should be 2 cm on each side, and one should be 1 cm on each side.
4. **Figure 1** Place the three agar cubes inside the beaker. Cover with 100 mL dilute hydrochloric acid solution.

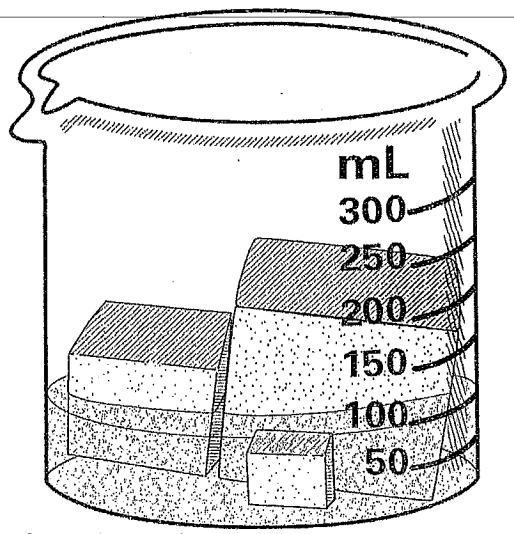


Figure 1

5. Leave the agar blocks in the dilute hydrochloric acid for a total of 10 min. Use a spoon to turn them every few minutes to ensure that they are soaking evenly.
6. Complete the data table on the next page.

Part B. Measuring Diffusion

1. After 10 min, carefully use the plastic spoons to remove the agar blocks. Blot them dry with paper towels. Use care not to splash HCl on skin; it will cause burns.
2. Use the edge of the plastic ruler to cut each block in half. Measure the depth of the uncolored area in centimeters, recording the measurement to the nearest millimeter. This shows the depth of diffusion. Record these values in **Table 1**.
3. Complete **Table 1**, and answer the questions that follow.
4. You might need the following formulas:
   surface area = *length* × *width* × *number of surfaces*
   volume of a cube = *length* × *width* × *height*
   Use a calculator for your calculations if necessary.
5. Wash your hands with soap and water, and dispose of the materials as instructed by your teacher.

Data and Observations

Table 1

Agar Data				
Cube Size	**Surface Area**	**Volume**	**Ratio**	**Depth of Diffusion**
3 cm/side				
2 cm/side				
1 cm/side				

Analyze and Conclude

1. Is the distance of diffusion the same for all of the blocks? Explain.

2. Based on your answer to the question above, do you think that the depth of diffusion is the same in all cells? Explain.

3. List the agar cubes in order of size, from largest to smallest. Then list them in order of surface area-to-volume ratio (from largest ratio to smallest ratio). How do these lists compare?

4. Suppose you were given a microscopic, cube-shaped onion cell that was 0.01 cm/side. What would be the surface area-to-volume ratio of that cube?

5. Which block has the greatest surface area-to-volume ratio—the onion cube or the 3 cm/side cube you used in this lab?

6. What is the relationship between surface area-to-volume ratio and diffusion across a cell?

7. What happens to diffusion as a cell grows?

8. **Error Analysis** What are some possible sources of error in your experiment?

9. Form a hypothesis to explain how cell division affects a cell's ability to absorb the material necessary for growth. Base your answer on your observations of the surface area-to-volume ratio.

Inquiry Extensions

1. Which cells in the human body divide most frequently? Why is this? What activities or conditions spur cell division? What slows it down?
2. During adolescence the human body grows at a rate faster than at any other time after infancy. Explain how what you learned in this lab plays out in the human body during adolescence.

Osmosis and Diffusion

Student Study and Analysis Sheets

Introduction

Every plant and animal cell has a membrane which acts as a barrier between the "outside" environment and the cell's cytoplasm. Membranes are selectively permeable, allowing only certain molecules to enter and exit the cytoplasm freely.

In 1827, Scottish scientist Robert Brown found that tiny particles suspended in water moved in small, quick movements. This phenomenon, known as Brownian movement or random motion, illustrates that molecules are in a state of constant, random motion in all liquids and gases; they move in an undirected fashion, bouncing off other molecules.

Because molecules are in constant motion, they bounce off each other and move toward an area of fewer molecules. This action, known as diffusion, is the movement of molecules from an area with a high concentration of molecules to an area of low concentration of molecules.

When a concentration gradient (a high concentration of molecules in one area and a low concentration in another) exists, diffusion will take place, and molecules will move until an equilibrium is reached. For example, when a bottle of hydrogen sulfide, which smells like rotten eggs, is opened on one side of a room, the smell can quickly be detected on the other side. The bottle has a high concentration of hydrogen sulfide; the room has a low concentration. The hydrogen sulfide diffuses to the less-concentrated area until an equilibrium is found.

Like all molecules, water molecules are in constant motion, moving from areas of high concentration to areas of low concentration. Water moves through a selectively permeable membrane whenever there is an unequal concentration of water on either side of the membrane, until an equilibrium is reached. This process is called osmosis. The osmotic process is a special case of diffusion involving the movement of a solvent, such as water, rather than substances dissolved in the solvent (solutes).

Sometimes the water molecules carry other molecules along with them. The action of the cell transporting substances in and out of its cell membrane is called active transport. The cell uses energy derived from ATP or a protein to move the solutes into or out of the cell.

Objective

To create a model of a cell membrane to observe osmosis and diffusion.

Materials Needed per Lab Group

1 Cup, 9 oz.
2 Glucose Testing Strips
Dialysis Tubing, 1 ft.
Graduated Cylinder
Goggles
Gloves
Aprons

Shared Materials

Glucose Solution
Starch Solution
Iodine Potassium Iodide

Procedure

Safety: *Wear goggles, gloves, and apron when conducting this investigation.*

1. Fill the plastic cup three-quarters full with water.
2. Test the water for glucose by dipping a glucose test strip in the water. Record the data in the table below.
3. Add 20 drops of IKI solution to the cup of water. Note the color of the water and record it in the table.

   Note: *Iodine potassium iodide is a corrosive/irritant. Store away from other chemicals. Read MSDS before use.*

4. Hold the section of dialysis tubing under running water until it is pliable.
5. Once the tubing is pliable, tie a knot in one end.

   Note: *Handle the tubing carefully; make sure that you do not rip the tube.*

6. Open the tubing by rubbing the untied end between your fingers.
7. Pour 15ml soluble starch solution into the tubing.
8. Pour 15ml glucose solution into the tubing.
9. Carefully tie a knot in the open end to form a bag. Note the color of the solution in the tubing and record the color in the table.
10. Rinse the tube thoroughly to wash off any glucose or starch that may have spilled onto the outside of the tube.
11. Place the dialysis tube in the cup of water-IKI solution.
12. Observe the tube for 15 minutes. Record the final color of the solutions in the tubing and in the cup.
13. Test the water-IKI solution once again for glucose with the second glucose test strip. Record the results in the table.

Analysis

		Color		Glucose		Starch	
Container	Contents	Initial	Final	Initial	Final	Initial	Final
Cup							
Dialysis Tubing							

Note: *Both glucose and starch are present, and will remain, in the tubing; only enough will move until an equilibrium is reached between the outside and the inside of the membrane, leaving a certain amount inside the tubing.*

Questions

1. Which substance(s) migrated into or out of the dialysis tubing? How do you know?

2. Which, if any, substance(s) did not diffuse through the membrane? How do you know?

3. What is osmosis? How can you tell if osmosis occurred in the dialysis tube?

4. What is selective permeability?

5. Molecules of similar substances are about the same size, whereas molecules of different substances are different sizes. From the results of the experiment, is it possible to determine the relative sizes of molecules that did or did not diffuse across the dialysis membrane?

6. Can it be said that the dialysis membrane is similar to a plasma membrane?

Procedure

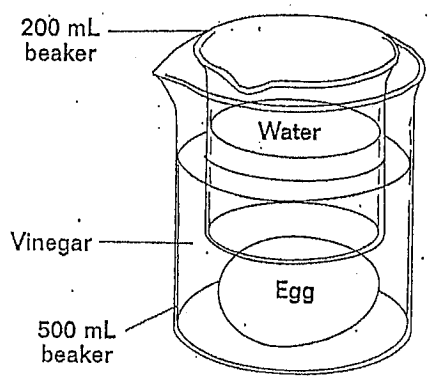
1. Label one 600 mL beaker "Egg 1: water" and the other 600 mL beaker "Egg 2: syrup." Also label the beakers with the initials of each member of your group. Measure the mass of each of two eggs to the nearest 0.1 g, and record your measurements in **Table 1** below. **CAUTION: When handling raw eggs, clean up any material from broken eggs immediately. Wash your hands with soap and water after handling the eggs.**
2. Put on safety goggles and a lab apron. Pour 200 mL of vinegar into each labeled beaker. Using a tablespoon or tongs, place an egg into each beaker. *Note: Always return each egg to the same beaker.*

TABLE 1: EGGS IN VINEGAR

Egg	Mass of fresh egg with shell	Observations after 24 h	Mass after 24 h in vinegar
1			
2			

3. Place a 250 mL beaker containing 100 mL of water on each egg to keep it submerged as shown in **Figure 1** below. Add more vinegar if the egg is not covered by the vinegar already in the beaker. If some vinegar spills over when the 250 mL beaker is placed on the egg, carry the 600 mL beaker carefully to a sink and pour vinegar some out. Store your beakers for 24 hours in the area specified by your teacher.
4. Clean up your work area and wash your hands before leaving the lab.

FIGURE 1



Observing Plasmolysis in Onion Skin Cells

Materials

onion section

scalpel

forceps

15% NaCl solution (dissolve 15 g NaCl in 85 mL of water)

microscope slides

coverslips

distilled water

dropping pipets

absorbent paper

microscopes

Procedure

1. An onion is made up of several layers of thick scale leaves. You will need one portion of scale from a cut section of an onion. Working on the concave surface of the scale, cut out a section about 1 cm^2. Use forceps to remove the epidermal layer (onion skin) from the concave surface of the section you have cut. Place the onion epidermis on a microscope slide and smooth it to remove as many wrinkles as possible. Add one or two drops of distilled water and a coverslip, and observe under a microscope.
2. You have probably observed onion cells before, but reacquaint yourself with their structure and appearance. Note especially the cell walls and the location of the nuclei.
3. Remove the slide from the microscope. Add a drop or two of 15% NaCl solution to one edge of the coverslip. Use a piece of absorbent paper to absorb water from the opposite edge of the coverslip. This should "pull" the salt solution under the coverslip and bring it in contact with the onion cells.
4. Observe under the microscope for several minutes for signs of change in the onion cells. If after several minutes you have seen no change, remove the coverslip, blot away excess water, and add one or two drops of 15% NaCl solution directly to the square of onion epidermis. Replace the coverslip and observe again.
5. Once you have observed plasmolysis, remove the coverslip and blot away the excess water. Flood the epidermis with distilled water and blot again. Add another drop of distilled water and replace the coverslip. Observe under the microscope. Do you see any change that would indicate that water is entering the cells?