Name _____ Date _____

The Deadly Picnic

A Lab on Deductive Reasoning

Objective

You will use deductive reasoning to decide who committed the murder.

Background Information

Centerville police discovered the body of a 36-year-old white male (later identified as Gaven Brooks) in an open field of daisies about five miles outside of town. Mr. Brooks's body was discovered at 10:02 P.M. Friday night, October 11. He was found lying face up on a yellow, queen-size sheet. According to autopsy reports, one fatal gunshot to the back of the head ended Mr. Brooks's life. Scientists estimate that death occurred at about 7:45 P.M.

As investigators scanned the crime scene, they made the following notes:

- Paper plates filled with partially eaten fried chicken, potato salad, and chocolate cake were located near Mr. Brooks's body.
- An open bottle of red wine and two partially-filled glasses of wine were found next to the yellow sheet.
- One of the wine glasses had a smudge of red lipstick on the rim.
- A recently smoked cigarette butt was found near the sheet.
- Footprints from the road to the field were those of a male, size 10, and a female, size 5. The only footprints from the field back to the road were those of a female, size 5.
- Car tracks of the same wheel base and tread pattern as Mr. Brooks's automobile were found at the road. The car was not found at the scene.
- Later that evening Mr. Brooks's car was found abandoned in an empty parking lot in downtime Centerville.

Investigators believe that a female friend of Mr. Brooks was responsible for his demise. After questioning family and friends, it was discovered that the deceased had frequent social outings with six women who live in or near Centerville. The women's names are Rita, Lauren, Gail, Janice, Elaine, and Peggy.

In today's lab you will answer these questions: Who was responsible for the murder? What events surrounded this murder?

Materials

Pencil

Procedure

1. After reading the Background Information, record some important pieces of information in Data Table 1.
2. Read the special notes (given below) that the police gathered during their investigation. Record this information in Data Table 2.
3. Special notes gathered by police investigation:
   - Janice works full time as a cosmetologist.
   - Elaine and Gail are school teachers.
   - Peggy and Elaine live together in a two-bedroom apartment in downtown Centerville.
   - Gail lives in a nearby town called Jordan.
   - Rita lives in a country house about three miles to the west of Centerville.
   - Elaine and Janice are very petite women—they wear size 4 blue jeans.
   - Gail and Janice are nonsmokers.
   - Janice works part time as an aerobics instructor at a health club in Centerfield. She teaches a 7:30 P.M. step aerobics class each Friday night and has not missed a class in two years.
   - Peggy is deathly allergic to grapes.
   - Gail attends the aerobics class that Janice teaches. She has not missed a Friday night class in nine months.
   - Lauren works at a chemical supply house.
   - Rita's father owns a rifle range.
   - Lauren is allergic to all species of flowering plants.
   - Rita is a florist.
   - Janice and Elaine have never met.
   - Janice and Gail hate the color yellow.
   - Lauren played center for a semi-professional basketball team five years ago. She has red hair and is 6-feet, 1-inch tall.

Postlab Questions

1. Who do you believe killed Mr. Brooks?

2. Cite key pieces of information that caused you to believe the other five women were innocent.

3. What information helped you identify the murderer?

4. On the back of this sheet, write a two-paragraph story that describes what you believe happened on the night of the murder. Explain how the couple got to the murder site, why they went there, what happened while they were there, and how the murderer escaped. What do you believe was her motive?

DATA TABLE 1

Question	*Answer*
Description of location where body was found	
Approximate time and day of death	
Weapon used to inflict fatal wound	
Description of any footprints, tire prints, lip prints, etc., around the crime scene	
Description of objects found at or around the crime scene	
Any other pieces of evidence that may help solve this crime	

DATA TABLE 2

	Comments on size of women	*Occupation and hobbies*	*City or place she lives*	*Medical information*	*Miscellaneous information*
Rita					
Lauren					
Gail					
Janice					
Peggy					
Elaine					

NAME _____ Date _____ LAB # _____

CHAPTER

32

Interpreting a Bar Graph

TURANO LE161 ☑ WORD CHECK

	a *graph* on which the data are shown as bars of different lengths that correspond to the numbers that they represent
	diseases that affect the blood, blood vessels, or the heart

PROBLEM: What information can you learn from a bar graph?

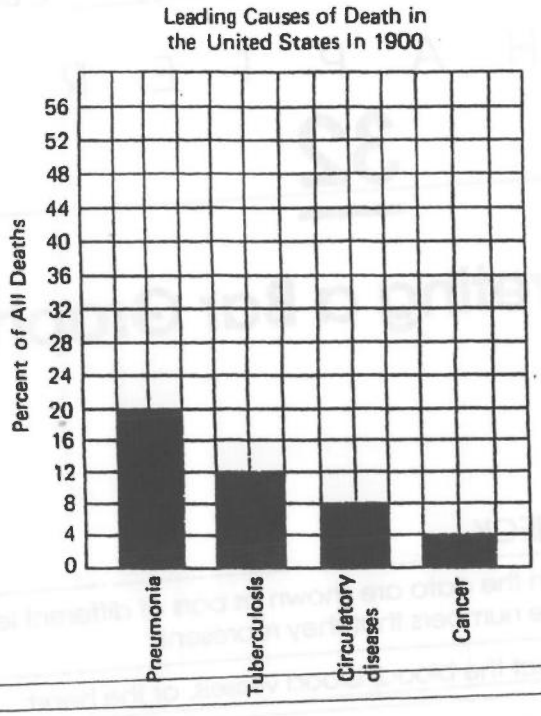
The line graphs you constructed and interpreted in previous worksheets are good ways of showing changes over a period of time of something that is measurable, such as the spread of disease. You also learned how a double-line graph can be used to compare two sets of related data, such as the changes in life expectancy for males and females over the same period of time.

Today, you will learn another way to display and interpret data in the form of a graph—a **bar graph.** A bar graph is used to make comparisons among numbers of similar types of information or data that have no effect on one another. The numbers making up this data are used to determine the length of the bars on the graph.

PROCEDURES

1. On the graph that follows, what information do the labels provide at the base of the graph?

2. Why is the information shown on the side of the graph important?



3. What was the major cause of death in 1900?

_____

4. Which of the four diseases shown on the graph caused the smallest percent of deaths in 1900?

_____

5. What percent of all the deaths in 1900 were caused by **diseases** of the **circulatory** system?

_____

6. What percentage of all the deaths in 1900 were caused by just these four diseases?

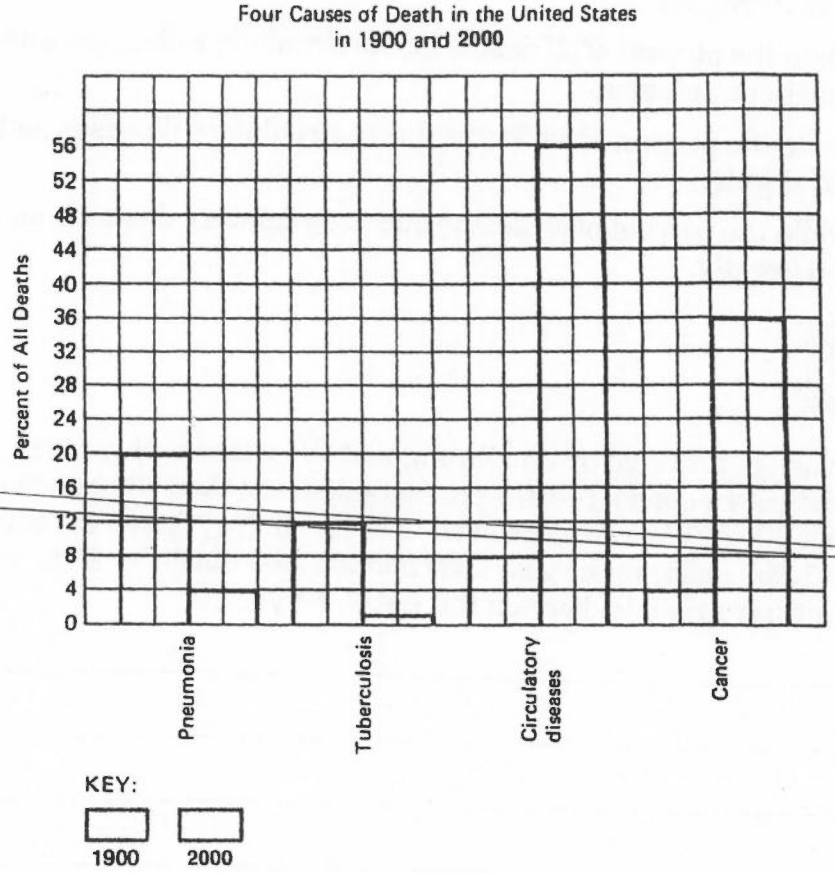
_____

7. The combined percent of deaths due to pneumonia and tuberculosis was ____ (Write the letter of the correct choice.)
   a. about the same as the combined percent of deaths due to circulatory diseases and cancer.
   b. less than the combined percent of deaths due to circulatory diseases and cancer.
   c. almost three times greater than the combined percent of deaths due to circulatory diseases and cancer.
   d. about five times greater than the combined percent of deaths due to circulatory diseases and cancer.

TEST YOUR UNDERSTANDING

Use your understanding of bar graphs to interpret the following graph, which gives two sets of data for each item. One set is the same as the data you have just studied—leading

causes of death in 1900. The other set shows the percent of all deaths due to these causes in 2000. The key beneath the graph shows how to tell one set of data from the other.



1. Of the four diseases shown, which disease caused the highest percent of deaths in 2000?

2. Of the four diseases, which disease caused the smallest percent of deaths in 2000?

_____

3. What percent of all deaths in 2000 were due to cancer?

_____

4. Choose the phrase that best completes the statement of how the percent of all deaths due to cancer compared in 1900 and 2000. Write the letter of the correct choice in the answer space.

   The percent of all deaths due to cancer was _____

   a. about the same in 1900 and in 2000.
   b. higher in 1900 than in 2000.
   c. about four times higher in 2000 than in 1900.
   d. about nine times higher in 2000 than in 1900.

5. To summarize the data shown in the double-bar graph, complete the following statement with one of the choices given below it.

Since 1900, the percent of all deaths due to pneumonia and tuberculosis has ____ (Write the letter of the correct choice.)

a. stayed about the same while the percent of all deaths due to circulatory diseases and cancer has increased.

b. decreased while the percent of all deaths due to circulatory diseases and cancer has remained about the same.

c. decreased while the percent of all deaths due to circulatory diseases and cancer has increased slightly.

d. decreased while the percent of all deaths due to circulatory diseases and cancer has increased greatly.

GOING FURTHER 

6. The amount of energy provided by coal throughout the world each year is measured in units called quads. In 1975, coal supplied less than 100 quads of energy worldwide. About 600 quads were consumed in 2000. Energy from coal will probably rise to 1,200 quads in the year 2050 and to 2,300 quads by 2100. Would you use a linegraph or bar graph to diagram this data? Why?

7. Studies of people who smoke cigarettes have shown that the risk of developing lung cancer is 59% for those who continue to smoke, 47% for those who are seriously attempting to stop smoking, and 35% for those who have successfully quit. Would you use a line graph or a bar graph to diagram this data? Why?

8. Why are both line graphs and bar graphs useful tools in science?

Turano LE 161

NAME _____ Date _____ LaB # _____

CHAPTER

33

Constructing a Bar Graph

TURANO LE 16 ☑ WORD CHECK

	the contamination of the air especially with waste materials produced by the human population
	either the whole mass of air surrounding the earth or the air of a specific area (locality)

PROBLEM: How can you design a bar graph from data?

University scientists have issued a report based on research of average homes in six cities. The homes were studied to find out whether **air pollution** was worse indoors or outdoors.

In your work today, you will be assembling the report's data into tables. You will then use this information to construct bar graphs.

PROCEDURES

Your first set of data concerns air pollution *inside* the homes in these cities. Particles from dusting, cooking, and smoking pollute 20% of the air inside homes in city P. For city T, the figure is 22%; city K is 48%; city W is 28%; city St is 44%, and city S is 40%. Use this information to complete the data table.

P	20%
T	22%
W	
S	
St	
K	48%

8. More and more local and state governments are passing laws to restrict indoor smoking in public places. Why may such laws be important to all people who live or work in such areas?

TURANO LE161

Name_____ Class_____ Date_____

Using Graphing Skills

Turano LB 161

Introduction

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?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. Would a line graph or a bar graph be better for showing the number of birds of each color in a population?

_____

2. How could you plot more than one responding variable on a line graph?

_____

_____

3. Where do you place the manipulated variable on a line graph?

_____

4. Which type of graph would you use to show comparisons? Explain your reason.

_____

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

_____

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 manipulated variable in the experiment. Along the vertical axis or *y*-axis, you will find the responding variable.

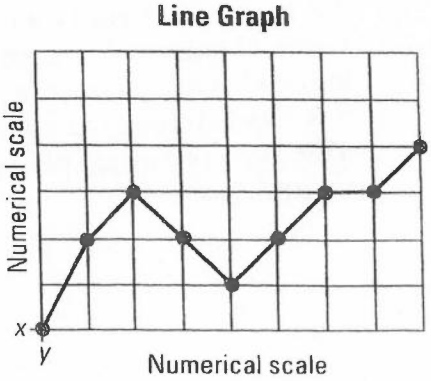


Figure 1

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2. Use the line graph in Figure 2 to answer questions a through f below.

   a. Which plant grew the tallest? _____

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

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

   d. Which line represents plant 2? _____

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

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

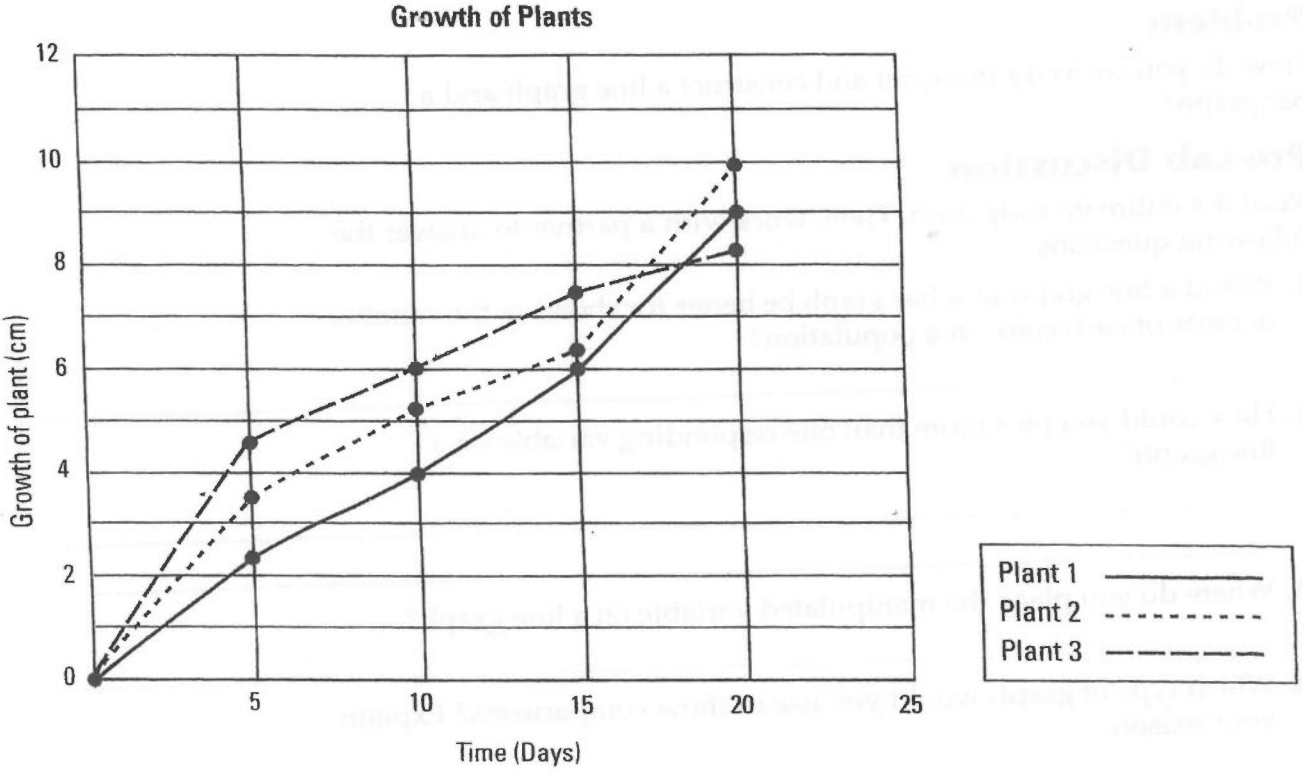

Figure 2

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.

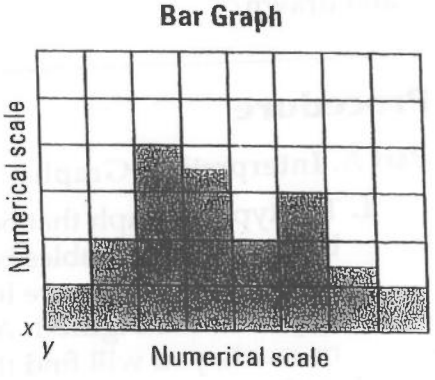

Figure 3

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4. Use the bar graph in Figure 4 to answer questions a through e below.

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

   _____

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

   _____

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

   _____

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

   _____

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

   _____

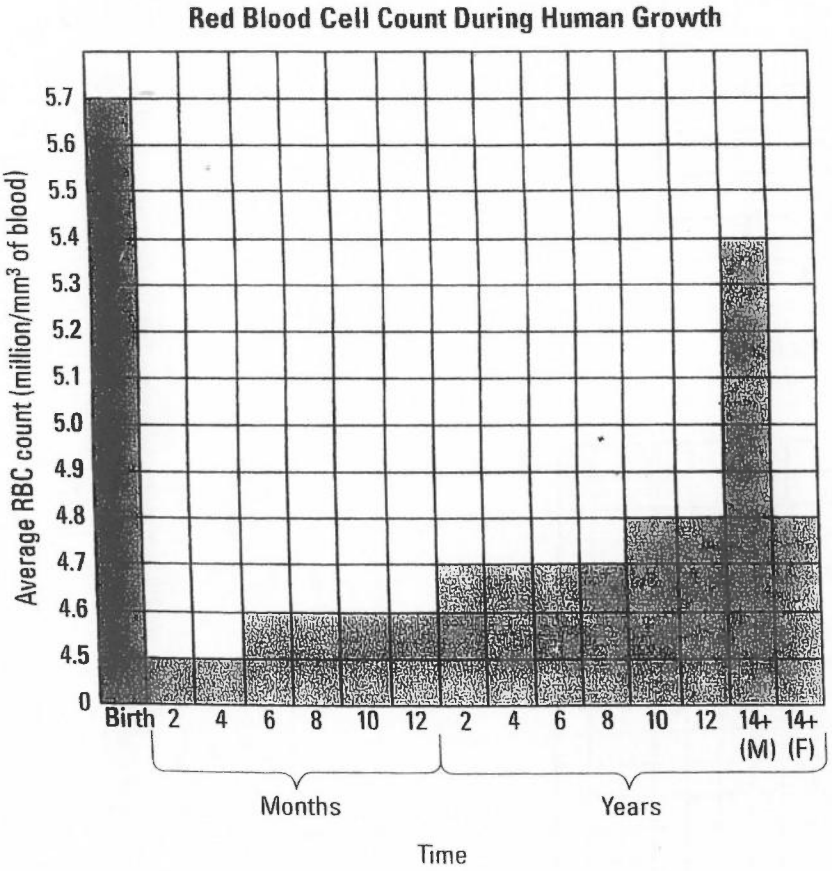


Figure 4

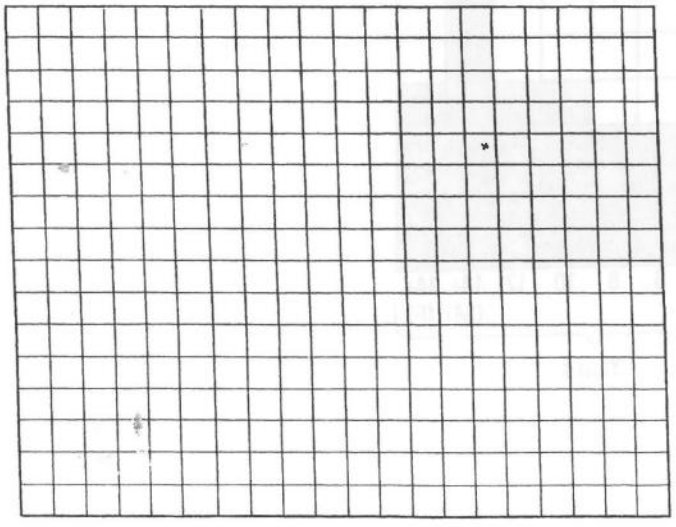
Part B. Constructing Graphs

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 below. You should label each axis, mark an appropriate scale on each axis, plot the data, connect the points, and give your graph a title.

Data Table 1

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

Breathing Rate of the Freshwater Sunfish



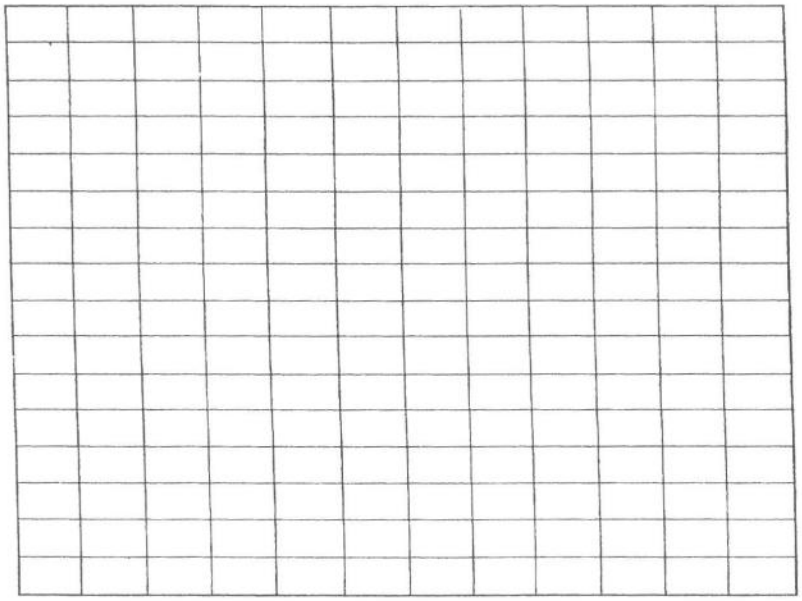
Name _____ Class _____ Date _____

3. Use the information recorded in Data Table 2 to construct a bar graph on the grid provided below. 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.

Data Table 2

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

Average Rainfall in Willamette Valley



Analysis and Conclusions

1. Comparing and Contrasting How is a graph similar to a data table?

_____

_____

2. Comparing and Contrasting How is a line graph different from a bar graph?

_____

_____

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

_____

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4. **Using Graphs** 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.

_____

_____

_____

5. **Using Graphs** What is an advantage of using multiple lines in a line graph? (See Figure 2.)

_____

_____

_____

Going Further

A circle graph (sometimes called a "pie chart") is a convenient way to show the relative sizes of the parts that together form a whole body of data. Look through magazines and newspapers to find examples of circle graphs. Construct a chart listing the similarities and differences between circle graphs, line graphs, and bar graphs.

Name: _____ Date Completed: _____

Class: _____ Lab Minutes: _____ Teacher: _____

Graphing Activities

This lab was created by Mr. Buckley from Edward Knox High School. Credit is given for this original activity to Mr. Buckley.

Introduction

Graphing is used by scientists to display the data that is collected during a controlled experiment. A line graph must be constructed to accurately depict the data collected. An incorrect graph often leads to the acceptance of an incorrect hypothesis or detract from the acceptance of a correct hypothesis.

The graph should contain 5 major parts: the title, the independent variable, the dependent variable, the scales for each variable, and a legend.

1.) **The title:** this shows what the graph is about. Reading the title should give the reader an idea about the graph. It should be a concise statement placed above the graph.

2.) **The Independent Variable:** this is the variable (part of the experiment that changes) that can be controlled or manipulated by the experimenter. This variable should be placed on the horizontal or x-axis.

3.) **The Dependent Variable**: this is the variable directly affected by the independent variable. It is the result of what happens because of the independent variable. This variable is placed on the y or vertical axis.

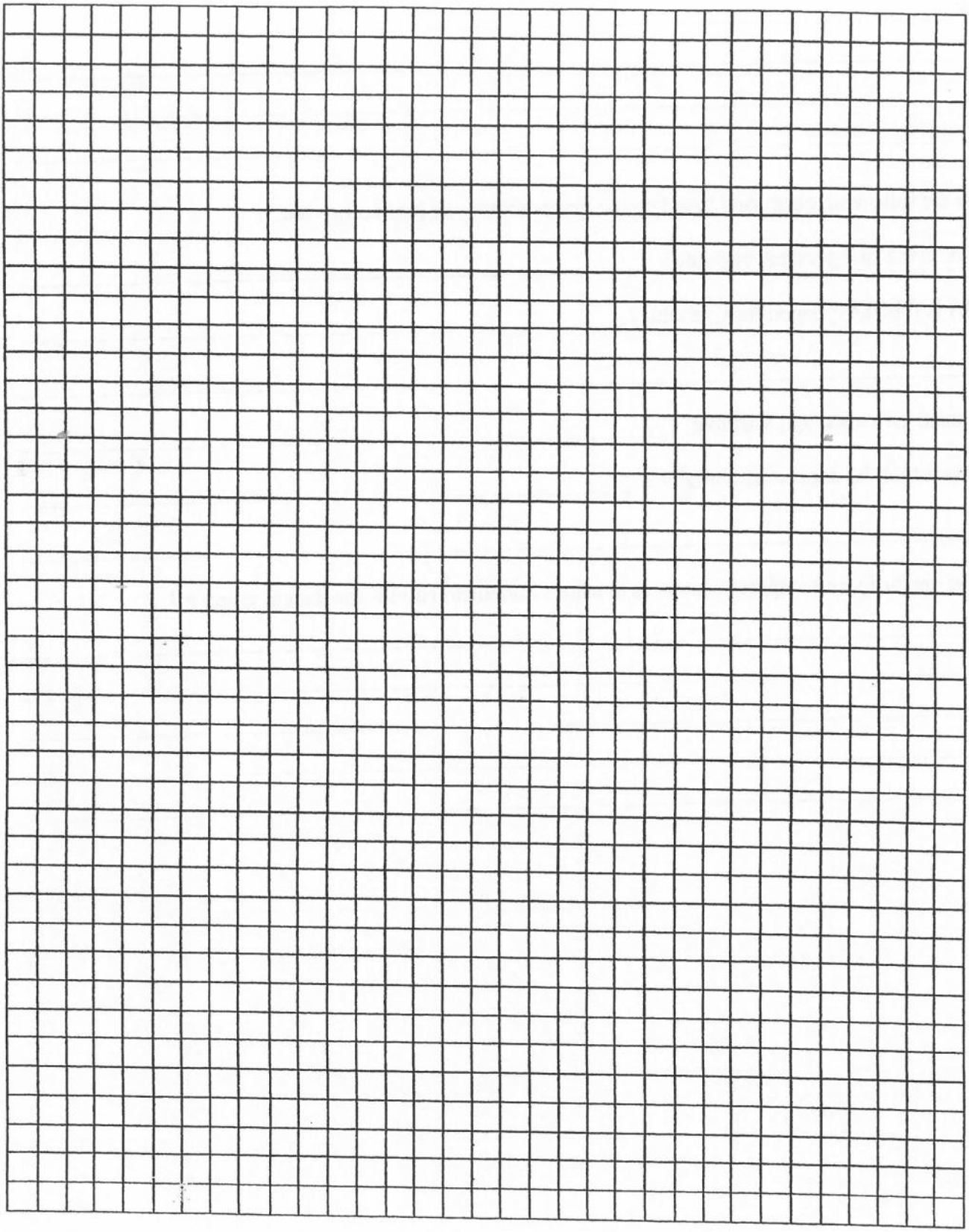
4.) **The Scales for each Variable**: In constructing a graph, one needs to know where to plot the points representing the data. In order to do this a scale must be employed that will include all the data points. Each block should have a consistent amount or increment on a particular axis. While the scale should allow as much of the graph to be taken up as possible, it is not a good idea to set up a scale that is hard to manage. For example, multiples of 5, 10, etc. are good, while multiples such as 1.22 are not! Your scale must be plotted on the amount of graph space available, and will be dictated by the data points.

5.) **The Legend**: this is a short descriptive narrative concerning the graph's data. It should be short and to the point and placed directly under the graph.

Graphing Activity # 1

1. Use the data in the table below to complete the graph provided. Remember to title your graph, label the axes properly when setting up your scale, make a key, and to write a legend for your graph when completed.

Depth in meters	Number of bubbles/min Plant A	Number of Bubbles/min Plant B
2	29	21
5	36	27
10	45	40
16	32	50
25	20	34
30	10	20



Legend: _____

_____

_____

_____

Answer the following questions based on the graph above you just completed.

1. What is the independent variable? _____
2. Why is this the independent variable? _____

   _____
3. What is the dependent variable? _____
4. Why is this the dependent variable? _____

   _____
5. Use one or more complete sentences to state a conclusion about the data in graph # 1.

_____

_____

_____

_____

_____

Graphing Activity # 2

Diabetes is a disease affecting the insulin producing glands of the pancreas. If there is not enough insulin being produced by the cells, the amount of glucose in the blood will remain high. A blood glucose level above 140 for an extended period of time is not considered normal. This disease, if not brought under control, will lead to severe complications and even death.

1. Use the data in the table below to complete the graph provided. Remember to title your graph, label the axes properly when setting up your scale, make a key, and to write a legend for your graph when completed.

Time After Eating (hrs.)	Glucose Level in ml/liter of blood in person A	Glucose Level in ml/liter of blood in person B
0.5	170	180
1	155	195
1.5	140	230
2	135	245
2.5	140	235
3	135	225
4	130	200

Name: _____ ***Period:*** _____ ***Date:*** _____

Lab 6 – Data Collection and Graphing ***Lab Minutes = 60***

I. ORGANIZING A DATA TABLE: Every lab investigation involves observations that must be recorded for later study and interpretation. The recorded observations of an investigation are called data. Data is very often recorded in a data table. A data table usually has labeled columns and rows for various items of data that the investigation is expected to produce. Data in a scientific investigation often consists of numerical results or measurements. When measurements are to be recorded the data table must state the unit of measurement such as cm., ml., or g.

Organize the following information into the data table: A student was working on an investigation to measure the relative activity of an enzyme at various pH values. She collected the following data:

pH 2, enzyme activity 10;
pH 12, enzyme activity 10;
pH 6, enzyme activity 40;
pH 8, enzyme activity 50;
pH 4, enzyme activity 20;
pH 10, enzyme activity 40;

Make sure you follow these directions:

(a) label each column with an appropriate heading.

(b) complete the two columns in the data table so that the pH values are **increasing**.

II. CONSTRUCTING A LINE GRAPH:

Experiments are an important part of the everyday work of the scientist. As we have seen, one step in the scientific method is the collection of data while another step is the interpretation or understanding of this data. Sometimes, it is a help to scientists and us to make a graph to picture results.

A graph can help us to see and understand difficult results in a simpler manner. A graph is a picture that relates two different things. The type of graph that best shows the relationship between two variables is a line graph.

Vocabulary:

1. Title: depicts what the graph is about. By reading the title, the reader should get an idea about the graph. It should be placed above the graph.
2. The Independent Variable: The variable that can be controlled by the experimenter. It usually includes time (dates, minutes, hours), depth (feet, Meters) temperature. This variable is placed on the X axis (horizontal axis).

3. The Dependent Variable: Variable directly affected by independent variable. Example: How many O_2 bubbles are dependent on the water depth? This variable is placed on the Y axis (vertical axis).
4. The Legend: short descriptive narrative concerning the graph's data. Short, concise and placed under the graph. Could contain the colors, numbers or shapes used to represent figures in the graph.

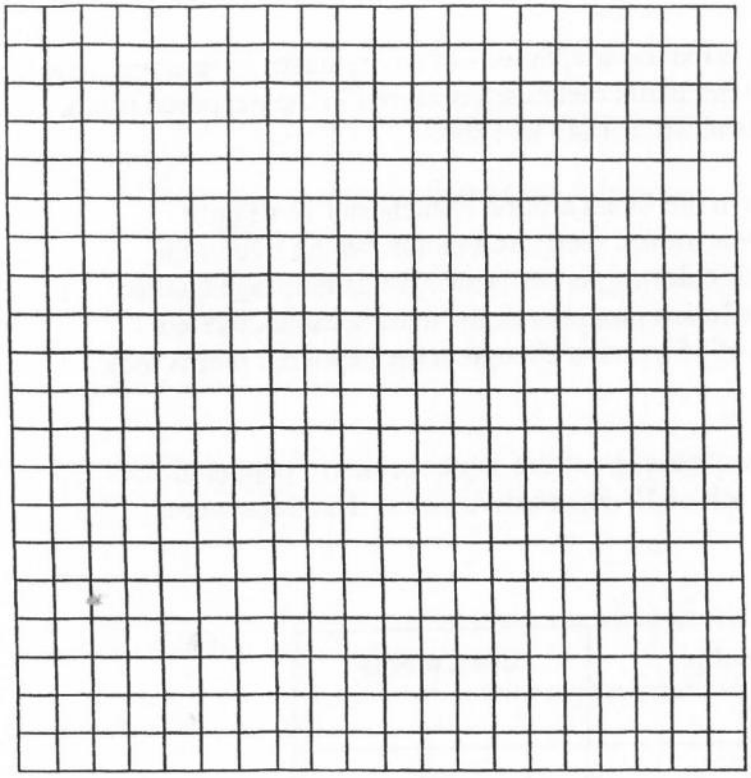
When plotting data on the line graph, you must first decide which variable is the independent and which is the dependent. You then label the axis of your graph accordingly. Then you must decide on the scale of each axis, that is, how much each unit along the axis will represent. Scales should be chosen to make the graph as large as possible within the limits of the paper and still include the largest item of data.

Graph #1 - Growth Rate Data

Have you ever glanced at the family photo album and considered the developmental changes your body has undergone? If so you have probability wondered what biological event triggered these transformations. Chemical messengers within your body dictated these changes. In this activity you will analyze the relationship between age and human growth.

1. Using graph paper, prepare a grid for graphing the data in the table shown below.
2. Use a solid line to make a graph that compares height to age for human males.
3. Use a dotted line to make a line graph that compares height to age for human females.

Age	Height	in cm
	Male	Female
5	109	109
7	119	119
9	133	133
11	138	145
13	157	160
15	169	162
17	177	162
19	177	163



Answer the following questions referring to the graph you just completed.

1. Use the data to explain whether humans grow at a continuous rate or in spurts.

2. Explain how the growth pattern in males differs from that of females.

3. What evidence suggests that sex hormones might play a role in growth patterns.

4. How does a graph make interpreting the data easier?

Graph #2 - Peppered Moth Survey

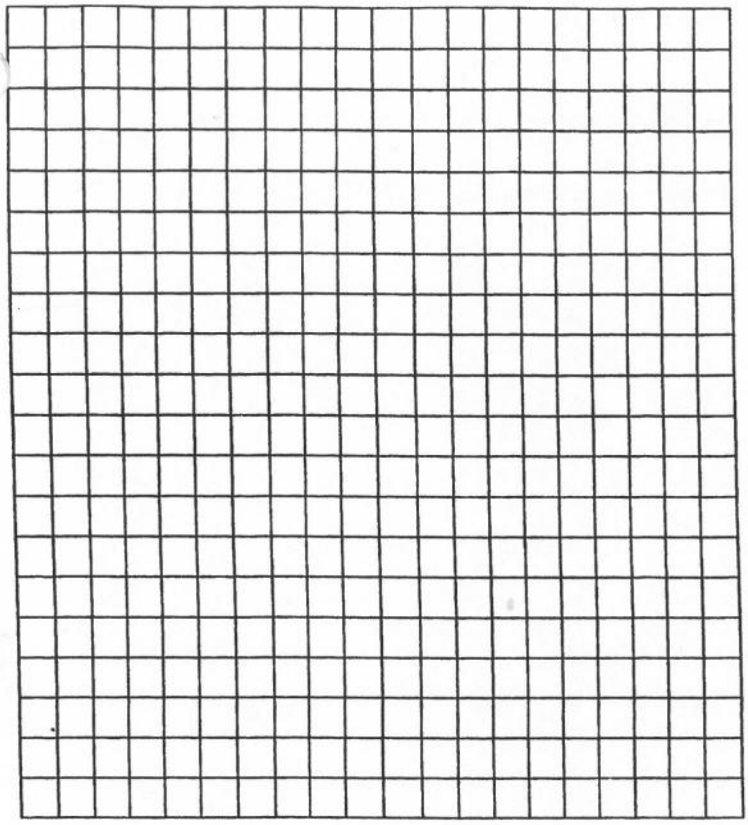
Industrial melanism is the term used to describe the adaptations of an organism in response to a type of industrial pollution. One example of rapid industrial melanism occurred in the peppered moth, *Biston betularia*, in the area of Manchester , England, from 1845 to 1890.

Before the Industrial Revolution, the trees in the forest around Manchester were light grayish green due to the presence of lichens on their trunks. Peppered moths, which live in the area, were colored with light and dark spots. Their coloring serves protective camouflage against predators, especially birds. As the Industrial Revolution progressed, the trees became covered with soot, turning the trunks dark. Over a period of 45 years, a change in the peppered moths took place.

Table A. Contains data from a 10 year study of two varieties of the same species of peppered moth.The numbers represent moths captured in each of 10 consecutive years. The traps were located in the same area each year.

Year	Light moths	Dark moths
2	537	112
3	484	198
4	392	210
5	246	280
6	225	356
7	193	412
8	146	503
9	84	594
10	56	638

Using the data provided in Table A, construct a line graph. Label the axes with the year of the study on the x-axis and the number of moths captured on the y-axis. Use different colored pencils (or a solid or dotted line) to indicate each of the two color variations of the moths. Be sure to include a key on your graph.



Answer the following questions referring to the graph on the peppered moth.

1. What preys on the peppered moth?

_____

2. If the bark of the trees is dark and the moths that rest there are light, what might happen to the moths?

_____

_____

3. Which variety of moth increased over the 10 year period?

_____

4. Using the data on the graph, draw a conclusion concerning the population of peppered moths in the sampled area of England.

_____

_____

_____

Critical Thinking *(Answer on separate paper and attach.)*

Explain the reason for the increase in the number of dark colored moths.

What means could be used to return the environment of the peppered moth to its original state?

Name: _____ ***Period:*** _____ ***Date:*** _____

Lab 6 – Data Collection and Graphing ***Lab Minutes = 60***

I. ORGANIZING A DATA TABLE: Every lab investigation involves observations that must be recorded for later study and interpretation. The recorded observations of an investigation are called data. Data is very often recorded in a data table. A data table usually has labeled columns and rows for various items of data that the investigation is expected to produce. Data in a scientific investigation often consists of numerical results or measurements. When measurements are to be recorded the data table must state the unit of measurement such as cm., ml., or g.

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pH 12, enzyme activity 10;
pH 6, enzyme activity 40;
pH 8, enzyme activity 50;
pH 4, enzyme activity 20;
pH 10, enzyme activity 40;

Make sure you follow these directions:

(a) label each column with an appropriate heading.

(b) complete the two columns in the data table so that the pH values are **increasing**.

II. CONSTRUCTING A LINE GRAPH:

Experiments are an important part of the everyday work of the scientist. As we have seen, one step in the scientific method is the collection of data while another step is the interpretation or understanding of this data. Sometimes, it is a help to scientists and us to make a graph to picture results.

A graph can help us to see and understand difficult results in a simpler manner. A graph is a picture that relates two different things. The type of graph that best shows the relationship between two variables is a line graph.

Vocabulary:

1. Title: depicts what the graph is about. By reading the title, the reader should get an idea about the graph. It should be placed above the graph.
2. The Independent Variable: The variable that can be controlled by the experimenter. It usually includes time (dates, minutes, hours), depth (feet, Meters) temperature. This variable is placed on the X axis (horizontal axis).

3. The Dependent Variable: Variable directly affected by independent variable. Example: How many O_2 bubbles are dependent on the water depth? This variable is placed on the Y axis (vertical axis).
4. The Legend: short descriptive narrative concerning the graph's data. Short, concise and placed under the graph. Could contain the colors, numbers or shapes used to represent figures in the graph.

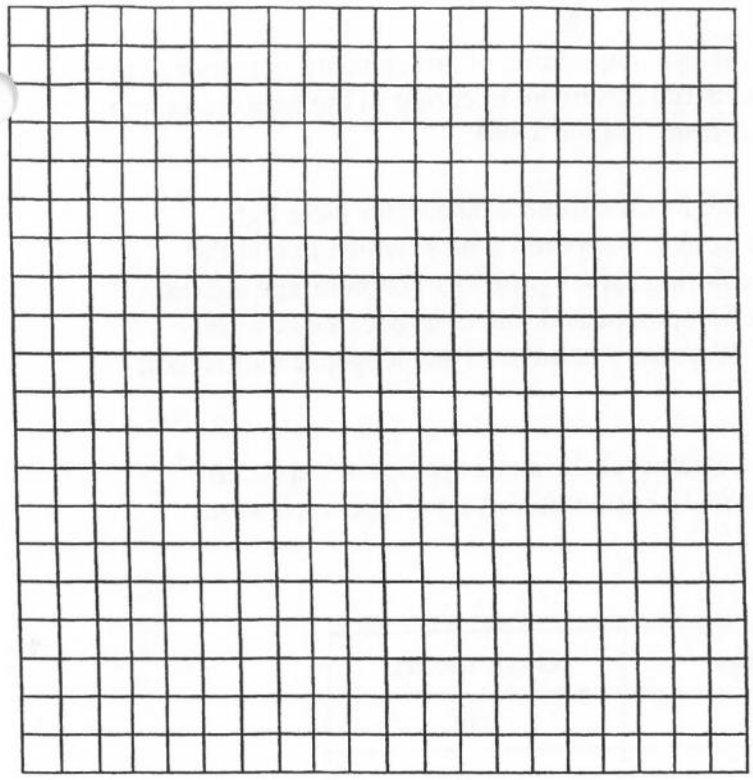
When plotting data on the line graph, you must first decide which variable is the independent and which is the dependent. You then label the axis of your graph accordingly. Then you must decide on the scale of each axis, that is, how much each unit along the axis will represent. Scales should be chosen to make the graph as large as possible within the limits of the paper and still include the largest item of data.

Graph #1 - Growth Rate Data

Have you ever glanced at the family photo album and considered the developmental changes your body has undergone? If so you have probability wondered what biological event triggered these transformations. Chemical messengers within your body dictated these changes. In this activity you will analyze the relationship between age and human growth.

1. Using graph paper, prepare a grid for graphing the data in the table shown below.
2. Use a solid line to make a graph that compares height to age for human males.
3. Use a dotted line to make a line graph that compares height to age for human females.

Age	Height	in cm
	Male	Female
5	109	109
7	119	119
9	133	133
11	138	145
13	157	160
15	169	162
17	177	162
19	177	163



Answer the following questions referring to the graph you just completed.

1. Use the data to explain whether humans grow at a continuous rate or in spurts.

2. Explain how the growth pattern in males differs from that of females.

3. What evidence suggests that sex hormones might play a role in growth patterns.

4. How does a graph make interpreting the data easier?

Graph #2 - Peppered Moth Survey

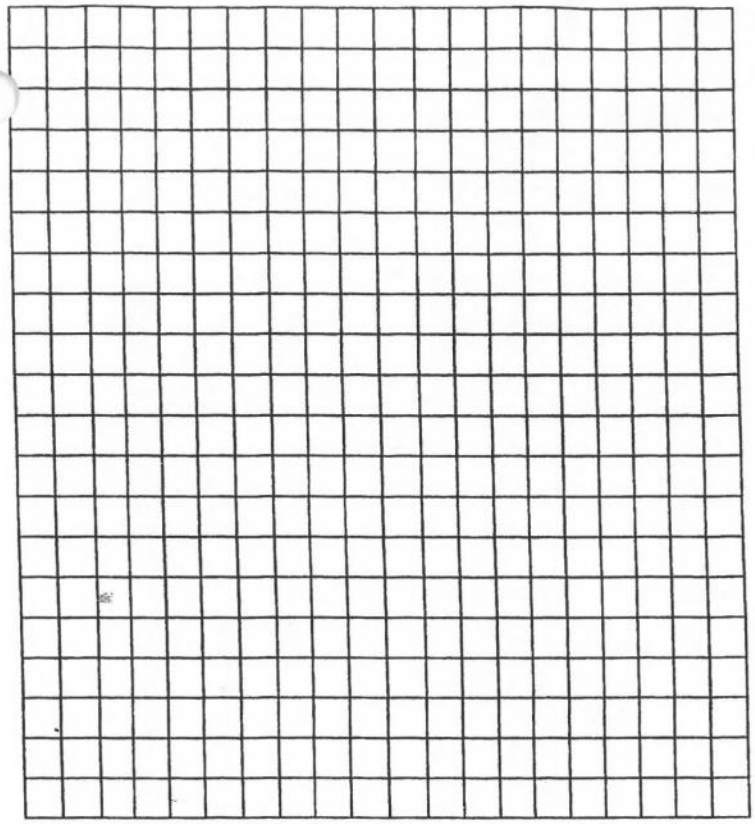
Industrial melanism is the term used to describe the adaptations of an organism in response to a type of industrial pollution. One example of rapid industrial melanism occurred in the peppered moth, *Biston betularia*, in the area of Manchester , England, from 1845 to 1890.

Before the Industrial Revolution, the trees in the forest around Manchester were light grayish green due to the presence of lichens on their trunks. Peppered moths, which live in the area, were colored with light and dark spots. Their coloring serves protective camouflage against predators, especially birds. As the Industrial Revolution progressed, the trees became covered with soot, turning the trunks dark. Over a period of 45 years, a change in the peppered moths took place.

Table A. Contains data from a 10 year study of two varieties of the same species of peppered moth.The numbers represent moths captured in each of 10 consecutive years. The traps were located in the same area each year.

Year	Light moths	Dark moths
2	537	112
3	484	198
4	392	210
5	246	280
6	225	356
7	193	412
8	146	503
9	84	594
10	56	638

Using the data provided in Table A, construct a line graph. Label the axes with the year of the study on the x-axis and the number of moths captured on the y-axis. Use different colored pencils (or a solid or dotted line) to indicate each of the two color variations of the moths. Be sure to include a key on your graph.



Answer the following questions referring to the graph on the peppered moth.

1. What preys on the peppered moth?

_____

2. If the bark of the trees is dark and the moths that rest there are light, what might happen to the moths?

_____

_____

3. Which variety of moth increased over the 10 year period?

_____

4. Using the data on the graph, draw a conclusion concerning the population of peppered moths in the sampled area of England.

_____

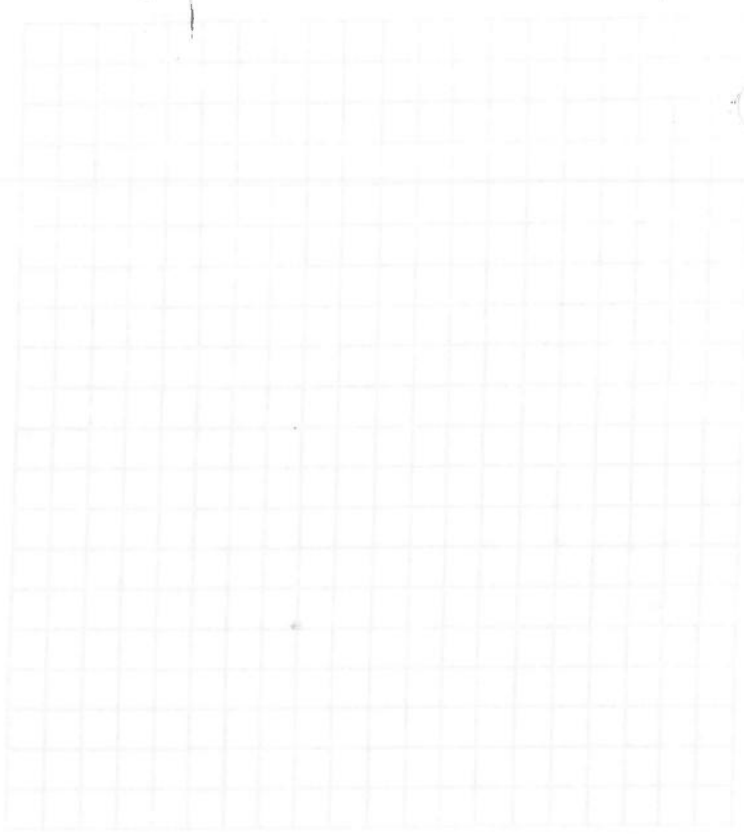
_____

_____

Critical Thinking *(Answer on separate paper and attach.)*

Explain the reason for the increase in the number of dark colored moths.

What means could be used to return the environment of the peppered moth to its original state?



Practice Questions - Graphing and Reading Interpretation

Student Name _____

The following information was obtained from a graphing tutorial at Florida International University. The data used in this exercise was posted on this website from a database from a long-term study that is open to the public. The database was created and maintained by the Coalition For Children's Health (CCH).

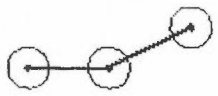
The data presented in this table is from a long term study conducted by the Coalition for Children's Health. It compares IQ as measured for 8 different first grade children by the Standardized Stanford-Binet IQ test with the amount of lead in each child's blood in micrograms per deciliter.

Lead Level and IQ Relationship of Some First Grade Children:

Child	micrograms per deciliter of lead in blood	Measured IQ
1	2	120
2	5	108
3	9	100
4	15	93
5	19	92
6	27	87
7	33	79
8	46	75

Using the information in the data table, construct a line graph on the grid provided on the next page, following the directions below.

1. Mark an appropriate scale on each axis.
2. Plot the data for lead levels and IQ from your data table. Surround each point with a small circle and connect the points.

Example: 

3. Provide an appropriate title for this graph.

Researchers have recently determined that children scored better in intelligence tests after the amount of lead in their blood was reduced. This study offers hope that the effects of lead poisoning can be reversed. Lead poisoning can cause mental retardation, learning disabilities, stunted growth, hearing loss, and behavior problems. Scientists estimate that at least 3 million children in the United States have lead concentrations above the danger level of 10 micrograms per deciliter blood. Researchers found an average increase of one point on an index scale for intelligence for every decrease of 3 micrograms per deciliter blood concentration.

Lead has been used in paint and in jewelry, because it makes the paint apply more smoothly and lends itself to shiny, inexpensive jewelry. In older automobile engines, lead was added in the form of tetraethyl lead to keep the engines running more smoothly so they would not "knock". A common source of lead poisoning therefore is peeling or chipping paint in buildings constructed before 1960. Also, soil near heavily traveled roads may have been contaminated by the exhaust from older cars burning leaded gasoline. In a recent related study, another group of researchers concluded that removing lead contaminated soil does not reduce blood lead levels enough to justify its cost. The children in the study began with blood levels 7 to 24 micrograms per deciliter. Replacing the lead contaminated soil resulted in a reduction in blood lead levels of 0.8 to 1.6 micrograms per deciliter in 152 children under the age of 4. These studies are not conclusive. Results indicate a need for further studies to determine if reducing environmental lead levels will significantly reduce lead levels in the blood.

7. Besides learning disabilities, list three problems lead poisoning can cause in children.

_____

_____

_____

8. State two things which can be done to reduce the amount of lead exposure some children must face.

_____

_____

_____

9. A tradeoff is when something occurs or is used, because it has good effects, even though it has bad effects.

Describe an example of a trade-off discussed in the reading passage.

Name:_____ **Class:**_____
Ms. Diecidue **Homework**

Base your answers to questions 46 through 50 on the information and data table below and on your knowledge of biology.

The effect of temperature on the action of pepsin, a protein-digesting enzyme present in stomach fluid, was tested. In this investigation, 20 milliliters of stomach fluid and 10 grams of protein were placed in each of five test tubes. The tubes were then kept at different temperatures. After 24 hours, the contents of each tube were tested to determine the amount of protein that had been digested. The results are shown in the table below.

Protein Digestion at Different Temperatures

Tube #	Temperature (°C)	Amount of Protein Digested (grams)
1	5	0.5
2	10	1.0
3	20	4.0
4	37	9.5
5	85	0.0

Identify:

The Experimental Group: _____

The Control Group: _____

Three Factors that should remain constant:

(1) _____

(2) _____

(3) _____

Independent Variable: _____

Dependent Variable: _____

Name: _____ Date Completed: _____
Class: _____ Lab Minutes: _____ Teacher: _____

Dichotomous Key Laboratory

*This lab was modified from an activity at biologycorner.com. Credit for this original idea from this site.

Introduction

A dichotomous key is a tool that allows the user to determine the identity of items in the natural world, such as trees, wildflowers, mammals, reptiles, rocks, and fish. Keys consist of a series of choices that lead the user to the correct name of a given item. "Dichotomous" means "divided into two parts". Therefore, dichotomous keys always give two choices in each step.

In constructing keys, keep the following in mind:

- Use constant characteristics rather than variable ones.
- Use measurements rather than terms like "large" and "small".
- Use characteristics that are generally available to the user of the key rather than seasonal characteristics or those seen only in the field.
- Make the choice a positive one - something "is" instead of "is not".
- If possible, start both choices of a pair with the same word.
- If possible, start different pairs of choices with different words.
- Precede the descriptive terms with the name of the part to which they apply.

When using a key, keep the following in mind:

- Always read both choices, even if the first seems to be the logical one at first.
- Be sure you understand the meaning of the terms involved. Do Not Guess.
- When measurements are given, use a calibrated scale. Do Not Guess.
- Since living things are always somewhat variable, do not base your conclusion on a single observation. Study several specimens to be sure your specimen is typical.
- If the choice is not clear, for whatever reason, try both divisions. If you end up with two possible answers, read descriptions of the two choices to help you decide.
- Having arrived at an answer in a key, do not accept this as absolutely reliable. Check a description of the organism to see if it agrees with the unknown specimen. If not, an error has been
- Made somewhere, either in the key or in its use. The ultimate check of identifications is a comparison of the unknown with an authentically named "Type Specimen".

Dichotomous Key

1. Has pointed ears ..... go to 3

   Has rounded ears ..... go to 2

2. Has no tail ..... Kentuckyus

   Has tail ..... Dakotus

3. Ears point upward..... go to 5

   Ears point downward..... go to 4

4. Engages in waving behavior ..... Dallus

   Has hairy tufts on ears .....Californius

5. Engages in waving behavior ..... WalaWala

Does not engage in waving behavior.....go to 6

6. Has hair on head ..... Beverlus

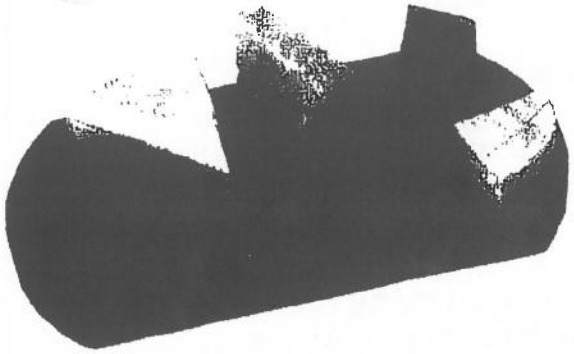
   Has no hair on head (may have ear tufts) .....go to 7

7. Has a tail ..... Yorkio

   Has no tail, aggressive ..... Rajus

- All of the in the reading.

Name: _____ Date: _____



Lab: Protein Chemistry
FUN WITH MILK & CHEESE!

Purpose:
The purpose of this experiment is to demonstrate the effect of pH and temperature on the structure of proteins. This lab will also introduce the concept of denaturing proteins.

Background:
Most people think of milk as a liquid. Yes, it is a liquid, but milk is really a mixture of fat and protein molecules in a watery solution.

As we discussed in class, proteins are large organic molecules that are built as chain (or polymer) of amino acids. The behavior and function of the protein is caused by the specific amino acids that are linked together in the chain. These amino acids react with each other and cause the protein chain to twist and fold up into large 3-D shape, forming a globular protein.

The "R" groups (or side groups) of each amino acid can either be hydrophobic (water-fearing) or hydrophilic (water-loving). When a section of the protein is made of hydrophobic amino acids, it will cause that part of the protein to try to stay away from water. When a section of the protein is made of hydrophilic amino acids, it will cause that part of the protein to try to stay in water.

The protein molecules in milk, called caseins, are very hydrophobic. They try to get away from the watery liquid of the milk, so they fold in on themselves a lot to hide from the water. This folding makes the milk protein molecules into globules in the milk. You can't see them because even though they are large molecules, they are still too small to see with the human eye.

Because pH (the acidity of a liquid) and high temperature both disrupt chemical bonds, they can affect how a molecule forms or how it behaves. This is especially true for proteins, since how they are shaped directly controls how they function. When a protein loses its 3-D shape and unravels back into a long chain, it is called "denaturing".

<over>

SAY CHEESE!!!

In this experiment we are investigating the effect of pH on protein structure.

Vinegar is a mild acid. It has a lower pH than water. An acid affects how the milk protein molecules hold together. When you add a mild acid to milk, the hydrogen atoms (H+) floating in the acid try to bond with parts of the amino acids in the milk protein globules. They break some of the internal bonds that hold the milk protein in a 3-D shape and force the protein to unravel back into a long chain.

All these long protein chains in the milk start to twist around each other trying to get away from the watery part of the milk, like lots of loose string getting all tangled up. All the proteins clump up and coagulate. You see this as milk curds, or cheese curds like in cottage cheese. We will now investigate this by making our own cheese. You see cooking is all about chemistry too!

Materials:

- ❑ 400-500 ml of whole milk
- ❑ 500 ml beaker
- ❑ 25-30 ml of vinegar (or lemon juice)
- ❑ hot plate
- ❑ stirring rod

Procedure:

1. Place milk in the beaker and warm on hot plate to approximately 37°C.
   37°C is roughly body temperature, so the milk should be just warm to the touch.

2. Add vinegar (or lemon juice) while stirring. Coagulation, or curdling, occurs quickly.

3. Drain excess liquid. This is the <u>whey</u>.
   You may let the curds sit in the filter (or cheese cloth) until well-drained, for a drier cheese.

4. Make observations.

5. Taste your cheese! You may want to add to salt for extra flavor.

Hint: If the mixture does not coagulate quickly, add more vinegar or lemon juice. Heating the mixture further may help as well.

Observations:

ıe:_____ <page 2>

Questions (answer in complete sentences):

1. What is the "building block" of a protein?

_____

_____

2. How are there so many proteins when there are only 20 "building blocks" to work with?

_____

_____

_____

How can proteins become "denatured"?

_____

_____

_____

4. What effect does pH and temperature have on proteins?

_____

_____

_____

5. How does the addition of hydrogen atoms (H+) affect the milk protein molecules?

_____

_____

_____

<over>

6. What happens in coagulation?

_____

_____

_____

7. How did your cheese taste?

_____

_____

Name:
Date:

Period:
Cell POGIL

The Incredible Cell

Why?

It was in the year 1665 when Robert Hooke first coined the term ***cell*** in his book *Micrographia*. Since then the field of cell biology has exploded and has helped to develop virtually every other branch of biology. Every single human as well as all other living things on earth are made up of cells, and each has the ability to do all of the life processes. How could something so small do all of these amazing activities essential for life to exist?

Learning Objectives

Students will:

-identify cell organelles and the function of each
-identify diagrams of the cells and their organelles
-describe how each organelle carries out the life processes required by the cell
-explain the differences between plant/animal cells

Prerequisites

1. Life Processes:

Homeostasis is the ability to maintain a stable internal environment even though the external environment changes

Metabolism is the rate at which an organism performs all of the life processes

Nutrition is the process by which organisms take materials from their environment and chemically change them so they are usable by the body

Transport is the process by which substances enter and leave the cell

Respiration is the process by which energy is released from food, with ATP being the main form of biological energy

Synthesis involves creating larger molecules from smaller building blocks

Assimilation involves taking molecules and using them as the building blocks for your body (i.e. protein is turned into muscle)

Growth is the process by which an organism increases in size

Excretion is the process by which an organism gets rid of waste

Reproduction is the process of having offspring

2. Cells are the basic unit of structure and function for all living things.

Vocabulary

- Organelle
- Cell wall
- Nucleus
- Cytoplasm
- ER
- Mitochondria
- Ribosomes
- Vacuole
- Chloroplast

Model 1 **Figure 1: Cell Organelles and Their Functions**

Cell wall	Surrounds the cell, providing support and structure
Cell membrane	1. Acts as a semi-permeable barrier allowing only certain things in or out of the cell 2. Acts as a mechanism for cellular communication 3. Separates the interior of the cell from the exterior environment
Nucleus	DNA storage and maintenance, control center of the cell
Cytoplasm	Gel-like fluid in which many organelles, enzymes, and dissolved nutrients are found
Endoplasmic Reticulum (ER)	Cellular storage and transport system
Mitochondria	Aerobic Cellular Respiration
Ribosome	Protein production
Vacuole	Storage and water balance
Chloroplast	Photosynthesis

1.) Circle the type of cell you would find all of the structures above.

Prokaryote **Eukaryote**

2.) What is the function of the nucleus?

_____

_____

_____

3.) Mitochondria perform the life process of respiration in the cell. Based on your knowledge of respiration, complete the chart for the mitochondria's function within the cell.

_____

_____

_____

4.) What form of energy does the mitochondria create?

5.) Ribosomes are responsible for the life process of synthesis. What do ribosomes synthesize?

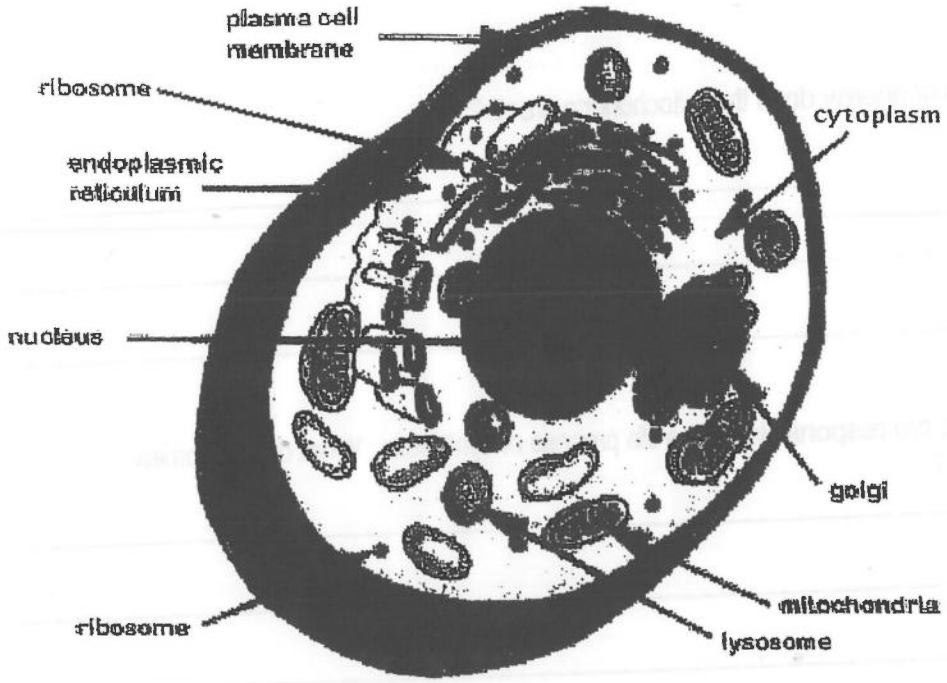
6.) What life process does the cell membrane perform?

7.) These structures found in eukaryotic cells are called **organelles**. The term organelle literally means "little organ". Why do you think these structures are called organelles?

8.) Which one of the above organelles do you think is the most important? Explain your answer.

Model 2

Figure 2: Eukaryotic Animal Cell



1.) What is the name of the structure that surrounds the cell?

2.) In addition to the cytoplasm, where else do you find ribosomes?

3.) Knowing that ribosomes can be found on its surface, what substance is transported by the endoplasmic reticulum?

4.) Lysosomes contain digestive enzymes, and very often fuse with food vacuoles. For which life process is the lysosome responsible?

_____

_____

_____

5.) Why do you think the nucleus has pores?

_____

_____

_____

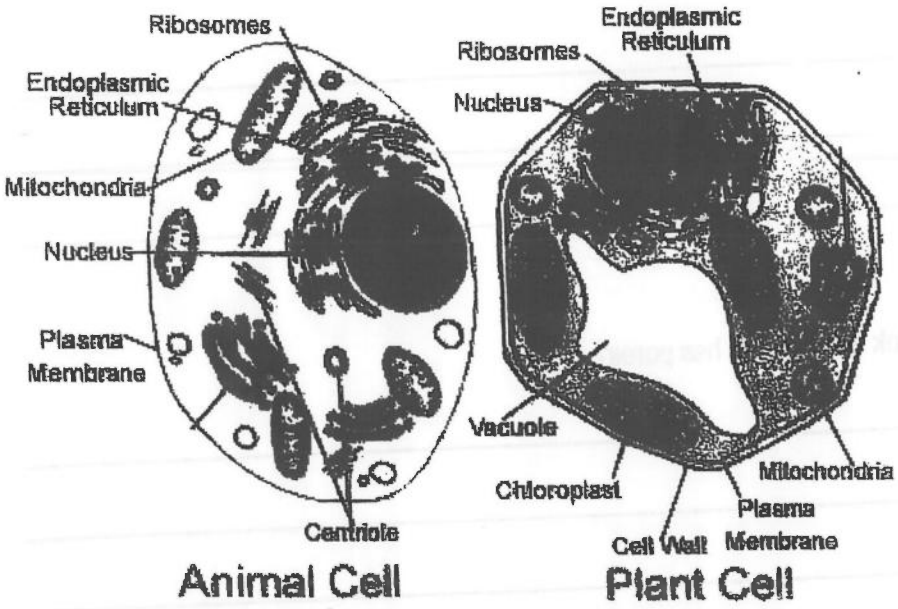
6.) On the cross section of the mitochondria, there seems to be many folds that increase its surface area. Based on what you know about mitochondria, what do you think is an advantage of the mitochondria having increased surface area?

_____

_____

_____

Model 3 Figure 3: Comparison between Animal and Plant Cells



1.) Name two organelles that are in the plant cell but **not** in the animal cell.

_____

_____

_____

2.) What is the largest organelle in the plant cell?

_____

_____

_____

3.) The chloroplasts of a plant cell perform a process in which they use light energy to put two inorganic substances (CO_2 and H_2O) together *to make* a more *complex* carbohydrate. What life process does the chloroplast perform?

_____

_____

_____

4.) The cell also uses that carbohydrate (made during photosynthesis) to make ATP, which organelle is responsible for this conversion?

_____

_____

_____

5.) When you look at a plant that has not been watered in a while, it appears is limp and not very rigid. The vacuole of plant cells is much larger than that of animal cells in order to store water.
What do you think the vacuole will look like in plant cells that have not received enough water? Explain.

_____

_____

_____

6.) Notice the difference in external structure between the plant and animal cells. The box-like structure of the plant cell results from the cell wall that surrounds it. Why do you think plants cells have a cell wall and animal cells do not?

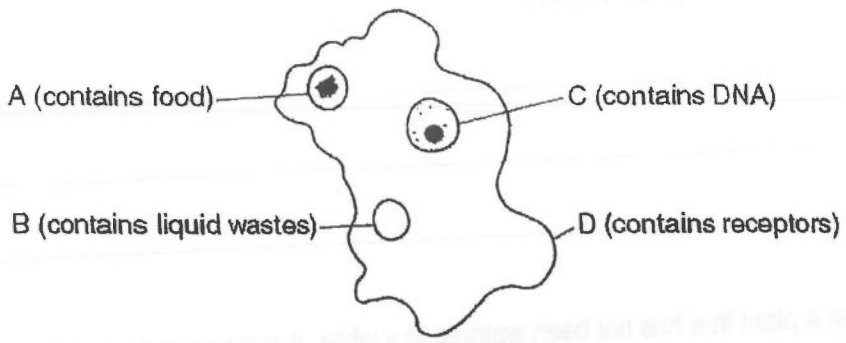
_____

_____

_____

1.) The diagram below shows some of the specialized organelles in a single-celled organism.

Figure 4



(a) Write the letter of one of the labeled organelles and state the name of that organelle.

_____

_____

(b) Explain how the function of the organelle you selected in part (a) assists in the maintenance of homeostasis.

_____

_____

2.)

Figure 5

	Set A	Set B
Organelle 1	Ribosome	Mitochondrion
Organelle 2	Nucleus	Cell membrane

(a) Select one set of organelles from the table above and record the letter of the set.

SET: _____

(b) Identify a cellular process that is accomplished by organelle 1 in the set you selected in part (a).

_____

(c) Explain how the two organelles in the set you selected in part (a) interact to carry out the cellular process you identified in part (b).

_____

_____

_____

Problems

1.) If you were to think of the cell as a city, pick 3 organelles and discuss what buildings they would be in the city? Explain your answer.

_____

_____

_____

2.) There are many diseases that can result because of dysfunctional mitochondria. No matter what the disease, however, the same tissues seem to be affected by these non functioning mitochondria. Explain why brain, skeletal muscle, heart muscle and endocrine glands are particularly susceptible to mitochondrial malfunction.

_____

_____

_____

3.) One of the functions of smooth ER is to detoxify poisons like alcohol. In the liver cells of a person that died of alcoholism, an extremely dense network of smooth ER was found. Why do you think this was so? How can this finding explain why an alcoholic needs to drink more to feel a buzz?

_____

_____

_____

Name _____ Period _____ Date _____

Cell Organelle Research Worksheet

Using the websites provided complete this web quest researching the cell organelles.

Organelle	Nucleus
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Nucleolus
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Cell Membrane
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Cytoplasm
Where found (plant/animal/both)	

What it does in the cell	
Something that performs the same function	

Organelle	Ribosome
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Mitochondria
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Vacuole
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Golgi Body
Where found (plant/animal/both)	

What it does in the cell	
Something that performs the same function	

Organelle	Rough ER
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Smooth ER
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Lysosome
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

Organelle	Cell Wall
Where found (plant/animal/both)	

What it does in the cell	
Something that performs the same function	

Organelle	Chloroplast
Where found (plant/animal/both)	
What it does in the cell	
Something that performs the same function	

"Don't mind Ashley. After looking through a microscope all day, anything large startles him."

Name_____Block_____Date_____

Cell WEBQUEST: An interactive journey into the cell!

Answer the following questions. You do not have to answer these questions in complete sentences, but your answers should be complete with details and information!

- Go to: http://askabiologist.asu.edu/research/buildingblocks/cellparts.html

1) How many different kinds of cells are in your body? _____

2) What parts of our bodies are made of dead cells?_____

_____

- Go to: http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm
- Click on "Animal Cell" Read the text and follow the directions. (Click on each organelle and read about what it does)

3) Name and define 3 of the organelles that we are learning about.

a)

b)

c)

- Click "continue" and answer the "Pop-up Questions." When you are finished, click on "Plant cell" and read the text.

4) Which organelle in the plant cell would mainly help the cell take in water or get rid of water, just like the potato did? This is also known as "osmosis." How do you know that this organelle would help with that process?

_____

5) Which organelle, if empty, would cause the plant to wilt? Why is this?

_____

6) Name an organelle that you see in the plant cell that you did not see in the animal cell.

_____

7) Why do you think an animal cell does not have the part that you name in #6?

_____

- http://www.cellsalive.com/cells/cell_model.htm and go to "Plant Cell" first.
- Click around the plant cell and look/read about some other organelles. Then, click on the "Animal Cell." Click on the different parts and read about them.

8) Why is the rough endoplasmic reticulum so "rough?"

_____

9) Think about your house, condo or apartment. What part of your home would be like the mitochondria of the cell?

Why?

- Go to the left column of the page and click on "Cell Biology" and go to "How big?..." and click on "Start the Animation"

10) How big is a blood cell? How does its size compare to Dust Mites, and then to the E. coli bacteria?

- Go to the left column of the page and click on "Mitosis." Watch this animation.

11) Which of the 8 characteristics of life is the cell doing here?

- Go back to http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm and click on "Construct a cell" First, construct an animal cell.

12) Name a part that does NOT BELONG in the animal cell (as you figured out during construction)

---

13) Construct the plant cell next. Name a part that DOES BELONG here but didn't belong in one of the other 2 cells.

- Cell Disorders and Diseases... Go to http://www.umdf.org/site/c.otJVJ7MMIqE/b.5692879/k.3851/What_is_Mitochondrial_Disease.htm

14) How is a person's life affected by mitochondrial disease?

- Go to http://www.pompe.com/patient/learning/pc_eng_pt_lsds.asp

15) What organelle does "Pompe Disease" affect in the cell, and how does this disease affect someone's life?

Games and Activities... Take the Quiz + Print w/ Score!

- http://www.tvdsb.on.ca/westmin/science/sbi3a1/Cells/cellquiz.htm and try this quiz!
- http://www.cellsalive.com/puzzles/index.htm and try the word puzzles at the bottom of the page!
- http://webinstituteforteachers.org/~halliepeskin/2003/activity3.html plant cell labeling
- http://webinstituteforteachers.org/~halliepeskin/2003/activity4.html animal cell labeling
- http://darwin.nmsu.edu/~molbio/cellgame/cellpin.html animal cell labeling
- http://darwin.nmsu.edu/~molbio/cellgame/CellGamePlant.html plant cell labeling
- http://science.nhmccd.edu/BIOL/biolab/cell.htm animal cell labeling

Name_____Block_____Date_____

Cell WEBQUEST: An interactive journey into the cell!

Answer the following questions. You do not have to answer these questions in complete sentences, but your answers should be complete with details and information!

- Go to: http://askabiologist.asu.edu/research/buildingblocks/cellparts.html

1) How many different kinds of cells are in your body? _____

2) What parts of our bodies are made of dead cells?_____

_____

- Go to: http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm
- Click on "Animal Cell" Read the text and follow the directions. (Click on each organelle and read about what it does)

3) Name and define 3 of the organelles that we are learning about.

a)

b)

c)

- Click "continue" and answer the "Pop-up Questions." When you are finished, click on "Plant cell" and read the text.

4) Which organelle in the plant cell would mainly help the cell take in water or get rid of water, just like the potato did? This is also known as "osmosis." How do you know that this organelle would help with that process?

_____

5) Which organelle, if empty, would cause the plant to wilt? Why is this?

_____

6) Name an organelle that you see in the plant cell that you did not see in the animal cell.

_____

7) Why do you think an animal cell does not have the part that you name in #6?

_____

- http://www.cellsalive.com/cells/cell_model.htm and go to "Plant Cell" first.
- Click around the plant cell and look/read about some other organelles. Then, click on the "Animal Cell." Click on the different parts and read about them.

8) Why is the rough endoplasmic reticulum so "rough?"

_____

9) Think about your house, condo or apartment. What part of your home would be like the mitochondria of the cell?

Why?

- Go to the left column of the page and click on "Cell Biology" and go to "How big?..." and click on "Start the Animation"

10) How big is a blood cell? How does its size compare to Dust Mites, and then to the E. coli bacteria?

- Go to the left column of the page and click on "Mitosis." Watch this animation.

11) Which of the 8 characteristics of life is the cell doing here?

- Go back to http://www.wiley.com/legacy/college/boyer/0470003790/animations/cell_structure/cell_structure.htm and click on "Construct a cell" First, construct an animal cell.

12) Name a part that does NOT BELONG in the animal cell (as you figured out during construction)

---

13) Construct the plant cell next. Name a part that DOES BELONG here but didn't belong in one of the other 2 cells.

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- http://darwin.nmsu.edu/~molbio/cellgame/CellGamePlant.html plant cell labeling
- http://science.nhmccd.edu/BIOL/biolab/cell.htm animal cell labeling

Cheek Cells.....Name_____

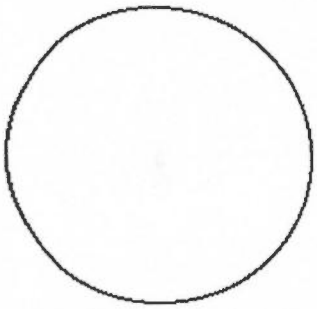
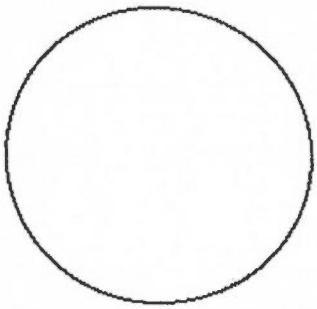
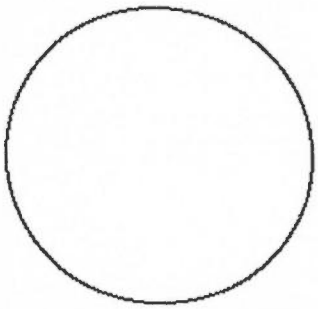
--Internet Lab--

Introduction: If you missed the microscope lab we did in class, you will need to make it up by using a "virtual microscope" which can be accessed on the internet. The virtual microscope is a little more complicated than the microscope we used in the lab, but it will not be difficult to use.

Access the Virtual Microscope at http://www.udel.edu/biology/ketcham/microscope/
Click on the link that says "the virtual scope"

1. Familiarize yourself with the microscope, run the tutorial and examine the parts you will be working with.

2. View the slide labeled cheek smear. Sketch the image at Scanning, Low and High Power. **LABEL on high power the CELL MEMBRANE, CYTOPLASM, and NUCLEUS.**

Scanning (4)	Low (10)	High (100)
		

3.The light microscope used in the lab is not powerful enough to view other organelles in the cheek cell.What parts of the cell were visible.

4. List 2 organelles that were NOT visible but should have been in the cheek cell.

5. Is the cheek cell a eukaryote or prokaryote? How do you know?

6. Keeping in mind that the mouth is the first site of chemical digestion in a human.Your saliva starts the provss of breaking down the food you eat.Keeping this in mind, what organelle do you think would bem numerous inside the cells of your mouth?

Plant Cells
--Internet Lab--

Introduction: If you missed the microscope lab we did in class, you will need to make it up by using a "virtual microscope" which can be accessed on the internet. The virtual microscope is a little more complicated than the microscope we used in the lab, but it will not be difficult to use.

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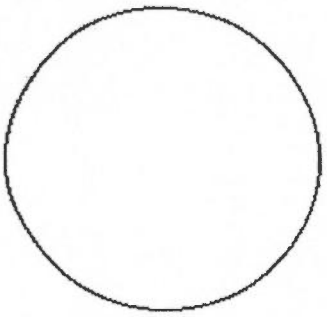
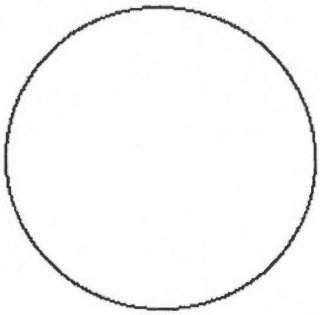
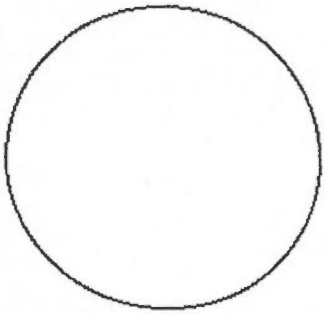
2. View the slide onion. Sketch the image at Scanning, Low and High Power. **LABEL on high power the CELL MEMBRANE, CYTOPLASM, and NUCLEUS.**

Scanning (4)	Low (10)	High (100)
		

Name _____ Class _____ Period _____

22–1 What Happens When Cells Divide?

Cells form new cells by a process called cell division or mitosis. During mitosis, one cell divides in half to form two new cells. Suppose you could watch a cell divide. You could see that the cell parts called chromosomes move around the cell during mitosis. Because chromosomes move in particular ways, you could arrange the events of mitosis into several steps.

Biologists have been able to arrange the events of mitosis into several steps. They examined many dividing cells in order to learn the steps. What are the steps of cell division? In what order do they occur?

GOALS

In this exercise, you will:

a. build models of the steps of mitosis.
b. compare your models to the steps of animal-cell mitosis.

KEYWORDS

Define the following keywords:

chromosome _____

cytoplasm _____

nucleolus _____

nucleus _____

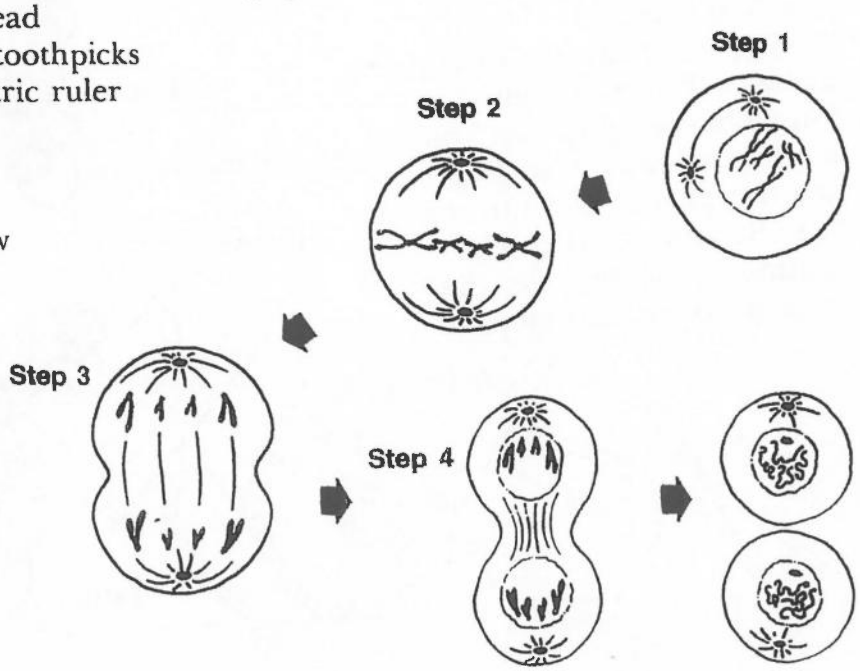
MATERIALS

4 pieces of different-colored construction paper
scissors
glue
yarn
thread
24 toothpicks
metric ruler

PROCEDURE

1. Using Figure 1 and your textbook, review the steps of mitosis.

FIGURE 1. Stages of mitosis



2. Use the materials listed in Table 1 to represent the cell parts. Cut the pieces of paper, yarn, and thread to the sizes given in Table 1.

FIGURE 2. Making cell parts

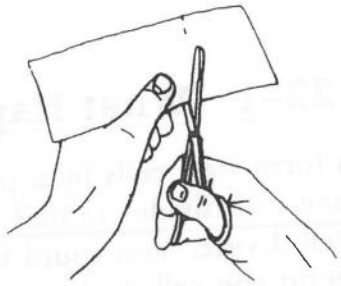
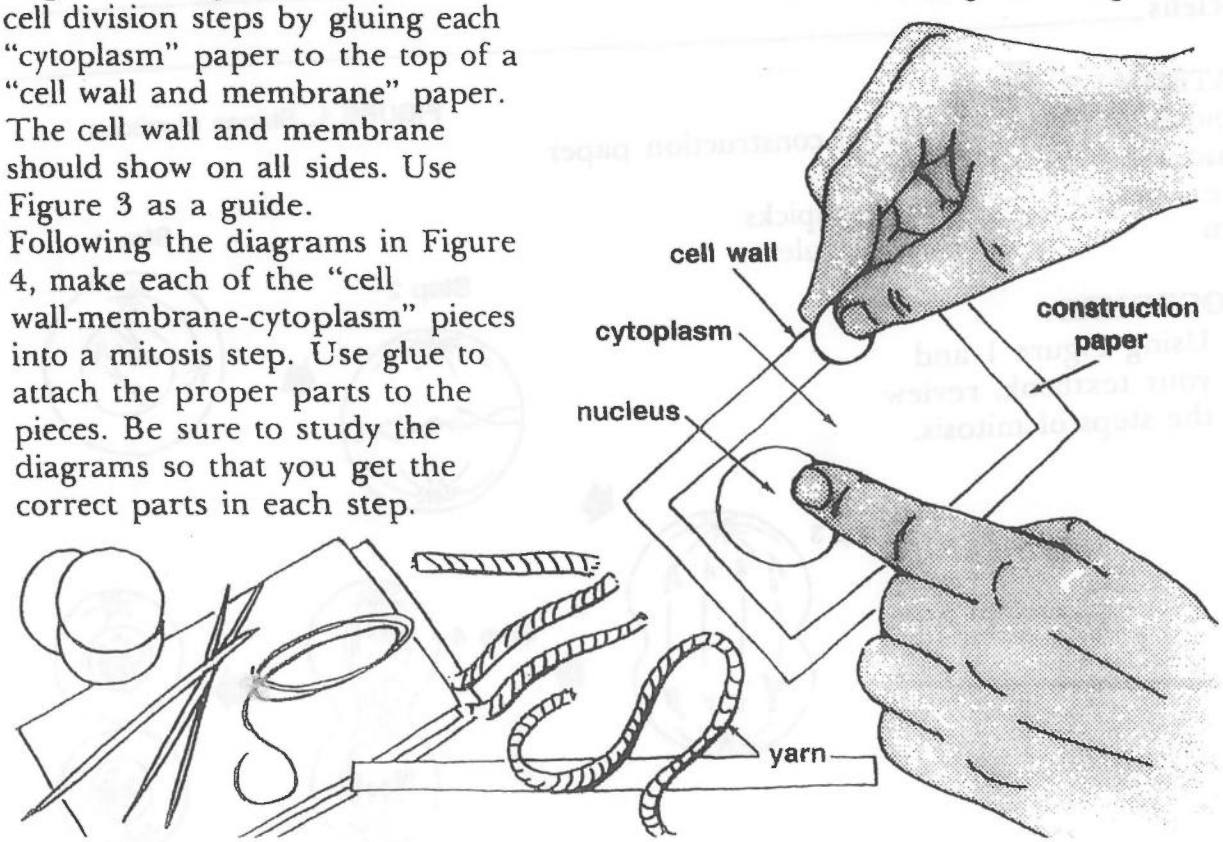


Table 1. Making Cell Parts

Cell Part	Material to Use	Size	Number Needed
Cell wall and membrane	Dark-colored paper	14 × 8 cm	5
Cytoplasm	Light-colored paper	13 × 7 cm	5
Nucleus	Dark-colored paper	5 cm circle	3
Nucleolus	Light-colored paper	1 cm circle	2
Chromosomes	Light-colored yarn	4 cm long 10 cm long	20 2
Fibers	Toothpicks	full size	24
Cell wall between new cells	Dark-colored paper	½ × 8 cm	1
Nuclei in new cells	Thread	½ m	2

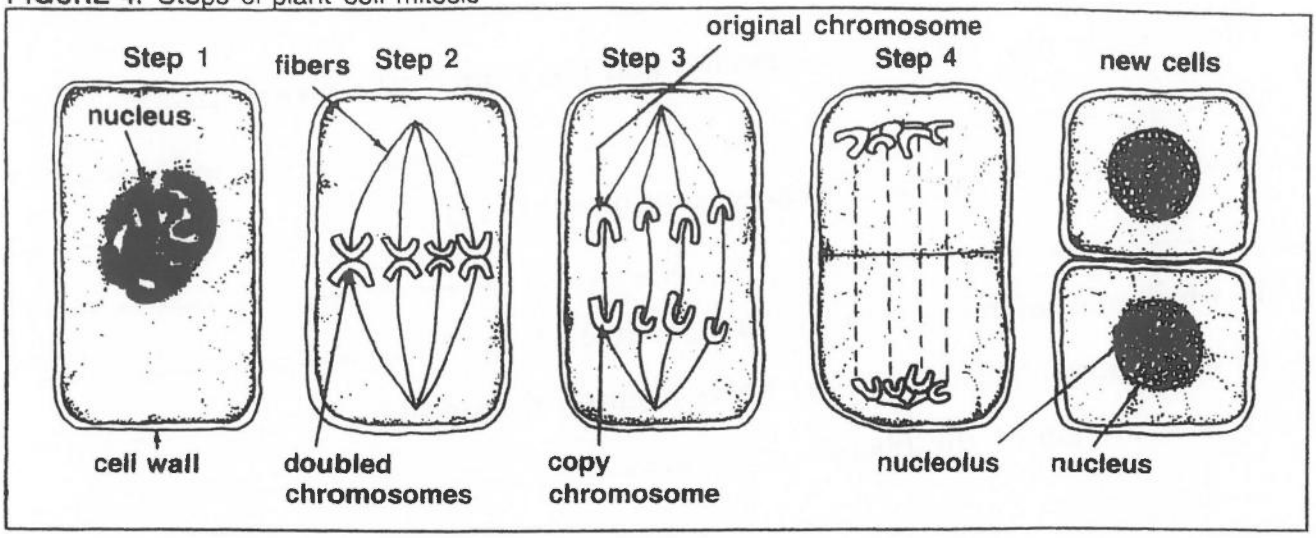
3. Begin building the models of the cell division steps by gluing each "cytoplasm" paper to the top of a "cell wall and membrane" paper. The cell wall and membrane should show on all sides. Use Figure 3 as a guide.
4. Following the diagrams in Figure 4, make each of the "cell wall-membrane-cytoplasm" pieces into a mitosis step. Use glue to attach the proper parts to the pieces. Be sure to study the diagrams so that you get the correct parts in each step.

FIGURE 3. Putting models together



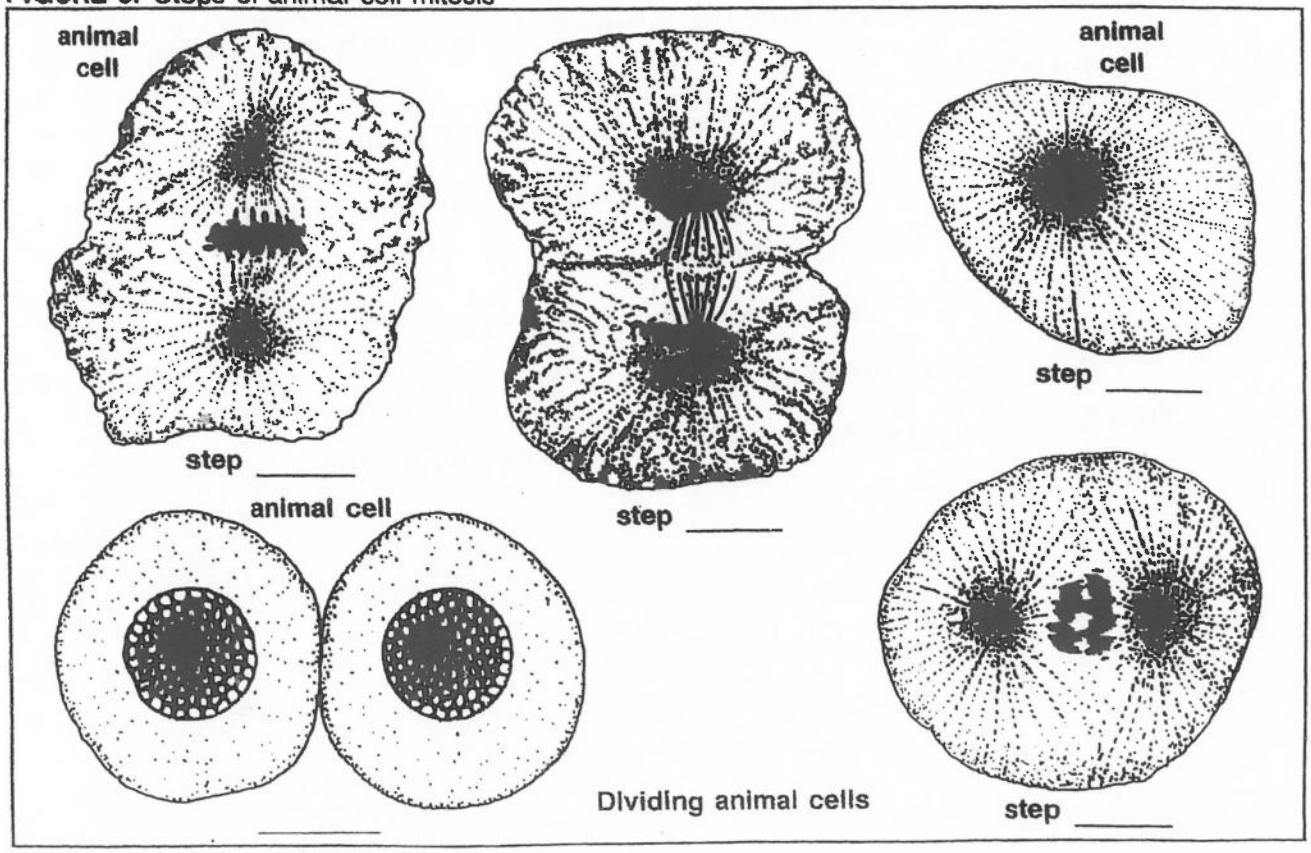
Name _____ Class _____ Period _____

FIGURE 4. Steps of plant cell mitosis



6. Arrange your models in the order in which mitosis occurs. Note how your models differ from those shown in Figure 1. Your models show dividing plant cells.
7. Compare your models with the drawings of the animal cells in Figure 5.
8. Write the name of the step of mitosis below each drawing of the animal cells.

FIGURE 5. Steps of animal cell mitosis



QUESTIONS

1. What part is present in plant cells but absent in animal cells?_____

_____

2. How are the new cells of your models and the animal cells alike?_____

_____

3. In which steps of mitosis is a nucleus visible?_____

_____

4. In which step of mitosis do you first see fibers?_____

5. In which step of mitosis do the fibers begin to disappear?_____

6. What is the job of the fibers?_____

_____

7. a. Doubled chromosomes first become visible in which step of mitosis?_____

   b. How many doubled chromosomes are visible in this step?_____

8. What is happening to the doubled chromosomes in steps 3 and 4?

_____

_____

9. How many cells does each dividing cell form?_____

10. What forms between the cells after the doubled chromosomes have pulled apart in plant cells?_____

11. Match the following by writing the correct letter in the proper blank.

_____ Step 1	a. chromosomes move apart to the ends of each cell
_____ Step 2	b. nucleus reformed
_____ Step 3	c. doubled chromosomes separate
_____ Step 4	d. chromosomes become thick, dark, and doubled
_____ Step 5	e. membrane around nucleus disappearing

Name _____Period _____ Date _____

Biochemistry Webquest: Computer Lab

Log on to: http://teacherweb.com/MS/RosaScott/Biochemistrywebquest/
Click on the appropriate step to complete each tutorial

Carbohydrate Tutorial

1. Carbohydrates provide the raw fuel for _____ _____ _____.
2. Give 3 examples of monosaccharides.
   a.
   b.
   c.
3. _____ is the 6 carbon sugar found in blood.
4. _____ is the sugar that sweetens fruit.
5. _____ is the sugar found in milk.
6. Glucose can have a straight line of carbon atoms or form a _____ structure.
7. The 5 carbon sugars called pentose are used in nucleic acid synthesis are _____ and _____.
8. Give 3 examples of disaccharides.
   a.
   b.
   c.
9. Polysaccharides include _____, _____, and _____.
10. _____ is the storage molecule made from glucose by plants.
11. _____ is made by plants for cell wall construction.
12. Glycogen is the carbohydrate storage molecule found in _____ and _____.

Lipid Tutorial

1. Lipids are organic molecules that are _____ in water.
2. Give 3 examples of lipids.
   a.
   b.
   c.
3. Neutral fats are also called _____ because they have 3 fatty acids.
4. Neutral fats 3 functions:
   a.
   b.
   c.
5. The building blocks of neutral fat molecules are _____ _____ _____.
6. _____ fatty acids originate form animal sources and are _____ at room temperature.
7. _____ fats originate from plants and are _____ at room temperature.

8. _____ are the chief components of all cell membranes.
9. _____ helps to stabilize cell membranes and is used by the body to break down steroids.

Protein Tutorial

1. Proteins make up _____ % to _____ % of cell mass.
2. Examples of proteins in an organism.
   a.
   b.
   c.
   d.
3. Proteins are built from _____ common building blocks called _____ _____.
4. The primary structure of protein is determined by the sequence of _____ _____ connected by _____ bonds.

DNA Tutorial

Intro

1. DNA comes with a complete set of _____ to make an entire organism.
2. Using only _____ letters the DNA molecule builds everything from a bug to a human.

Role of DNA

3. While you are growing you need DNA to produce more _____.
4. As an adult you also need DNA to :
   a.
   b.
   c.

The Cell

5. DNA directs the entire operation by issuing instructions to make things you need such as _____.
6. DNA allows organisms to make _____ of themselves which is a requisite of life.

Chromosomes

7. Inside the nucleus you find DNA packaged into _____.

8. You get 1 set of chromosomes from your _____ and 1 set of chromosomes from your _____.
9. Each cell has _____ chromosomes arranged into _____ pairs.

Watson and Crick

10. What are the 4 nitrogen bases found in DNA?
    a.
    b.
    c.
    d.

11. What is the shape of DNA? _____

Draw the structure of the following molecules:

Carbohydrate

Lipid

Protein

Nucleic Acid (DNA)

Name _____ Class _____ Period Part B

10–1 How Do Digestive System Lengths Compare?

You know that the diet of different animals may vary. You can buy cat food, dog food, and bird food in most supermarkets.

The length of the digestive system may also vary. Animals that eat plants usually have longer digestive systems than animals that eat meat.

GOALS

In this exercise, you will:

a. measure the length of the digestive system in three animals.
b. compare these lengths with the type of food eaten.

KEYWORDS

Define the following keywords:

caecum _____

carnivore _____

digestive system _____

_____

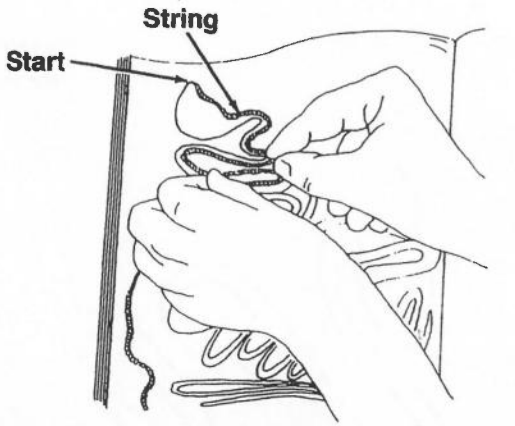
herbivore _____

MATERIALS

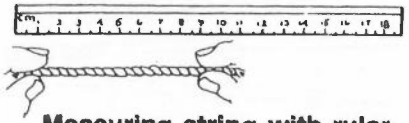
string metric ruler scissors tape

PROCEDURE

1. Place a piece of string down on the outline drawing of the rabbit digestive system in Figure 2 on the next page. Figure 1 shows you how.
2. Tape the end of the string in place at the label marked "start" on the stomach of the rabbit.
3. Position the string only over the entire length of the *unshaded* organs. It must match, exactly, the many twists and turns of the stomach, the small intestine and the large intestine (the unshaded organs).
4. When you reach the anus, cut the string, remove it from the drawing, and stretch it out its full length. **CAUTION:** *Use care with scissors.*
5. Measure the length of the string in centimeters and record this number in Table 1.



Measuring intestine with string



Measuring string with ruler

FIGURE 1. Measuring the digestive system

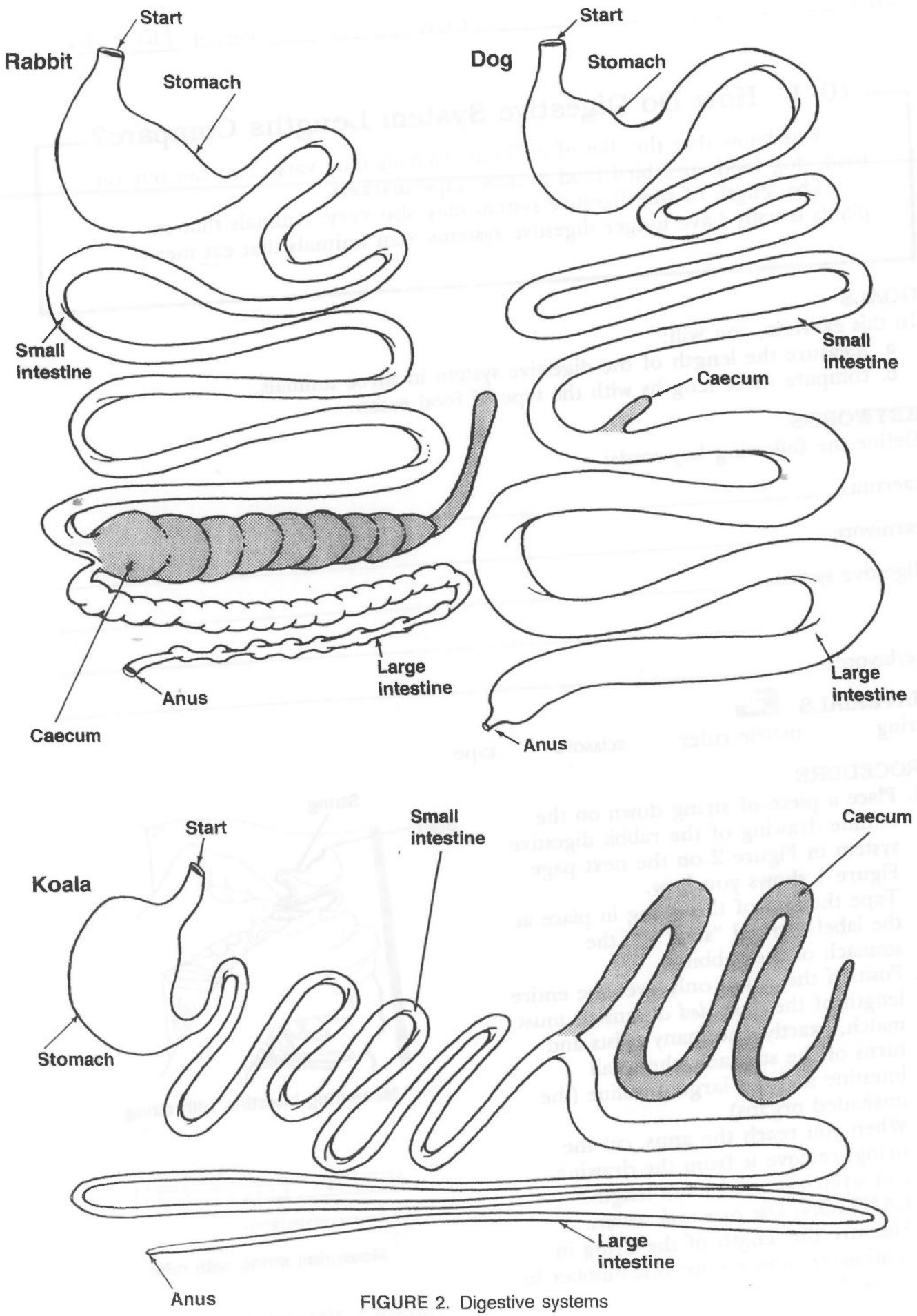


FIGURE 2. Digestive systems

Name _____ Class _____ Period _____

6. Position the string over the shaded portion of the rabbit digestive system and measure the length of the caecum. Record this measurement in centimeters in Table 1.
7. Add together the two numbers that you have now recorded in the table in order to get the total length of the digestive system. Record this number in Table 1.
8. The diagram of the rabbit digestive system is drawn ⅓ smaller than actual size. Multiply the total digestive system length by 3 to complete the first row of Table 1. This number is the actual length of the rabbit digestive system.
9. Repeat steps 1 through 8 for the digestive system of the koala and the dog.

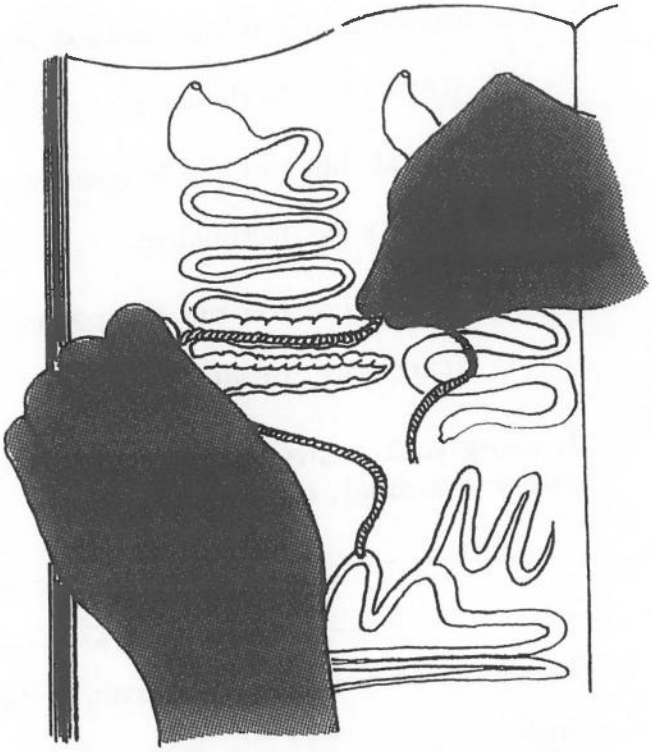


FIGURE 3. Measuring caeca of animals

Table 1. Digestive System Measurements

Animal	Length of stomach, small intestine, large intestine		Caecum length		Total digestive system length		Multiply by 3		Actual length of digestive system
Rabbit		+		=		×		=	
Koala		+		=		×		=	
Dog		+		=		×		=	

QUESTIONS

1. Which animal has the longest actual digestive system? _____
2. Which animal has the shortest actual digestive system? _____
3. Based on what you already know, tell whether the animals used in this experiment are carnivores or herbivores. NOTE: The koala is an Australian animal that feeds only on the leaves and buds of the eucalyptus tree.

   rabbit _____ koala _____ dog _____

4. Circle the correct answer to the following questions:
   a. The animal that has the longest actual digestive system is a

      (carnivore, herbivore).

   b. The animal that has the shortest actual digestive system is a

      (carnivore, herbivore).

   c. The animal that has the longest caecum is a

      (carnivore, herbivore).

   d. The animal that has the shortest caecum is a

      (carnivore, herbivore).

5. By using your answers to question 4, describe how the length of the digestive system in animals seems to be related to the type of food the animals eat.

   _____

   _____

6. Are plants or meat more difficult to digest?_____

   Explain._____

   _____

   _____

   _____

7. Use the word *long* or *short* to describe what you think the length of the digestive system might be in the

   lion _____ cat _____ horse_____ deer _____

   panther _____ donkey _____ cow _____ wolf _____

8. Two different animals of almost the same size have digestive systems that are of the following lengths:

   Animal A—410 cm Animal B—145 cm

   a. Which one of these animals is most likely to be a carnivore?_____

   b. Explain your answer._____

   _____

   c. Which one of these animals is most likely to be a herbivore?_____

   d. Explain your answer._____

   _____

Name _____ Class _____ Period Part A

9–2 What Nutrients are Present in Cereal?

You can find out which nutrients are present in foods by looking at the food package label. The nutrition information on the label usually provides the amount of nutrients that are contained in one serving. Vitamins and minerals are listed as a percent of the Recommended Daily Allowance (RDA), the amount of a nutrient that a person needs for one day.

By learning how to read and compare the labels of several different cereals, you will discover that it is very easy to compare nutrients in many kinds of foods.

GOALS

In this exercise, you will:

a. learn how to read a food label.
b. compare the nutrients of three different cereals.

KEYWORDS

Define the following keywords:

Calorie _____

mineral _____

nutrient _____

RDA _____

_____

vitamin _____

MATERIALS

pencil

PROCEDURE

1. Examine Figure 1. It contains nutrition information from the label of a box of cereal and explains what certain parts of the information mean.
2. Examine Table 1. This table shows the nutrition information from three different cereal labels, marked A, B, and C.
3. Complete Table 2 by filling in the information that is required for each cereal (refer to Table 1).
4. Complete Table 3 by filling in the information that is required for each cereal.
5. Complete Table 4 by filling in the information that is required for each cereal.

FIGURE 1. Nutrition information

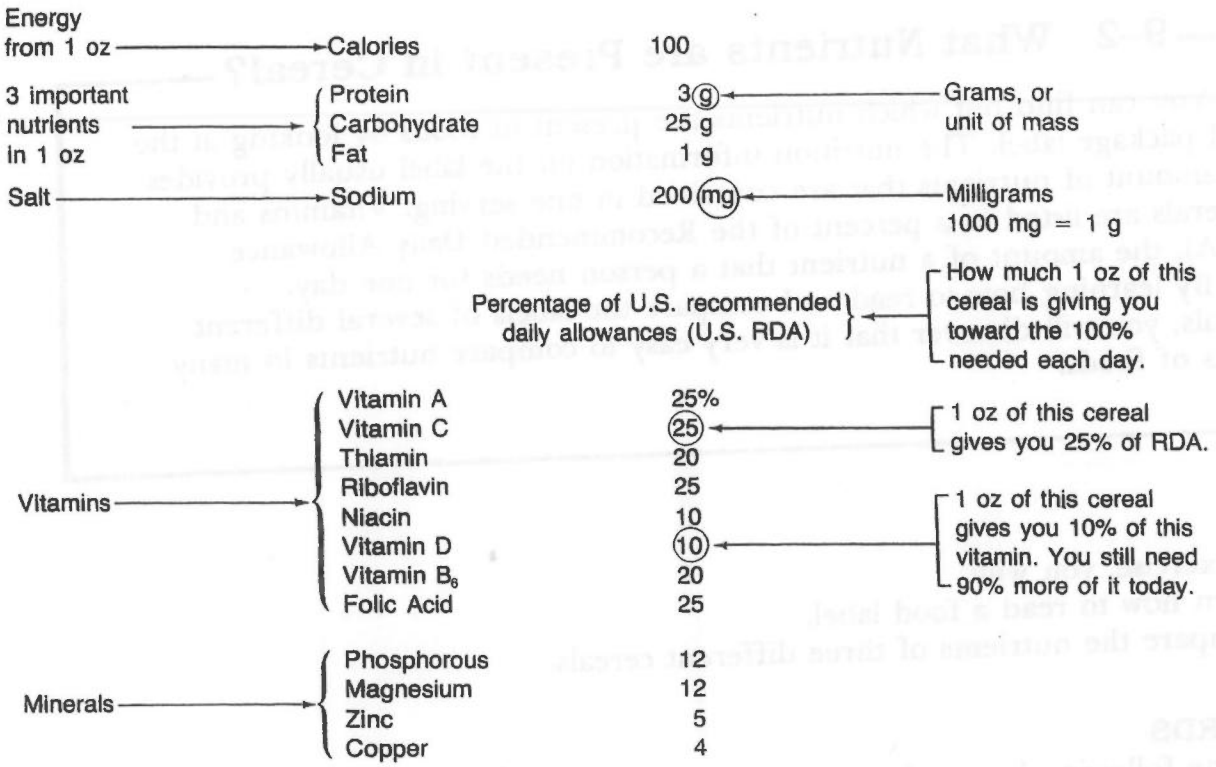


Table 1. Nutrients in Three Cereals (1-ounce servings)

Nutrient	Cereal A	Cereal B	Cereal C
Calories	110	60	85
Protein	2 g	2 g	2 g
Carbohydrate	28 g	15 g	22 g
Fat	3 g	0 g	2 g
Sodium	275 mg	300 mg	150 mg
	% of U.S. RDA		
Vitamin A	20	25	20
Vitamin C	25	25	0
Thiamin	0	35	30
Riboflavin	0	33	25
Niacin	0	20	10
Vitamin D	10	0	10
Vitamin B_6	5	5	5
Vitamin B_{12}	0	15	15
Folic Acid	10	10	5
Phosphorus	6	4	10
Magnesium	2	0	10
Zinc	20	25	20
Copper	5	0	5

Name _____ Class _____ Period _____

Table 2. Amount in a 1-ounce serving by grams

Cereal	Calories	Protein	Carbohydrate	Fat	Sodium
A					
B					
C					

Table 3. Percent of RDA in a 1-ounce serving

Cereal	Vitamins								
	A	C	Thiamin	Riboflavin	Niacin	D	B_6	B_{12}	Folic Acid
A									
B									
C									

Table 4. Percent of RDA in a 1-ounce serving.

Cereal	Minerals			
	Phosphorus	Magnesium	Zinc	Copper
A				
B				
C				

QUESTIONS

1. If you are trying to cut down on the amount of salt you take in,

   a. which cereal would you choose to eat?_____

   b. which cereal would you avoid?_____

2. If you are trying to cut down on Calories,

   a. which cereal would you choose to eat?_____

   b. which cereal would you avoid?_____

3. With Table 2 as a guide, which two nutrients seem to supply the most Calories?

   _____

   _____

4. What is the difference between grams and milligrams?_____

_____

5. What is the role of fat, protein and carbohydrate in the diet?_____

_____

_____

6. Which cereal appears to be supplying you with the best RDA of

   a. vitamins?_____

   b. minerals?_____

7. How many servings of Cereal B must you eat to receive 100% of your RDA for

   a. riboflavin? _____ c. niacin? _____

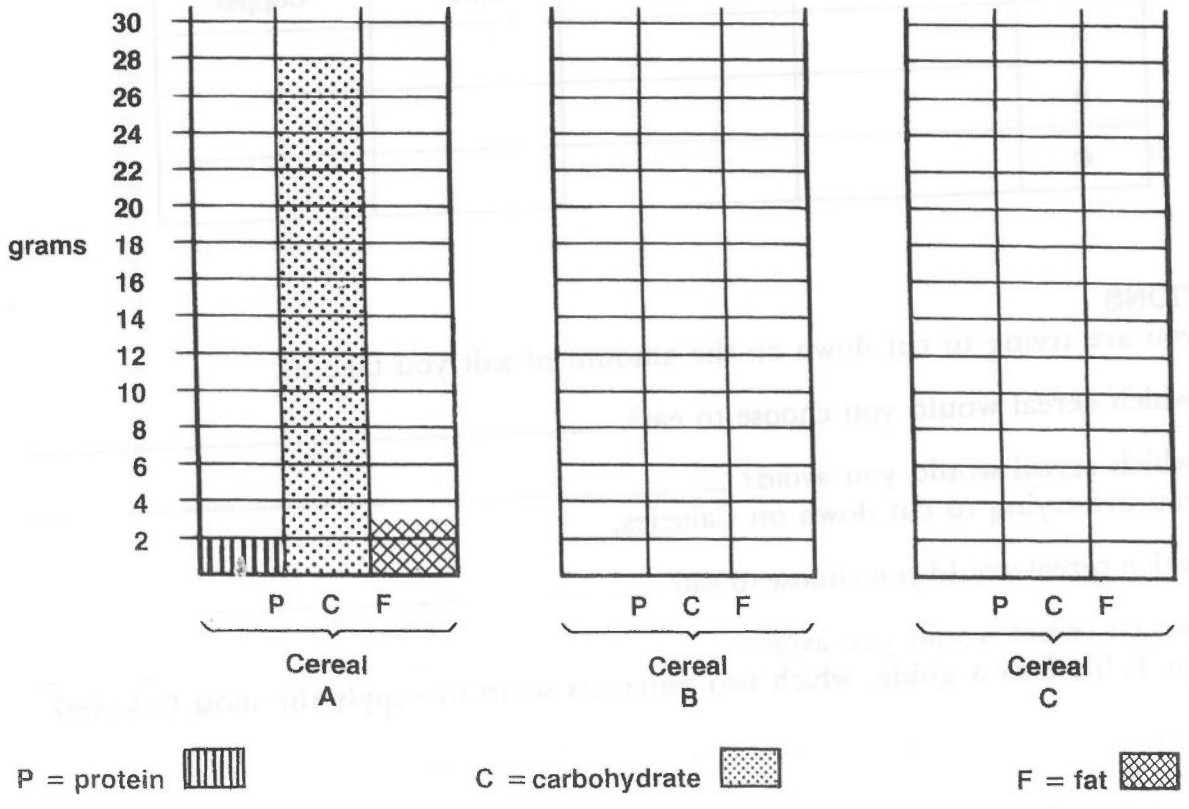
   b. vitamin A? _____ d. folic acid? _____

8. With Tables 3 and 4 as guides, which cereal supplies the best balance of vitamins and minerals?_____ Explain._____

_____

9. In Figure 2, prepare and compare bar graphs of the protein, carbohydrate and fat found in cereals A, B and C. Refer to Table 2 for the proper information. The bar graph for cereal A has already been prepared for you.

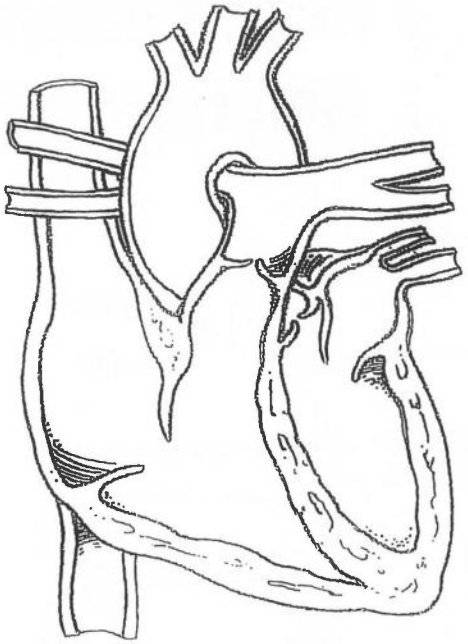
FIGURE 2. Comparing nutrients in cereals



_____ Date _____ Period ____

Colors of the Heart

ctions: Use the diagram on page 87 in your textbook to help you complete the
ou ctivity. You will need red and blue colored pencils or crayons for this worksheet.



HELPFUL HINT

The left ventricle and atrium of this heart are on the right side of the page.

The atria (singular is atrium) are the upper chambers of the heart. The ventricles are the
wer chambers of the heart. Label the left and right atria as well as the left and right
ntricles on the diagram.

Oxygen-rich blood flows through veins from the lungs (called pulmonary veins) into the
t atrium. Color the left atrium and the pulmonary veins that carry blood from the lungs
d. Label the pulmonary veins.

Blood flows from the left atrium into the left ventricle. Color the left ventricle red.

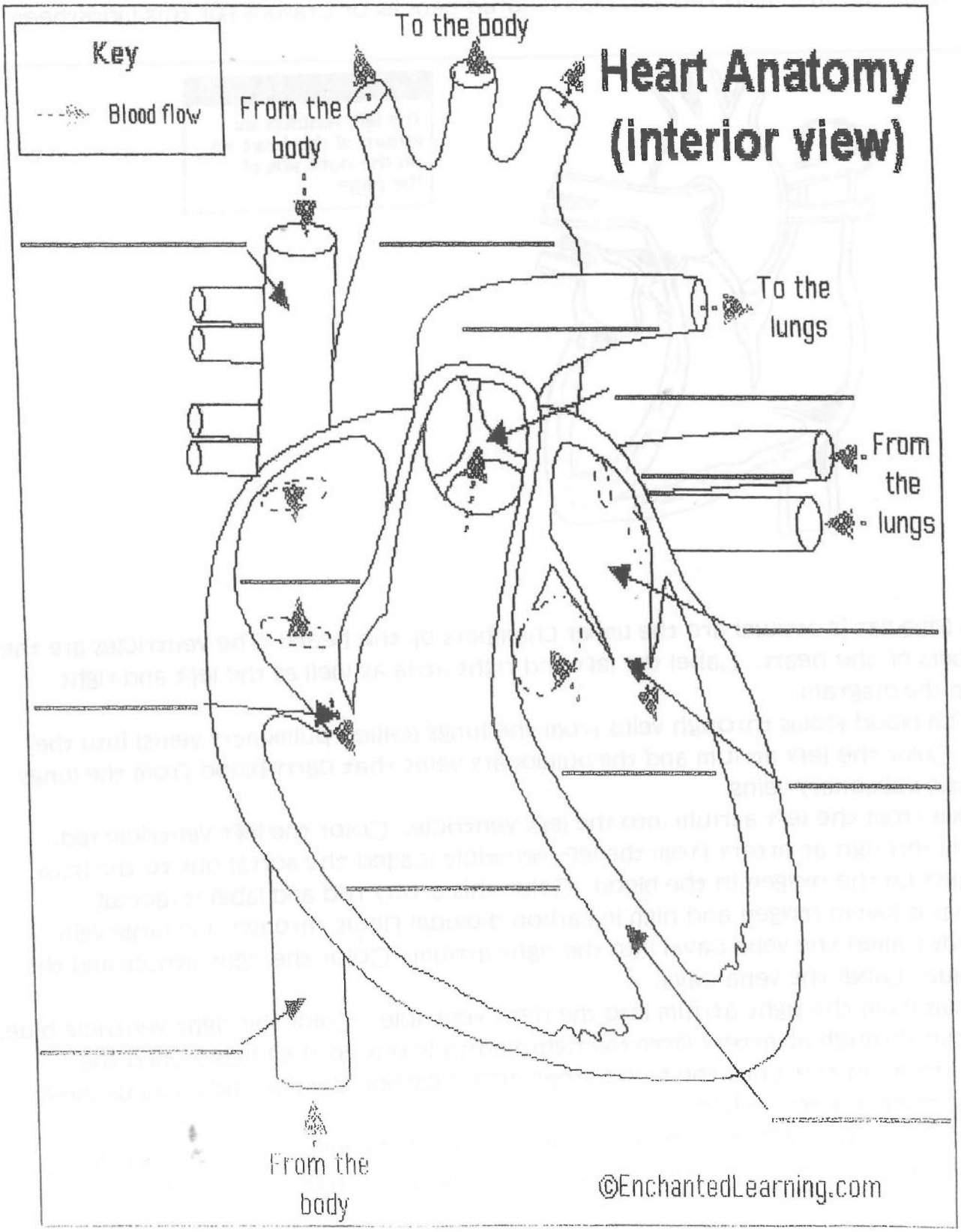
Blood flow through an artery from the left ventricle (called the aorta) out to the body.
he body takes up the oxygen in the blood. Color this artery red and label it (aorta).

Blood (that is low in oxygen and high in carbon dioxide) flows through two large veins
om the body (called the vena cava) into the right atrium. Color the right atrium and the
ena cava blue. Label the vena cava.

Blood flows from the right atrium into the right ventricle. Color the right ventricle blue.

Blood flows through an artery from the right ventricle out to the lungs (called the
ulmonary artery). In the lungs the blood drops off its carbon dioxide and picks up oxygen
olor the pulmonary artery blue

Add arrows to your diagram to show the flow of blood through the heart. Label
ether each blood vessel (arteries or veins) is carrying blood to or from the lungs or the
o


Key
Blood flow
To the body
From the body
Heart Anatomy (interior view)
To the lungs
From the lungs
From the body
©EnchantedLearning.com

aorta - the biggest and longest artery (a blood vessel carrying blood away from the heart) in the body. It carries oxygen-rich blood from the left ventricle of the heart to the body.

inferior vena cava - a large vein (a blood vessel carrying blood to the heart) that carries oxygen-poor blood to the right atrium from the lower half of the body.

left atrium - the left upper chamber of the heart. It receives oxygen-rich blood from the lungs via the pulmonary vein.

left ventricle - the left lower chamber of the heart. It pumps the blood through the aortic valve into the aorta.

mitral valve - the valve between the left atrium and the left ventricle. It prevents the back-flow of blood from the ventricle to the atrium.

pulmonary artery - the blood vessel that carries oxygen-poor blood from the right ventricle of the heart to the lungs.

pulmonary valve - the flaps between the right ventricle and the pulmonary artery. When the ventricle contracts, the valve opens, causing blood to rush into the pulmonary artery. When the ventricle relaxes, the valves close, preventing the back-flow of blood from the pulmonary artery to the right atrium.

pulmonary vein - the blood vessel that carries oxygen-rich blood from the lungs to the left atrium of the heart.

right atrium - the right upper chamber of the heart. It receives oxygen-poor blood from the body through the inferior vena cava and the superior vena cava.

right ventricle - the right lower chamber of the heart. It pumps the blood into the pulmonary artery.

septum - the muscular wall that separates the left and right sides of the heart.

superior vena cava - a large vein that carries oxygen-poor blood to the right atrium from the upper parts of the body.

tricuspid valve - the flaps between the right atrium and the right ventricle. It is composed of three leaf-like parts and prevents the back-flow of blood from the ventricle to the atrium.

BLOOD FLOW THROUGH THE HEART

1. Blood enters the heart through the Superior and Inferior vena cava. These are the major veins.
    a) Superior vena cava-gets its blood from the parts of the body higher than the heart, head, and arms.
    b) Inferior vena cava-gets its blood from areas of the body below the heart, torso and legs.

2. From the Superior and Inferior vena cava's, the blood then enters the right atrium. (this blood is rich in carbon dioxide and low in oxygen)

3. The blood then passes through the tricuspid valve. (Valves stop the back flow of blood)

4. Once the blood has passed through the valve, it then enters the right ventricle.

5. The right ventricle then ejects the blood into the pulmonary artery and it is now on its way to the lungs.

6. Once the blood has been to the lungs it is now full of oxygen and needs to be sent to all parts of the body.

7. The blood re-enters the heart through the left pulmonary veins and then enters the left atrium.

8. From the left atrium the blood passes through the bicuspid valve which is also called the mitral valve, into the left ventricle. Both the tricuspid and bicuspid valves open and close at the same time creating the "lub dub" sound of the heart.

9. The left ventricle is the largest chamber and the strongest pump it discharges blood into the body through the aorta.

CONCLUSION QUESTIONS FOR THE HEART LAB

1. On which side does the oxygen poor blood enter?_____
2. Through which blood vessel does the oxygen poor blood enter through?_____
3. Where does the oxygen poor blood pick up the oxygen that is distributed to the rest of the body?_____
4. Once the blood has picked up oxygen, what path does it take back into the heart?_____
   _____
   _____
5. What blood vessel pushes the oxygen rich blood out into the body?_____
6. Describe an artery and what its function is._____
   _____
   _____
7. Describe a vein and what its function is._____
   _____
   _____
8. Describe what capillaries are and their function_____
   _____
   _____
9. What is the name of the muscle that divides the heart?_____
10. What in the heart prevents the backflow of blood?_____

SUMMARY: Why is it important for the circulatory system to stay healthy?

_____
_____
_____

Name _____ Class _____ Period _____

12–2 What Blood Types Can Be Mixed?

Sometimes patients may lose a lot of blood. In these cases blood from another person can be given to the patient. This giving of someone else's blood to a person is called a transfusion.

There are four main blood types: A, B, AB, and O. Only certain blood types can be mixed when a transfusion is made. Mixing blood types incorrectly during a transfusion can lead to serious illness or the death of a patient.

GOALS

In this exercise, you will:

a. set up plastic cups filled with water and food coloring to represent the four blood types.
b. mix "blood" to see if color changes take place.
c. judge which blood types can be mixed safely.

KEYWORDS

Define the following keywords:

blood type _____

donor _____

recipient _____

MATERIALS

colored pencils: red, green, and black
food coloring: red and green
graduated cylinder
20 small clear plastic cups
6 droppers

PROCEDURE

Part A. Set Up

1. Turn over the page and examine the grid in Figure 2. Note the columns marked *Recipient* and the rows marked *Donor*.
2. Place one of the small plastic cups onto each of the 20 squares as shown here in Figure 1.
3. Fill each cup with 10 mL of water.
4. Using a dropper, add 4 drops of red food coloring to each of the four cups in the column marked *Recipient A* (red), and to the cup marked *Donor A*.

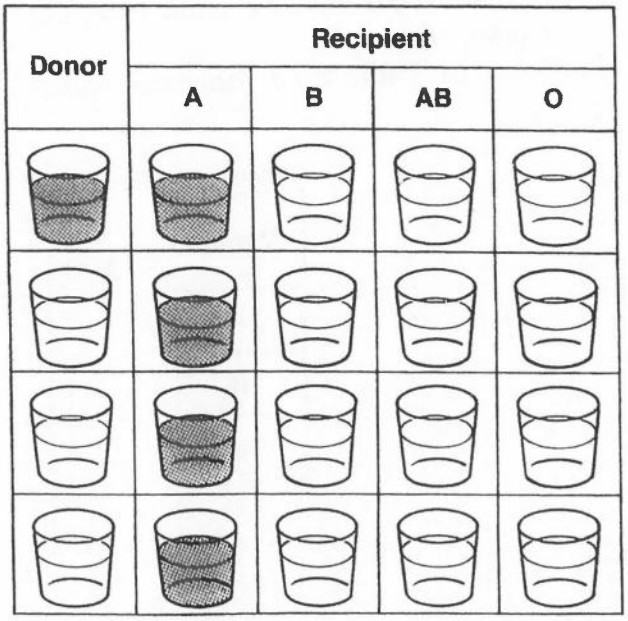


FIGURE 1.

5. Using a different dropper, add 2 drops of green food coloring to the four cups in the column marked *Recipient B* (green), and to the cup marked *Donor B*.
6. Add 3 drops of red food coloring and 3 drops of green food coloring to each of the four cups in the column marked *Recipient AB* (red and green), and to the cup marked *Donor AB*.
7. Note that the four cups in the column marked *Recipient O*, and the one cup marked *Donor O* have no food coloring added to them.
8. Using colored pencils, color in Table 1 to show the colors of all 16 cups marked *Recipient*.

Table 1. Before Blood Is Mixed

Donor	Recipient			
	A	B	AB	O
A				
B				
AB				
O				

Part B. Mixing Blood Types

1. Using a clean dropper, remove "blood" from the cup marked *Donor A*. Moving across the grid, add 2 droppers full of Type A "blood" to each of the four cups in the same row. This step shows what happens when a donor gives his or her blood to a recipient.
2. Repeat step 1 for the next row, but this time use "blood" from the cup marked *Donor B*.
3. Repeat step 1 for the next row, but this time use "blood" from the cup marked *Donor AB*.
4. Repeat step 1 for the final row, but this time use "blood" from the cup marked *Donor O*.
5. Color in Table 2 to show the colors of all 16 recipient cups.

Table 2. After Blood Is Mixed

Donor	Recipient			
	A	B	AB	O
A				
B				
AB				
O				

Name _____ Class _____ Period _____

FIGURE 2. Grid for mixing food colors

Donor	Recipient			
	A	B	AB	O
A (red)	(red)	(green)	(red + green)	(clear)
B (green)	(red)	(green)	(red + green)	(clear)
AB (red + green)	(red)	(green)	(red + green)	(clear)
O (clear)	(red)	(green)	(red + green)	(clear)

Part C. Judging If Blood Is Safe to Mix

1. Compare Tables 1 and 2. Blood is *safe* to mix between donor and recipient if there is *no change in color* in the same cup from Table 1 to Table 2. Blood is *not safe* to mix between donor and recipient if there is *a change in color* in the same cup from Table 1 to Table 2.
2. Complete Table 3. Write the word *safe* or *unsafe* in each of the 16 squares.

Table 3. Is Blood Safe To Mix?

Donor	Recipient			
	A	B	AB	O
A				
B				
AB				
O				

QUESTIONS

1. List the blood types of people to which a Type A donor can safely donate blood._____
2. List the blood types of people to which a Type B donor can safely donate blood._____
3. List the blood types of people to which a Type AB donor can safely donate blood._____
4. List the blood types of people to which a Type O donor can safely donate blood._____
5. A person with Type O blood is often called a "universal donor." Why might this be a good term to use to describe such a person?_____

   _____
6. A person with Type AB blood is often called a "universal recipient." Why might this be a good term to use to describe such a person?_____

   _____

Name _____ Class _____ Period _____

12–1 How Can Blood Diseases Be Identified?

Blood is a tissue. It has many different cells with many different jobs. If you look at blood under the microscope, you will find three different cell types—red cells, white cells, and platelets. In a normal person the numbers of types of blood cells are fairly constant. Sometimes, however, the number of cells will change due to a certain disease. Noticing this change in number can help a physician in the diagnosis of a person's disease.

GOALS

In this exercise, you will:

a. learn how to recognize three blood cell types.
b. examine diagrams of blood samples from six hospital patients.
c. match the blood samples with certain diseases.

KEYWORDS

Define the following keywords:

diagnosis _____

platelet _____

red blood cell _____

white blood cell _____

PROCEDURE

Part A. Normal Blood Cells

1. Examine Figure 1, which shows human blood cells magnified 1000 times.
2. Count each cell type present.
   HINT: To help avoid counting cells twice place a checkmark on each cell as you count.
   a. red blood cells—round, very numerous, no nucleus.
   b. white blood cells—round, few in number, larger than red blood cells, nucleus present.
   c. platelets—dotlike, many but less than red cells, very small.

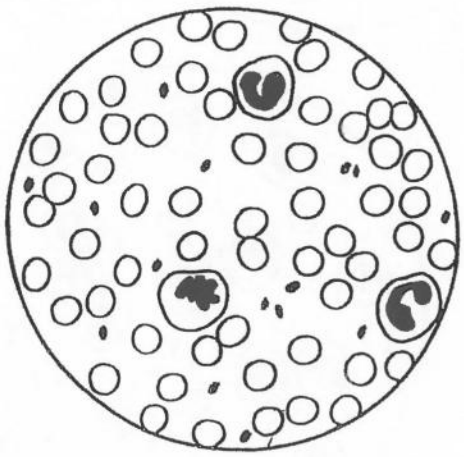


FIGURE 1. Normal blood sample

3. Record the number of each cell type for Figure 1 in Table 1. These numbers are for normal blood.
4. Using the numbers 1, 2, or 3, rank the cells in order from the most common (1) to the least common (3). Enter these rankings in the next column in Table 1 marked *Rank*.

Part B. Examining Abnormal Blood Cells

1. Examine Figures 2 to 6. These represent human blood samples from people with certain diseases.
2. Count each cell type and record the number for each sample in Table 1 under the right column.
3. Complete the rank columns using the numbers 1 to 3 as with the normal blood sample.

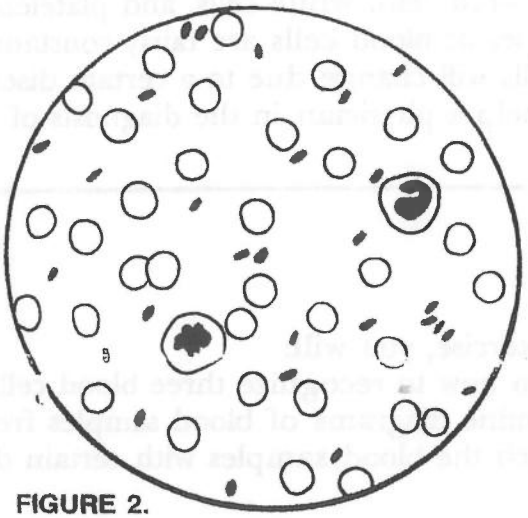


FIGURE 2.

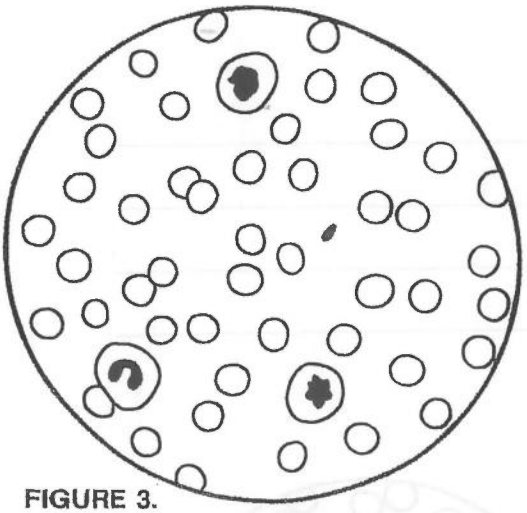


FIGURE 3.

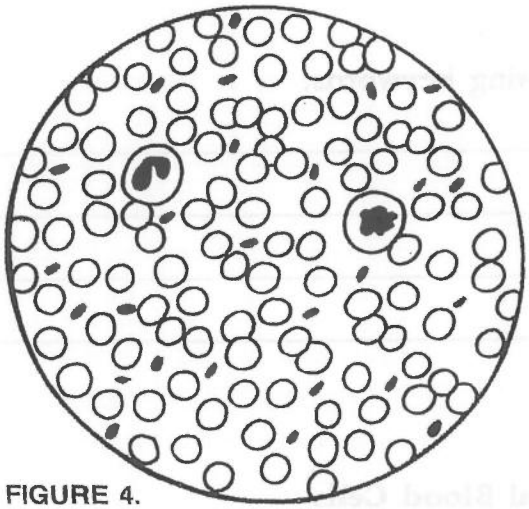


FIGURE 4.

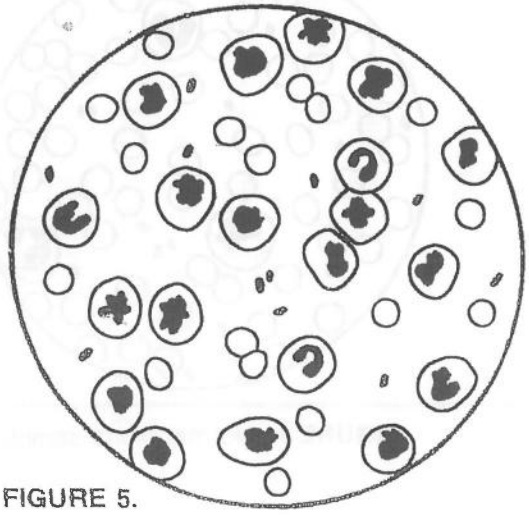


FIGURE 5.

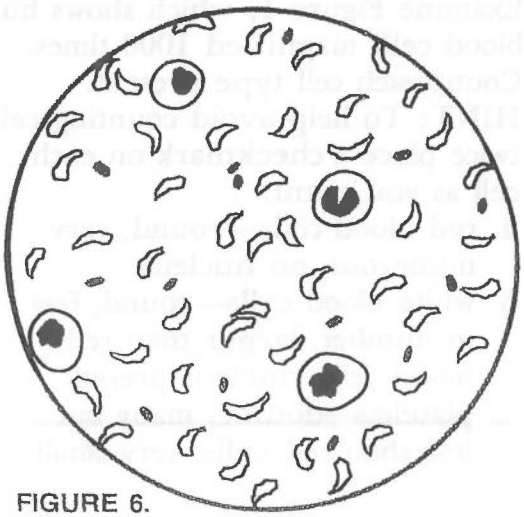


FIGURE 6.

Name _____ Class _____ Period _____

Table 1. Blood Cell Counts

Cell type	Fig. 1		Fig. 2		Fig. 3		Fig. 4		Fig. 5		Fig. 6	
	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank
Red												
White												
Platelet												
Disease diagnosis	Normal blood											

Part C. Diagnosing Blood Diseases

1. Read over the following case histories for five hospital patients.
2. Match each case history with the appropriate blood sample.
3. Record the name of the disease below each sample in Table 1 in the space provided for disease diagnosis.

Case History: Female, black, age 18; has poor nutrition, complains of always being tired and having no energy
Blood Analysis: Red cells—low in number, a few with unusual shape
Blood cell rank—red = 1, platelets = 2, white = 3
Disease Diagnosis: Iron deficiency anemia (an = no, emia = blood)

Case History: Male, black, age 15; is always tired and short of breath
Blood Analysis: Red cells—shaped like crescent moons
Disease Diagnosis: Sickle-cell anemia

Case History: Female, oriental, age 14; has a fever, sore throat, and frequent nosebleeds
Blood Analysis: Red cells—low in number; White cells—high in number
Blood cell rank—white = 1, red = 2, platelets = 3
Disease Diagnosis: Leukemia (leuk = white, emia = blood)

Case History: Male, white, age 68; has frequent headaches, nosebleeds, shows high blood pressure, a very red complexion
Blood Analysis: Red cells—a very high number
Disease Diagnosis: Polycythemia (poly = many, cyth = cell, emia = blood)

Case History: Female, white, age 22; has sudden appearances of purple marks under the skin, bruises easily, blood does not clot easily after a cut
Blood Analysis: Platelets—very few in number
Blood cell rank—red = 1, white = 2, platelets = 3
Disease Diagnosis: Thrombocytopenia purpurea (thrombo = platelet, cyto = cell, penia = shortage, purpurea = purple)

QUESTIONS

1. What is the function of

   a. red blood cells?_____

   b. white blood cells?_____

   c. platelets?_____

2. How many

   a. red blood cells are in a drop of normal blood?_____

   b. white blood cells are in a drop of normal blood?_____

   c. platelets are in a drop of normal blood?_____

3. Rank your answers given to question 2 as to the most common (1) to the least common (3).

4. Do your rankings for normal blood in Table 1 agree with your answer to question 3?_____

5. Explain why a person with anemia always feels tired (keep in mind the main job of red blood cells)._____

6. The rank of blood cells in a normal person and one with polycythemia is the same. How can you conclude that the person has polycythemia?_____

7. The rank of blood cells in a normal person and one with sickle-cell anemia is the same. How can you conclude that the person has sickle-cell anemia?_____

8. Name a blood disease that shows

   a. too many white blood cells_____

   b. too few platelets_____

   c. too few red blood cells_____

   d. too many red blood cells_____

9. Explain why a person with thrombocytopenia purpurea shows many bruises or purple marks._____

10. Explain how the counting and appearance of blood cells can help in the diagnosis of blood diseases._____

Name _____ Class _____ Period Part 1

14–1 What Causes Sports Injuries?

A number of different kinds of injuries can take place that involve the skeletal system or the muscular system. Many of these injuries result from everyday accidents while others may occur while participating in certain sports.

GOALS

In this exercise, you will:

a. learn what the difference is between ligaments and tendons.
b. relate sprains, torn tendons, and tendonitis to certain injuries.
c. learn the names of certain body muscles, bones, and tendons.

KEYWORDS

Define the following keywords:

ankle _____

ligament _____

muscular system _____

skeletal system _____

sprain _____

MATERIALS

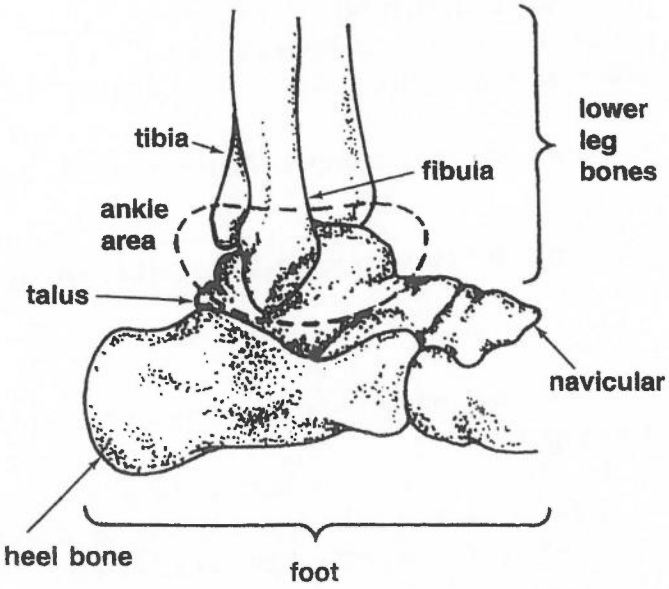
#2 pencil
colored pencils: blue and red

PROCEDURE

Part A. Sprains

1. Examine Figure 1. This is a drawing of the bones that are a part of the human ankle.
2. Examine Figure 2. This is a similar drawing of the ankle except that three ligaments have been added. They are marked 1, 2, and 3.

FIGURE 1. Bones of the ankle



3. a. Color all leg bones in Figure 2 grey (use #2 pencil).
   b. Color all foot bones in Figure 2 blue.
   c. Color all ligaments in Figure 2 red.

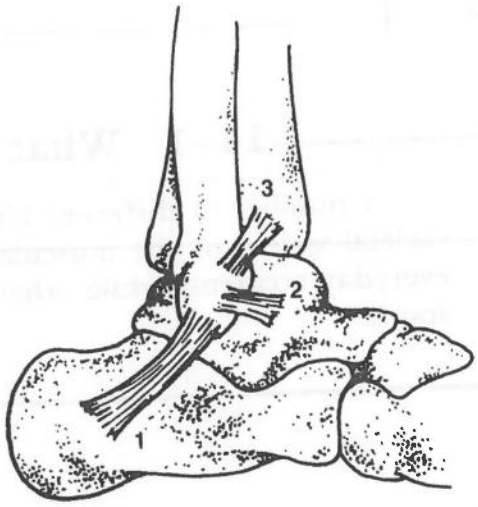


FIGURE 2. Ligaments of the ankle

4. Answer the following questions:
   a. Name the two bones held together by ligament 1.

   _____

   b. Name the two bones held together by ligament 2.

   _____

   c. Name the two bones held together by ligament 3.

   _____

5. Examine Figure 3 showing the three types of sprains. They are:
   First-degree sprain—ligaments are only stretched.
   Second-degree sprain—ligaments are only partly torn.
   Third-degree sprain—ligaments are torn completely.

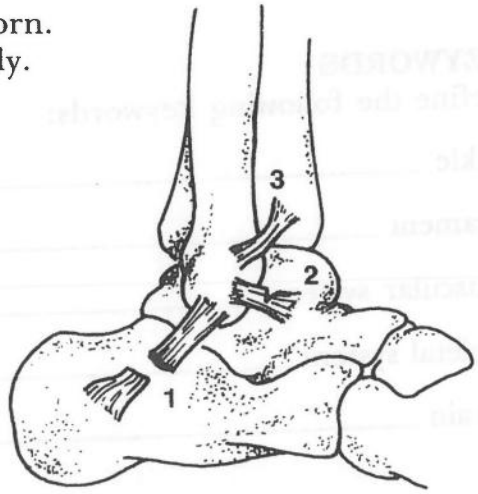


FIGURE 3. Sprained ligaments

6. a. Which ligament (1, 2, 3) shows a first-degree sprain? _____
   b. Which ligament (1, 2, 3) shows a second-degree sprain? _____
   c. Which ligament (1, 2, 3) shows a third-degree sprain? _____

7. Examine Figure 4. This is a drawing of the bones and ligaments of the shoulder.
   Color all shoulder bones grey.
   Color all upper arm bones blue.
   Color all ligaments red.

8. a. Name the two bones held together by ligament 1.

   _____

   b. Name the two bones held together by ligament 2.

   _____

9. Examine the incomplete drawing of the shoulder in Figure 5. Finish the drawing by:
   a. drawing in a second-degree sprain of ligament 1.
   b. drawing in a third-degree sprain of ligament 2.
   c. drawing in a normal ligament holding the humerus to the scapula.

Name _____ Class _____ Period _____

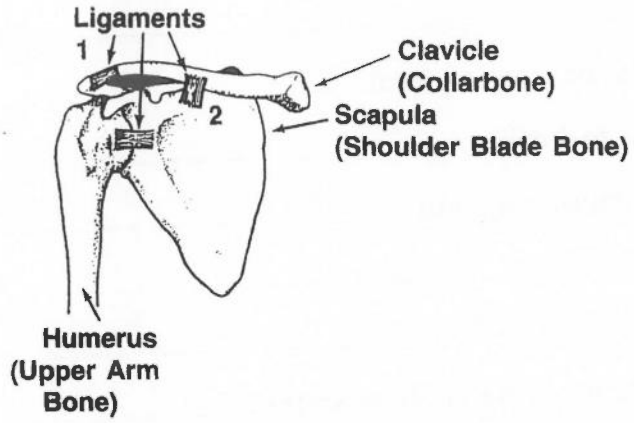


FIGURE 4. Ligaments of the shoulder

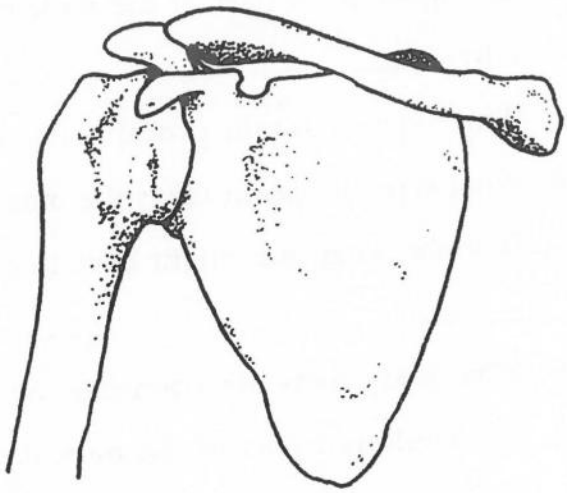


FIGURE 5. Sprains of the shoulder

Part B. Totally Torn Tendons—Tendonitis

1. Locate your calf muscle (your Gastrocnemius muscle). Run your hand down your calf until you nearly reach the back of your heel. You should now be able to feel a thick cord at the back of your heel. This cord is a tendon (your Achilles tendon.)
2. Examine Figure 6a. This drawing shows an actual view of the back of a person's leg. The skin has been removed.
3. Finish Figure 6b by showing what a totally torn Achilles tendon would look like. Draw an arrow pointing to the torn area and label it.
4. Finish Figure 6c by showing what tendonitis of the Achilles tendon would look like. Tendonitis is a soreness of the tendon. It is caused by small tears which occur along the tendon. Draw an arrow pointing to the tears and label them.

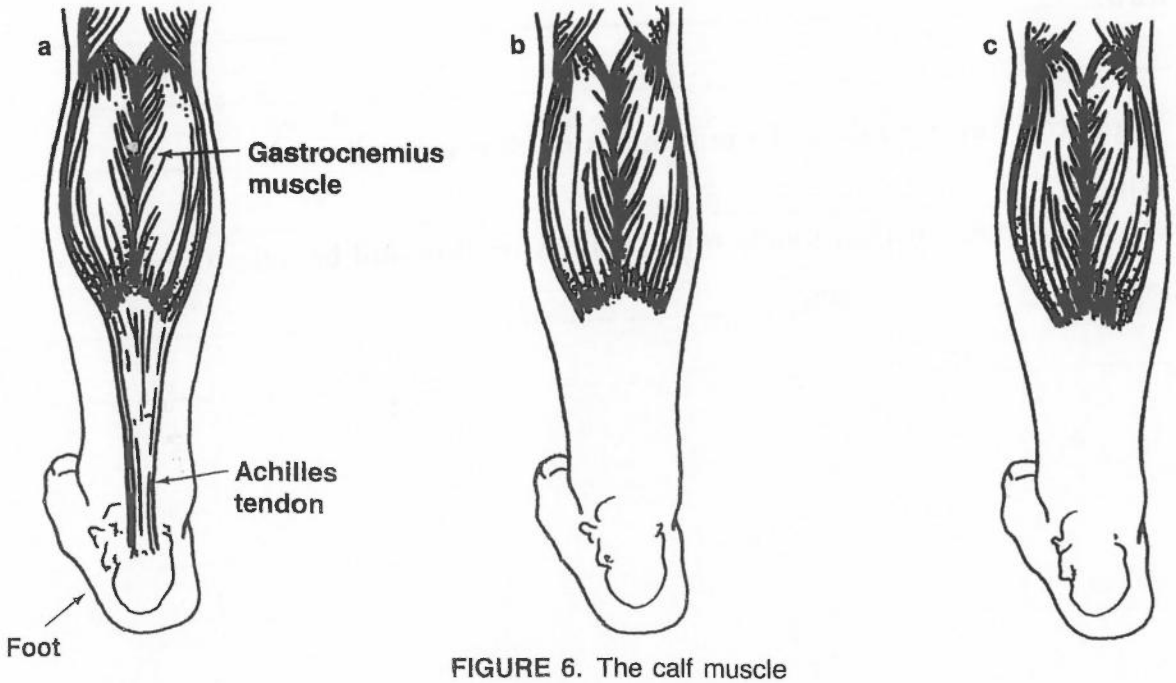


FIGURE 6. The calf muscle

QUESTIONS

1. What body parts are held together by ligaments? _____
2. Are ligaments a part of the muscular system or the skeletal system?_____

   Why?_____
3. What type of sprain probably takes the least time to heal?_____
4. What type of sprain takes the most time to heal?_____
5. Describe what one might have to do to cause a sprain._____

   _____
6. What body parts are connected by tendons?_____
7. Are tendons a part of the muscular system or the skeletal system?_____

   Why?_____
8. Explain how tendons differ from ligaments._____

   _____
9. Describe what one might have to do to cause a tendon to totally tear or develop tendonitis._____

   _____
10. A totally torn tendon is a serious problem for an athlete or anyone else. A person will lose the use of the body part to which the tendon attaches. For example, a totally torn Achilles tendon will prevent a person from lowering his foot. Muscles shorten (contract) when they work. The Gastrocnemius shortens and pulls the foot down.
    a. Explain why the foot cannot be pulled down if the Achilles tendon is totally torn._____

       _____
    b. Might the foot be raised if the Achilles tendon is totally torn?_____

       Why?_____
    c. Might a person with a totally torn Achilles tendon still be able to move his leg? _____ Why?_____

       _____

Name _____ Class _____ Period a: B

14–2 How Do Male and Female Skeletons Differ?

A skeleton is found. A doctor reports to the police that it is an adult male skeleton. How could the doctor determine if the skeleton were from a male or a female?

Several differences exist between the skeleton of a male and that of a female. The main difference is in the shape of the pelvis. The female usually has a wider pelvis. Let's see how some measurements compare.

GOALS

In this exercise, you will:

1. examine and measure diagrams of a male and female pelvis.
2. determine how these measurements differ in male and female pelvises.
3. use your data to determine if a third pelvis is male or female.

KEYWORDS

Define the following keywords:

femur _____

pelvis _____

sacrum _____

skeleton _____

MATERIALS

metric ruler

PROCEDURE

1. Examine Figure 1. Figure 1a is the pelvis from an adult male. Figure 1b is the pelvis from an adult female.
2. Measure the length (in millimeters) of the following dashed lines on Figures 1a and 1b: lines *a*, *b*, *c*, and *d*.
3. Record these numbers in Table 1. Note that lines b and c are part of the sacrum bone (shaded). This bone is found at the back of the pelvis and does not block the pelvis opening. It does, however, appear to block the opening in the figures.

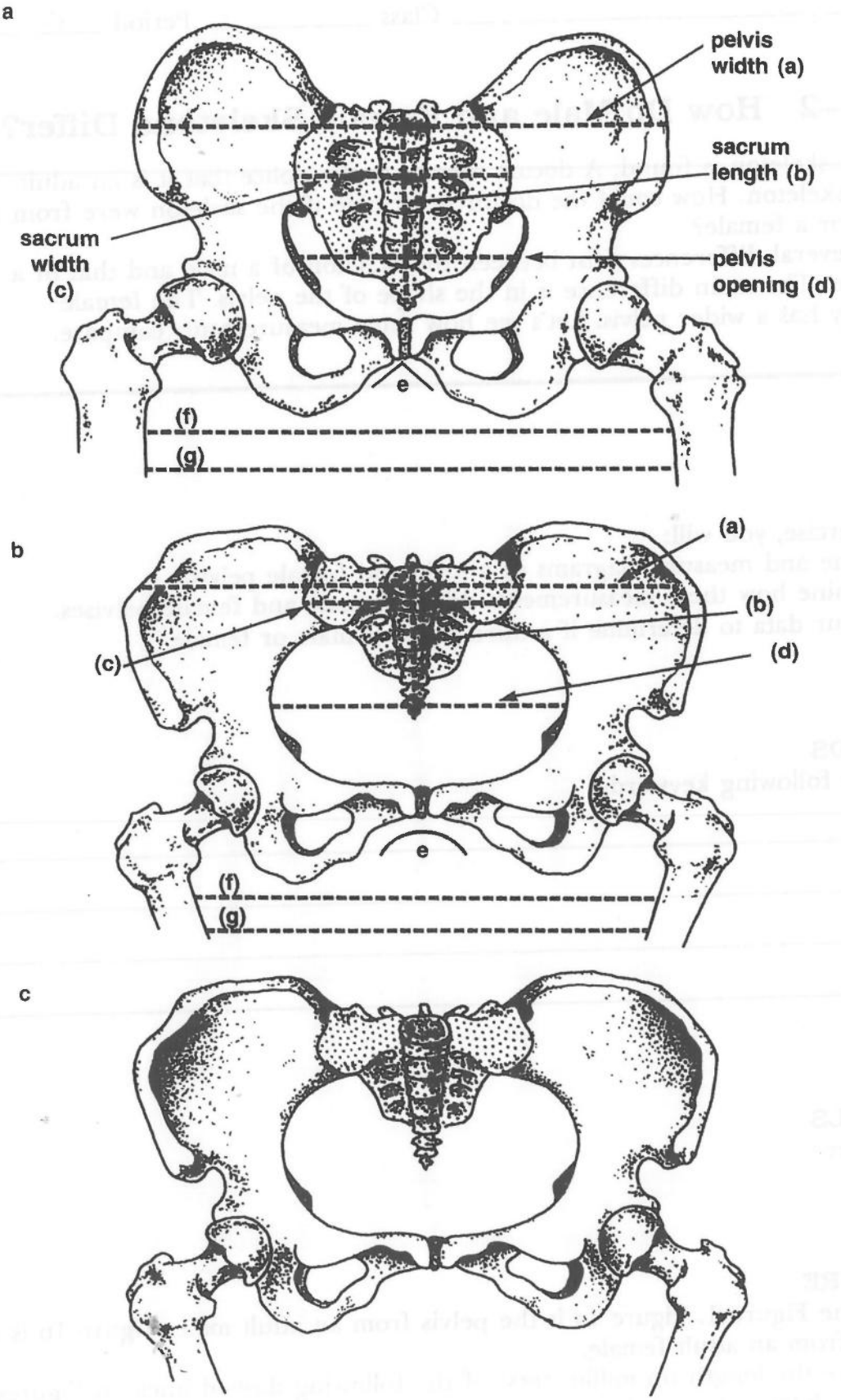


FIGURE 1. Human pelvises

Name _____ Class _____ Period _____

4. Locate letter *e* on Figures 1a and 1b. Note that the bottom of each pelvis is either round or pointed at this location. Record in Table 1 if the bottom is pointed or round.
5. Measure and record in Table 1 the lengths of dotted lines *f* and *g* on Figures 1a and 1b. If the femur bones hang *straight down*, the lengths of lines *f* and *g* will be the same. If the femur bones *slant inward*, the lengths of lines *f* and *g* will differ. This position of femur bones (thigh bones) provide a clue as to whether the skeleton is male or female.
6. Record your measurements and position of the femurs in Table 1.
   Note that now you have a way of telling male from female skeletons by using all the data in Table 1.
7. Measure and record all the lengths of the pelvis and femur parts in Figure 1c just as you did for Figures 1a and 1b. The dashed lines are not included in the figure. Record your data in Table 1.
8. Indicate in Table 1 if Figure 1c represents a male or female skeleton.

Table 1. Pelvic Bone Measurements

Figure	Sex	Pelvis width line a	Sacrum length line b	Sacrum width line c	Pelvis opening line d	Bottom shape	Line f	Line g	Position of femurs
1a	Male								
1b	Female								
1c									

QUESTIONS

1. Explain how each of the following differs in adult male and adult female skeletons:

   a. pelvis width _____

   b. sacrum _____

   c. pelvis opening width _____

   d. bottom shape of pelvis _____

   e. position of femur bones _____

2. Figure 1c is from a _____ (male or female.) List three things that helped you with your answer. _____

   _____

3. The approximate age of a skeleton can be told by measuring the length of the femur bone. The graph shown in Figure 4 gives you these measurements. By using this graph, determine the approximate age of a skeleton whose femur measures

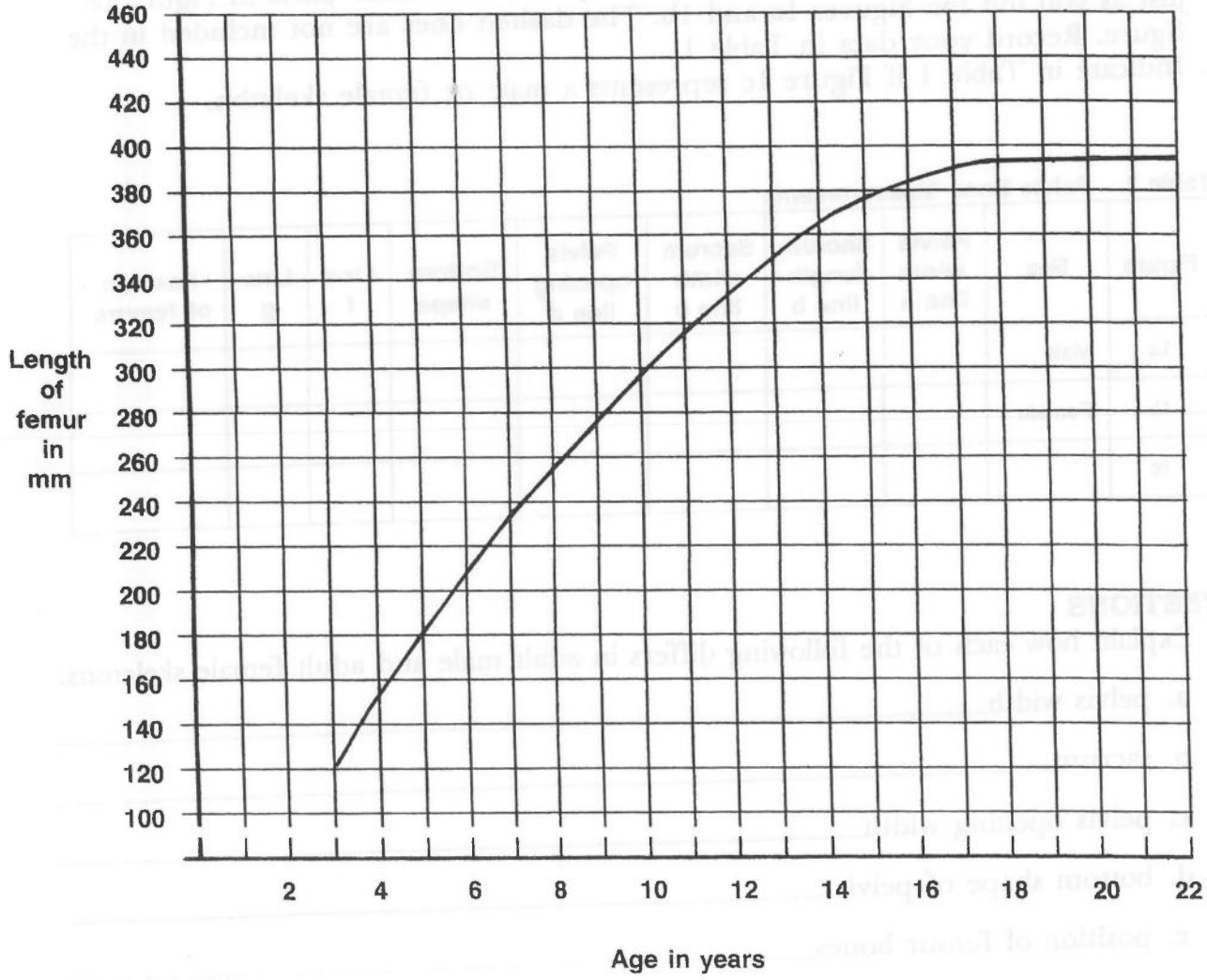
   a. 200 millimeters._____

   b. 300 millimeters._____

   c. 350 millimeters._____

4. Explain why the graph in Figure 2 cannot be used to determine the age beyond 18 years._____

FIGURE 2. Age of human skeletons



Name _____ Class _____ Period Part A

17–2 What Happens When You Learn By Trial and Error?

Suppose you were given a ring of keys and you were not told which key would open a door. How could you solve this problem? You could keep trying keys until you found the right one. Each time you made an error, you would try again. The process you used to find the correct key was trial and error. You learned by repeating over and over until you discovered the right key.

The next time you needed to use that same key, however, you would not have to go through the whole process again. You had already learned which key opens the door. This process of finding the key that fits is an example of learned behavior.

GOALS

In this exercise, you will:

a. solve the same paper puzzle several times.
b. run the same maze pattern several times.
c. see the effect of trial and error on learning how to solve puzzles.

KEYWORDS

Define the following keywords:

innate behavior _____

learned behavior _____

maze _____

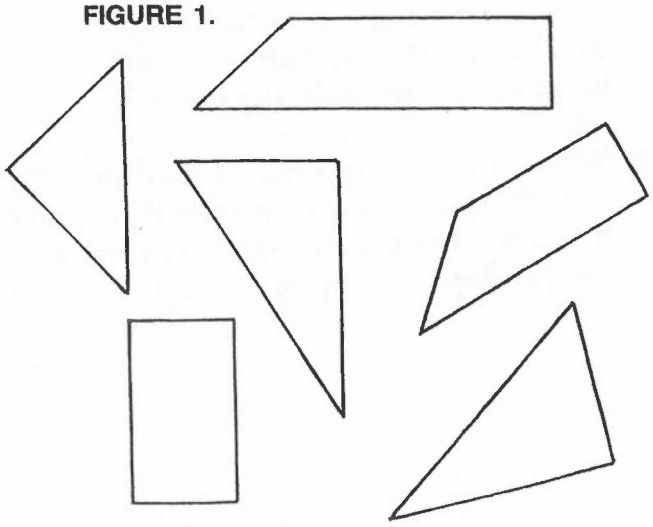
repeating or repetition _____

trial and error _____

MATERIALS

paper
file card
scissors
tape
ruler
wall clock
folder

FIGURE 1.



PROCEDURE

Part A. Paper Puzzle Trial and Error

1. Trace the shapes shown in Figure 1 onto a piece of paper.

2. Tape the paper tracings onto a file card.
3. Cut out the six pieces with the scissors.
4. Put the six pieces together to form a single square. Time how long it takes.
5. Record in Table 1 the amount of time it took you to put the pieces together for trial 1.
6. Study how the pieces fit together to form a square.
7. Mix up the pieces of the square.
8. Repeat steps 4–7 three more times and enter your times in Table 1 as trials 2, 3, and 4.

Table 1.

	Paper Puzzle	Maze	
Trial	Time	Time	Number of Errors
1			
2			
3			
4			

Part B. Maze Trial and Error

1. Make a hole 1 cm in diameter in the exact center of an opened folder. Use Figure 2 as a guide.
2. Place the folder hole exactly over the letter "S" (for start) on the maze in Figure 3.
3. Keep the maze covered with the folder during the entire exercise. Move the hole to the letter "F" (for finish) by following the path lines. If you come to a "dead end," count that as one error and move the folder hole the other way.

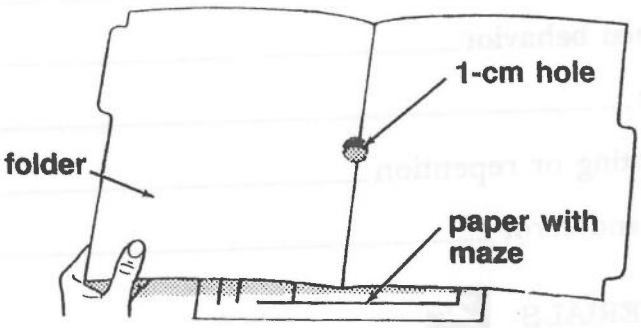


FIGURE 2. Holding folder over maze

4. Note your starting time. Record in Table 1 the number of errors that you make and the total amount of time that it takes you to complete the maze. Record the time and number of errors as Trial 1.
5. Repeat steps 2–4 three more times and record your results as trials 2, 3, and 4.

Name _____ Class _____ Period _____

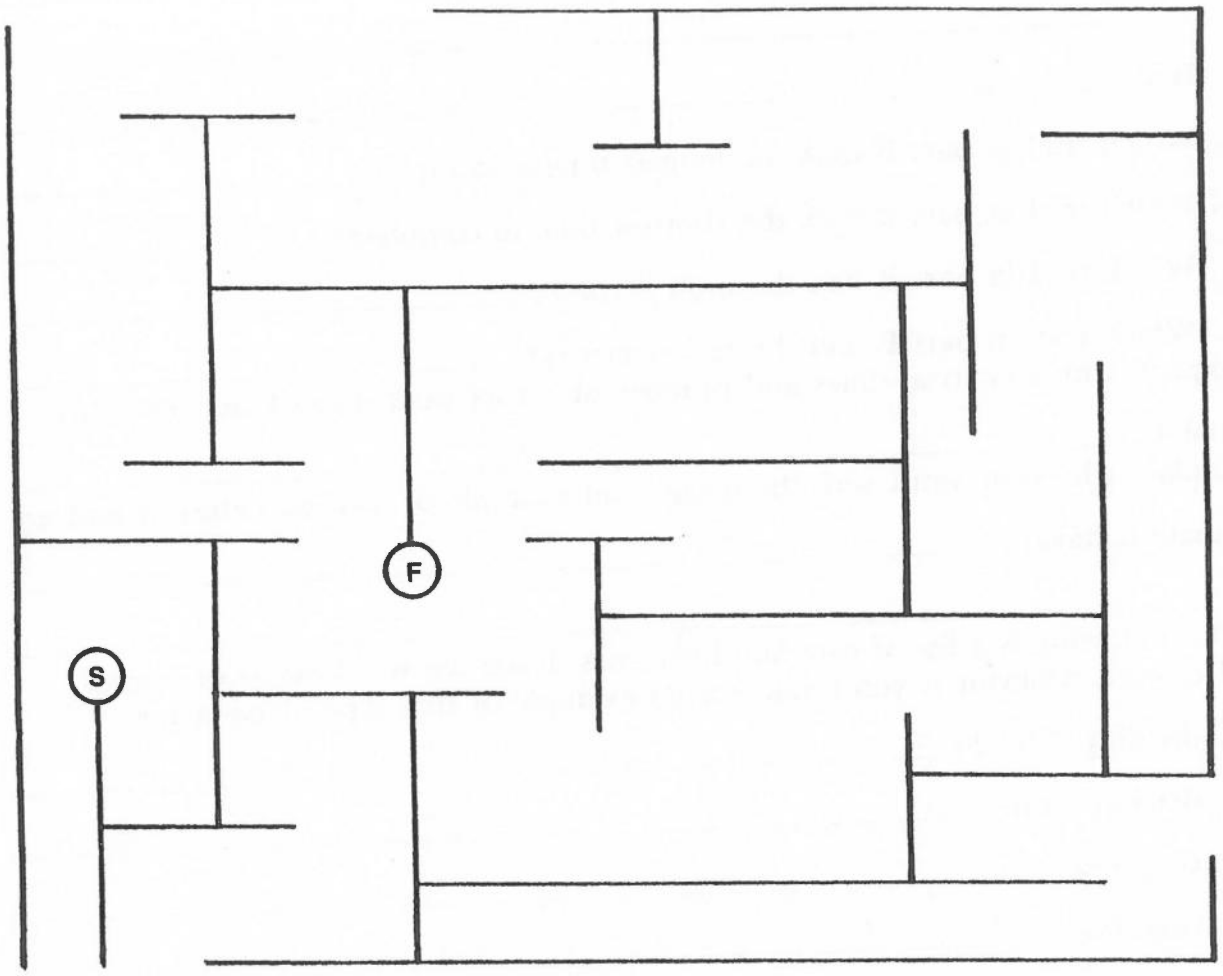


FIGURE 3.

QUESTIONS

1. a. Which trial in part A took the longest time to complete?_____

   b. Which trial in part A took the shortest time to complete?_____
2. Explain why the first trial in part A could be called trial and error learning.

   _____
3. Explain how repeating the puzzle through repetition improved your time at solving it. What was happening to your behavior in terms of learning?_____

   _____

   _____
4. a. Explain why part A of the experiment was not an example of innate behavior.

   _____

b. How might your data have looked for part A if solving the paper puzzle was an example of innate behavior?_____

_____

c. Why?_____

5. a. Which trial in part B took the longest time to complete?_____

b. Which trial in part B took the shortest time to complete?_____

c. Which trial in part B had the most errors?_____

d. Which trial in part B had the fewest errors?_____

6. Explain why your trial times and number of errors went down from trial 1 to trial 4._____

7. Explain why your work with the maze is an example of learned behavior and not innate behavior._____

_____

8. The following is a list of common behaviors. Place the word *innate* or *learned* after each behavior if you think it is an example of that type of behavior.

a. dividing 7 by 24_____

b. driving a car_____

c. coughing_____

d. sneezing_____

e. using a skateboard_____

f. blinking_____

g. finding your way out of a building if lost in it_____

h. memorizing the words to a song_____

Name _____ Class _____ Period _____

15–2 The Brain and Its Functions

The human brain is divided into three different parts. Each part is specialized. Each part has a job to perform that is different from the other parts. The brain is even more specialized in that specific brain sides control only specific body sides.

GOALS

In this exercise, you will:

a. identify and label the three brain areas.
b. determine the jobs of certain brain areas.
c. match brain areas with their corresponding areas of body control.

KEYWORDS

Define the following keywords:

cerebellum _____

cerebrum _____

involuntary _____

medulla _____

voluntary _____

MATERIALS

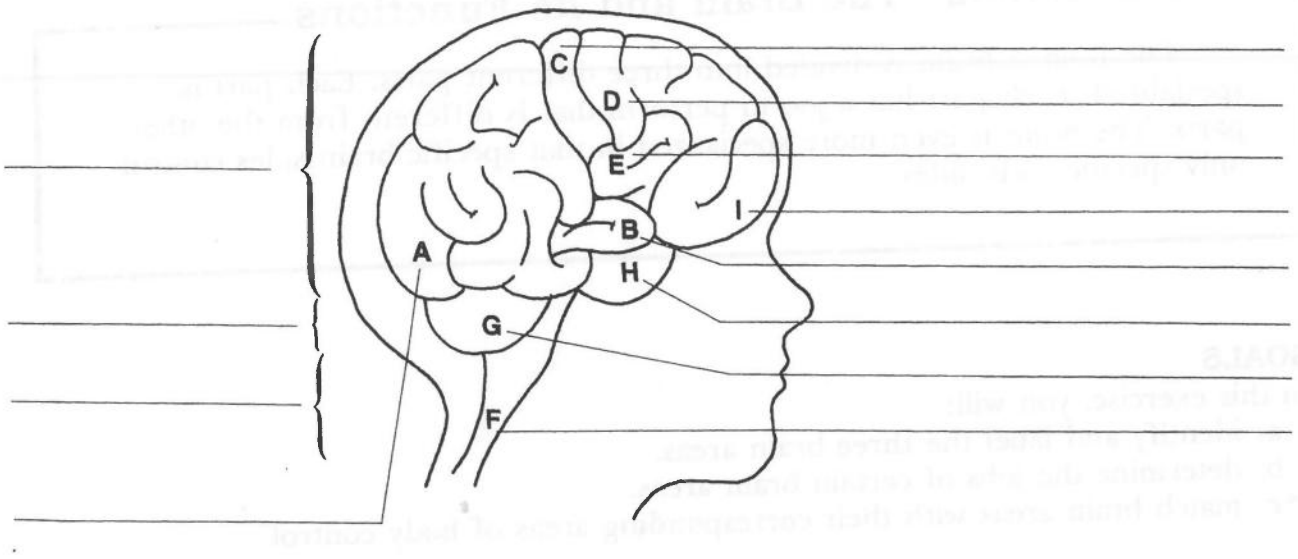
#2 pencil colored pencils: red, green, blue, gray, and yellow

PROCEDURE

Part A. Control Areas of the Brain

1. Examine Figure 1. This shows a side view of the human brain. Label the brackets correctly to show the brain's three parts or areas. Use the following labels: medulla, cerebrum, and cerebellum.
2. Label the functions of certain brain parts by using the following labels:
   A. vision center
   B. speech center
   C. sensation of body pain
   D. muscle control of body
   E. hearing center
   F. heartbeat center
   G. coordination center for body muscle
   H. smell center
   I. personality center
3. Still using Figure 1, color in the voluntary parts of the brain with a red pencil. Color the involuntary parts blue.

FIGURE 1. Side view of the human brain

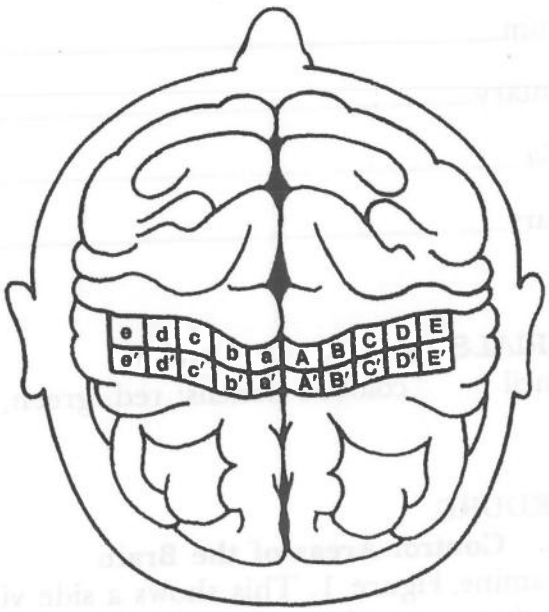


Part B. How the Brain Controls the Body

1. Examine the top view of the cerebrum in Figure 2. Note that the cerebrum is divided into left and right sides. Each side has been marked for you.

2. Locate and examine the two front views of the body in Figure 3. Note that in these views the left and right sides are reversed (this is because they are front views). The body views are marked either "sensation of body pain" or "muscle control of body." Muscle control and body pain are controlled by certain brain areas. The brain area controlling this and the corresponding areas on the body are marked with similar letters.

FIGURE 2. The cerebrum

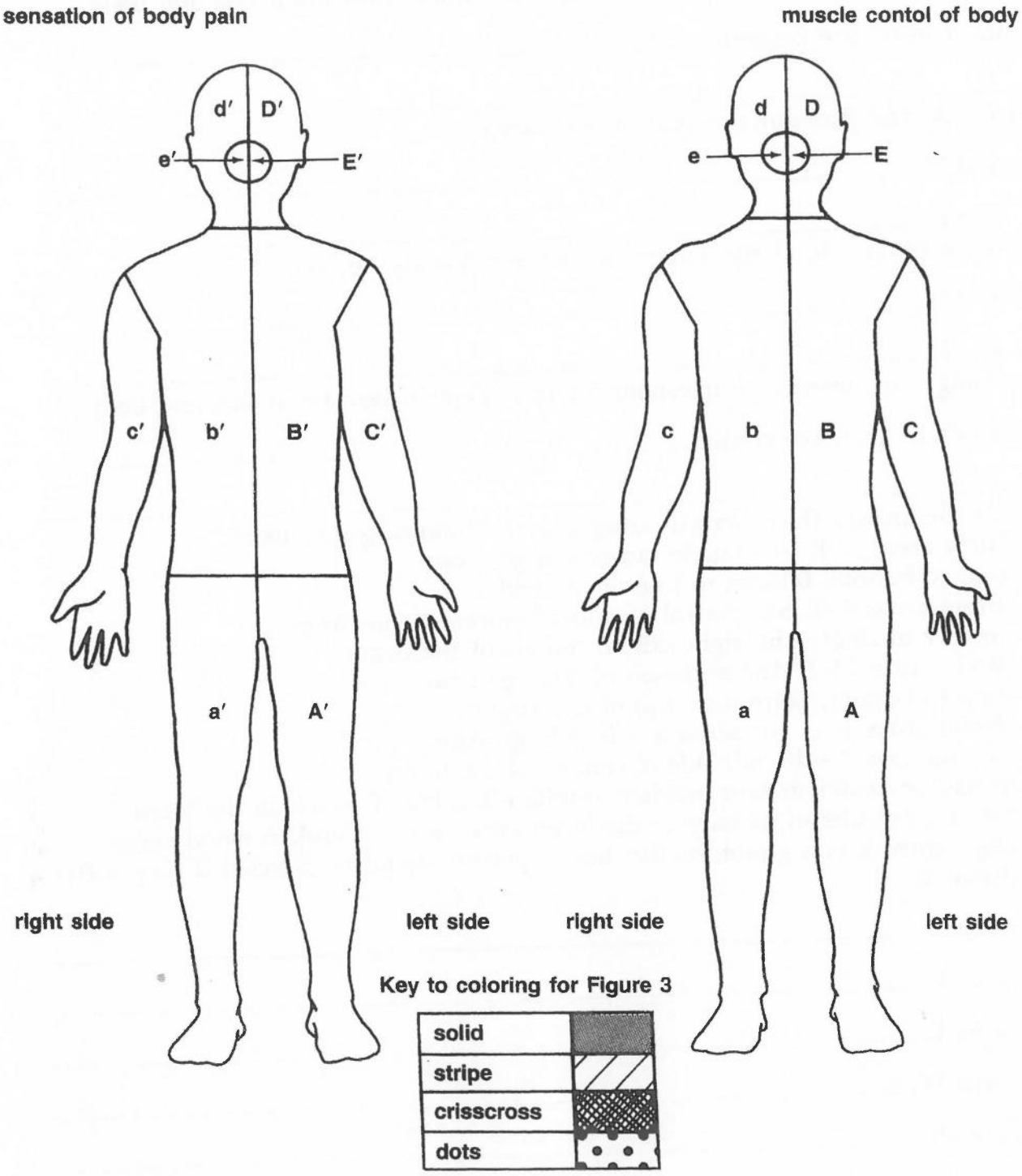


3. Match the brain areas of Figure 2 with their corresponding body areas of Figure 3 by coloring in parts of the figures as follows:

A–solid red	A′–stripe red	a–crisscross red	a′–dot red
B–solid blue	B′–stripe blue	b–crisscross blue	b′–dot blue
C–solid green	C′–stripe green	c–crisscross green	c′–dot green
D–solid yellow	D′–stripe yellow	d–crisscross yellow	d′–dot yellow
E–solid gray	E′–stripe gray	e–crisscross gray	e′–dot gray

Name _____ Class _____ Period _____

FIGURE 3. Front views of the human body



QUESTIONS

1. Which brain area is the largest?_____
2. What side and functions are part of body areas

   a. A–E?_____

   b. a–e?_____

3. On what brain side of the cerebrum do the following appear:

   a. A–E?_____

   b. a–e?_____

4. By using your answers to questions 2 and 3, explain how brain side and body muscle control are related._____

   _____

5. What side and function are part of body areas

   a. A′–E′?_____

   b. a′–e′?_____

6. On what brain side of the cerebrum do the following appear:

   a. A′–E′?_____

   b. a′–e′?_____

7. By using your answers to questions 5 and 6, explain how brain side and body sensation of pain are related._____

   _____

8. Circle the answer that correctly completes the following statements:
   a. Body areas A–E for muscle movement go from (top to bottom, bottom to top) of the body.
   b. Brain areas A–E for control of muscle movement go from (center to right side, right side to center) of the brain.
   c. Body areas A′–E′ for sensation of pain go from (top to bottom, bottom to top) of the body.
   d. Brain areas a′–e′ for sensation of pain go from (center to left side, left side to center) of the brain.

9. A stroke or cardiovascular accident results when blood vessels in the brain burst. This results in damage to the brain area near the broken blood vessel. Using Figure 2 as a guide, predict how a person would be affected if they suffer a stroke in

   a. area A._____

   b. area C._____

   c. area E._____

   d. area D′._____

   e. area b._____

   f. area e′._____

Name _____ Class _____ Period _____

15–1 Which Brain Side Is Dominant?

The human brain is divided into a left and a right side. Many things that you do with the right side of your body are controlled by your brain's left side. Many things that you do with the left side of your body are controlled by your brain's right side. If much of what you do is done by your body's right side, your dominant brain side is the left side. If much of what you do is done by your body's left side, your dominant brain side is the right side.

GOALS

In this exercise, you will:

a. check to see how many activities you do using your left hand or your right hand.
b. check to see how many activities you do using your left hand or your right foot.
c. find out if you draw or see objects more to the right side or the left side.
d. find out if the left side or the right side of your brain is dominant.

KEYWORDS

Define the following keywords:

cerebrum _____

dominant _____

left cerebrum side _____

right cerebrum side _____

MATERIALS

paper red pencil

PROCEDURE

1. Place a check mark in the proper column in Table 1 to show which hand you usually use to do the following tasks. Note: If you use either hand just as often, then check both columns.
   Tell which hand you use to
   a. write your name.
   b. wave "hello."
   c. bat while playing baseball.
   d. which thumb is on top when folding your hands.
   e. hold your spoon or fork while eating.

2. Place a check mark in the proper column in Table 1 to show which foot you usually use to do the following tasks. Note: If you use either foot just as often, check both columns.
   Tell which foot you use to
   a. start down a flight of stairs.
   b. start up a flight of stairs.
   c. catch yourself from falling as you lean forward.
   d. start skipping.
   e. place most weight on when you are standing.
   f. start to run.

3. Draw, in the space provided, a simple side view of a dog. Place a check mark in the column in Table 1 that shows the direction your drawing faces *away* from.

dog drawing

4. Draw a circle in the space provided with your *right* hand. Note the direction in which you made this circle. Now draw a circle with your left hand. Note the direction in which you made this circle. If both circles were drawn clockwise, mark the right column in Table 1. If both circles were drawn counterclockwise, mark the left column in Table 1. If you drew one circle in each direction, check both columns.

left hand | right hand

5. Roll a sheet of paper into a tube. Look through the tube at some distant object with both eyes open as shown in Figure 1. Then while looking through the tube at that distant object, close one eye and then the other. The eye that sees the object through the tube is your dominant eye. Place a check mark in the proper column in Table 1.

FIGURE 1. Finding your dominant eye

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6. Total up the check marks for each column of Table 1 and place the total at the bottom of the columns.

Table 1. Finding Your Dominant Side

Task	Left	Right
Write name		
Wave "hello"		
Bat		
Thumb position		
Hold spoon		
Walk down stairs		
Walk up stairs		
Catch from falling		
Skipping		
Standing		
Start to run		
Dog drawing		
Circle drawing		
Dominant eye		
Totals =		

QUESTIONS

1. Which column in Table 1 has the most check marks?_____
2. Which column in Table 1 has the fewest check marks?_____
3. Which body side seems to be your dominant side?_____
4. The human cerebrum is divided into left and right sides.
   a. Which brain side controls the left side of your body?_____
   b. Which brain side controls the right side of your body?_____
5. The brain side that you use the most is said to be your dominant brain side.

   Which is your dominant brain side?_____
   (HINT: The answer will be the opposite side from your answer to question 3.)
6. Look at Figure 2. It shows a top view of the brain. Label the following parts: left cerebrum side, right cerebrum side. Use a red pencil to shade in your dominant brain side.

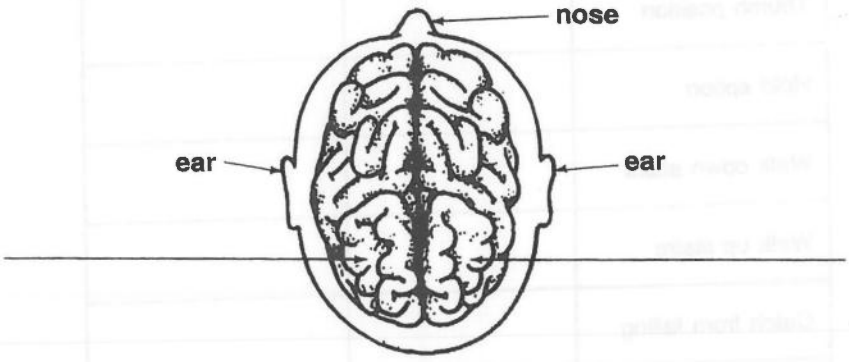


FIGURE 2. Top view of brain

7. Your teacher will ask for a class survey of certain results. Complete the following data for your class:
   a. number of students who are right-handed and show the right body side as dominant._____
   b. number of students who are right-handed and show the left body side as dominant._____
   c. number of students who are left-handed and show the right body side as dominant._____
   d. number of students who are left-handed and show the left body side as dominant._____
8. Using your results from question number 7,
   a. does a person who uses his or her right hand for writing always show a dominant right body side?_____
   b. does a person who uses his or her left hand for writing always show a dominant left body side?_____

Name _____ Class _____ Period Par 1 B

16–2 How Are Your Senses Sometimes Fooled?

What you see and what you think you see are not always the same. Seeing is done with your eyes. The message your eyes pick up is sent to the brain where it is interpreted. The brain may then "tell" you that you see something that is not present. The mistaken idea that you get is an illusion. If the mistaken idea is because of what you see, or your eyes, it is called an optical illusion.

GOALS

In this exercise, you will:

a. look at several diagrams and record what you see.
b. compare your results with what you know is present.

KEYWORDS

Define the following keywords:

illusion _____

optical illusion _____

sense _____

MATERIALS

ruler
file card
blank paper
red marker
yellow marker

PROCEDURE

Part A. Triangle Illusion

1. Examine Figure 1 for a white triangle. Record in Table 1 on page 127 if you see it.
2. Now record in the table if the white triangle is really present. Is there a white triangle drawn on the diagram? _____

Part B. Bent Line Illusion

1. Examine Figure 2. Record in Table 1 if you think the lines across the diagram could meet without the resulting line being bent.

FIGURE 1.

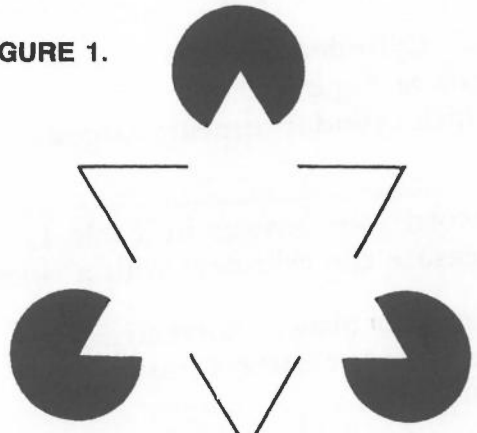
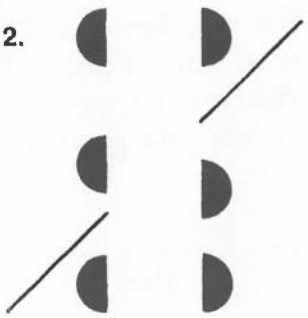


FIGURE 2.



2. Lay a ruler on Figure 2 next to both lines. Does it now appear that the lines would meet in the center without the resulting line being bent? _____
3. Record your results in Table 1.

Part C. Paper Fold Illusion

1. Fold a file card as shown here in Figure 3. Lay it on your desk about 20 cm from your eyes.
2. Stare at the figure for about 20 seconds with one eye closed. Does the fold appear to always be in the top of the figure? ____
3. Record your answer in Table 1. Also record where you know the fold really is.

Part D. Flower Illusion

1. Color Figure 4 so that the center is red and the petals are yellow.
2. Stare at the diagram for 30 seconds. Then stare at a blank piece of paper.
3. Record in Table 1 what you see. Also record what you know is on the blank paper.

Part E. Cylinder Illusion

1. Look at Figure 5.
2. Which cylinder appears largest?

   _____
3. Record your answer in Table 1.
4. Measure the cylinders with a ruler. Was your answer correct?_____
5. Record your correct answer in Table 1.

Part F. Cube Illusion

1. Stare at the number 1 in Figure 6 for at least one minute.
2. What appears to happen to corner 1 when you gaze at it steadily?

   _____
3. Record this in Table 1.

FIGURE 3.

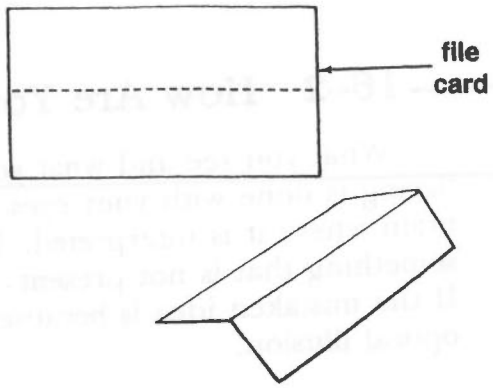


FIGURE 4.

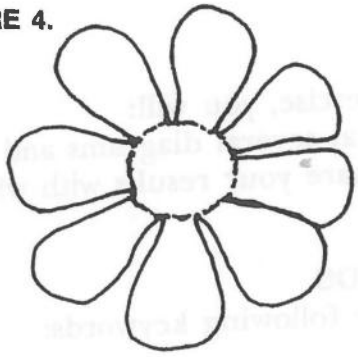


FIGURE 5.

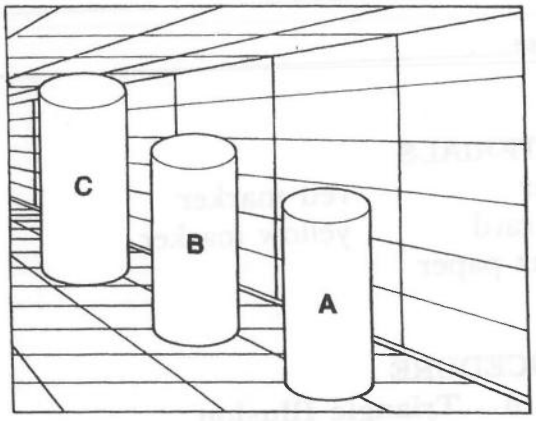
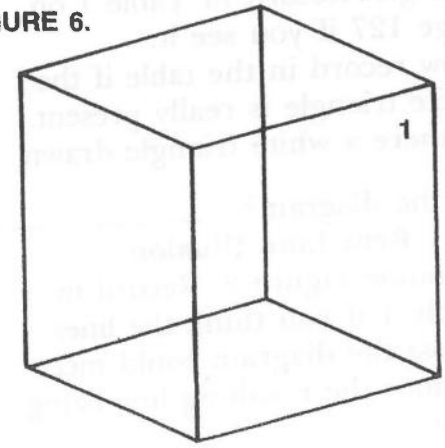


FIGURE 6.



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4. Also record in Table 1 what Figure 6 really shows.

Table 1. Observing Illusions

Illusion	Appears	Really Is
Triangle		
Bent line		
Paper fold		
Flower		
Cylinders		
Cube		

Part G. Figure Reversals

1. Examine Figure 7. What do you see?

   _____

2. When you look a second time, do you see anything different?_____

3. Do both figures ever appear at the same time?_____

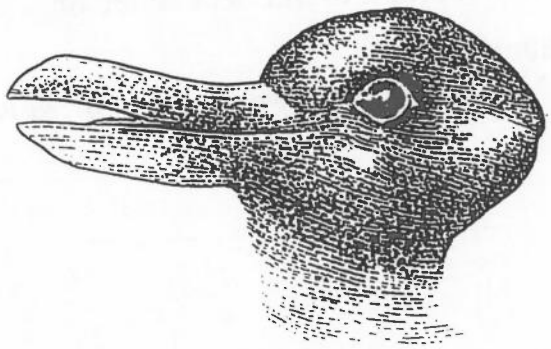
4. Examine Figure 8. This figure was used in 1900 by psychologist Joseph Jastrow. What do you see when the face looks to the left?_____

5. What do you see when the face looks to the right?_____
   Can you see both at the same time?

   _____

FIGURE 7.

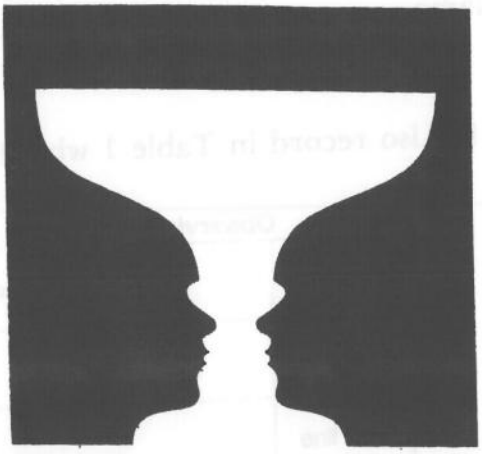
FIGURE 8.



6. Examine Figure 9. What do you see?_____

7. Look at the figure again. Do you see anything different? What do see?_____
Can you see both things at the same time?_____

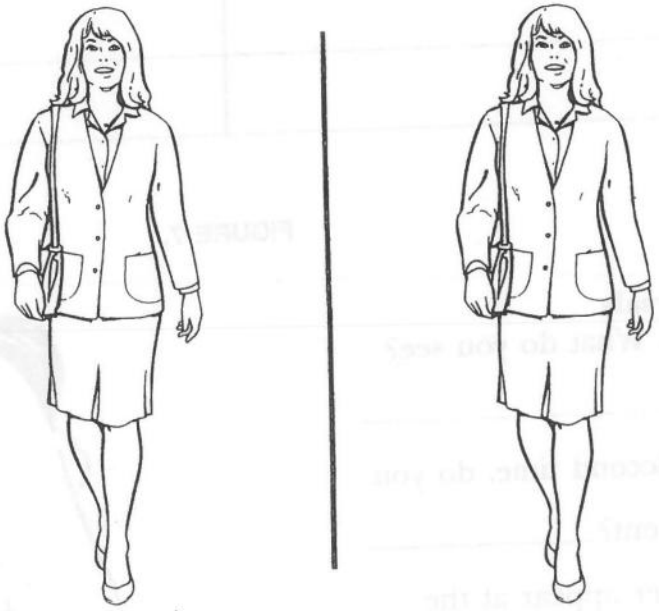
FIGURE 9.



Part H. Creating Illusions

1. Examine the figure of the two girls below. They are both exactly the same size. Without changing their size, create the illusion that one girl is taller than the other.

FIGURE 10. Make your own illusion



QUESTIONS

1. Which of the illusions in this activity were optical illusions?_____
_____
2. Sometimes a driver sees water on a dry highway. Why is this water an optical illusion?_____
3. Name some jobs people have in which they must be aware of optical illusions.
_____
_____

Name _____ Class _____ Period _____

Lab# _____ How Do Internal and External Reproduction Compare?

Some animals that live in water gather in large groups during their breeding season. The females release their eggs into the water. The males of the species then release their sperm over the eggs. The sperm cells fertilize the eggs in the water. This is called external fertilization because it takes place outside the animal's body.

In other animals, the male releases sperm directly into the female's body where fertilization takes place. This is internal fertilization.

INTERPRETATION

OBJECTIVES

In this exercise, you will:

a. interpret and chart data collected by a student.
b. determine if there is a relationship between the number of young produced, the type of fertilization, and the type of place where an animal lives.
c. determine how parental care helps the young.

KEYWORDS

Define the following keywords:

external fertilization _____

internal fertilization _____

parental care _____

MATERIALS

pencil

PROCEDURE

Part A. Observing Data On Animal Reproduction

Study the data in Table 1 below that was collected by a student.

Table 1.

Animal	Where Animal Lives	Number Of Young Produced	Number Of Young That Survive	Parental Care	
				Yes	No
Horse	land	1	1	X	
Spider	land	100	10	X	
Oyster	water	750,000	100		X
Jellyfish	water	1,000	10		X
Tiger Salamander	land	100	8		X
Starfish	water	1,500	5		X
Garter Snake	land	35	3	X	
Falcon	land	5	2	X	
Humpback Whale	water	1	1	X	
Clam	water	1,000,000	30		X

11. Which of the animals do you think have the best chance of survival? Why?

12. The bluegill sunfish cares for its eggs and young while the rainbow trout does not. Which would probably have a greater number of young survive to reproduce? Explain.

13. Write a short paragraph that explains each of the following points:
    a. The type of fertilization of an animal is different between animals that live on land and those that live in water.
    b. The number of eggs produced by an animal is different between animals that have internal fertilization and those that have external fertilization.
    c. The number of young that survive differs between animals that have internal fertilization and those that have external fertilization.
    d. The number of young that survive differs between animals that give parental care and those that do not.

Name _____ Class _____ Period Part A

25–1 How Does a Human Fetus Change During Development?

Development in a human takes about 38 weeks. Many changes take place with the fetus during that time. Two changes that do occur are increases in size and mass. How much of a change in mass and size takes place each week?

GOALS

In this activity, you will:

a. measure the length of diagrams of the human fetus.
b. graph the length and mass of a human fetus.
c. determine when during development most changes in mass and size occur.

KEYWORDS

Define the following keywords:

development _____

embryo _____

fetus _____

mass _____

premature _____

MATERIALS

metric ruler

PROCEDURE

Part A. Development of a Human Fetus

1. Look at Figure 1. It shows six stages of a developing human fetus. They are shown at 40% of their natural size.
2. Follow the steps outlined below to measure the total length of each stage. Use the metric ruler and measure in millimeters. Use the 38-week stage as a guide and record your data in the spaces provided in Table 1.
   a. Measure the body length from the rump to the top of the head.
   b. Measure the thigh length from the rump to the knee.
   c. Measure the length of the leg from the knee to the foot.
4. Add all three measurements together and record the total in the space provided in Table 1.
5. Multiply the total by 2.5 to give a figure that is close to the actual size of the fetus at each stage.
6. Record this actual size in the table.

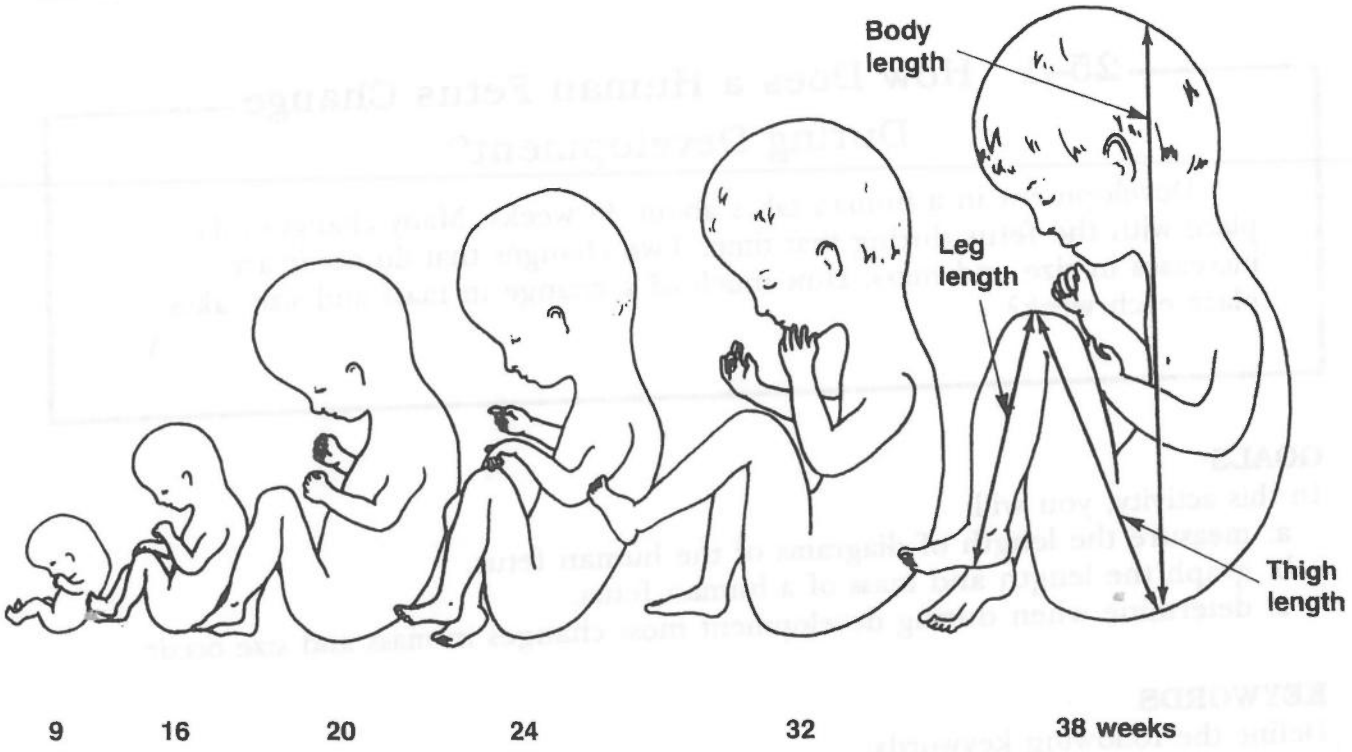


FIGURE 1. Stages in the development of a human fetus

Table 1. Lengths of a Developing Fetus

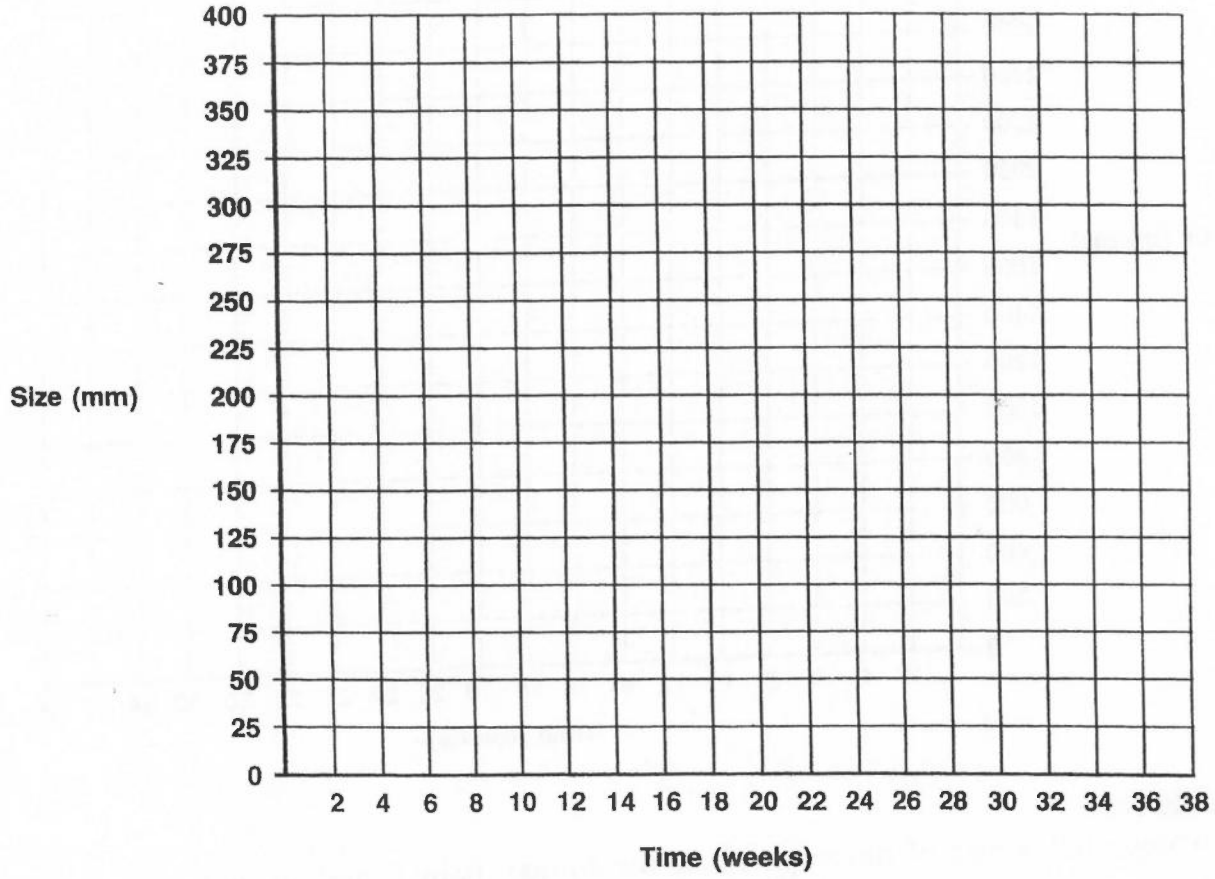
Age of fetus in weeks	Body length	+	Thigh length	+	Leg length	=	Total length	× 2.5 =	Actual length
2									
9									
16									
20									
24									
32									
38									

Part B. Plotting Length of a Developing Fetus

1. Plot the data from Table 1 onto the graph in Figure 2.
2. Plot the actual fetal length against the age of the fetus. Notice that the length of the fetus at week 2 has already been plotted.

Name _____ Class _____ Period _____

FIGURE 2. Length of a developing fetus



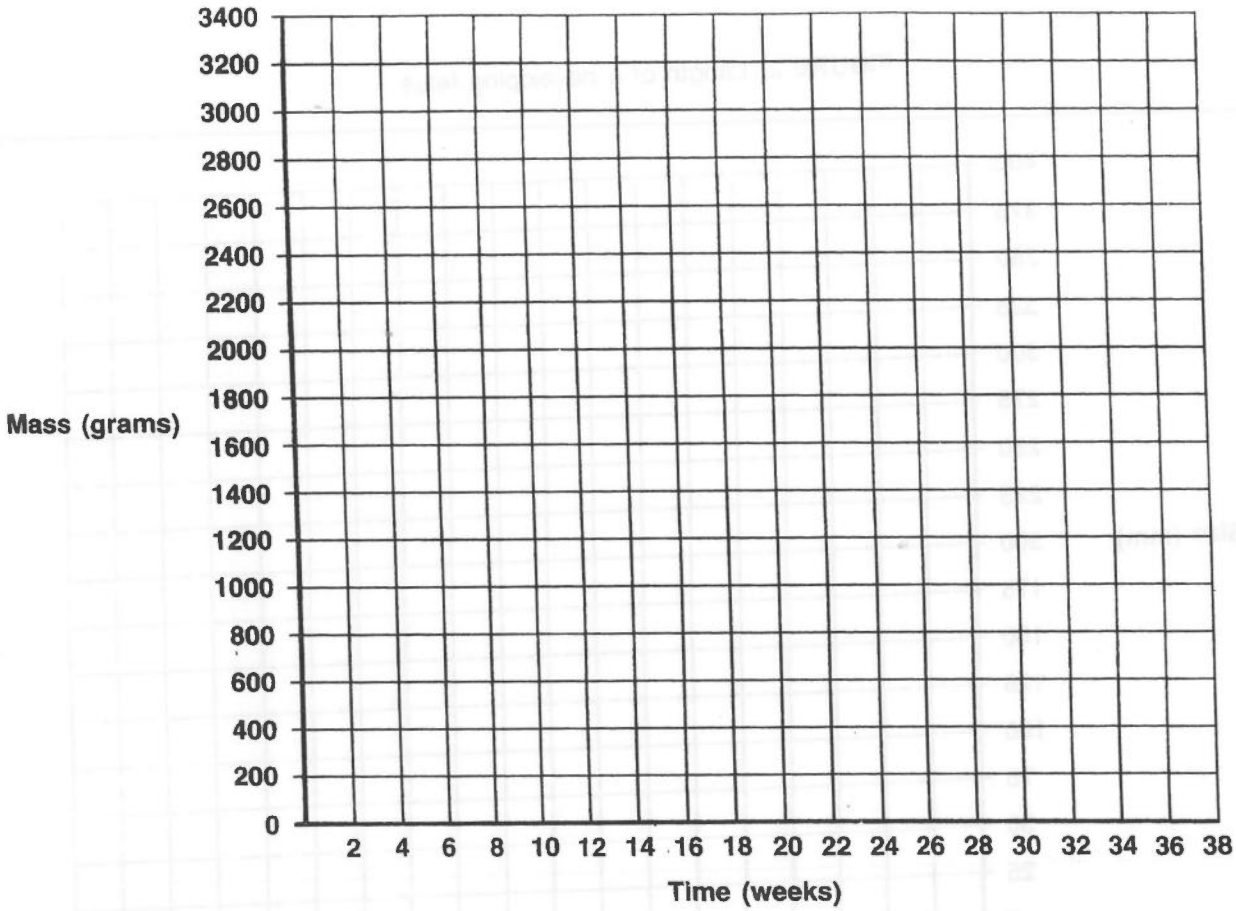
Part C. Plotting Mass of a Developing Fetus

1. Look at the data supplied in Table 2.
2. Plot the data of the developing fetus from Table 2 onto the graph in Figure 3.
3. Plot the mass of the fetus against the age of the fetus.

Table 2. Mass of a Developing Fetus

Time (weeks)	Mass (grams)	Time (weeks)	Mass (grams)
4	0.5	24	650
8	1	28	1100
12	15	32	1700
16	100	36	2400
20	300	38	3300

FIGURE 3. Mass of a developing fetus



QUESTIONS

1. During what weeks of development is the human baby called an embryo?

   _____

2. What is the length of an embryo during this time?_____

3. How much mass does an embryo gain during this time?_____

4. During what weeks of development is the human baby called a fetus?_____

   _____

5. Look at Figures 2 and 3 for the halfway point in development at week 19.

   a. Is the fetus half of its full length at this time?_____

   b. Is the fetus half of its full mass at this time?_____

6. a. At what week does the fetus reach half its full length?_____

   b. At what week does the fetus reach half its full mass?_____

7. If a premature baby is born with a mass of

   a. 2200 grams, how old is the fetus?_____

   b. 1800 grams, how old is the fetus?_____

Name _____ Class _____ Period Part B

25–2 What Changes Occur During Birth?

A human baby develops for about 38 weeks inside the mother. Then labor begins and the baby is born. What changes take place during and after birth? Why must a doctor sometimes have to perform a caesarean operation to help in delivery?

GOALS

In this activity, you will:

a. compare the changes that occur during birth.
b. learn why a caesarean delivery may be needed.
c. compare a delivery through the birth canal with a caesarean delivery.

KEYWORDS

Define the following keywords:

caesarean _____

contractions _____

fetus _____

labor _____

placenta _____

uterus _____

MATERIALS

metric ruler

PROCEDURE

Part A. Stages of Birth

1. Look at the diagrams of four stages of birth shown in Figures 1 and 2.

FIGURE 1.

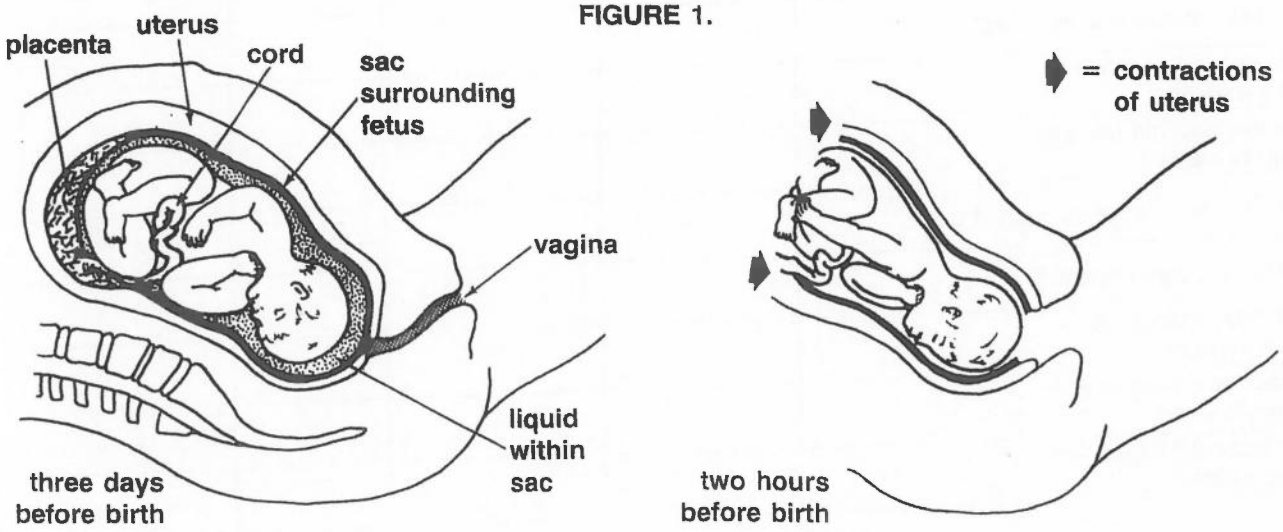
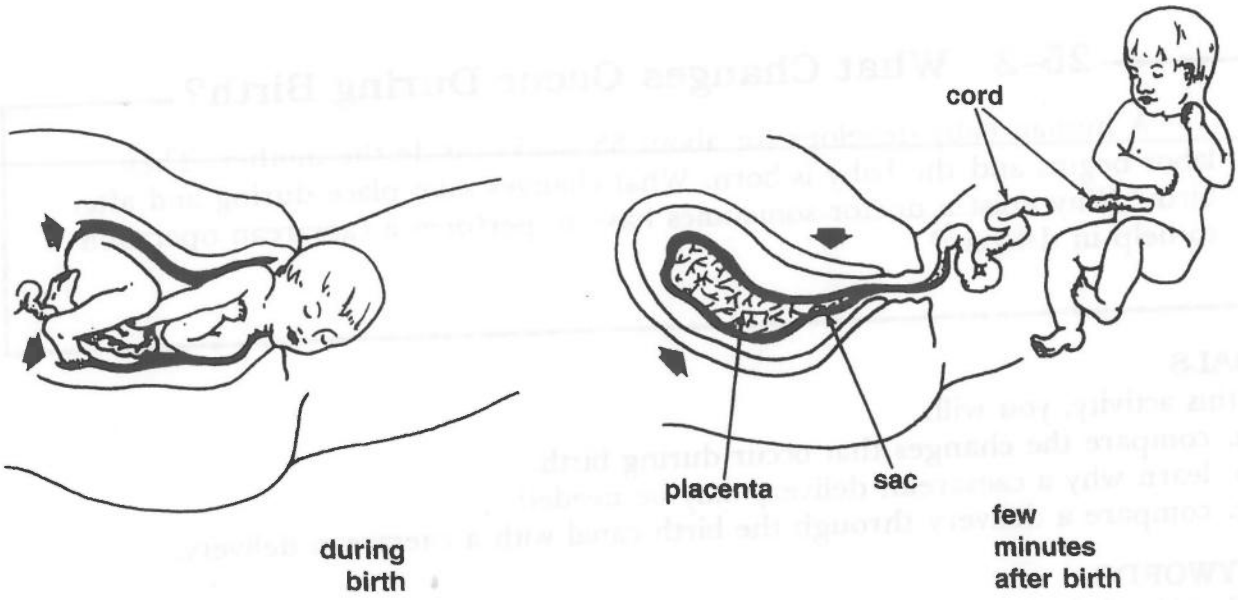


FIGURE 2.



2. Answer *yes* or *no* to each of the following questions in Table 1.

Table 1. Stages During Birth

	Three days before birth	Two hours before birth	During birth	Few minutes after birth
Is baby inside the uterus?				
Is baby inside the vagina?				
Is baby outside the mother's body?				
Is baby inside the sac?				
Has the sac broken?				
Are contractions occurring?				
Is baby attached to the cord?				
Is the cord attached to the placenta?				
Is the placenta attached to the uterus?				
Is the placenta being pushed out?				
Has the vagina opened?				
Is baby attached to the mother?				
Has liquid been lost from the sac?				
Is baby still dependent on the mother?				

Name _____ Class _____ Period _____

Part B. What Is a Caesarean Birth?

1. Look at the diagram in Figure 3 that shows the outline of the pelvis and the head of a fetus just before the time of birth.
2. Note carefully that the head must be able to pass through the opening in the pelvis during birth.
3. Measure line a. This represents the width of the opening in the pelvis.
4. Measure line b. This represents the width of the head of the fetus.

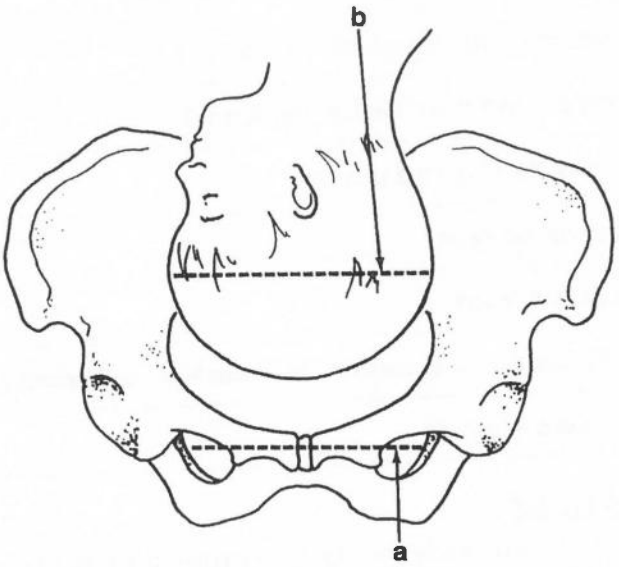


FIGURE 3. Sizes of pelvis and head of fetus

5. Record your data in millimeters here:

   a. width of pelvis opening _____

   b. width of fetus head _____

6. Notice that this fetus would not be able to pass through this pelvis opening.
7. A caesarean operation must be done to deliver the baby.
8. Look at how a caesarean birth is done in Figure 4. This is usually done before the mother goes into labor.
9. To compare a birth canal delivery with a caesarean delivery, answer the questions in Table 2.

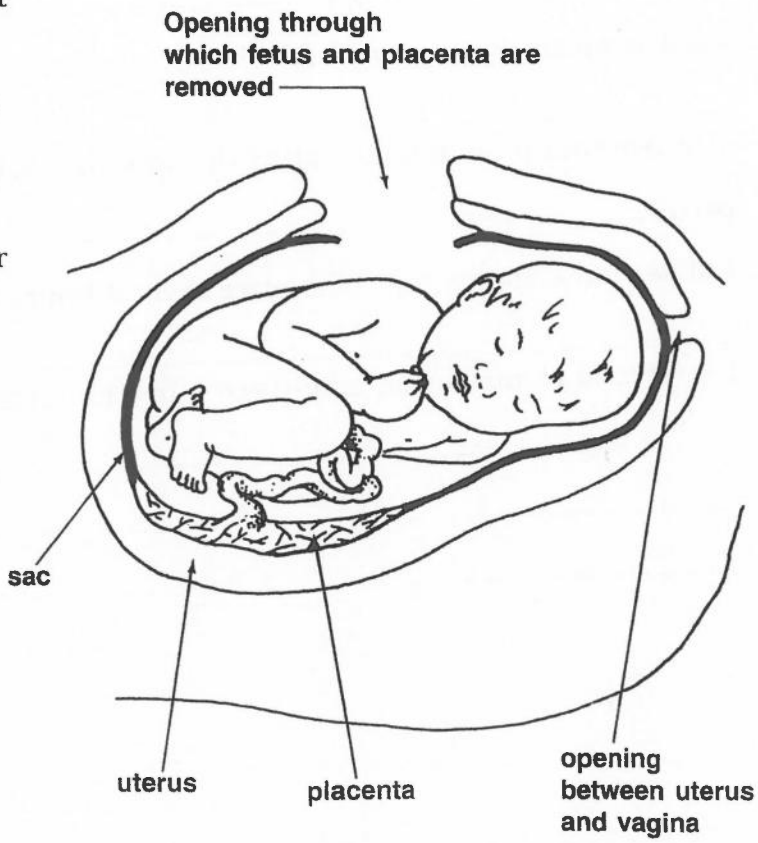


FIGURE 4. Caesarean birth

Table 2. Comparing a Caesarean Delivery With a Birth Canal Delivery

Trait	Birth canal	Caesarean
Does the fetus pass through opening in the pelvis?		
Does the fetus pass through the vagina?		
Does the placenta move through the vagina?		
Is the fetus lifted from the uterus?		
Is the uterus cut open?		
Is the sac cut open?		
Must the cord be cut to separate the fetus from the placenta?		
Do contractions occur?		

QUESTIONS

1. What two body parts surround and protect the fetus as it develops?

   _____

2. What is the job of the placenta?_____

   _____

3. What is the job of the cord?_____

4. What is meant by the word *labor*?_____

   _____

5. The placenta is sometimes called the *afterbirth*. Why is this a good name for this part?_____

6. List several changes that take place several hours before birth._____

   _____

7. List several changes that take place a few minutes after birth.

   _____

   _____

   _____

Name_____ Class_____ Date _____

Investigating Inherited Traits

TURANO LE 161

Introduction

Heredity is the passing on of traits, or characteristics, from parent to offspring. The genetic makeup of an individual is known as its genotype. The physical traits you can observe in a person are his or her phenotype. Phenotype is a result of the genotype and the individual's interaction with the environment.

The units of heredity are called genes. Genes are found on the chromosomes in a cell. An allele is one of two or more forms of a gene. When the two alleles of a pair are the same, the genotype is homozygous, or pure. When the two alleles are not the same, the genotype is heterozygous, or hybrid. In nature, specific combinations of alleles happen only by chance.

Some alleles are expressed only when the dominant allele is absent. These alleles produce recessive phenotypes. Alleles that are expressed when the genotype is either homozygous or heterozygous produce dominant phenotypes. An allele that codes for a dominant trait is represented by a capital letter, while an allele that codes for a recessive trait is represented by a lowercase letter.

Sometimes when the genotype is heterozygous, neither the dominant nor recessive phenotype occurs. In this case, called incomplete dominance or codominance, an intermediate phenotype is produced.

In humans, the sex of a person is determined by the combination of two sex chromosomes. People who have two X chromosomes (XX) are females, while those who have one X chromosome and one Y chromosome (XY) are males.

In this investigation, you will see how different combinations of alleles produce different characteristics.

Problem

How are traits inherited?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. What does a single side of the coin or disk represent?

_____

_____

2. What are the chances that any coin or disk tossed will land heads up?

_____

_____

3. How is a coin toss like the selection of a particular allele?

_____

_____

4. For the traits in this investigation, do all heterozygous pairs of alleles produce an intermediate phenotype?

_____

_____

5. Can you accurately determine a person's genotype by observing his or her phenotype?

_____

_____

Materials *(per pair)*

3 textbooks
2 coins

Procedure

1. Place the textbooks on the laboratory table so that they form a triangular well.
2. Obtain two coins. You and your partner will each flip a coin to determine the traits in a hypothetical offspring.
3. Start by determining the sex of the offspring. Flip the coins into the well. If both coins land the same side up, the offspring is a female. If the coins land different sides up, the offspring is a male. Record the sex of the offspring in the blank on page 117.
4. For the rest of the coin tosses you will make, heads will represent the dominant allele and tails will represent the recessive allele.
5. You and your partner should now flip your coins into the well at the same time to determine the phenotype of the first trait, the shape of the face. **Note:** *The coins should be flipped only once for each trait.* After each flip, record the trait of your offspring by placing a check in the appropriate box in Figure 1.
6. Continue to flip the coins for each trait listed in the table in Figure 1. **Note:** *Some information in Figure 1 has been simplified. Some listed traits are actually produced by two or more genes.*
7. Using the recorded traits, draw the facial features for your offspring in the space provided on page 117.

Name_____ Class_____ Date _____

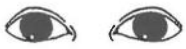
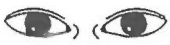
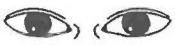
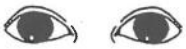
Traits	Dominant (both heads)	Hybrid (one head, one tail)	Recessive (both tails)
Shape of face	 round *RR*	 round *Rr*	 Square *rr*
Cleft in chin	 present *CC*	 present *Cc*	 absent *cc*
Texture of hair	 curly *HH*	 wavy *Hh*	 straight *hh*
Widow's peak	 present *WW*	 present *Ww*	 absent *ww*
Spacing of eyes	 close together *EE*	 medium distance *Ee*	 far apart *ee*
Shape of eyes	 almond *AA*	 almond *Aa*	 round *aa*
Position of eyes	 straight *SS*	 straight *Ss*	 slant upward *ss*
Size of eyes	 large *LL*	 medium *Ll*	 small *ll*

Figure 1

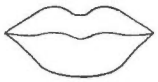
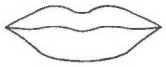
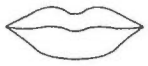
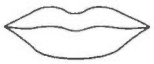
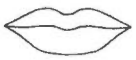
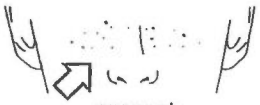
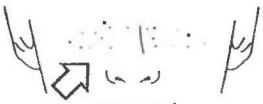
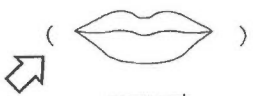
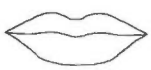
Traits	Dominant (both heads)	Hybrid (one head, one tail)	Recessive (both tails)
Length of eyelashes	 long *LL*	 long *Ll*	 short *ll*
Shape of eyebrows	 bushy *BB*	 bushy *Bb*	 fine *bb*
Position of eyebrows	 not connected *NN*	 not connected *Nn*	 connected *nn*
Size of nose	 large *LL*	 medium *Ll*	 small *ll*
Shape of lips	 thick *TT*	 medium *Tt*	 thin *tt*
Size of ears	 large *LL*	 medium *Ll*	 small *ll*
Size of mouth	 large *LL*	 medium *Ll*	 small *ll*
Freckles	 present *FF*	 present *Ff*	 absent *ff*
Dimples	 present *DD*	 present *Dd*	 absent *dd*

Figure 1 *continued*

Analysis and Conclusions

1. **Calculating** What percent chance did you and your partner have of "producing" a male offspring? A female offspring? Explain your answer.

2. **Predicting** Would you expect the other pairs of students in your class to have an offspring completely similar to yours? Explain your answer.

3. **Inferring** What are the possible genotypes of the parents of a child who has wavy hair *(Hh)*?

4. **Classifying** Which traits in this investigation showed incomplete dominance?

5. **Drawing Conclusions** Do you think that anyone in your class has all the same genetic traits that you have? Explain your answer.

6. **Drawing Conclusions** How might it be possible for you to show a trait when none of your relatives shows it?

Going Further

Repeat this investigation with your partner to "produce" your second offspring. After completing all of your tosses, make a drawing of the offspring. What similarities exist between your first and second offspring? What differences? Would you expect a third offspring to resemble either the first or the second offspring? Explain your reason.

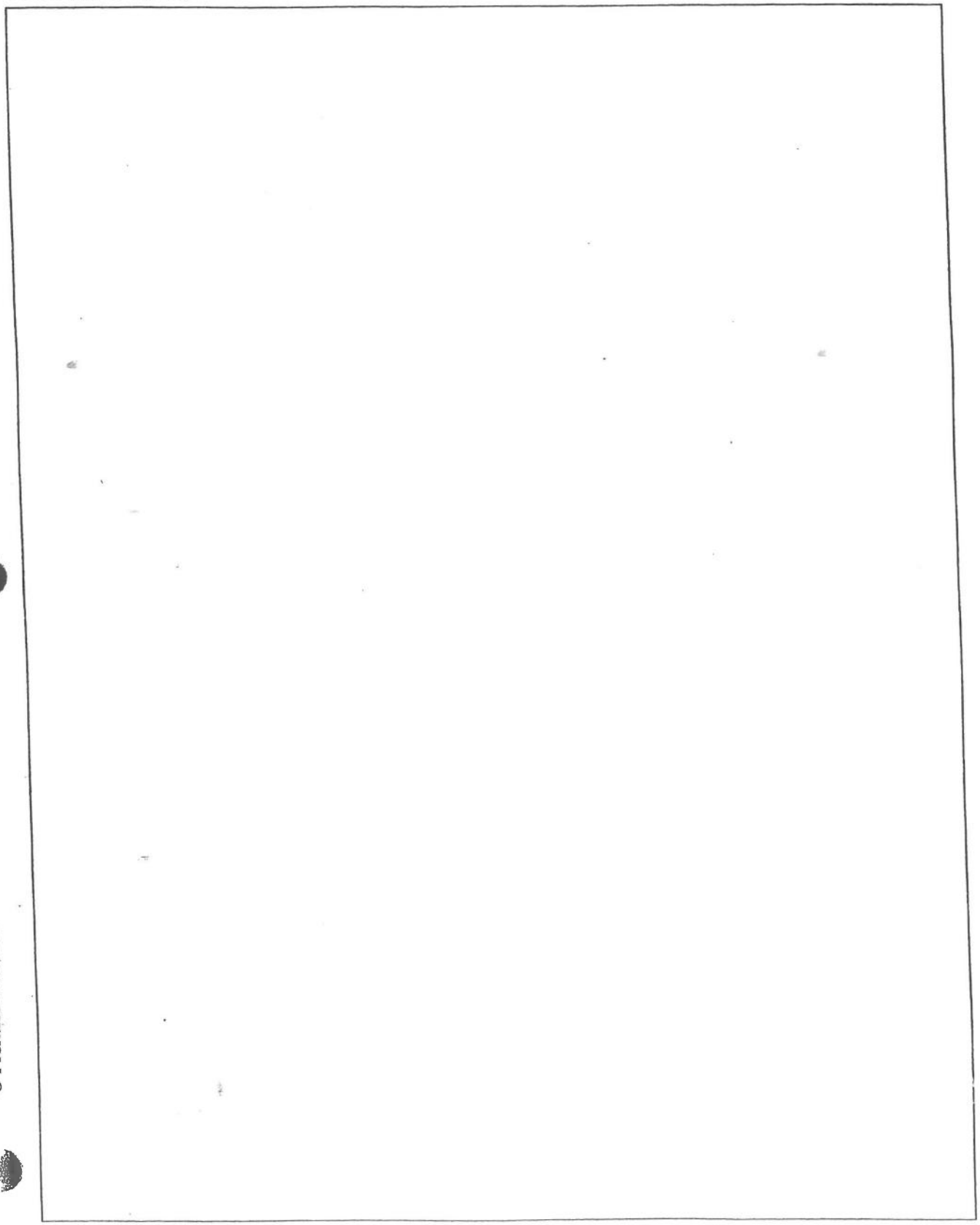
TURANO LE161

Name_____ Class_____ Date _____

Sex of offspring

_____

Drawing of Offspring



Name_____ Class_____ Date _____

Solving Heredity Problems

Turano LE 161

Introduction

Inheritable characteristics of organisms are passed from parents to offspring by genes. Four terms are used to describe organisms genetically. Genotype describes an organism's genetic makeup. Genotypes made up of like alleles are homozygous; those made up of unlike alleles are heterozygous. Phenotype describes an organism's appearance and is based on the organism's genotype.

In this investigation, you will solve two different heredity problems. The first problem is concerned with the color of hair in guinea pigs. The second problem is concerned with codominance.

Problem

What are the possible genotypes and phenotypes of offspring produced by parent organisms with known characteristics?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. In pea plants, the allele for purple flower color is dominant. The allele for white flower color is recessive. Write the genotype of a pea plant that is heterozygous for flower color. What two genotypes might a pea plant homozygous for flower color have?

_____

_____

_____

_____

_____

2. Predict the phenotype of a pea plant with the genotype *Pp* for flower color. (Hint: Flower color in pea plants is completely dominant.)

_____

3. What is the difference between alleles that are codominant and those that are completely dominant?

_____

_____

_____

_____

_____

4. What do the boxes in a Punnett square represent? How will you use the boxes to calculate genotypic ratios?

5. For a given Punnett square, will the genotypic ratio always be the same as the phenotypic ratio? Explain your answer.

Procedure

1. In guinea pigs, the allele for black fur (*B*) is dominant over the allele for white fur (*b*). Fill in the Punnett square in Figure 1 to determine the possible genotypes and phenotypes of offspring produced from the cross between a homozygous black guinea pig and a heterozygous black guinea pig.

Phenotype: black
Genotype: homozygous

Phenotype: black
Genotype: heterozygous

	B	*B*
B	Genotype: _____ Phenotype: _____	Genotype: _____ Phenotype: _____
b	Genotype: _____ Phenotype: _____	Genotype: _____ Phenotype: _____

Figure 1

2. In cattle, codominance of the allele for a red coat (*R*) and the allele for a white coat (*W*) results in offspring with a roan coat (*RW*); that is, a coat with both red and white hairs. Fill in the Punnett square in Figure 2 to determine the possible genotypes and phenotypes of offspring produced from the cross between a roan cow and a white bull.

Name_____ Class_____ Date _____

Phenotype: _____

Phenotype: _____

	R	W
W	Genotype: _____ Phenotype: _____	Genotype: _____ Phenotype: _____
W	Genotype: _____ Phenotype: _____	Genotype: _____ Phenotype: _____

Figure 2

Analysis and Conclusions

1. **Calculating** What is the genotypic ratio in Figure 1?

2. **Calculating** What is the phenotypic ratio in Figure 1?

3. **Drawing Conclusions** Is it possible to produce a white guinea pig by crossing a homozygous black guinea pig and a heterozygous black guinea pig? Explain your answer.

4. **Calculating** What is the genotypic ratio in Figure 2?

5. **Calculating** What is the phenotypic ratio in Figure 2?

6. **Using Tables** What would the genotypes and phenotypes of the offspring be from the cross between a roan cow and a roan bull? Draw a Punnett square below to support your answer.

7. Is it possible for two organisms to have different genotypes but the same phenotype? Explain your answer.

Going Further

Animal and plant breeders often keep careful records about the phenotypes of the organisms they raise—often in the form of a pedigree. Find examples of pedigrees and trace the inheritance of traits from one generation to the next. Why do you think pedigrees and careful records might be important to breeders?

TURANO LG 161

Name _____ Date _____

Lab # _____

Evidence of Evolution

Background

Much evidence has been found to indicate that living things have evolved or changed gradually during their natural history. The study of fossils as well as work in embryology, biochemistry, and comparative anatomy provides evidence for evolution.

Objective

In this lab you will learn about homologous, analogous, and vestigial structures and their significance in evolution theory.

Materials

colored pencils

Procedures and Observations

PART I. HOMOLOGOUS STRUCTURES ----------

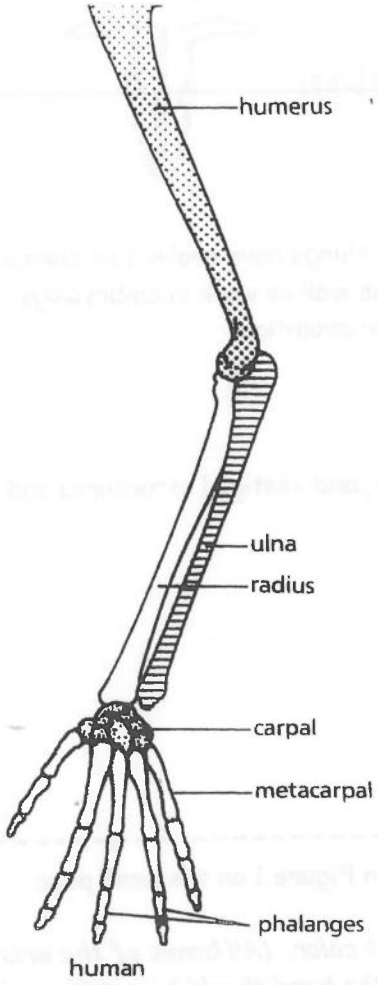
1. Carefully examine the drawings of the bones shown in Figure 1 on the next page. Look for similarities among the various animals.
   a. *Color each part of the human arm a different color. (All bones of the wrist should be a single color, the bone groups of the hand should be a different single color.) Then color the corresponding bone in each of the other animals the same color as the human bone.*
   b. *Describe the function of each set of bones below:*

Animal	Function
human	
whale	
cat	
bat	
bird	
crocodile	

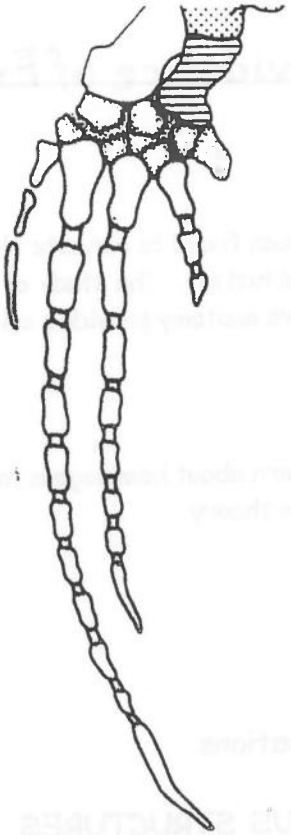
   c. *Are the bones arranged in a similar way in each animal?*

   _____

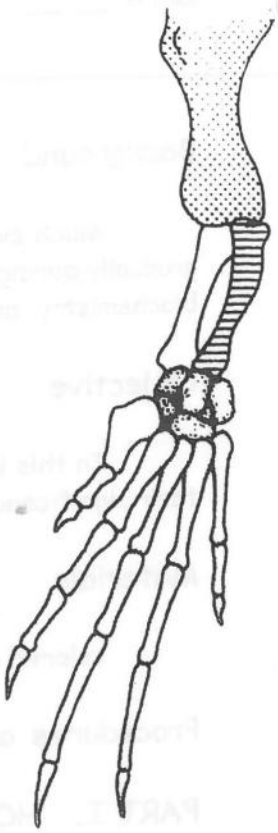
These structures are formed in similar ways during embryonic development and share like arrangements; however, they have somewhat different forms and functions. They are called *homologous structures.*



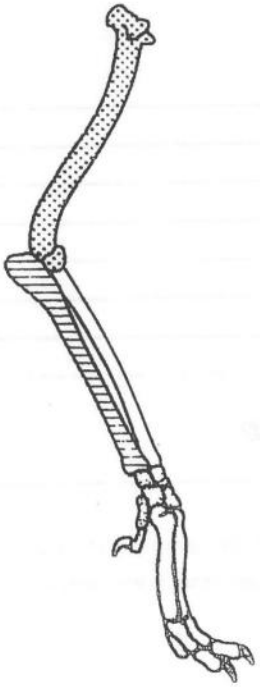
human



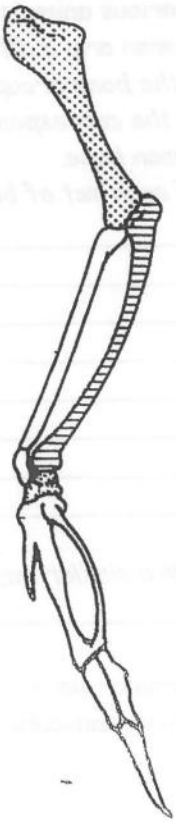
whale



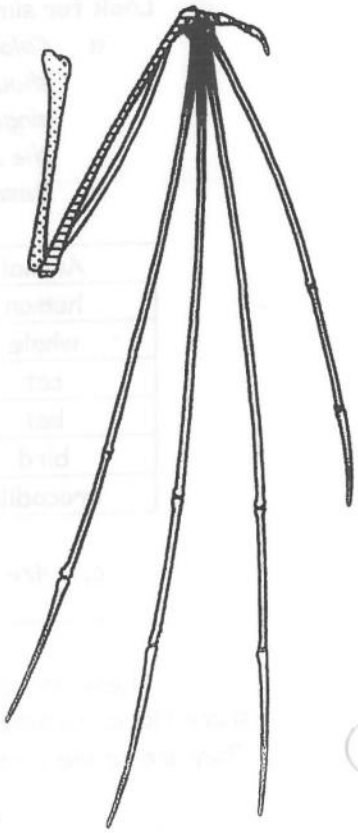
crocodile



cat



bird



bat

PART II. ANALOGOUS STRUCTURES ----------

1. Examine the butterfly wing and the bird wing shown in Figure 2.

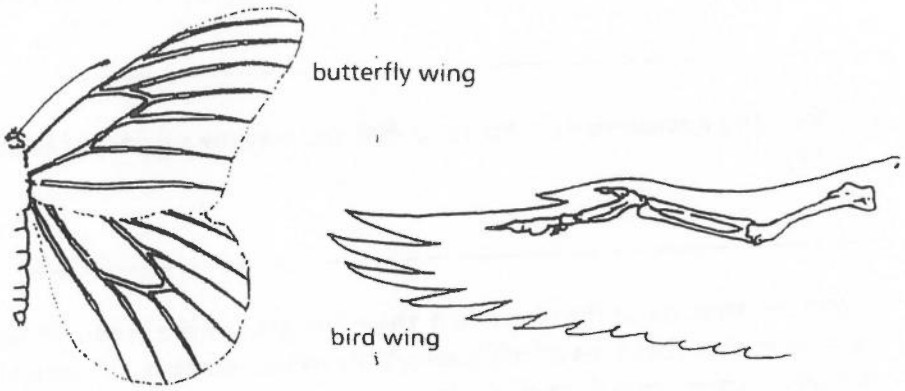


Figure 2

a. *What function do these structures share?*

_____

b. *How do the structures differ?*

_____

_____

c. *Do birds and insects share any structural similarities that would suggest they are closely related taxonomically (when classified)?*

_____

Some apparently unrelated animals have organs with similar functions, yet are very different in structure and form. These structures are called ***analogous structures.***

PART III. VESTIGIAL STRUCTURES----------

Gradual changes have occurred through time that have in some cases reduced or removed the function of some body structures and organs. The penguin's wings and the leg bones of snakes are examples of this phenomenon.

1. The cave fish and minnow shown in Figure 3 are related, but the cave fish is blind.

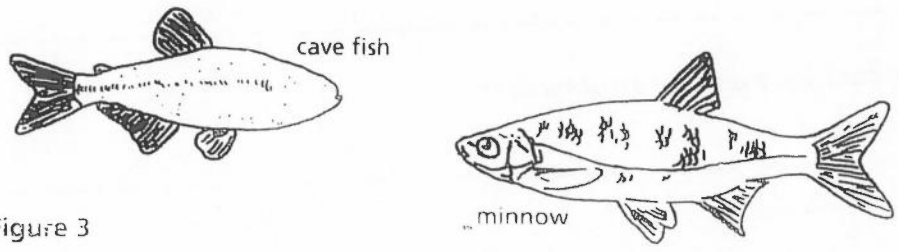


Figure 3

Figure 3

a. *Explain why eyesight is not an important adaptation to life in a cave.*

_____

b. *Does the appearance of the cave fish and minnow suggest common ancestry? Why?*

_____

Organs or structures that have lost their function in the organism and become reduced in size (because of efficiency) are called ***vestigial structures***. Human vestigial organs are well documented.

2. Read the list of human vestigial structures shown in Table 1.
   d. *Suggest a possible function for each structure and explain why it became vestigial. Record your answers in the table.*

Table 1.

Structure	Probable Function	Why Vestigial?
Appendix		
Coccyx (tail bones)		
Muscles that move ears		
Muscles that make hair stand up		
Little toe		
Wisdom teeth		

Analysis and Interpretations

1. What is meant by the term homologous structures?

_____

2. What is meant by analogous structures?

_____

3. What are vestigial structures?

4. Explain why the homologous structures in Part I are evidence of evolutionary relationships.

5. Explain the evolutionary relationship between the fin of a fish and the flipper of a whale.

6. List two structures (not from Table 1) that you think are vestigial and explain why.

7. How can we account for the presence of such useless organs in the human body as the appendix and the coccyx?

8. Why would UNRELATED organisms evolve organs (structures) with SIMILAR function(s)?

Name: _____

Lab # _____

COMPARATIVE ANATOMY

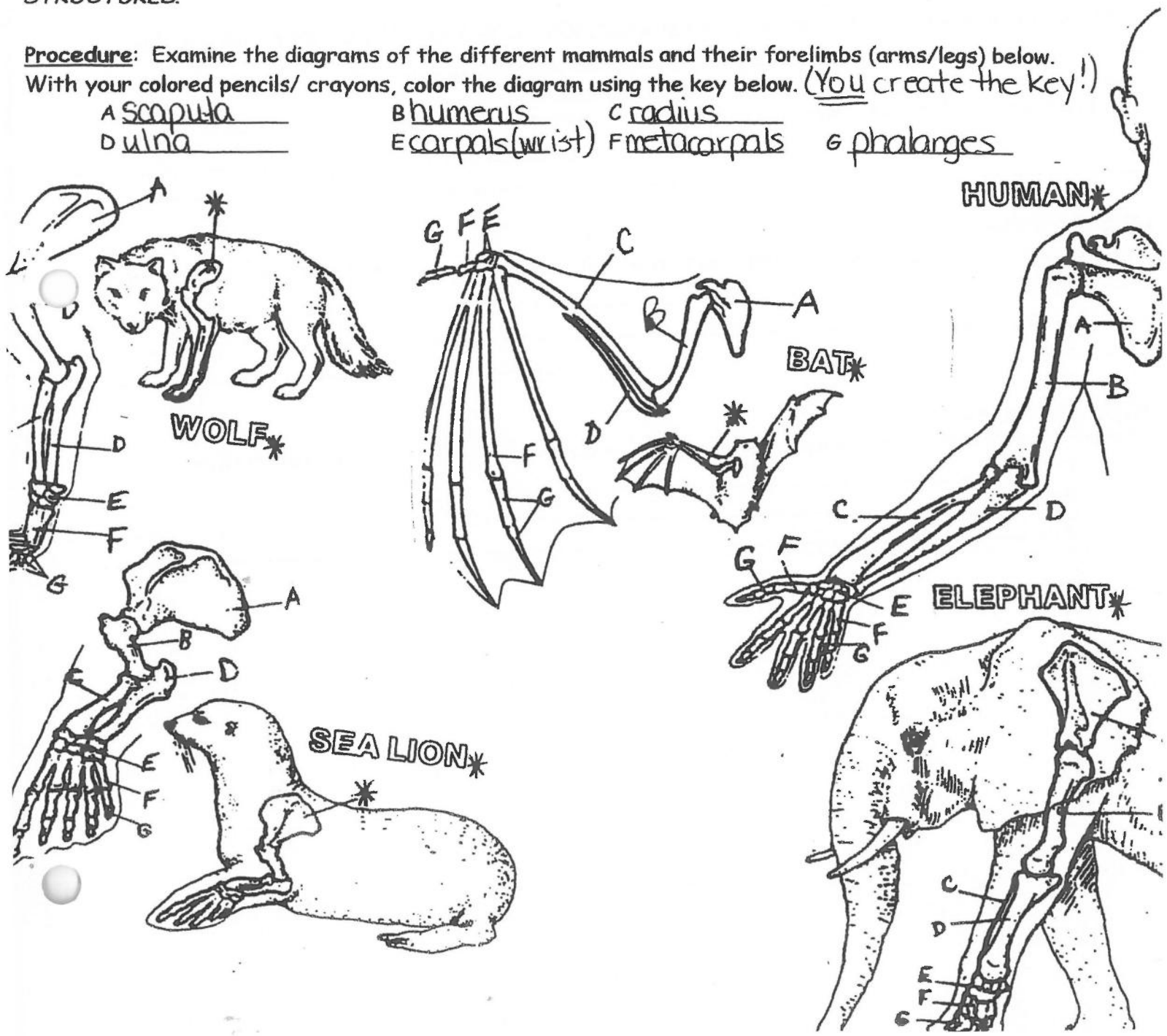
Background Information: There are millions of species of living organisms. All species appear to be different from each other and even within a species, there are differences (variations). Yet, there are similarities within this diversity. In this activity, you will be looking at the skeletons of seven completely different mammals to understand what we mean by similarities within the diversity.

Varieties of animal species build their skeletons along similar lines. Similar parts of these skeletons may be adapted to the same or different functions. Structures that are similar in build, whether or not they have the same function are *HOMOLOGOUS STRUCTURES*.

Sometimes very different organisms have structures that are similar in function, but upon close examination, these structures are different in many ways. These structures are *ANALOGOUS STRUCTURES*.

Procedure: Examine the diagrams of the different mammals and their forelimbs (arms/legs) below. With your colored pencils/ crayons, color the diagram using the key below. (You create the key!)

A scapula B humerus C radius
D ulna E carpals (wrist) F metacarpals G phalanges



Questions:

1. Do all of the pictured mammals have the same bones in their forelimbs? How do you know?

   _____

   _____

2. Are the bones arranged in similar ways? How do you know? _____

   _____

   _____

3. Next to each organism, write the general function for the forelimb:
   a. human- _____
   b. elephant- _____
   c. wolf- _____
   d. sea lion- _____
   e. bat- _____
4. All of the forelimbs you colored in are considered HOMOLOGOUS STRUCTURES. Why is this?

   _____

   _____

5. Explain why the lungs of a whale and the gills of a fish are ANALOGOUS STRUCTURES.

   _____

   _____

Critical Thinking:

Think of another pair of organisms that have either ANALOGOUS or HOMOLOGOUS STRUCTURES. Explain which type of structure they have. _____

_____

_____

What did you learn?

Identify, in full sentences, 3 pieces of specific information you learned by doing this activity.

1. _____
2. _____
3. _____

Date

Identifying Adaptations in Birds

Lab 56

Background

Birds have many adaptations for flight. Hollow bones make birds light. Their feather-covered bodies are streamlined, which reduces air resistance. Strong flight muscles move the wings, and the wings provide aerodynamic lift.

Birds are also adapted to their food source and to their environment. Their beaks and tongues are shaped in ways that help in getting food. Their feet are modified to function in a particular environment.

The various sizes and shapes of beaks and tongues are adaptations for capturing, holding, and eating particular kinds of food. Tongues vary in length and shape. Some beaks are hooked or toothed for grasping and tearing; some are pointed for spearing food; some are long and thin, for probing flowers.

The legs and feet of birds are adapted for running, swimming, climbing, perching, seizing prey, and other activities. Toes on the feet may be long and slender, or short and stout. Many birds have a long toe that points backward. At the end of each toe is a nail, made of strong, hornlike material. Nails may be blunt or sharp. They may be long or short. The nails of birds of prey, such as hawks and owls, are called *talons*. These nails are very long, hooked, thick, and sharp.

Objectives

1. Observe adaptations of beaks of birds, and relate these to each bird's method of feeding.
2. Observe adaptations of legs and feet of birds, and relate these to each bird's environment.

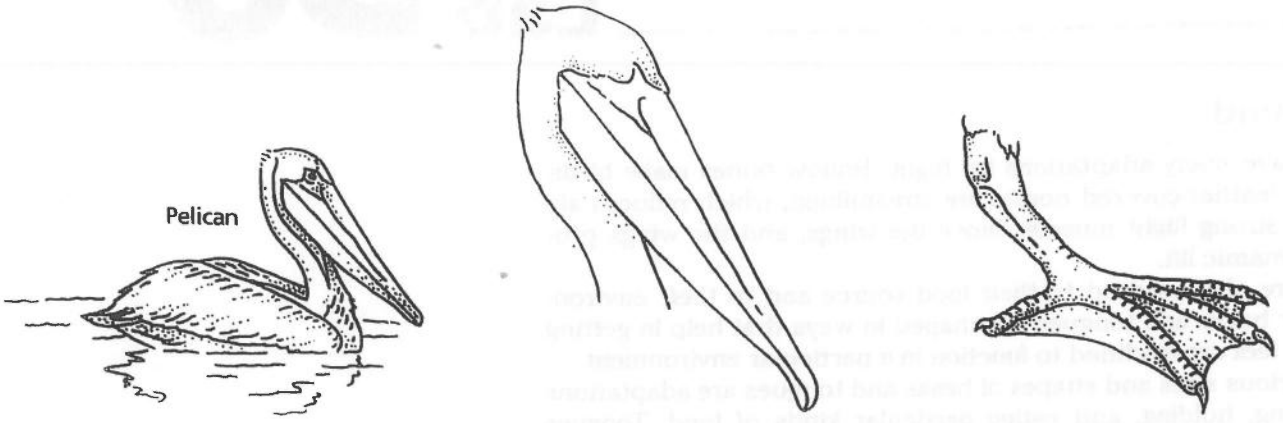
Procedures and Observations

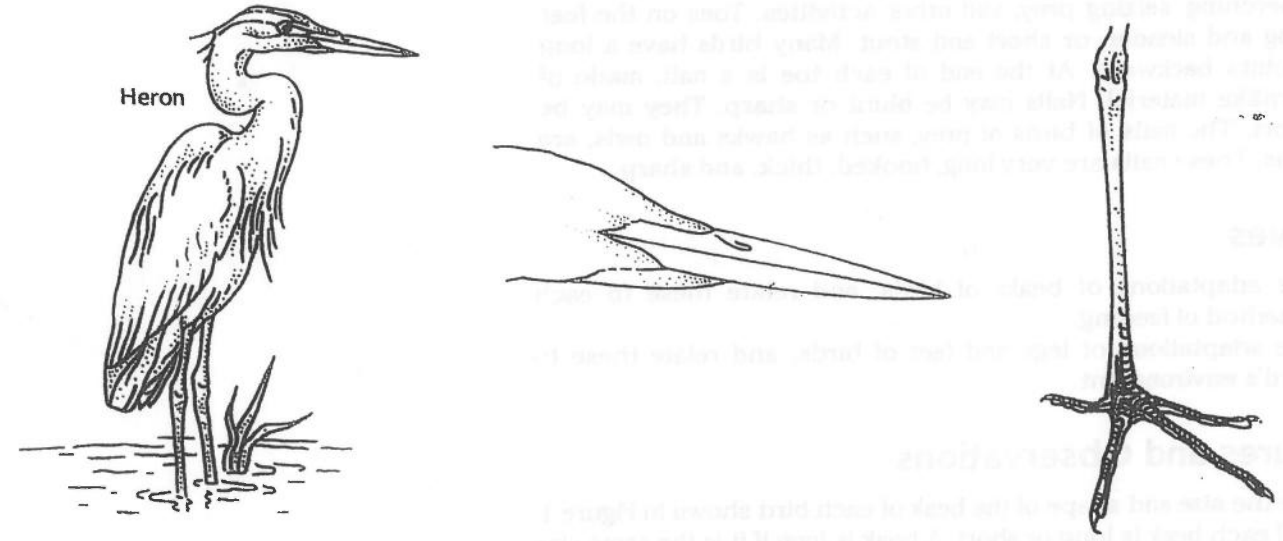
1. Examine the size and shape of the beak of each bird shown in Figure 1. Decide if each beak is long or short. A beak is *long* if it is the same size or longer than the bird's head. It is *short* if it is shorter than the bird's head.

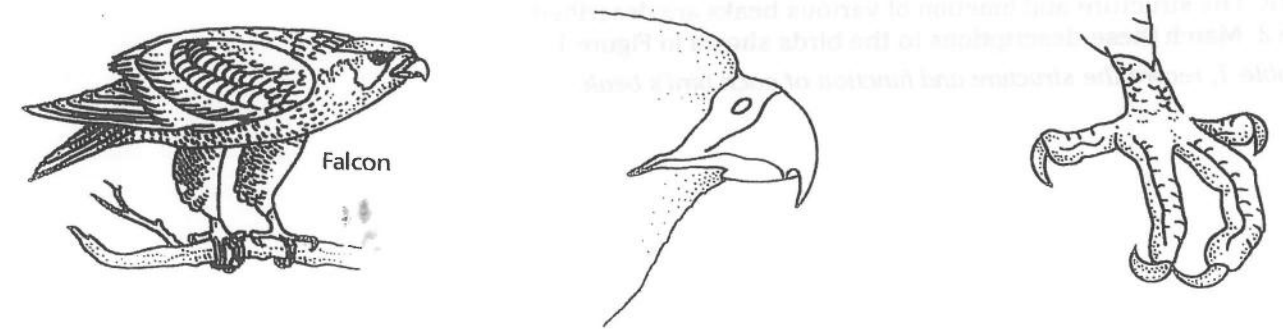
   a. *Record these observations in Table 1 on page 346.*

2. You can determine the function of a bird's beak by examining its structure. The structure and function of various beaks are described in Table 2. Match these descriptions to the birds shown in Figure 1.

   b. *In Table 1, record the structure and function of each bird's beak.*


Pelican

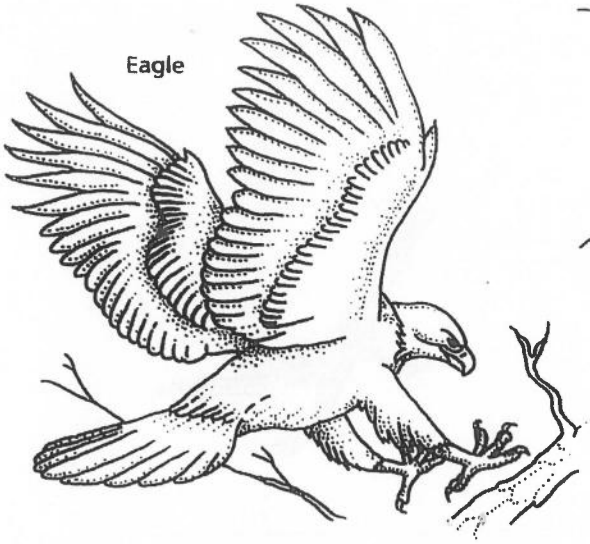

Heron

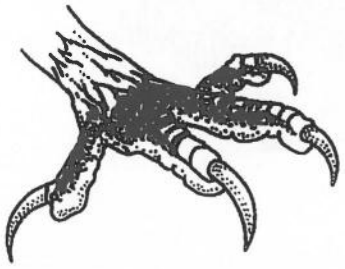

Falcon

Name _____

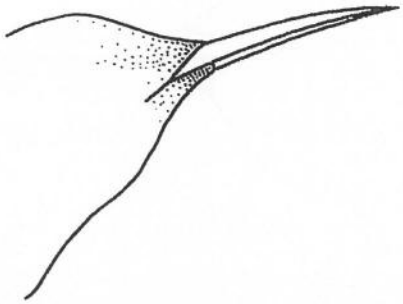
Identifying Adaptations in Birds (continued) 56

Eagle

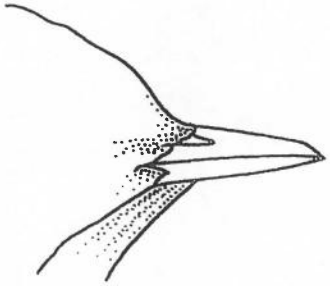


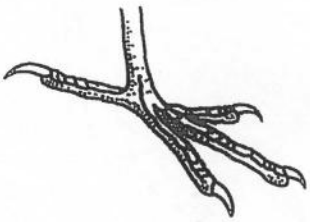


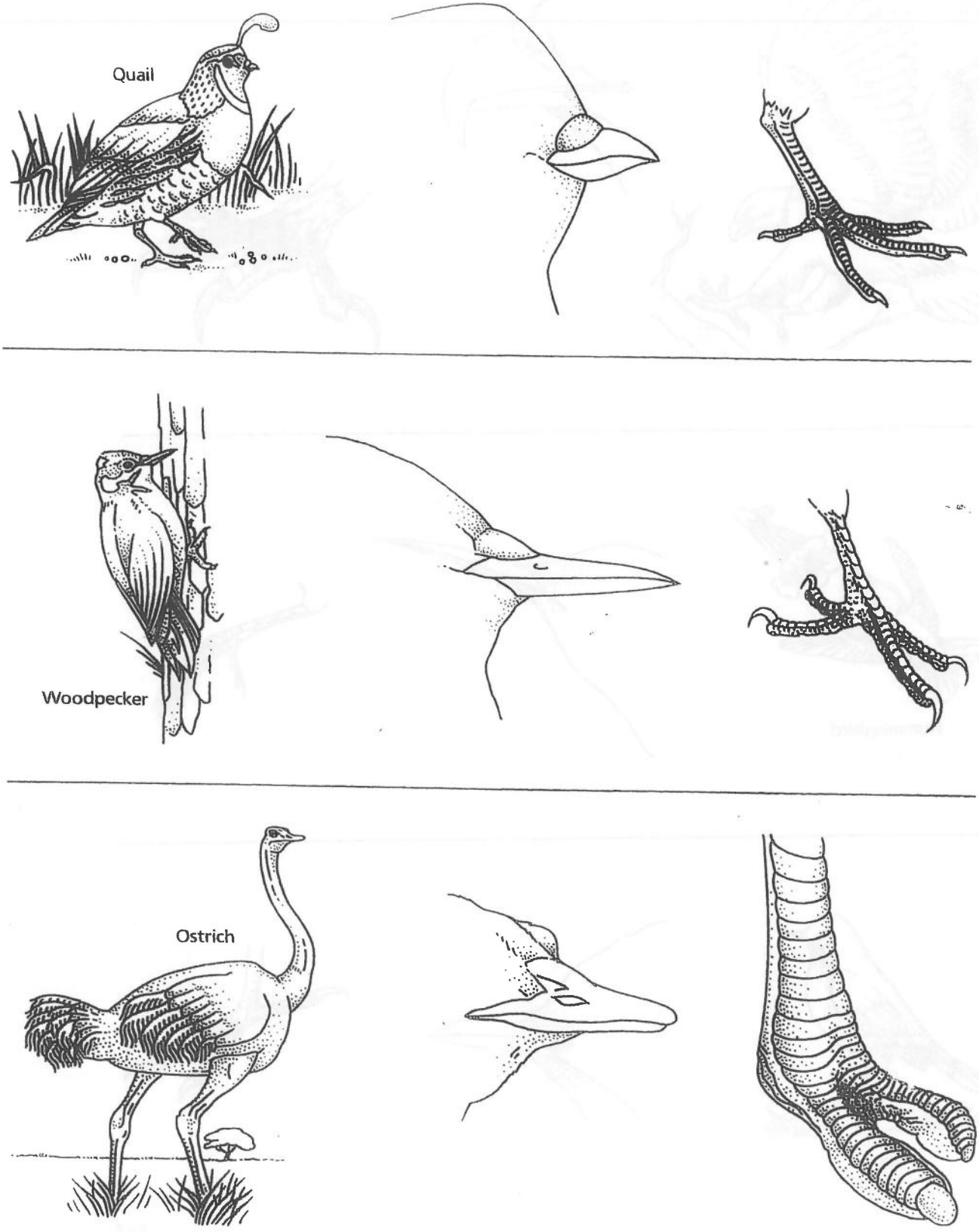
Hummingbird



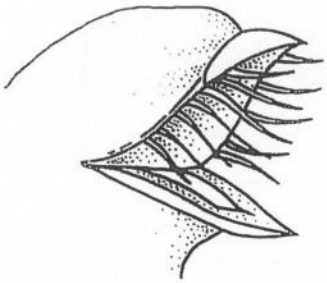
Robin



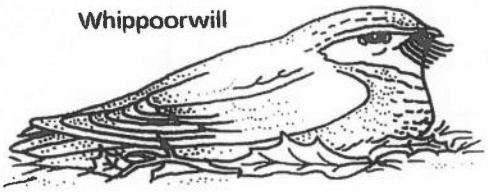


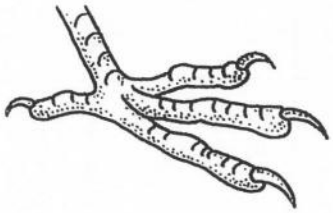

Quail
Woodpecker
Ostrich

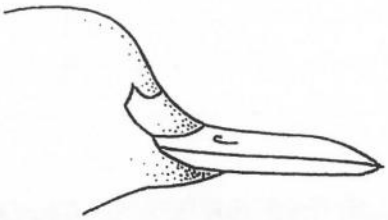
Identifying Adaptations in Birds (continued) 56



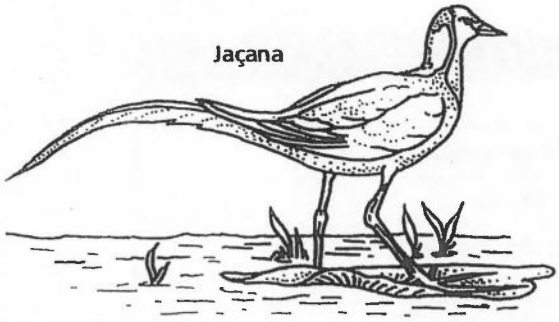
Whippoorwill

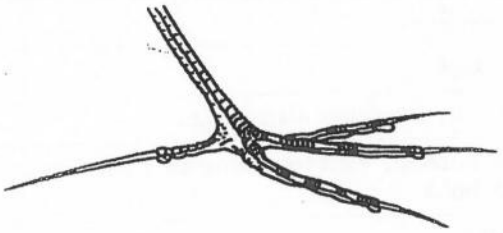


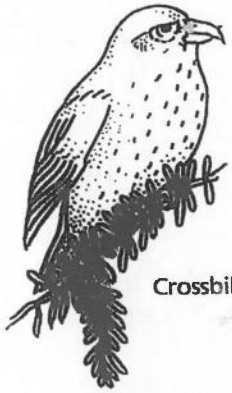




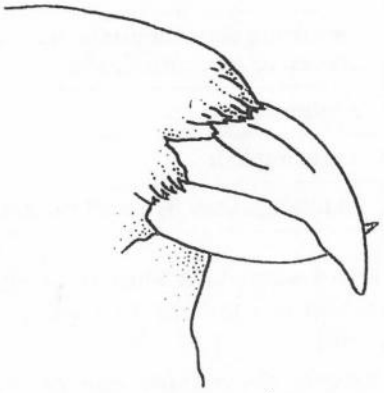
Jaçana







Crossbill



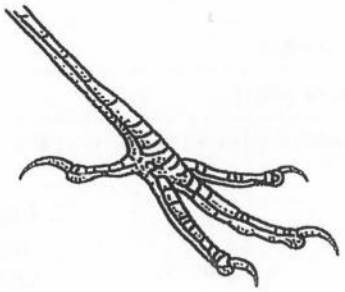


Table 1. Adaptations in Beaks of Birds

Bird	Length of beak	Structure of beak	Function of beak
Pelican			
Heron			
Falcon			
Eagle			
Hummingbird			
Robin			
Quail			
Woodpecker			
Ostrich			
Whippoorwill			
Jacana			
Crossbill			

Table 2. Sizes and Shapes of Beaks

short, hooked, thick	tearing flesh
short, very thick	cracking and crushing seeds
short, wide, with fringelike structures	trapping insects in the air
short, thick, hooked, with toothlike structure on each side of hook	capturing prey and tearing flesh
short, pointed	capturing worms and insects
short, with curved and crossed tips	prying open scales of pine cones
long, thin, pointed	probing into flowers to get nectar
long, straight, pointed	drilling into trees
long, thick, broad	capturing small animals, eating fruits, and picking up stones to mix with foods
long, with pouch	scooping fish
long, spear-shaped	spearing fish
long, straight, flattened slightly at tip	catching small fish and mollusks

3. Examine the foot of each bird shown in Figure 1. Notice that the number and position of the toes, as well as the type of nail, varies with the type of bird.

   c. *In Table 3, indicate the number and position of the toes for each bird.* Front toe *refers to a toe that points forward.* Back toe *refers to a toe that points backward.*

Identifying Adaptations in Birds (continued) 56

d. *In Table 3, describe the type of nail of each bird.*

Use the descriptions given in Table 4 to determine the function of each bird's foot.

e. *In Table 3, record the function of each bird's foot.*

Table 3. Adaptations in Feet of Birds

Pelican				
Heron				
Falcon				
Eagle				
Hummingbird				
Robin				
Quail				
Woodpecker				
Ostrich				
Whippoorwill				
Jacana				
Crossbill				

Table 4. Sizes and Shapes of Bird Feet

strong, thick toes; short, blunt nails	scratching
relatively long back toe, three front toes; short, sharp, curved nails	perching
webbing between toes; short nails	swimming
only two toes; short nails	running (on land)
very long legs and toes; short nails	wading
extremely long toes that are very widely spread; very long nails	running (over water plants)
two front toes, two back toes; nails are curved and pointed	climbing
stout toes; large, thick, very sharp, curved talons	grasping

Analysis and Interpretations

1. In the birds you studied, what was the most common function of the feet?

_____

2. What was the most common number and arrangement of toes on the birds that you studied?

_____

3. How are the beaks of the heron and pelican adapted for feeding on fish?

_____

_____

_____

4. How are the feet of a woodpecker adapted for the way the bird feeds?

_____

_____

_____

5. Some hummingbirds have longer beaks than others. How does this show that they are adapted for feeding on different flowers?

_____

_____

6. Imagine a bird with a certain habitat and feeding habits. What would this bird look like? What kind of beak and feet would it have? Describe the habitat and type of food that the bird would eat. Describe the physical characteristics of the bird

_____

For Further Investigation

1. Set up a bird feeder where you can see it from a window. Try putting out different kinds of bird food. Observe the birds that come to the feeder. Using binoculars, note the structure of the beaks of these birds, and try to determine the foods that different birds eat.

2. Many bird watchers form clubs that go for bird-watching hikes. If such a group exists in your area, find out if you can accompany them on a hike. Be sure to get parental permission.

Name _____ Class _____ Date _____

INVESTIGATION
15-1 Peppered Moth Survey

Introduction

Industrial melanism is the term used to describe the adaptation of an organism in response to industrial pollution. One example of rapid industrial melanism occurred in the peppered moth, *Biston betularia*, in the area of Manchester, England from 1845 to 1890.

Before the Industrial Revolution, the trees in the forest around Manchester were light, greyish-green due to the presence of lichens on their trunks. Peppered moths, which lived in the area, were light with dark spots. Their coloring served as camouflage against predators. As the Industrial Revolution progressed, the trees became covered with soot, turning the trunks dark. Over a period of 45 years, the peppered moth changed to a predominantly dark species, with only a few light-colored individuals remaining.

In this investigation, you will observe the effects of industrial melanism in the peppered moth over the course of several years.

Purpose

To observe the effect of environmental changes on the color variation of the peppered moth, *Biston betularia*

Objective

- ***Use* research data to graph the results of an environmental adaptation in the peppered moth.**

Materials

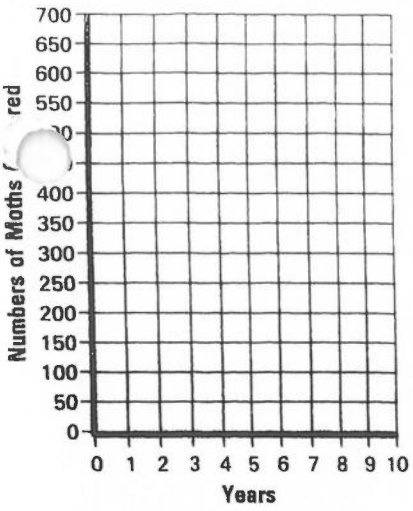
Graph Paper Pencils, colored (2) Textbook

Procedure

1. Table A represents data from a ten-year study of two varieties of the same species of peppered moth. The numbers represent moths captured in traps for ten consecutive years. The traps were located in the same area each year.

Table A

Year	Numbers of Light Moths Captured	Numbers of Dark Moths Captured
1	556	64
2	537	112
3	484	198
4	392	210
5	246	281
6	225	357
7	193	412
8	147	503
9	84	594
10	56	638



Students need only construct one graph using two different colors to show the variations in the moth.

2. Using the data provided, construct a graph comparing the numbers of each variety of peppered moth. Label the axes as shown in the illustration.

3. Use your textbook and your graph to answer the following questions.
What preys on the peppered moth?

_____

If the bark of trees is dark and the moths that rest there are light what will happen to the moths?

_____

_____

What is a mutation?

_____

_____ _____

_____

What could have caused the first moth to change from a light variety to a dark variety?

_____

What event caused the tree trunks of many trees in England to turn from light to dark?

_____

_____

_____

_____

Which variety of moth increased over the ten year period?

_____

What is the name of this type of evolutionary change?

_____

Analyses and Conclusions

1. Using the data on the graph, draw a conclusion concerning the population of peppered moths in the sampled area of England.

_____

_____

_____

2. Explain the reason for the increase in the number of dark-colored moths.

_____

_____

_____

3. What means could be used to return the environment of the peppered moth to its original state?

_____

_____

4. What effect would cleaning up the environment have on the moths?

_____

_____

_____

_____

Going Further

Research another organism that has shown a dramatic adaptation over a short period of time, such as sightless, albino animals in caves or antibiotic-resistant bacteria. Prepare a report on the circumstances surrounding this event.

Name:_____ Class: _____ Date: _____

Peppered Moth Analysis (http://biologycorner.com/worksheets/pepperedmoth.html)

Introduction:

Charles Darwin accumulated a tremendous collection of facts to support the theory of evolution by natural selection. One of his difficulties in demonstrating the theory, however, was the lack of an example of evolution over a short period of time, which could be observed as it was taking place in nature. Although Darwin was unaware of it, remarkable examples of evolution, which might have helped to persuade people of his theory, were in the countryside of his native England. One such example is the evolution of the peppered moth *Biston betularia*.

The economic changes known as the industrial revolution began in the middle of the eighteenth century. Since then, tons of soot has been deposited on the country side around industrial areas. The soot discolored and generally darkened the surfaces of trees and rocks. In 1848, a dark-colored moth was first recorded. Today, in some areas, 90% or more of the-peppered moths are dark in color. More than 70 species of moth in England have undergone a change from light to dark. Similar observations have been made in other industrial nations, including the United States.

1. Data Table

	Percent Dark Moths	Percent Light Moths
Lichen Forest	20	80
Sooty Forest	75	25

2. Explain how the color of moths increases or decreases their chances of survival depending on the environment.

3. 500 light colored moths and 500 dark colored moths are released into a polluted forest. After 2 days the moths were recaptured, make a prediction about the number of each type of moth that would be captured.

4. How has the striking change in coloration come about? (Include an explanation of how the dark moth appeared and how the proportion of dark moths changed from 0.0005% to more than 90% in polluted forests.)

5. What underlying law of nature has produced this change? (Use Darwin's theory of evolution and apply it to what you have learned in this investigation.)

Name _____ Class _____ Period _____

29–2 How Do Fossils Show Change?

Most organisms live, die, and decompose. They leave no traces of having lived. Under certain conditions, an organism's remains or tracks may be preserved as a fossil. Fossils give clues about how an organism looked and where it lived. They are often used by scientists as evidence of change.

A fossil is any remains of a once-living thing. Fossils may only be the outline of some plant, animal, or other organism that is preserved in rock. Sometimes, entire skeletons of animals that lived millions of years ago are found.

GOALS

In this activity, you will:

a. examine diagrams of fossil horses and present-day horses shown in their surroundings.
b. examine diagrams of the structure of the front foot of fossil horses and present-day horses.
c. note the changes in horses that have taken place over time.

KEYWORDS

Define the following keywords:

adaptation _____

Equus _____

fossil _____

Hyracotherium _____

natural selection _____

_____

MATERIALS

metric ruler
colored pencils: red, blue, green, and yellow

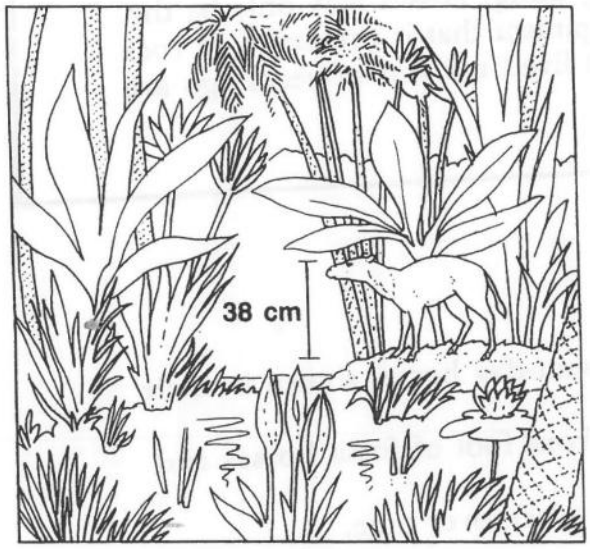
PROCEDURE

Part A. Change in Size With Time

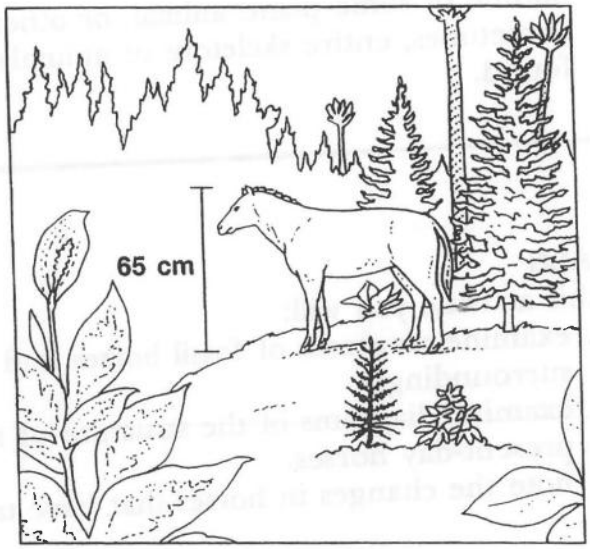
1. Examine the diagrams in Figure 1 of *Hyracotherium, Miohippus, Merychippus,* and *Equus.*
2. Use the diagrams to fill in Table 1.

Table 1. Evolution in the Horse

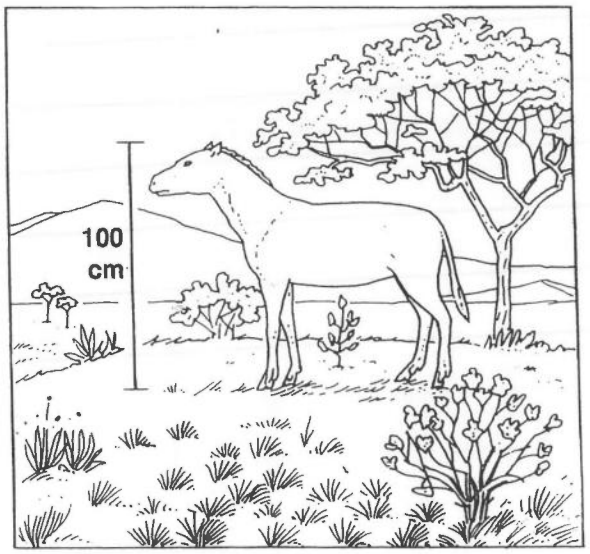
Horse	*Hyracotherium*	*Miohippus*	*Merychippus*	*Equus*
Size				
Type of surroundings				



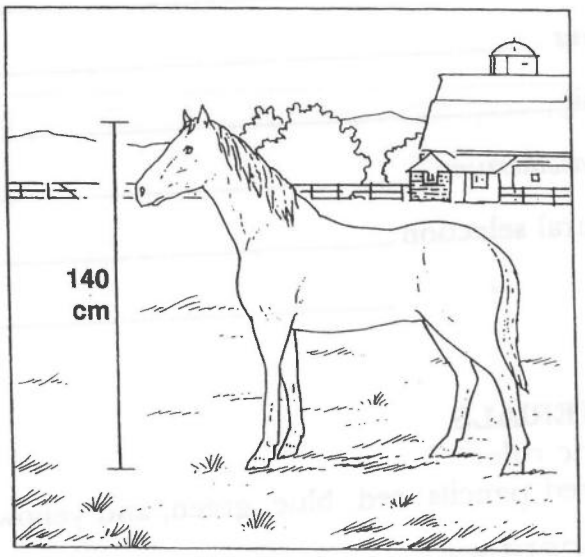
Hyracotherium
55 million years ago



Miohippus
30 million years ago



Merychippus
13 million years ago



Equus
Today

FIGURE 1. Evolution of the horse

Name _____ Class _____ Period _____

Part B. Changes in Bone Structures With Time

The changes in horses over the last 55 million years have been shown by studies of large numbers of fossils. The earliest kind of horse was small and had teeth that were adapted to browsing on young shoots of trees and shrubs. The present-day horse is much larger and has larger teeth that are adapted to grazing on the tough leaves of grasses. Early horses were adapted to living in wooded, swampy areas where more toes were an advantage. The single-hoofed toes of the present-day horse allow it to travel fast in the plains.

1. Examine the diagrams in Figure 2. They show fossils of the front foot bones and the teeth of horses. The foot bones at the upper right of each diagram indicate the relative bone sizes of each kind of horse.

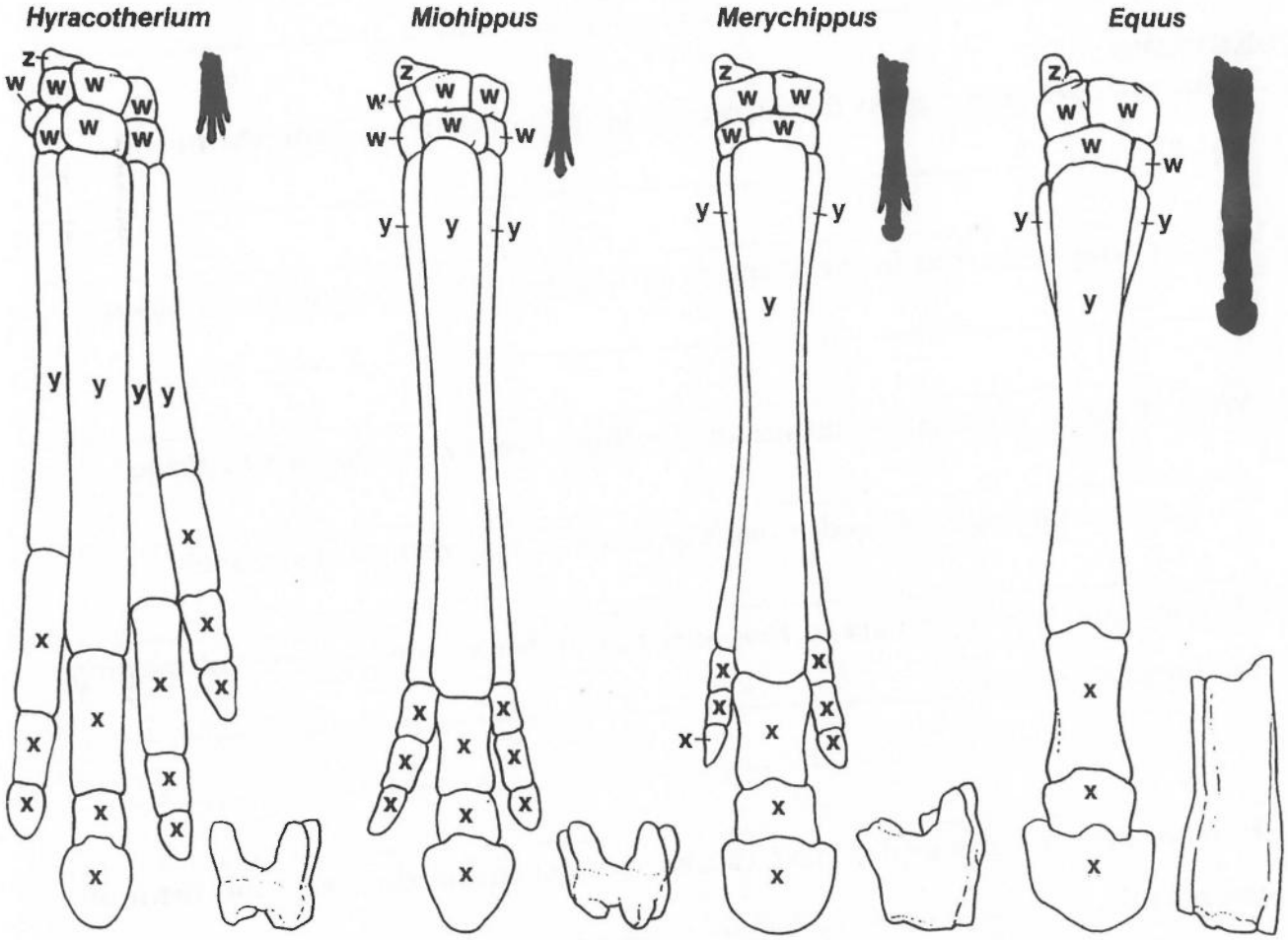


FIGURE 2. Forefoot bones and teeth of horses

2. Look for and color the following kinds of bones for each fossil horse.
   a. Color the toe bones red. These are marked for you with an *x*.
   b. Color the foot bones blue. These are marked with a *y*.
   c. Color the ankle bones green. These are marked with a *w*.
   d. Color the heel bones yellow. These are marked with a *z*.
3. Using the diagrams in Figure 2, make measurements to fill in Table 2.

Table 2. Evolution of the Horse

Kind of horse	*Hyracotherium*	*Miohippus*	*Merychippus*	*Equus*
Number of toes				
Number of toe bones				
Number of foot bones				
Number of ankle bones				
Number of heel bones				
Total number of foot bones				
Length of foot (measure inset diagrams) (mm)				
Height of teeth (mm)				

QUESTIONS

1. What changes occurred in the surroundings of horses from *Hyracotherium* to *Equus*?

2. What change occurred in the shape of the horse from *Hyracotherium* to *Equus*?

3. What changes occurred in the size of the horse from *Hyracotherium* to *Equus*?

4. As the surroundings changed, what happened to the teeth of the horse?

5. Describe the overall changes in foot length, number of toes, and size of toes in the horse over time.

6. How would natural selection have caused changes in the size, feet, and teeth of the horse?

Name _____ Class _____ Period _____

28–2 How Can a Mutation in DNA Affect an Organism?

Sometimes the DNA code that makes up a gene has an error in it. This error is called a mutation. When the DNA contains an error, the mRNA it makes will copy that error. When the mRNA contains an error, it will code for incorrect tRNAs and produce an incorrect protein.

Sickle-cell anemia is a disease that gets its name from the sickle shape of the red blood cells. The sickled red blood cells are caused by a mutation in the hemoglobin of the person with the disease. Hemoglobin is the main protein in red blood cells. Each hemoglobin molecule carries oxygen from the lungs to all other parts of the body.

GOALS

In this exercise, you will:

a. examine the coding errors produced in mRNA and tRNA when there is a mutation in the DNA.
b. examine the effect of a mutation in the gene that codes for blood hemoglobin.

KEYWORDS

Define the following keywords:

gene _____

hemoglobin _____

mutation _____

sickle-cell anemia _____

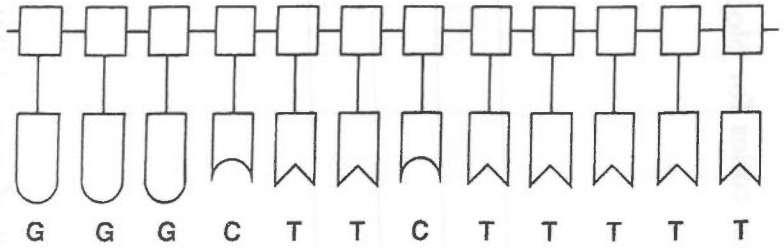
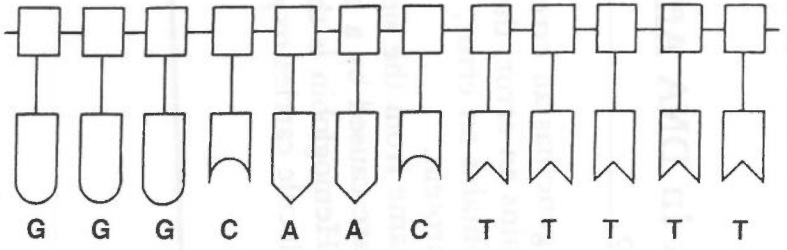
MATERIALS

colored pencil

PROCEDURE

1. Examine Table 1. The two columns show a section of normal DNA and a section of DNA that has a mutation in it. The mutation is called *sickle hemoglobin*.

Table 1. **Comparing Normal With Sickle Mutation DNA**

	This section codes for normal hemoglobin	**This section codes for "sickle" hemoglobin**
DNA code		
mRNA code		
tRNA code		
Order of protein parts		
Shape of blood cells		

Name _____ Class _____ Period _____

2. In Table 1, in the row marked *mRNA code*, write in the correct letters that will match with the nitrogen base letters of DNA given in the row above. Do this for both columns. Remember that A matches with U, T matches with A, C matches with G, and G matches with C.
3. In the row marked *tRNA code*, write in the correct letters that will match with the nitrogen base letters of mRNA in the row above. Remember that A matches U, U matches with A, C matches with G, and G matches with C.
4. Examine Table 2. This table shows which protein parts are coded for by specific sets of nitrogen bases (three per set) of the mRNA molecule. For example, the mRNA sequence CCC codes for protein part A.

Table 2. Nitrogen Bases of Protein Parts

Protein part	mRNA
A	CCC
B	GAA
C	AAA
X	GUU

5. In Table 1, in the row marked *Order of protein Parts*, write in the correct order of protein parts coded for by the mRNA. Do this for both normal and sickle hemoglobin.
6. In the row marked *Shape of blood cells*, draw in what you think will be the correct shape of blood cells for the kind of protein found in the row above. Use the diagrams in Figure 1 for reference.

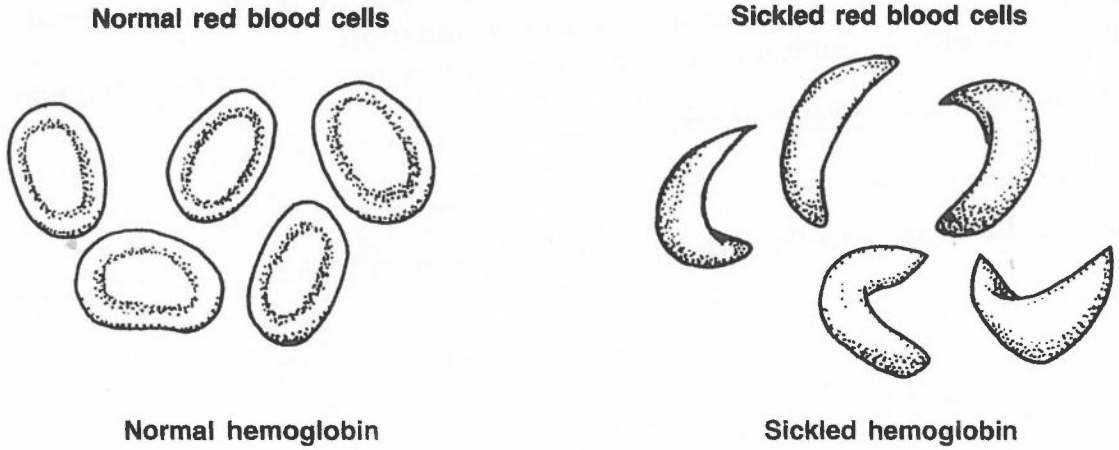


FIGURE 1. Shapes of blood cells

7. In the column marked *This section codes for sickle hemoglobin*, locate the two nitrogen bases that are different in DNA, mRNA, and tRNA from those in the column for normal hemoglobin. Color those bases that are mutations with the colored pencil.

QUESTIONS

1. Look at the two DNA molecules in Table 1. What nitrogen bases in the sickle mutation DNA are different from those of the normal DNA?

   _____

2. If every three nitrogen bases on DNA represent a gene, how many genes are shown on

   a. the section of normal DNA?_____

   b. the section of sickle hemoglobin DNA?_____

3. List the nitrogen bases (examined in Table 1) for

   a. the normal genes of hemoglobin_____

   b. the sickle hemoglobin genes_____

4. How many genes are different in sickle hemoglobin DNA compared with normal hemoglobin DNA?_____

5. How many protein parts are different in sickle hemoglobin compared with normal hemoglobin?_____

6. How many genes are needed to code one protein part into a protein such as hemoglobin?_____

7. Define the word *mutation*

   a. by using the word "gene."_____

   _____

   b. by using the phrase "DNA code."_____

   _____

8. It is possible to move genes from one molecule of DNA to another. A normal gene could be put in the place of a gene with a mutation.

   a. If the DNA with a mutation were corrected in this way, what would happen to the mRNA that DNA makes?_____

   _____

   b. What would happen to the protein formed by this mRNA?_____

   _____

NAME:_____ DATE:_____

Ecosystem Lab

An ecosystem, or ecological system, is made up of biotic and abiotic factors that interact with one another. In this lab you will be creating your own ecosystem using construction paper and colored pencils. Using an aquarium as our model we will construct ecosystems that are able to sustain themselves. Remember, all the energy that exists in an ecosystem begins with the sun or another light source.

Materials:

1. Construction Paper
2. Colored Pencils/Markers
3. Question Sheet

Procedure:

1. Draw the outline of your aquarium or habitat
2. Indicate the source of light energy for your ecosystem
3. Draw producers using a green colored pencil.
4. Draw herbivores using a blue colored pencil.
5. Draw carnivores using a red colored pencil.
6. Include other abiotic factors in your drawing using other colors.
7. Make a key for your drawing indicating what each color stands for.
8. **Clean up your lab area when you are finished.**
9. Answer the questions that follow.

Questions:

1. Describe your habitat.

2. Which organism directly used the energy from your light source? How?

3. Which organisms were primary consumers (herbivores)?

4. Which organisms were secondary consumers (carnivores)?

5. What is the difference between an autotroph and a heterotroph?

6. How many species were in your drawing?

7. What was the population of each?

8. The different populations of your ecosystem make up:
   a.

   b.

9. What abiotic factors were present in your ecosystem?

10. In an ecosystem why is it important that there are more producers than herbivores? Why is it important that there are more herbivores than carnivores?

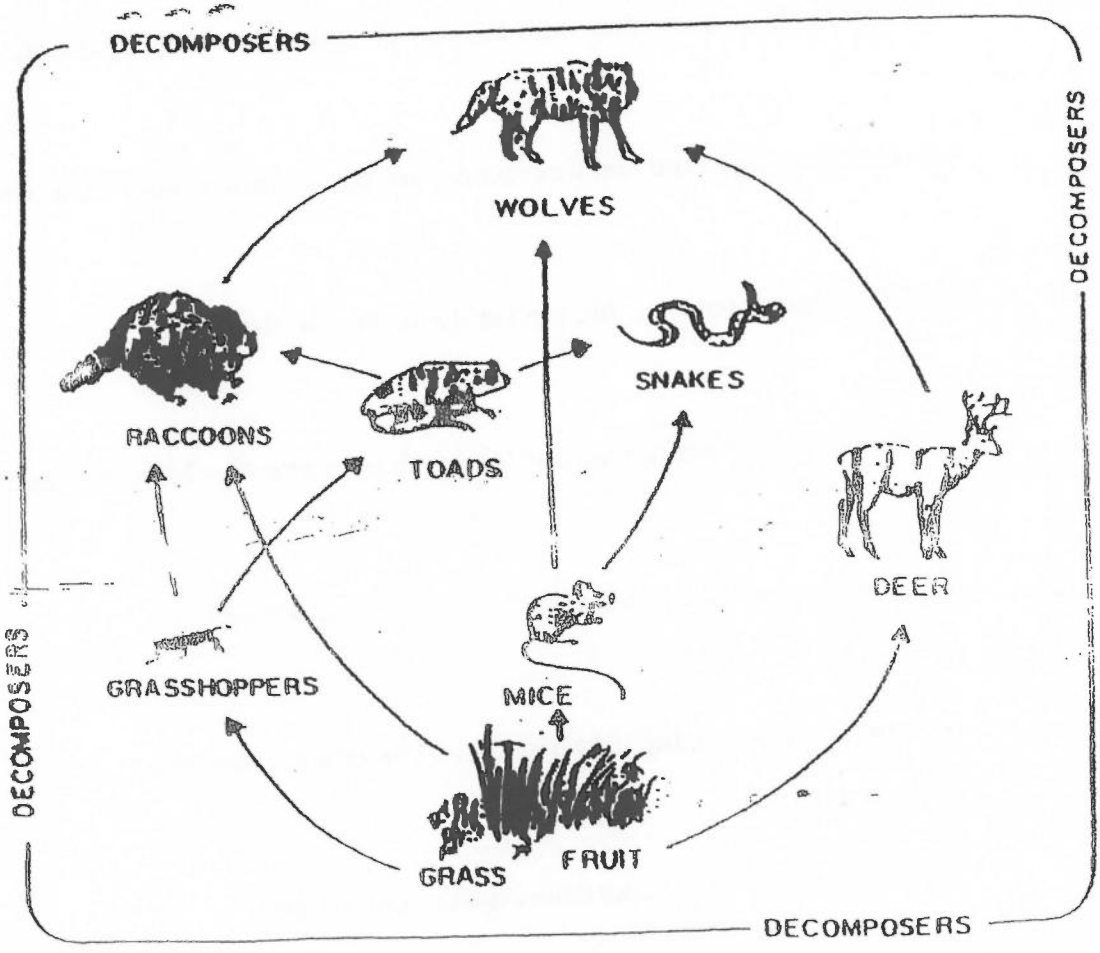
11. What type of organism would break down dead/waste material? How is the beneficial to the ecosystem?

NAME:_____ DATE:_____

In this lab you will construct a food web using pictures of organisms that you will cut out. A *food web* is made up of many interconnecting food chains. A *food chain* is a path through which food passes in an ecosystem. A food chain involves the transfer of food and energy from producer to consumer and from one consumer to the next.

A *producer* is any plant that manufactures food by photosynthesis. Green plants are producers. *Consumers* eat producers and/or other animals. All animals are consumers. *Primary consumers* are plant-eaters or *herbivores*. *Secondary consumers*, or *carnivores*, eat other animals.

The diagram below represents a food web located in and around a meadow environment. There are decomposers present at every level of a food chain. A decomposer chemically breaks down dead organisms and returns the materials back into the environment. In this diagram, the decomposers are placed around the sides.



A MEADOW ENVIRONMENT

Materials - Scissors, Construction paper, pictures of organisms, markers and/or pen

Procedure -

1. Use scissors to cut out pictures of plants and animals that interact in food webs.
2. Construct a food web by gluing the pictures of your organisms onto construction paper.
3. Make sure to show many interactions between various organisms. Use the diagram provided as an aid.
4. Try to make the food web as realistic as possible.....sharks don't eat mountain lions.
5. Draw a line from each organism to the organism that eats it.
   - Remember that these lines indicate the flow of energy within the food web
6. Indicate the presence of decomposers and draw lines showing which organisms are being decomposed.
7. When you are finished clean up the materials you have used.
8. Answer the questions that follow.

Questions

1. List the organisms that were producers in your food web.

2. List the organisms that were primary consumers in your food web.

3. List the organisms that were secondary consumers in your food web.

4. Which organism was the top carnivore in your food web?

5. Where did the energy for this food web originate & which organism used it?

6. What do decomposers do that benefits an ecosystem?

7. State the relationship between a food chain and a food web.

8. How is a food web more stable than a food chain?

Name _____ Class _____ Period _____

30–2 What Are Some Parts of a Food Chain and a Food Web?

Plants use light energy of the sun to make food. The food is stored in the cells of the plant. Plants are called producers because they make food. Some of the stored energy in the food that plants make is passed on to the animals that eat the plants. Plant-eating animals are called primary consumers. Some of the energy is passed on to the animals that eat primary consumers. Animals that eat other animals are called secondary consumers.

The pathway that food energy takes through an ecosystem is called a food chain. A food chain shows the movement of energy from plants to plant eaters and then to animal eaters. An example of a food chain can be written as follows:

(producer)		(primary consumer)		(secondary consumer)
seeds	→	sparrow	→	hawk

Some of the food energy in the seeds moves to the sparrow that eats them. Some of the food energy then moves to the hawk that eats the sparrow.

Because a hawk eats animals other than sparrows, you could make a food chain for each animal the hawk eats. If all the food chains were connected, the result is a food web. A food web is a group of connected food chains. A food web shows many energy relationships.

GOALS

In this exercise, you will:

a. determine what different animals eat in several food chains.
b. build a food web that could exist in a forest ecosystem.

KEYWORDS

Define the following keywords:

consumer _____

food chain _____

food energy _____

food web _____

producer _____

MATERIALS

colored pencils metric ruler

PROCEDURE

Part A. Examining Food Chains

1. Read the introduction and examine the food chains given below.

(producer)	(primary consumer)	(secondary consumers)		
plant roots	rabbit	fox		
plant seeds	mouse	fox		
plant leaves	earthworm	robin	snake	
plant leaves	rabbit	snake		
plant leaves	cricket	robin	fox	
plant stems	earthworm	snake	hawk	fox
plant stems	rabbit	hawk		
plant stems	small insects	mouse	owl	
plant leaves	rabbit	owl	fox	
plant leaves	cricket	mouse	hawk	
plant fruits	mouse	snake	owl	
plant fruits	small insects	robin	snake	

2. Answer the questions that follow:

a. List the organisms that you think are producers._____

b. Why are they called producers?_____

c. List the organisms that you think are primary consumers._____

_____

d. Why are they called primary consumers?_____

e. List the organisms that you think are secondary consumers._____

_____

f. Why are they called secondary consumers?_____

g. Herbivores are organisms that eat plants. List the herbivores in the food chains._____

h. How does your list of herbivores compare with your list in question c?_____

_____

i. Carnivores are organisms that eat other animals. List the carnivores in the food chains._____

j. How does your list of carnivores compare with your list in question e?

_____

k. Make two food chains using animals not listed in the above food chains.

_____

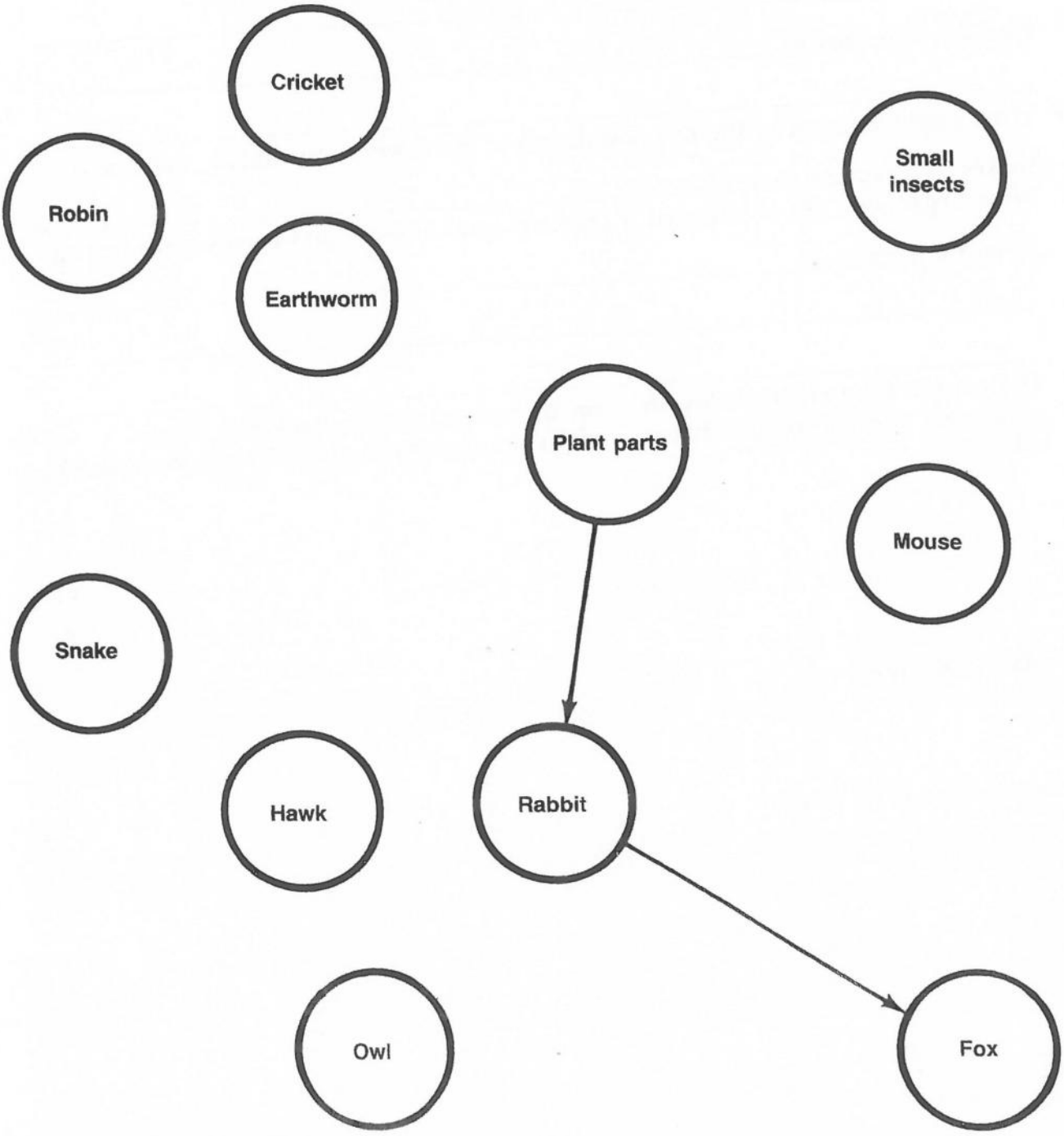
_____

Name _____ Class _____ Period _____

Part B. Making a Food Web

1. Use the information in Part A on the previous page to complete Figure 1.
2. Draw lines from each organism to other organisms that eat it.
3. Show which organism gets the energy by making an arrow pointing in the direction of energy flow from producers to primary consumers, to secondary consumers. One food chain has already been done for you.
4. Draw your lines with different colored pencils for different food chains. To make it easier to read when finished, do not draw through the circles.

FIGURE 1. A food web in a forest ecosystem



QUESTIONS

1. How many of the food chains you made in Figure 1 include the following animals? hawk _____ earthworm _____ fox _____

   small insects _____ owl _____ snake _____

2. How many of the food chains include plant parts?_____
3. Give the names of the producers that are in the food web._____
4. Give the names of the consumers that eat both plants and animals.

   _____

5. What would happen to the food web if all the plants were removed?

   _____

   Explain your answer._____

   _____

6. What might happen to the owl population if there were less rabbits, mice, and snakes in a certain year?_____
7. What organisms will be affected if crickets, small insects, and earthworms are killed by pesticides?_____

   _____

   _____

8. Draw three food chains below that can be connected in a food web. Show producers and consumers that you might see in your backyard or on your way to school.

secondary consumers

primary consumers

producers

Name _____ Class _____ Period _____

30–1 How Do Predator and Prey Populations Change?

A predator (PRED ut ur) is an animal that kills and eats another animal. A fox is an example of a predator. The prey (PRAY) is the animal killed by a predator. A rabbit is an example of an animal that is prey for the fox.

The sizes of predator and prey populations can change with the seasons. Biologists sometimes need to know the sizes of certain predator and prey populations. They can sample the population by trapping and/or counting the animals. The results of the samplings change as the populations change.

GOALS

In this exercise, you will:

a. set up a model of predator and prey populations.
b. observe changes in the results you get from sampling as the populations change.
c. construct a graph showing your results.

KEYWORDS

Define the following keywords:

population change _____

population sampling _____

predator _____

prey _____

MATERIALS

101 brown beans	small paper bag
13 white beans	colored pencils

PROCEDURE

Part A. Sampling a Population

1. Read this report about the animals on the abandoned James Hyde farm.

> The James Hyde farm has not had people living on it since June of 1974. An interstate highway was put through the middle of the farm. Now there are only 100 acres of land left on this farm. In April of 1982, two biologists wanted to find out how the fox and rabbit populations were changing on the farm. They counted rabbits by trapping them and releasing them. They counted foxes by looking for them with field glasses because the foxes would not go near the traps. They trapped and released 23 rabbits. They saw two foxes.

2. Put 92 brown beans and 8 white beans into a bag. Assume brown beans are rabbits and white beans are foxes. This number of beans is four times the sample size in the example above. This will represent the numbers in the actual populations of rabbits and foxes.
3. Shake the beans in the bag. Pick a bean without looking as shown in Figure 1. Put a strike mark in Table 1 in the correct column. If you picked a brown bean, put a mark in the rabbit column. If you picked a white bean, put a mark in the fox column.

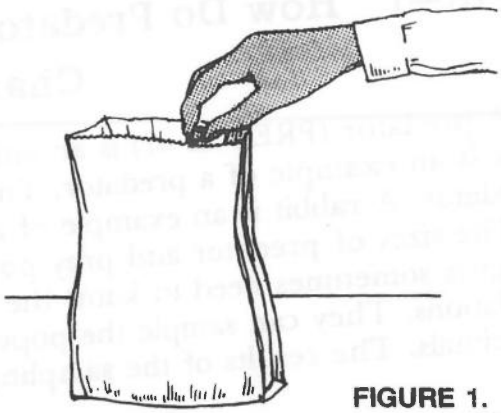


FIGURE 1.

4. Return the bean to the bag. Repeat the picking, returning the bean each time. Record the result by a mark in the table after each selection. Pick a total of 25 beans (25% of the actual numbers in the population). Total your results in the table.

Table 1. Recording Data in a Table

Data	Rabbits (brown beans)		Foxes (white beans)	
	Marks	Total	Marks	Total
April 1982				

Part B. Recording Changes in Populations

1. Examine Table 2 that explains how to change your numbers of beans to show how the rabbit and fox populations changed at later dates.

Table 2. Population Changes

Sampling date	Rabbit population	Fox population
October 1982	Remove 10 brown beans. (Winter was harsh and food was low. Many rabbits died.)	Add 2 white beans. (Foxes also ate pheasants. Fox numbers increased.)
October 1983	Add 15 brown beans. (Food was plentiful. More rabbits moved into the area.)	Add 2 white beans. (Foxes had larger litters than usual.)
April 1984	Remove 8 brown beans. (Many rabbits died from disease.)	Remove 3 white beans. (Food was low. Some foxes left the area.)
October 1984	Add 12 brown beans. (Spring came early. Rabbits could breed earlier.)	Remove 4 white beans. (Rabbits were fewer from disease. Foxes decreased.)
April 1985	No change.	Add 8 white beans. (Food was plentiful. Foxes moved into the area.)
October 1985	Remove 14 brown beans. (Hunters killed pheasants. Foxes ate more rabbits.)	Remove 2 white beans. (Hunters shot some foxes.)

Name _____ Class _____ Period _____

2. Using Table 2 and the sampling method in Part A, sample the populations of rabbits and foxes nine more times to fill in the data for Table 3.
   a. Compare the dates in Tables 2 and 3. For each date in Table 3, sample beans 25 times. Make marks and fill in the totals of brown and white beans.
   b. When you come to a date in Table 2 that indicates a change in population size, follow the directions as to adding or removing beans from the bag. Record this data in the same date listed in Table 3.

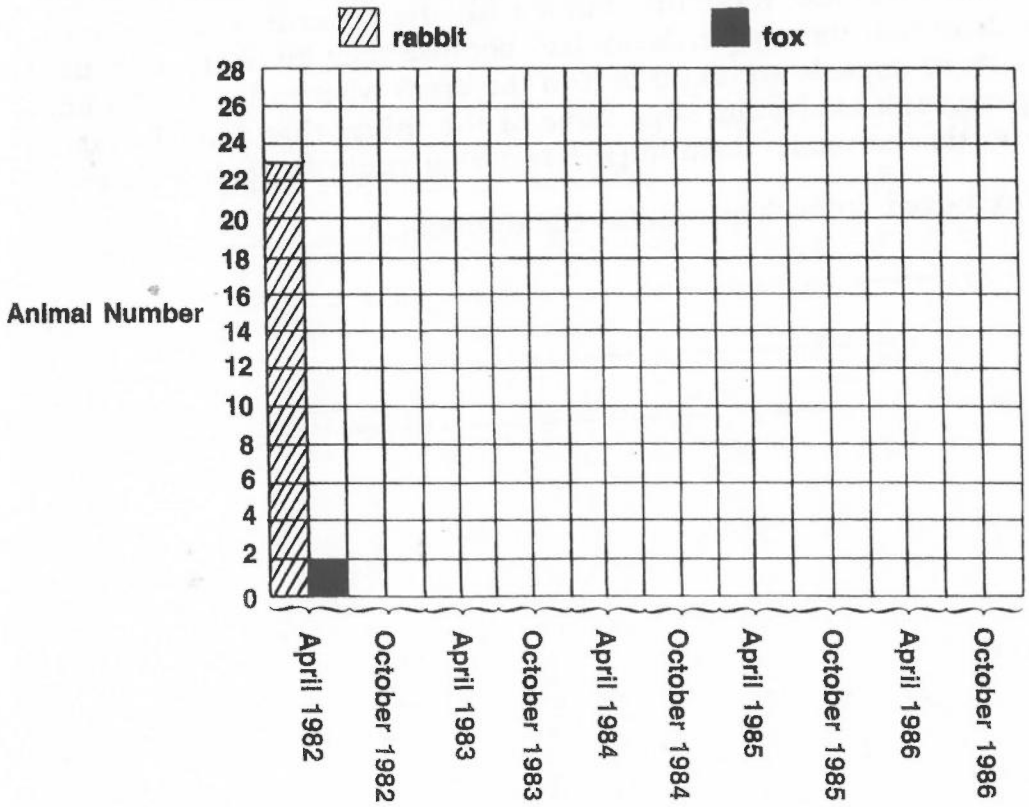
Table 3. Population Sampling

Date	Rabbits (brown beans)		Foxes (white beans)	
	Marks	Total	Marks	Total
October 1982				
April 1983				
October 1983				
April 1984				
October 1984				
April 1985				
October 1985				
April 1986				
October 1986				

Part C. Graphing the Data

1. Look at the graph in Figure 2. The number of animals are listed up the side, and the dates of sampling are along the bottom.
2. Complete the graph using the data in Table 3 that you have collected from your sampling of populations. Use different colors to color in the blocks for each animal. The first one is done for you with the biologists' data. (If you have trouble graphing, ask your teacher for help.)

FIGURE 2. Changes in rabbit and fox populations over 4 years



QUESTIONS

1. Which animal was the predator and which was the prey?_____

2. How did your sampling in Part A compare with those of the two biologists in April 1982?_____

3. Give three factors that caused a decrease in the rabbit population._____

4. Give two factors that caused an increase in the rabbit population._____

5. Give three factors that caused a decrease in the fox population._____

6. Give three factors that caused an increase in the fox population._____

7. How would the presence of pheasants affect the fox population?_____

8. What will happen to the rabbits when there is a decrease in the pheasant population?_____

9. In some areas rewards are given to humans for killing certain animals. Animals such as coyotes and foxes are, therefore, hunted for the rewards. Farmers and ranchers often claim that these animals are bad because they kill farm animals. Biologists think these animals are important to the areas where they are found. Write a short paragraph explaining what some of the things that animals such as coyotes and foxes do that make them important. What could happen if these animals are all removed from their natural environments?_____

Ecology Name_____

OH DEER!

Analyzing Population Data

(Adapted from Cranial Creations in Life Science #44---1990 J. Weston Walch)

Below is a table of data collected from a population of "OH DEER!" in the greater Webster area. Your task is to graph the data and answer the questions that follow. Place a circle around each plot points and connect your data.

Data Table

Year	# of Deer	Year	# of Deer
1964	8700	1979	8250
1965	34000	1980	22200
1966	57600	1981	42300
1967	6770	1982	60000
1968	22200	1983	4520
1969	43700	1984	12700
1970	55000	1985	25000
1971	5550	1986	37700
1972	15400	1987	7330
1973	31000	1988	21100
1974	46300	1989	41900
1975	6100	1990	60200
1976	18700		
1977	38800		
1978	57700		

Questions

1. Observe your graph, what trend (pattern or cycle) do you notice occurring between the years and the deer population? **(3pts)**

2. Give **three** logical explanations for why the graph shows cycles of tremendous decline in population numbers. What are these factors that **LIMIT** the deer population called? **(8pts)**

Ecology Name_____

3. What year has the largest deer population? _____ **(2pts)**

4. What year shows the largest increase over the previous year? What year shows the largest decrease over the previous year?

_____ Increase **(2pts)** _____ Decrease **(2pts)**

5. What year would you expect to have had the most deer predators in the area? Why? **(4pts)**

6. Predict the number of deer in the population for the year 1991. _____ **(2pts)**

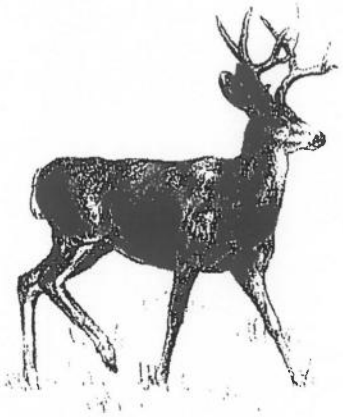
7. Define the term carrying capacity. What would you estimate the carrying capacity of the deer habitat to be? How did you arrive at the number? **(6 pts)**

8. Using the deer population data, support an agreement or disagreement with the following statement---"nature is never in 'balance,' but is constantly changing." **(3pts)**

9. Graph **X/Y Axis Labeled** ____ (2pts) **Intervals Even** ____ (2pts)

Data Plotted ____ (2pts) **Points Circled & Connected** ____ (2pts)

Name:
Lab
Deer: Predator/Prey Lab



Background: In 1970 the deer populations of an island forest reserve about 518 square kilometers in size was about 2000 animals. Although the island had excellent vegetation for feeding, the food supply obviously had limits. There were also wolves that lived in the same forest. The wolves were the major predator of the deer which were their prey. The population of wolves was able to limit the deer population and the deer population was able to limit the wolf population.

The populations of both the wolves and the deer are shown in the data table below. The data shows the population of both organisms from 1971 – 1980. The ***Population Change*** is the number of deer born minus the number of deer that died during that year. Fill out the last column for each year (the first has been calculated for you).

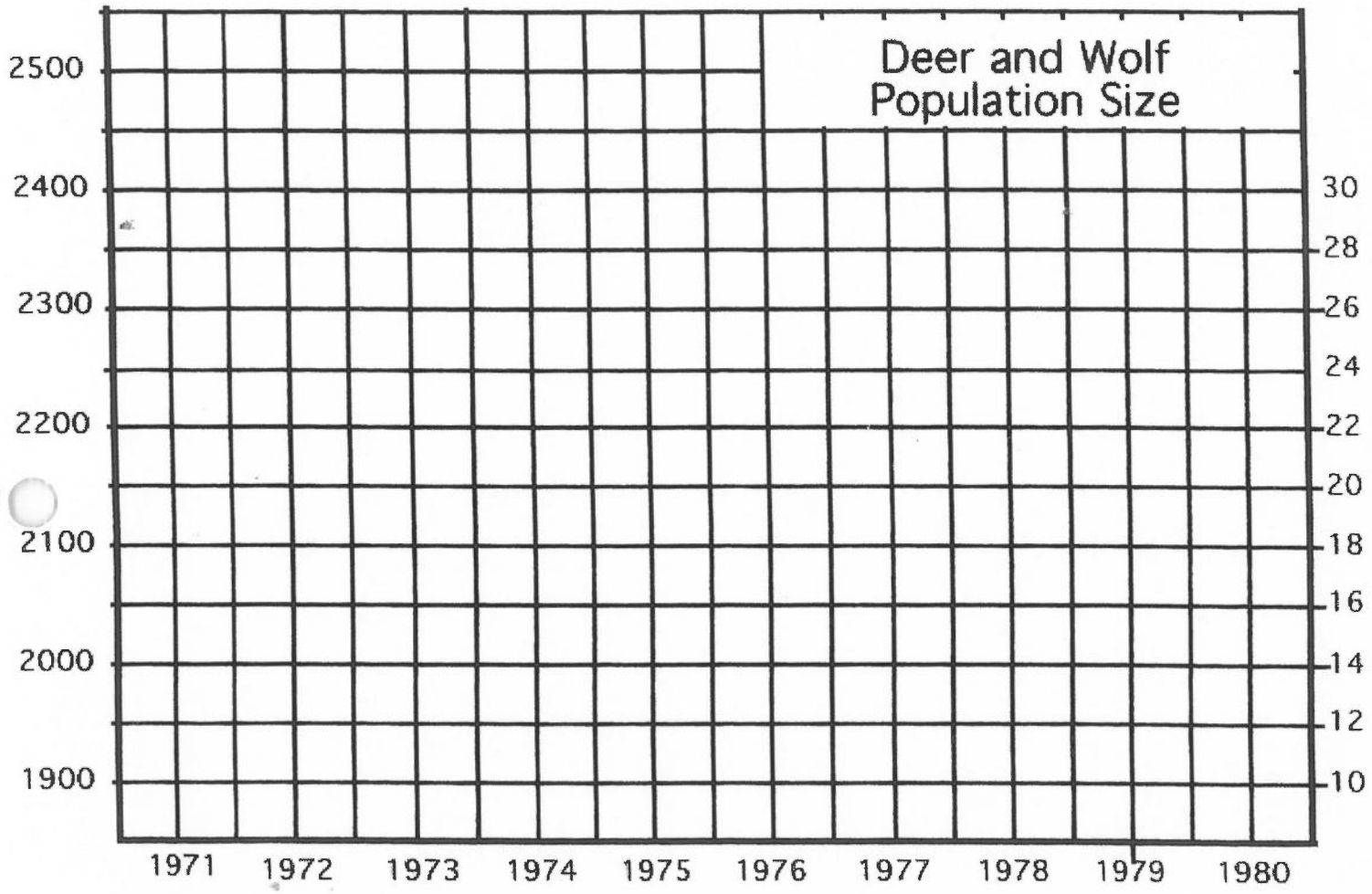
Predation = Killed by predators
Starvation = Died from not obtaining enough resources (food)

Data:

Year	Wolf Population	Deer Population	Deer Offspring	Predation	Starvation	Deer Population Change
1971	10	2,000	800	400	100	+300
1972	12	2,300	920	480	240	
1973	16	2,500	1,000	640	500	
1974	22	2,360	944	880	180	
1975	28	2,224	996	1,120	26	
1976	24	2,094	836	960	2	
1977	21	1,968	788	840	0	
1978	18	2,168	766	520	0	
1979	20	2,388	780	560	0	
1980	26	2,418	790	760	0	

Procedure:

1. Construct a line graph representing the deer and wolf populations on the graph below. Use one color to show deer populations and another color to show wolf populations.
2. Review the reading passage and complete the observation questions.
3. Review your completed graph and complete Conclusion (Analysis & Interpretations) questions.

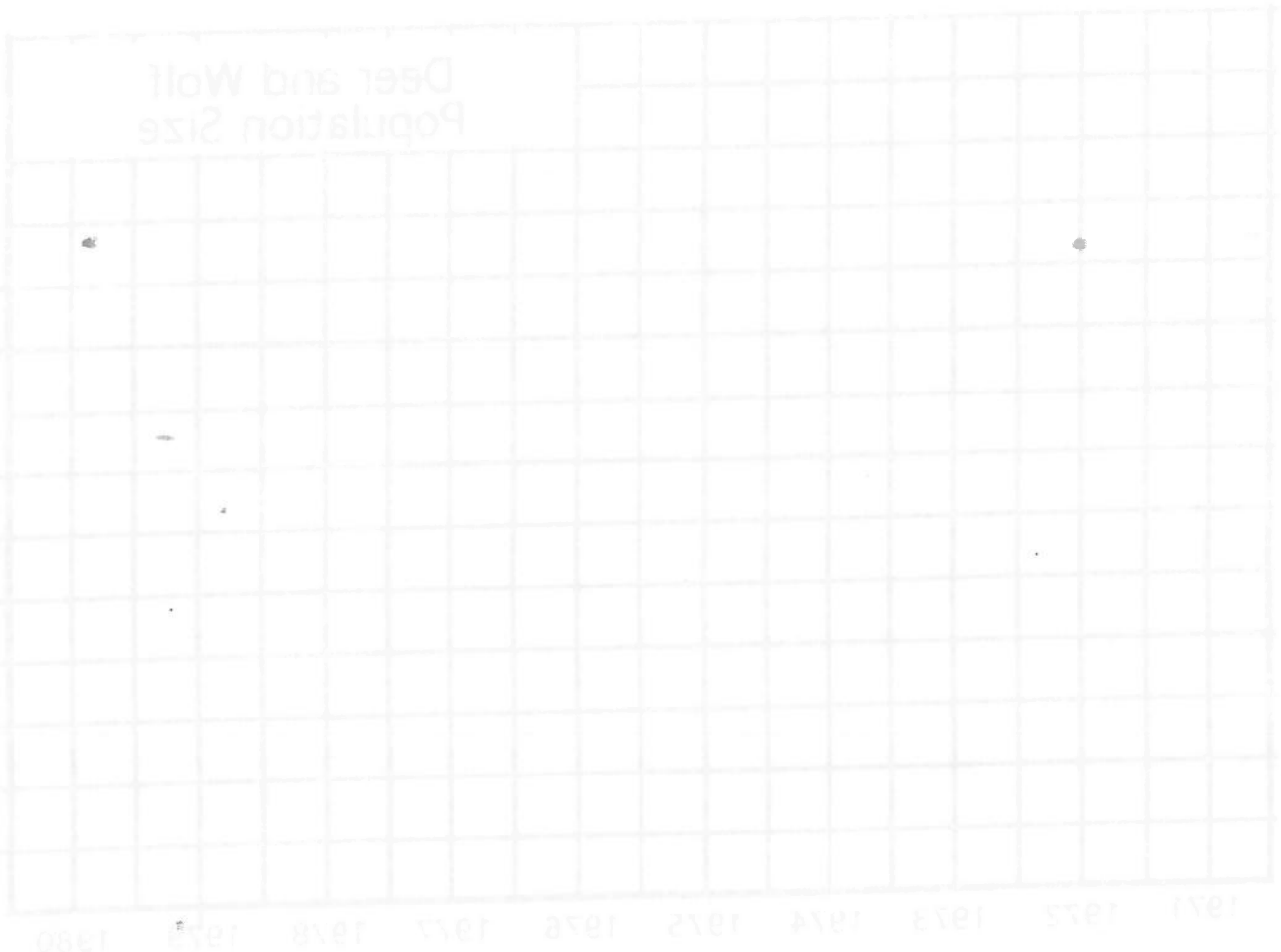


Observation Questions:

1. What are limiting factors?

2. Why are natural predators like the wolf important?

3. What is meant by population change?



Conclusion (Analysis & Interpretations):

1. Describe what happened to the deer and wolf populations between 1971 and 1980.

2. How does the population of wolves limit the population of deer?

3. How does the population of deer limit the population of wolves?

4. What other factors might limit the population of deer other than the wolves?

5. What do you think would have happened to the deer on the island had wolves NOT been living in the ecosystem?

6. Below draw a graph showing the carrying capacity of the forest for the population of deer.

7. Why does the population of deer reach a point where it can no longer increase?

Name: _____ Date Completed: _____
Class: _____ Lab Minutes: _____ Teacher: _____

Feeding Relationships Activity - Food Chains

This lab was created by Mr. Buckley from Edward Knox High School. Credit is given for this original activity to Mr. Buckley.

The mouse eats the red clover plant, and then an owl snatches the mouse. This series of events is called a food chain. A food chain can be described as a means of transferring energy from one organism to another. For most organisms, the only source of energy available to begin the chain is the sun. Therefore, the food chains we will study will start with the sun. Only autotrophs such as green plants and algae can convert sunlight into food. The mouse that consumes the grass seeds gets its energy from the sun through the plant. The owl in turn receives the sun's energy from eating the mouse. The food chain could be diagrammed as:

sun ----> red clover ----> mouse ----> owl

Each animal and plant can be thought of as a link in a chain. The sun is not usually included in the food chain diagram because it is assumed that we know the sun is in every food chain. An example of a three-link food chain is: grass - mouse - owl.
Notice that the arrow always points in the direction of the movement of energy.

There are millions of simple food chains that include a plant, a plant eater and a meat eater, that is, a producer, a herbivore (primary consumer) and a carnivore (secondary or higher level consumer). Here are a few more examples of a threelink food chain:

water lilies ----> moose ----> wolf

grass ----> rabbit ----> fox

Four-linked food chains are also common. In a four-link food chain there are two omnivores and/or carnivores. The larger or better adapted animal kills and eats the previous organism in the link. Some examples of a four-link food chain are:

leaf ----> caterpillar ----> shrew ----> badger

cattails ---->muskrat----> weasels ----> Great Horned Owl

1. What is the ultimate source of energy for most organisms and how is this energy captured so it is useful in a food chain? _____

2. What is a food chain? _____

3. Give an example of a four step food chain not listed in the examples above and label its levels of consumers and the producer organism. _____

4. What always starts off a food chain? _____ What ends it? _____

5. What is a carnivore? _____

6. What is an herbivore? _____

Food Webs

Food chains only show one possible source of food for the animal. A better way of seeing what an animal eats is to construct a food web. A food web describes all the feeding relationships of one animal or plant to the other members of the community. Most plants and animals are members of many different food chains. The animal eats a variety of different foods, but it is being preyed on by a number of predators. A field will have many food chains. These might include:

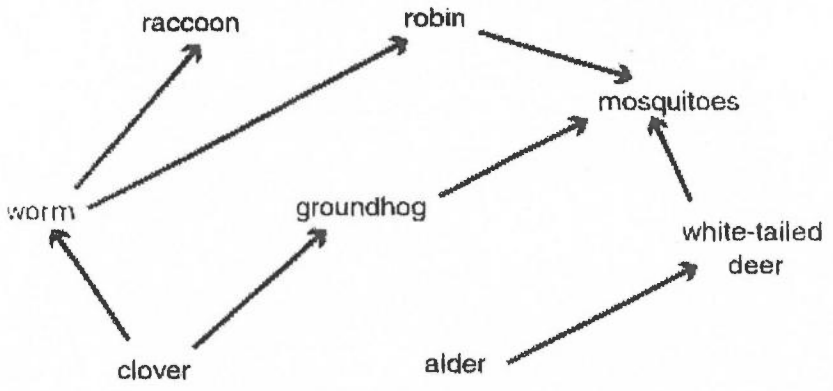
clover ---> worm ----> robin ---> mosquitoes

clover ---> worm ----> raccoon

clover ---> groundhog ---> mosquitoes

alder ----> white-tailed deer ---> mosquitoes

The food web diagram allows us to trace quickly these different food chains and to see how each chain is related to all the other food chains. The above four food chains can be drawn as a single food web. The resulting food web shows at a glance how the plants and animals are interrelated.



7. What is a food web? _____

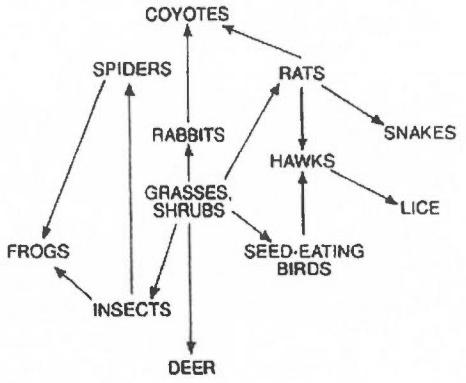
8. Why is a food web a better description of feeding relationships in a community than a food chain?

_____

_____

9-12. Use the diagram of the food web at the right to complete the following:

With the sun in the center create a functional food web combining at least 4 separate food chains. Identify the trophic feeding levels of each organism in the chains you create. Place your answer in to this question at the end of this lab.



Feeding Pyramids

The food pyramid illustrates the loss of food energy along the food chain. Energy is required in order for an animal or plant to carry out its life processes. Since animals cannot capture and use the sun's energy directly, they must eat plants. The plants along with oxygen and water provide the animal with its energy needs.

If we examine the food pyramid, we see that each feeding level is smaller than the feeding level directly below it. There must be more plants (producers) than plant eaters (herbivores) and more plant eaters than meat eaters (carnivores). The amount of energy available to the next higher level is only a fraction of the energy of the previous level. On average the energy available to the next trophic level is only 10% of the energy which was in the previous feeding (trophic level). This is called the rule of 10's. In animals much of the 90% of the energy which is wasted in metabolism is released as heat and metabolic wastes. Only a small part of the sun's energy is ever used by the plants in the production of food. Of the energy containing material stored in the leaf, some are used by the plant for its life processes. Not all of the material eaten by the herbivore can be used. Some of the plant material cannot be digested and this material passes out of the animal's body as solid waste. This waste material becomes the first link in a decomposer food chain.

Biomass is the weight of all living things within an environment or habitat. In a large meadow, for example, you might have one fox with a biomass of five kilograms, 60 rabbits with a combined mass of 120 kilograms, 4000 mice and voles with a combined mass of 50 kilograms and plants, trees and shrubs with a mass of 8000 kilograms. Even this large number of rabbits, mice and voles might be insufficient to support a fox. The red fox, very likely, considers the meadow to be only part of its habitat. The fox visits many other areas, such as ponds and woodlots each night while it is hunting.

Notice that there are far more mice, voles and rabbits than foxes, both in number and combined biomass. Also there are far more plants than herbivores. This is because at each level-producer, herbivore and carnivore - most of the energy is consumed in the life processes. Very little energy - only that stored in the bodies of the animals or plants - is available to the next level consumer. This means that the number of consumers and their total biomass must be far smaller than the level below. One useful way of showing this is with a food pyramid.

13. What is the rule of 10's?

14. Why are there more herbivores than carnivores?

_____

_____

15. Why are there no more than four or five links in a food chain?

_____

_____

17. Rewrite this feeding pyramid as a food chain.

_____

18. What is biomass? _____

19. What is the feeding (trophic) level of this pyramid containing the most biomass?

_____

20. Why does the tertiary consumer feeding level containing the grizzly bears contain less total energy and biomass than the chipmunk feeding level (secondary consumers)?

21. Which feeding level represents the primary consumers?

_____

22. Which feeding level represents the producer organisms in this feeding pyramid? _____

23. Imagine a massive population crash occurs in the rabbits in this food web. List two populations which would be influenced by this in the food web AND completely explain why the crash in the rabbit population would have this effect.

_____

_____

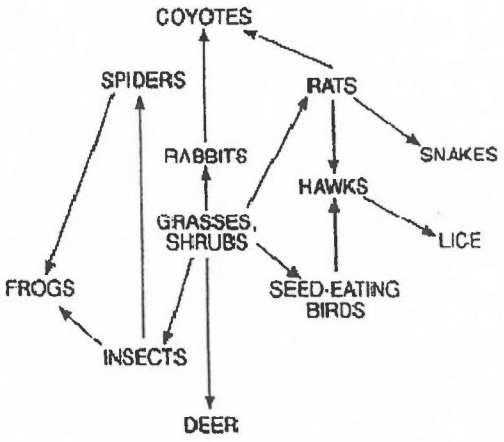
_____

_____

24. Select one other species besides rabbits in this food web AND explain how the removal of this species would influence another species population in this food web.

_____

_____



NAME:_____ TEACHER: _____

Protein Synthesis Simulation Lab

DNA STRUCTURE:

The following is the base sequence on one strand of a DNA molecule:

T A C G C C A G T G G T T C G A T C

1. Give the base sequence of the complementary DNA strand.

_____

2. In the box to the right draw in the strand of DNA.

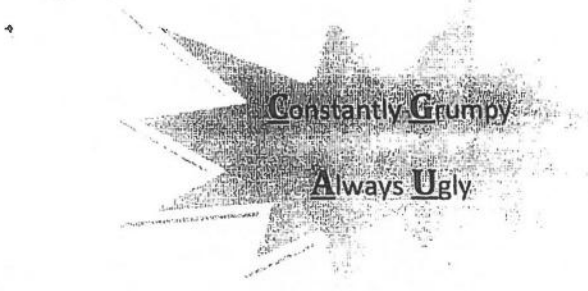
3. The original DNA strand serves as a template.
   What does the term **template** mean?

TRANSCRIPTION:

DNA is genetic information and is stored in the nucleus.DNA provides the information for a cell to make proteins. Proteins are made at a cell organelle called a ribosome, ribosomes are found in the cytoplasm of a cell. DNA cannot leave the nucleus to make proteins, but a helper molecule can. RNA takes the information to make proteins from DNA and carries it to the ribosomes.

RNA transcribes information in the following way.

DNA says...	RNA transcribes
C	G
G	C
T	A
A	U



5. Transcribe the original strand of DNA

DNA	T A C	G C C	A G T	G G T	T C G	A T C
RNA	_____	_____	_____	_____	_____	_____

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TRANSLATE:

The ribosome translates the RNA into strings of amino acids, or proteins. The Universal Genetic Code Chart is used to translate RNA into the amino acids. For example the RNA codon UUU is the amino acid PHE and the codon UAC is TYR.

6. Use the chart to translate the RNA from question 5.

DNA	T A C	G C C	A G T	G G T	T C G	A T C
RNA	____	____	____	____	____	____
Amino Acid Sequence	____	____	____	____	____	____

Universal Genetic Code Chart

Messenger RNA Codons and Amino Acids for Which They Code

First base	Second base: U	Second base: C	Second base: A	Second base: G	Third base
U	UUU, UUC: PHE UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR UAA, UAG: STOP	UGU, UGC: CYS UGA: STOP UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN AAA, AAG: LYS	AGU, AGC: SER AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

NAME:_____ TEACHER: _____

Mutations:

DNA is not perfect, sometimes exposure to radiation, chemicals or even during replication mistakes can happen. A DNA mistake is known as a mutation. Mutations can be a base added in (Additions), bases removed (deletions) or bases changed (substitutions). See what will happen if the following mutations occur to the original strand.

Addition of a base

T A C G G C C A G T G G T T C G A T C

7. TRANSCRIBE: What would the mRNA coding from this new DNA strand look like?

8. TRANSLATE: What would the resulting protein look like? (the amino acid sequence) (Hint: you can not have an amino acid for the last single letter)

9. How does the protein fragment you created in question 8 compare with the protein fragment you created in question 6?

Now the DNA strand is changed so the thirteenth base on the original DNA strand is changed from an A to a T. Use this new strand to answer questions 10 and 11 which follow.

Base substitution

T A C G C C A G T G G T T C G T T C

10. TRANSCRIBE: What would the mRNA coding from this new DNA strand look like?

11. TRANSLATE: What would the resulting protein look like?

12. What do we call changes in the base sequence of a DNA molecule?

13. How do nitrogenous base changes generally influence the protein formed from the code?

NAME:_____ TEACHER: _____

Questions for Regents Practice

the chart which follows and the Universal Genetic Code Chart to complete the table which follows questions 14 through 16.

14. Using the Universal Genetic Code Chart found previously in this lab, fill in the missing amino acids in the amino acid sequence for species *A* in the chart.

15. Using the information given, fill in the missing mRNA bases in the mRNA strand for species *B* in the chart.

16. Using the information given, fill in the missing DNA bases in the DNA strand for species *C* in the chart.

Species A	DNA strand:	TAC	CGA	CCT	TCA
	mRNA strand:	AUG	GCU	GGA	AGU
	Amino acid sequence:	____	____	____	____
Species B	DNA strand:	TAC	TTT	GCA	GGA
	mRNA strand:	____	____	____	____
	Amino acid sequence:	MET	LYS	ARG	PRO
Species C	DNA strand:	____	____	____	____
	mRNA strand:	AUG	UUU	UGU	CCC
	Amino acid sequence:	MET	PHE	CYS	PRO
Species D	DNA strand:	TAC	GTA	GTT	GCA
	mRNA strand:	AUG	CAU	CAA	CGU
	Amino acid sequence:	MET	HIS	GLN	ARG
Species E	DNA strand:	TAC	TTC	GCG	GGT
	mRNA strand:	AUG	AAG	CGC	CCA
	Amino acid sequence	MET	LYS	ARG	PRO

17. According to the information in the chart, which *two* species are most closely related? **Support your answer.**

Given the DNA sequence TAC GCA CCT, state an example of a mutation in one base of this sequence that WOULD NOT change the protein it codes for