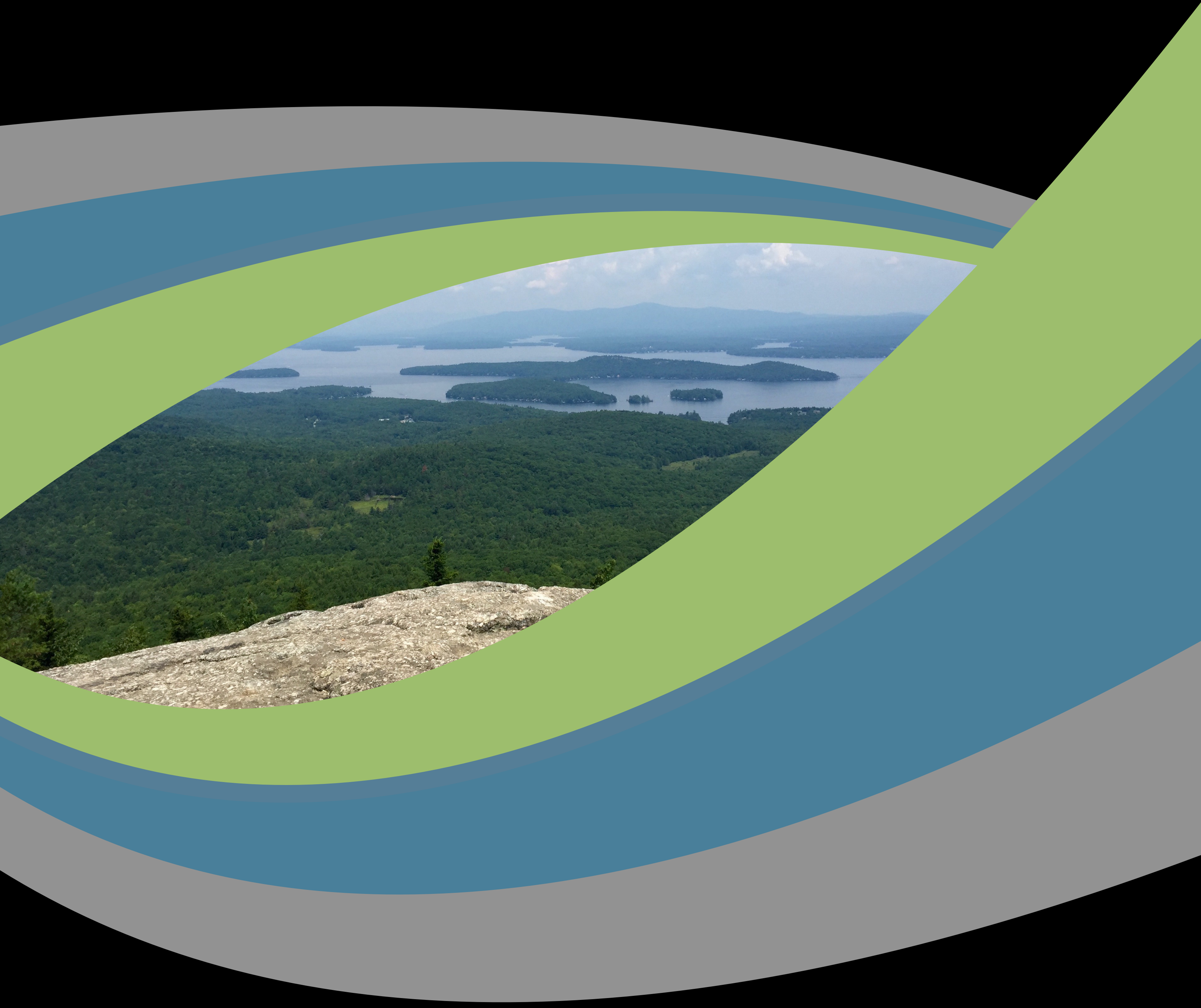
EARTH SCIENCE

LABORATORY ACTIVITIES



Name:

INTRODUCTION

This course studies the different processes, relationships, mechanisms, and concepts that help us interpret our planet Earth and is based on the New York State Physical Setting / Earth Science core curriculum. It incorporates hands-on laboratory experiences and covers an array of topics including: Astronomy, Geology, Meteorology, and Climatology.

NEW YORK STATE LABORATORY REQUIREMENTS

"Critical to understanding science concepts is the use of scientific inquiry to develop explanations of natural phenomena. Therefore, as prerequisite for admission to the performance test and written portion of the Regents examination in the Physical Setting / Earth Science, students must have successfully completed a minimum of 1200 minutes of hands-on laboratory experience with satisfactory reports on file." [SED]

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Name: ____ Foundations

Date: ________________________ Period: __________ Earth Science

Lab Activity: Observation and Inference

INTRODUCTION:

Science is knowledge, observing, inferring, experimenting, gathering data and questioning. These ideas help us determine if something is true and build upon our scientific knowledge. To accomplish this we make observations.

An observation is the act of taking notice and gathering data using your senses. It is something you witness happening with your senses and should be a fact if stated properly. An inference is a judgment based on reasoning from evidence or past experiences. Inferences are, more often than not, used when writing your conclusions.

OBJECTIVE:

You will gain an understanding what scientific knowledge is based on observations and inferences.

VOCABULARY:

Observation

Inference

Fossil

Classification

Prediction

Lab Activity: Observation and Inference

PROCEDURE:

Using the "Fossilized Dinosaur Footprints" on the adjacent page, write down five different observations and five different inferences on the blanks below.

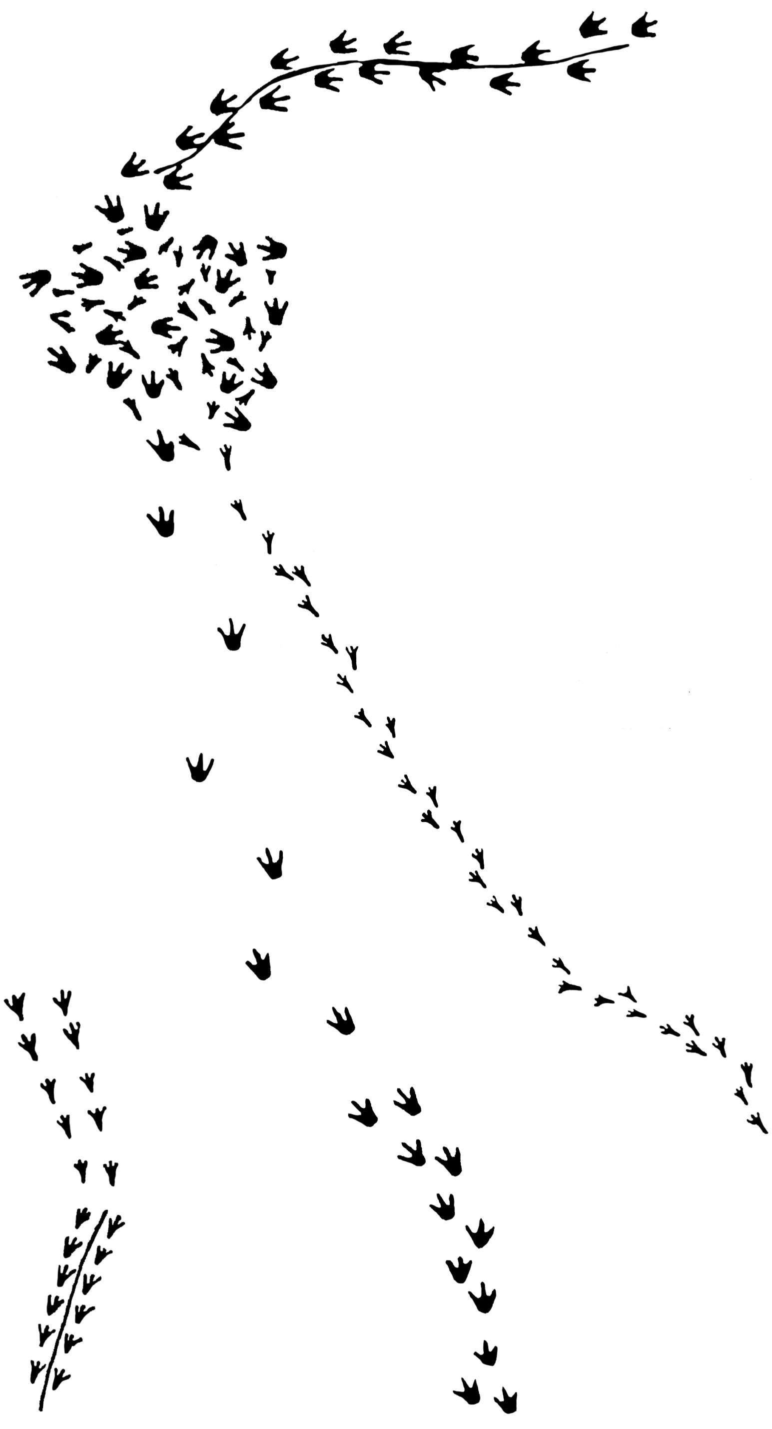
OBSERVATIONS:

1. ______________________________
____
2. ______________________________
____
3. ______________________________
____
4. ______________________________
____
5. ______________________________
____

INFERENCES:

1. ______________________________
____
2. ______________________________
____
3. ______________________________
____
4. ______________________________
____
5. ______________________________
____

FOSSILIZED DINOSAUR FOOTPRINTS



Lab Activity: Observation and Inference

DISCUSSION QUESTIONS:

1. How many different dinosaurs footprints can be seen in the sedimentary bedrock?

2. Are the amount of dinosaur footprints an observation or an inference?

3. What do humans use to make observations?

4. Why do scientists observe phenomena?

5. List one qualitative observation and one quantitative observation.

CONCLUSION: Infer what happened from the fossilized dinosaur footprints [be creative]?

Name: ______________________________________ Foundations

Date: ________________________ Period: __________ Earth Science

Lab Activity: Measurement

INTRODUCTION:

Measurements are comparisons with a known standard. They always include a number and the standard unit of measure. You are already familiar with many of these standard units such as: length, mass, temperature, time and volume.

Over the centuries, many different countries developed their own systems of measurement. This became confusing when scientist from different countries tried to communicate. Then in 1799 France adopted the metric system [SI]. Aside from the United Sates and a few other countries using Customary Measures, most of the world now uses the metric system.

OBJECTIVE:

To become familiar with the metric system by measuring various lengths, volumes and masses.

VOCABULARY:

Length

Meter

Volume

Liter

Mass

Gram

Lab Activity: Measurement

PROCEDURE A:

Using a centimeter ruler, find objects, in the classroom, that are approximately the lengths listed below. Be sure to find an objects that is as close as possible to the listed lengths within 1.0 cm.

Find this Length	Name of the Object	Your Measurement
4.7 cm		
8.0 cm		
11.5 cm		
15.5 cm		
29.3 cm		

PROCEDURE B:

Using a meter stick, find objects, in the classroom, that are approximately the lengths listed below. Be sure to find an objects that is as close as possible to the listed lengths within 0.1 meters.

Find this Length	Name of the Object	Your Measurement
0.6 m		
1.5 m		
1.9 m		
2.1 m		
2.5 m		

PROCEDURE C:

Using an electric balance, find objects in the classroom that have an approximate mass listed below. Be sure to find an object that is as close as possible to the listed mass within 5.0 grams.

Find this Mass	Name of the Object	Your Mass
117.5 g		
228.8 g		
163.9 g		
20.6 g		
25.6 g		

PROCEDURE D:

Using a graduated cylinder, measure the mass of water for the following volumes. Be sure to measure the amount of water to the nearest 1.0 ml and record the mass to the nearest 0.1 g.

Volume	Measured Mass
10.0 ml	
35.0 ml	
50.0 ml	
67.0 ml	
78.0 ml	

Lab Activity: Measurement

DISCUSSION QUESTIONS:

1. What units would you use to measure the distance from the High School to your house?

2. What units would you use to measure the width of a pencil?

3. Based on answers to 1 and 2, why would you use two different units to measure the lengths?

4. What metric base units would you use to measure the amount of liquid inside a bottle of soda?

5. What metric base units would you use to measure the amount of matter in a brick?

CONCLUSION: Explain why the metric system is easier to use than Customary Measures?

Name: ____ Foundations

Date: ________________________ Period: __________ Earth Science

Lab Activity: Missing Volume

INTRODUCTION:

One plus one equals two… or does it? Measuring is extremely important in science and accuracy is just as important. Often time small errors in accuracy can have drastic results. Such was the case with a Mars landing craft crashing due to a 1 second inertial measurement error.

Even with being extremely accurate, some scientific phenomenon call for additional questioning and have deeper explanations. Such is the case with the missing volume.

OBJECTIVE:

To recognize the importance of measuring correctly and explain scientific phenomenon.

VOCABULARY:

Graduated Cylinder

Volume

Liter

Molecule

Hydrogen Bond

Lab Activity: Missing Volume

PROCEDURE A:

1. Measure exactly 50 ml of water into the graduated cylinder [if you are not exact, this will not work].
2. Measure exactly 50 ml of water into the other graduated cylinder.
3. Pour the contents of one cylinder into the other.
4. Measure the total volume.

Volume of Water

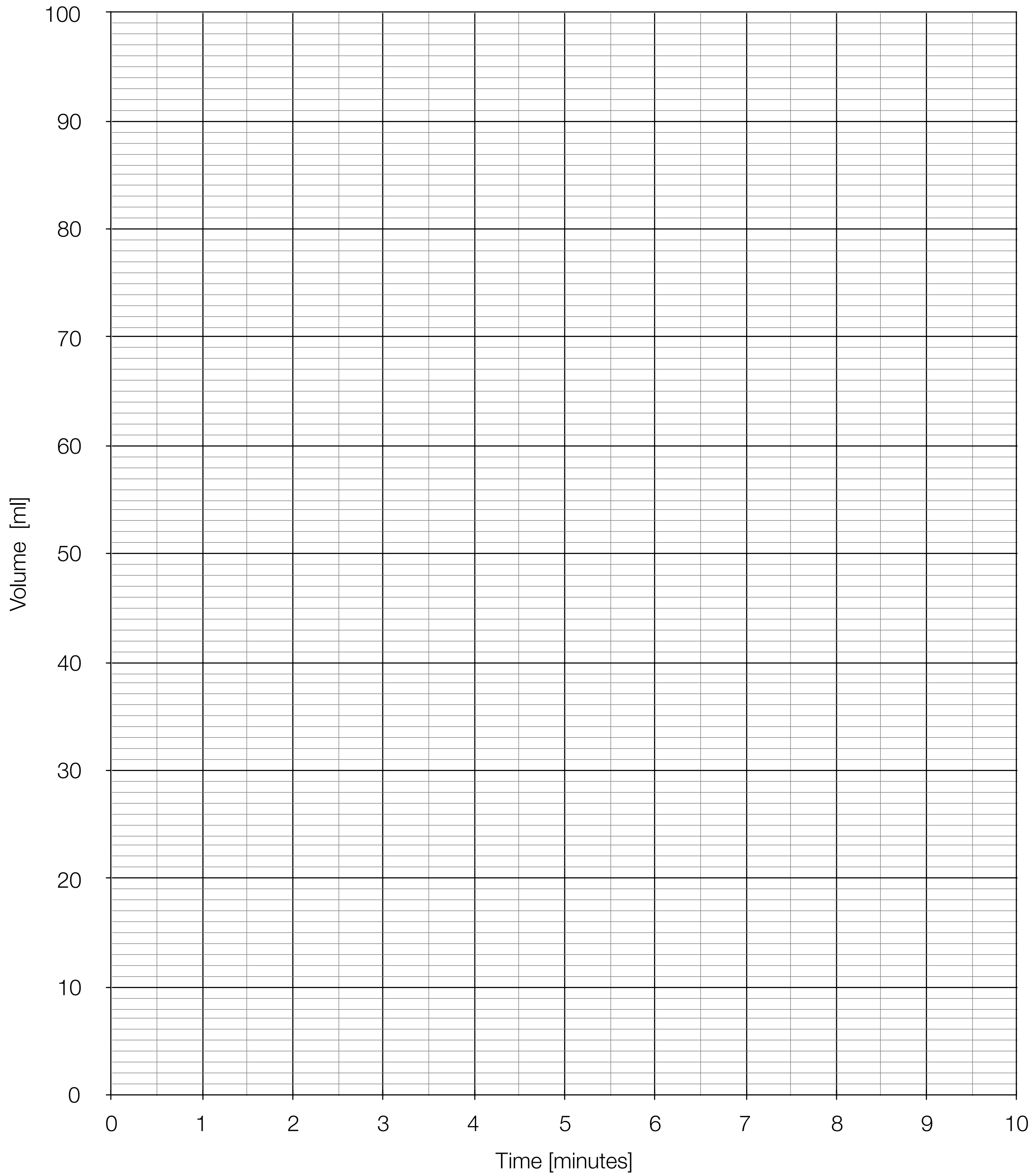
PROCEDURE B:

1. Empty the graduated cylinders from part one.
2. Measure exactly 50 ml of water into one graduated cylinder.
3. Measure exactly 50 mL of isopropyl alcohol into the other graduated cylinder.
4. Pour the contents of one into the other and immediately read the volume.
5. Using the stopwatch app on your phone, watch and record the volume at the times below.
6. Graph your results on Time vs. Volume Chart.

Time	Volume
0 minutes	
2 minutes	
5 minutes	
10 minutes	

Lab Activity: Missing Volume

TIME VS. VOLUME CHART



Lab Activity: Missing Volume

DISCUSSION QUESTIONS:

1. Make five observations about this experiment [do not taste].

2. Infer what would happen if you conducted the same experiment in a much colder classroom.

3. Would you expect the same results if you combine two different liquids, other then water?

4. List at least three things that could cause an error in your answers for this experiment.

5. Why do we graph data after completing an experiment?

CONCLUSION: Why do you think the combined volume of water and alcohol was not exactly 100 ml?

Name: ____ Foundations

Date: ________________________ Period: __________ Earth Science

Lab Activity: Density and Percent Error

INTRODUCTION:

Density is the term used to describe the relationship between the mass of an object and its volume. Under given conditions of temperature and pressure, the density of a material is constant. The density of any earth material can be determined by measuring its mass and volume and using the equation in your Earth Science Reference Tables.

OBJECTIVE:

You will be able to calculate the densities of materials and the accuracy in your measurements.

VOCABULARY:

Mass

Volume

Density

Displacement

Percent Deviation

Lab Activity: Density and Percent Error

PROCEDURE A:

1. Find and record the mass of each object using an electric balance to the nearest tenth.
2. Find and record the volume of each object, to the nearest tenth, using one of the following:
   - The metric ruler and the equation V = L x W x H
   - The graduated cylinder and the water displacement method
3. Calculate the density using your measurements for mass and volume. Be sure to round your answer to the nearest tenth and include proper units.

REPORT SHEET

Aluminum Bar	Aluminum Cube
Mass = ______________________	Mass = ______________________
L = ________ W = ________ H = ________	L = ________ W = ________ H = ________
Volume = ______________________	Volume = ______________________
Density [your value] = ________________	Density [your value] = ________________
Steel Sphere	**Glass Sphere**
Mass = ______________________	Mass = ______________________
Initial = ____________ Final = ____________	Initial = ____________ Final = ____________
Volume = ______________________	Volume = ______________________
Density [your value] = ________________	Density [your value] = ________________

Lab Activity: Density and Percent Error

PROCEDURE B:

Use your density calculations from Procedure A and the accepted densities provided to calculate percent deviation on your measurements. Record your answers on the Report Sheet below.

REPORT SHEET

Aluminum Bar	Aluminum Cube
Your Value = ______________________	Your Value = ______________________
Accepted Value = 2.7 g/cm^3	Accepted Value = 2.7 g/cm^3
% Deviation = ______________________	% Deviation = ______________________
Calculations:	Calculations:
Steel Sphere	**Glass Sphere**
Your Value = ______________________	Your Value = ______________________
Accepted Value = 8.0 g/ml	Accepted Value = 2.4 g/ml
% Deviation = ______________________	% Deviation = ______________________
Calculations:	Calculations:

Lab Activity: Density and Percent Error

DISCUSSION QUESTIONS:

1. What is the effect of shape on the density of samples of the same material?

2. If the aluminum bar is cut in half, what is the density of each half compared to the original?

3. Of the three phases of matter, what phase has the greatest density for most substances?

4. Water is an unusual earth material because it is denser in which phase?

5. How would additional water on the pan of the balance effect your density calculation?

CONCLUSION: Describe the procedure for determining the density of earth materials.

Name: ______________________________

Date: ____________________ Period: ________

Lab Activity: Graphing Analysis

INTRODUCTION:

Constructing and interpreting graphs are an integral part of Earth Science. When data is collected and plotted a pattern can emerge. The picture-like representation makes it easier to see relationships that are not obvious from a column of data. Moreover, these patterns can be extrapolated to predict a future event.

OBJECTIVE:

You will see how graphing a natural phenomenon can aid in predicting future events.

VOCABULARY:

Direct Relationship

Dependent Variable

Inverse Relationship

Independent Variable

Cyclic Change

Dynamic Equilibrium

Lab Activity: Graphing Analysis

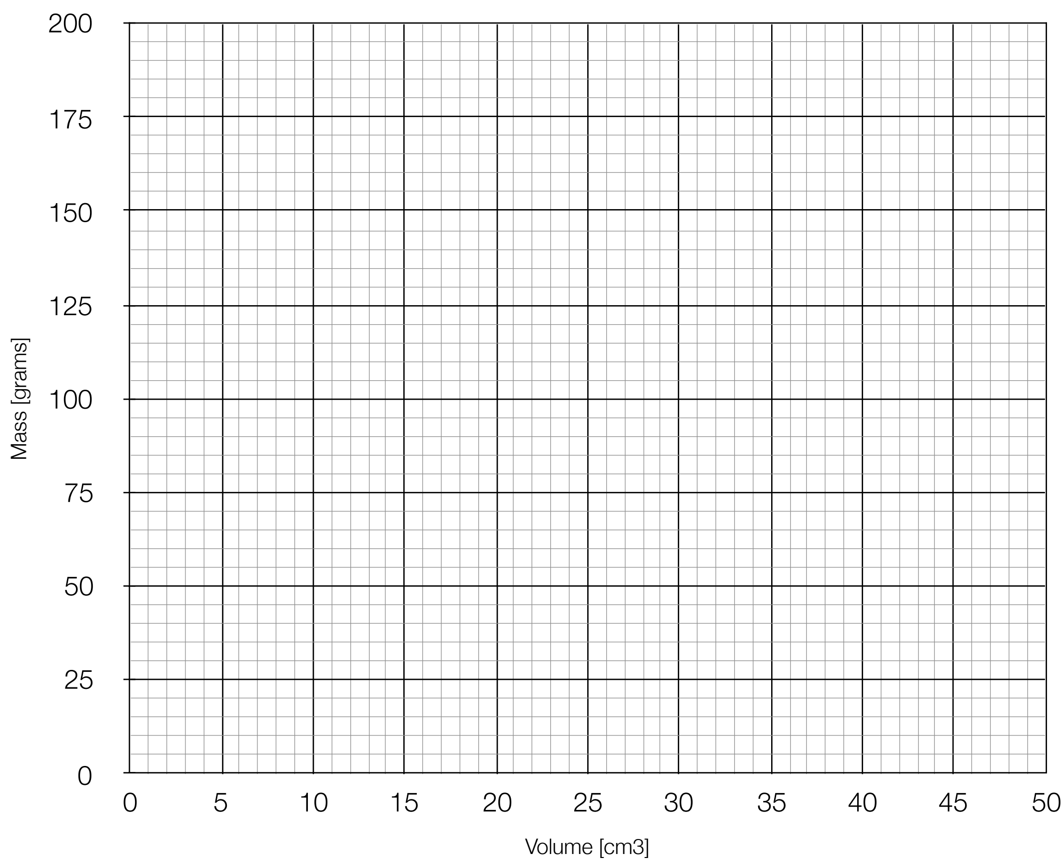
PROCEDURE A:

1. Using the “Density Data”, graph the Mass vs. Volume of the mineral sample.
2. Be sure to connect the points with a line.

DENSITY DATA

Mass [grams]	0	10	20	30	40	50	60	70	80	90	100
Volume [cm^3]	0	2	4	6	8	10	12	14	16	18	20

MASS VS. VOLUME



Lab Activity: Graphing Analysis

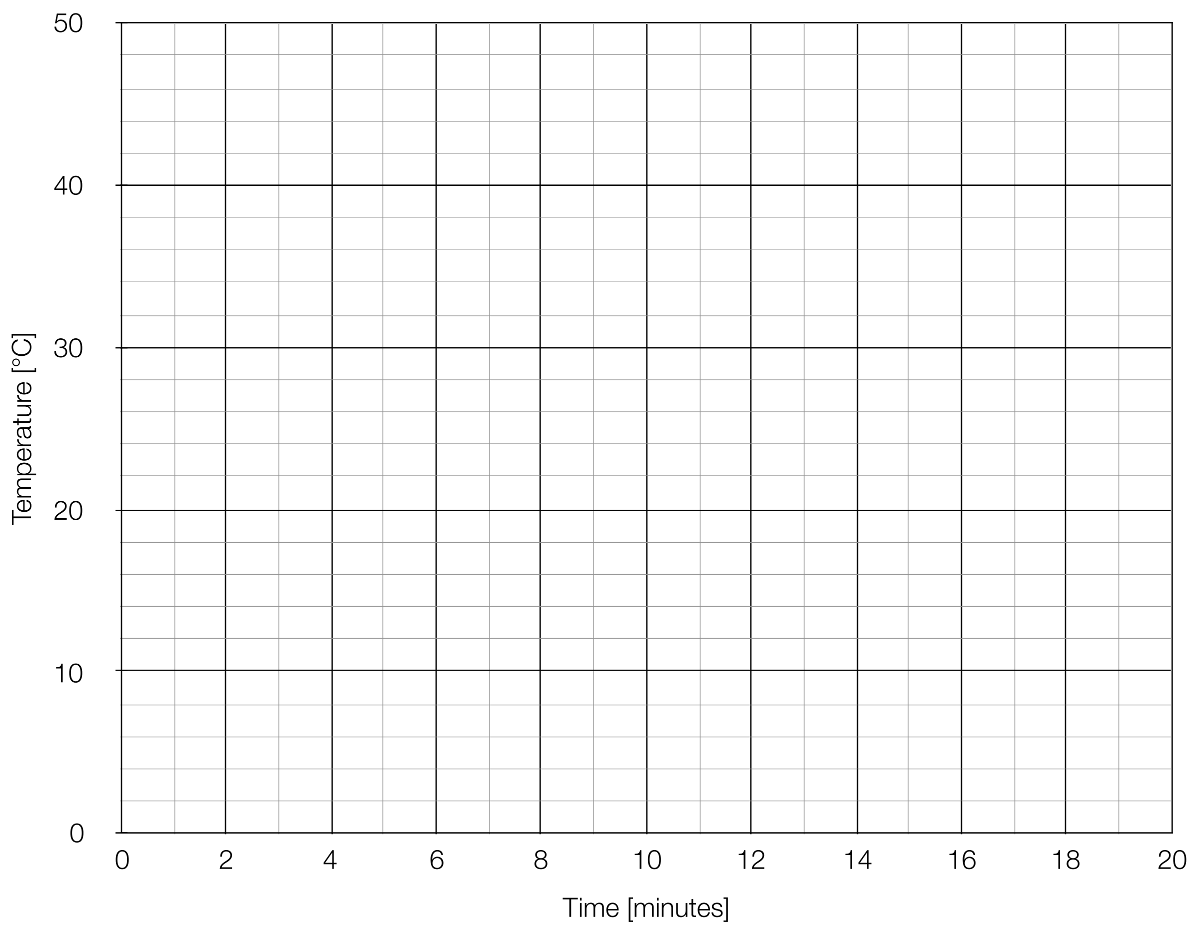
PROCEDURE B:

1. Mrs. Parrinello left her chi latte on the lab table. Temperature was measured and recorded at one-minute intervals. Plots the given data on the the "Cooling Rate of Chai Latte" graph.
2. Be sure to connect the points with a line.

CHAI LATTE TEMPERATURE

Time [min]	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Temp. [°C]	36.0	32.5	30.5	29.0	28.0	27.0	26.0	25.5	24.5	24.0	23.5	23.0	23.0	23.0	23.0	23.0

COOLING RATE OF CHAI LATTE



Lab Activity: Graphing Analysis

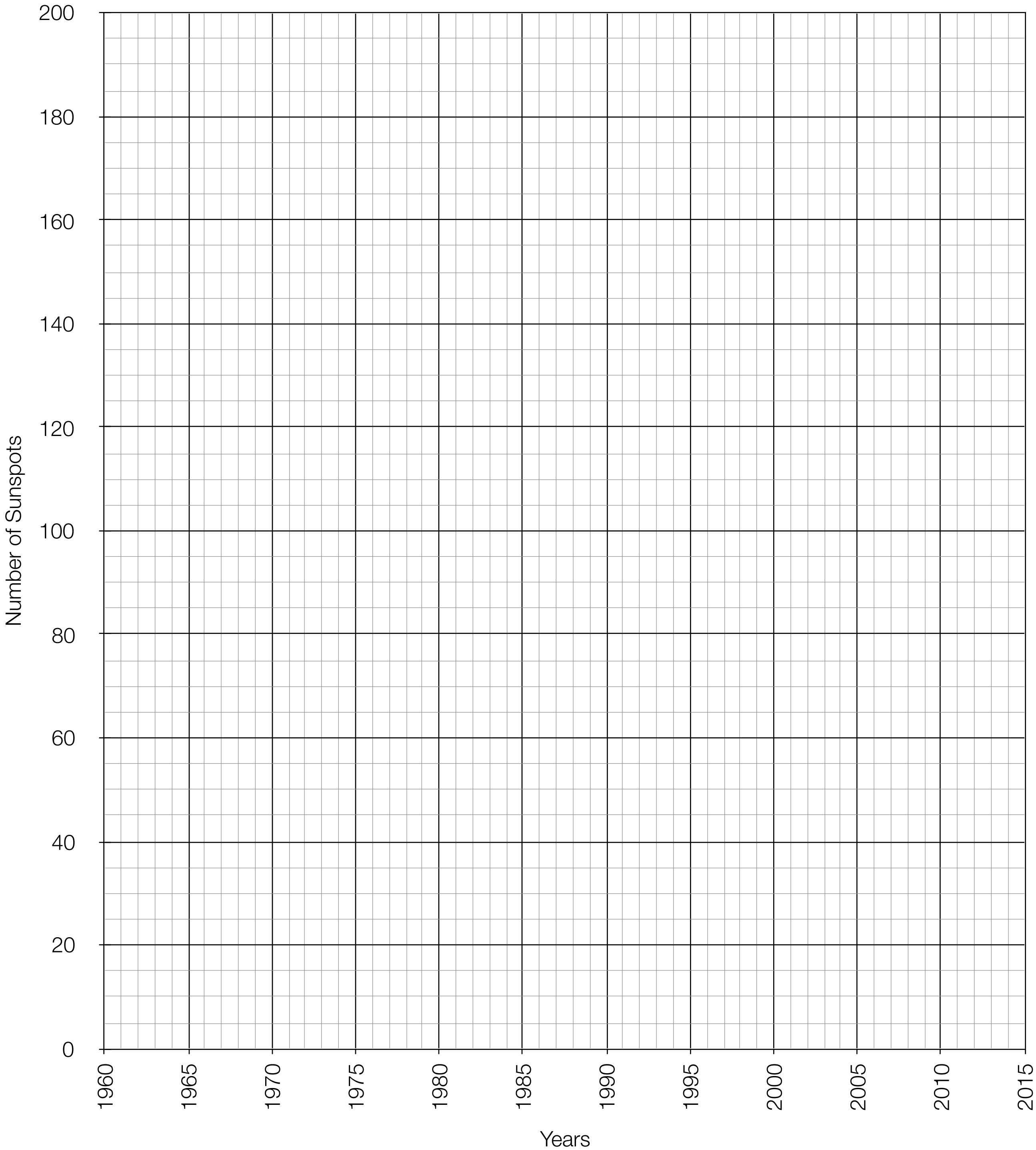
PROCEDURE C:

1. Using the data given, graph the number of sunspots in the years from 1960 to 2013.
2. Be sure to connect the points with a line.

Year	Number of Sunspots
1960	112
1961	54
1962	38
1963	28
1964	10
1965	15
1966	47
1967	94
1968	106
1969	105
1970	105
1971	67
1972	69
1973	38
1974	34
1975	16
1976	13
1977	27
1978	93
1979	155
1980	146
1981	134
1982	116
1983	72
1984	46
1985	18
1986	13

Year	Number of Sunspots
1987	29
1988	50
1989	145
1990	155
1991	150
1992	94
1993	55
1994	30
1995	18
1996	7
1997	21
1998	64
1999	93
2000	120
2001	111
2002	104
2003	64
2004	40
2005	30
2006	15
2007	8
2008	2
2009	3
2010	17
2011	56
2012	58
2013	65

AVERAGE ANNUAL SUNSPOT NUMBERS



Lab Activity: Graphing Analysis

DISCUSSION QUESTIONS:

1. What type of relationships exist for procedure A, procedure B and procedure C?

2. In procedure A, extrapolate the data to find the mass if the mineral has a volume of 40.0 cm^3?

3. In procedure B, describe the condition that exists for time and temperature from time 12 to 15?

4. In procedure B, calculate the rate of temperature change from time 0 to time 4?

5. In procedure C, calculate how long does it take to complete one sunspot cycle?

CONCLUSION: Describe the advantages of plotting data in graph form.

Name: ____

Date: ________________________ Period: ___________

Lab Activity: Spheres of the Earth

INTRODUCTION:

The Earth consists of a number of layers with unique compositions. When Earth was first beginning to form, the layers of Earth organized and separated from one another based upon density differences. These layers are now defined and recognized by changes in temperatures, pressures and velocities of seismic waves as they propagate throughout Earth's interior.

OBJECTIVE:

In the following activity, you will create a cross-section of Earth that shows the layers of Earth's interior and the atmosphere that are drawn to scale [100 km = 1 cm].

VOCABULARY:

Lithosphere

Hydrosphere

Atmosphere

Troposphere

Asthenosphere

Lab Activity: Spheres of the Earth

PROCEDURE A:

1. Cut a 90 cm piece of register tape and secure each end of the paper to the table.
2. Using a ruler, draw a line across the register paper 10 cm from one end, parallel to that end. Label this line "CENTER OF THE EARTH".
3. Calculate the "Scale Thicknesses" of each of the layers in the data below using the scale 100 km = 1 cm. Be sure to round your answer to the the nearest tenth.

Layer	Average Thickness	Scale Thickness	Distance from the Center
Inner Core	1221 km	12.2 cm	0.0 - 12.2 cm
Outer Core	2259 km		12.2 - 34.8 cm
Mantle	2598 km		34.8 - 60.8 cm
Asthenosphere	200 km		60.8 - 62.8 cm
Lithosphere	100 km		62.8 - 63.8 cm
Layer	**Average Thickness**	**Scale Thickness**	**Distance from the Surface**
Troposphere	10 km	.1 cm	0.0 - 0.1 cm
Stratosphere	60 km		0.1 - 0.7 cm
Mesosphere	80 km		0.7 - 1.5 cm
Thermosphere	460 km		1.5 - 4.6 cm

4. Using these calculations, draw in the remaining lines to complete your scale model. Neatly label each layer with its correct name. Draw a person or tree on the surface of the lithosphere to indicate that this is the outermost surface of the Earth.

Lab Activity: Spheres of the Earth

PROCEDURE B:

Go over the boundaries between the layers with a black colored pencil or a pen. Then, using colored pencils, lightly and neatly shade the layers using the following color scheme:

Layer	Color
Inner Core	Brown
Outer Core	Red
Mantle	Orange
Asthenosphere	Yellow
Lithosphere	Gray
Troposphere	Light Blue
Stratosphere	White
Mesosphere	Dark Blue
Thermosphere	Purple

Lab Activity: Spheres of the Earth

DISCUSSION QUESTIONS:

1. Why could the hydrosphere never be found above the atmosphere?

2. Which layer of Earth's interior is the thinnest and what is the density of that layer?

3. What element is found in the crust, the hydrosphere, and the troposphere?

4. List the layers of the Earth's interior from least dense to most dense.

5. What is the pressure 3000 km below the surface of the Earth?

CONCLUSION: How are Earth's layers organized?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Earth's Size and Shape

INTRODUCTION:

Pictures of the earth taken from space show that the earth appears to be perfectly round and smooth. However, to us, the earth appears to have a highly irregular surface. In addition, accurate measurements of the Earth's shape show that the equatorial diameter is slightly different than the polar diameter.

OBJECTIVE:

After you complete this lab you will better understand the true roundness and smoothness of the Earth.

VOCABULARY:

Relief

Model

Scale

Oblate Spheroid

Sphere

Lab Activity: Earth's Size and Shape

PROCEDURE A:

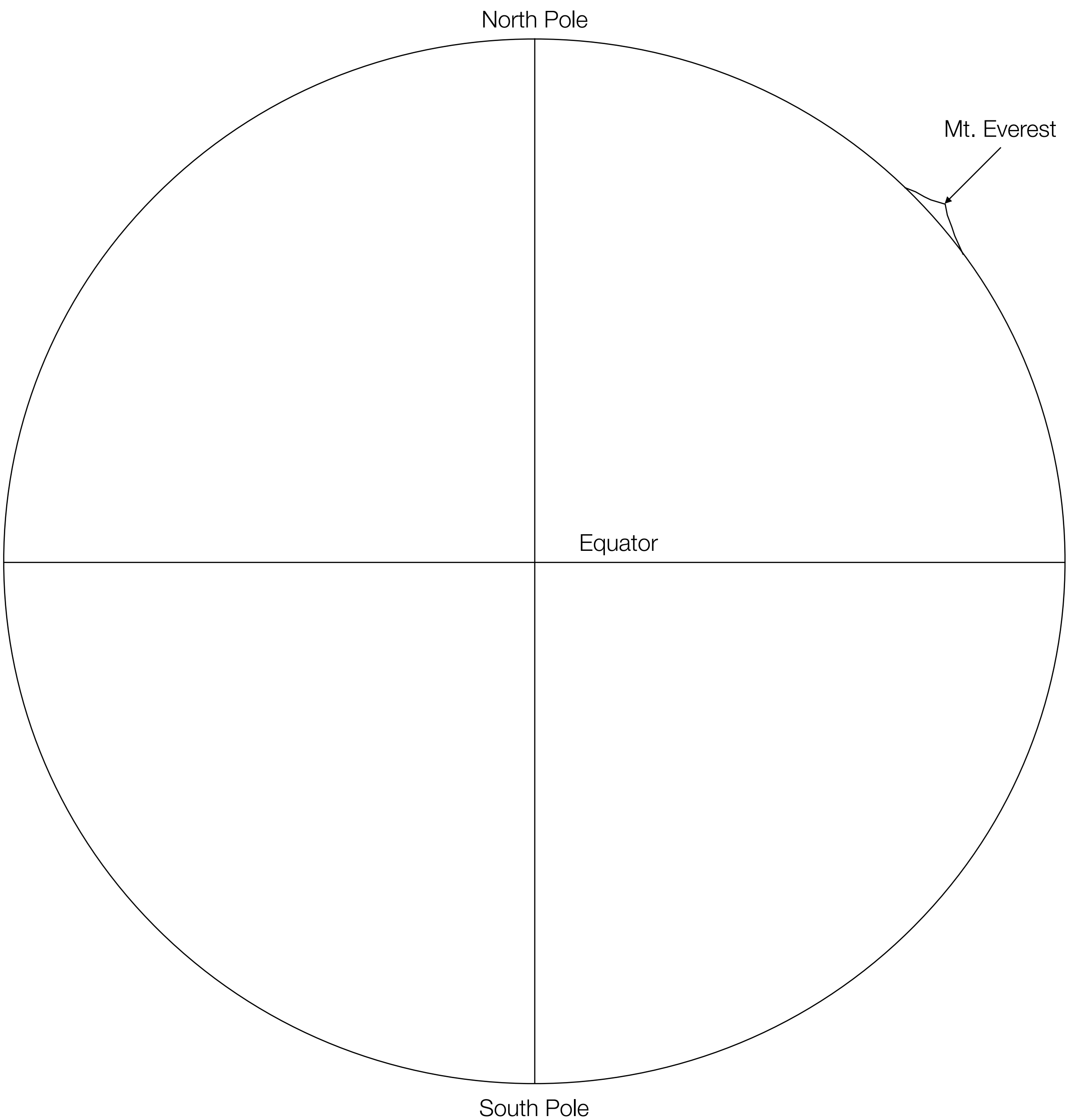
The ratio of the polar diameter to the equatorial diameter of a sphere is a measure of its roundness. Dividing the polar diameter by the equatorial diameter would give a value of 1 since both diameters of a perfect sphere are equal. The farther from 1 the actual computed ratio is, the less spherical a globe is.

5. Use the values given for the equatorial and polar diameters of the earth in the Data Chart on the Report Sheet to calculate the roundness-ratio of the Earth. Record this value on the Data Chart to the nearest thousandth.
6. Measure the equatorial and polar diameters of the “Average Classroom Relief Globe” represented by the diagram with your ruler to the nearest 0.1 cm. Record these measurements on the Report Sheet.
7. Calculate the roundness ratio for the “globe” using the data from step 2. Record this value on the report sheet to the nearest thousandth.

	Polar Diameter	Equitorial Diameter	Roundness Ratio
Earth	12,714 km	12,756 km	
Relief Globe			

Lab Activity: Earth's Size and Shape

AVERAGE CLASSROOM RELIEF GLOBE



Lab Activity: Earth's Size and Shape

PROCEDURE B:

A relief globe shows the relative height of its surface features, such as mountains. It is a scale model of the Earth. The following procedures will show you whether or not these features are constructed to scale on such a globe. To calculate, you must use the proportion shown below.

$$\frac{\text{Actual Height of Surface Feature [km]}}{\text{Earth's Diameter [km]}} = \frac{\text{Relief Globe Height of Surface Feature [cm]}}{\text{Relief Globe Diameter [cm]}}$$

When you place your data into the equation shown above, you have one unknown value [Relief Globe height of Surface Feature]. You then apply the mathematical rules for cross-multiplying ratios, and solve for the unknown value. Record the all answers on the “Correct Scale Data Table”.

1. Measure the Relief Globe Height of Mt. Everest in centimeters using the diagram [nearest 0.1].
2. The actual height of Mt. Everest = 8.8 km
3. The equatorial diameter of the Earth can be found in your ESRT on page 15.
4. Measure the Relief Globe Equatorial Diameter in centimeters [nearest 0.1].
5. Using the values obtained in steps 2 through 4, and the equation shown above, solve for the relief globe height of the surface feature [Mt. Everest] to correct scale for this globe.
6. Determine the % Deviation [Error] between the height of Mt. Everest on the “Average Classroom Relief Globe” and the height it should have been if drawn to the correct scale [#5].

$$\text{Percent Deviation [Error]} = \frac{\text{Difference from Accepted Value}}{\text{Accepted Value}} \times 100$$

Lab Activity: Earth's Size and Shape

CORRECT SCALE DATA TABLE

1. Height of Mt. Everest on the Diagram [cm]	
2. Actual Height of Mt. Everest [km]	
3. Actual Equatorial Diameter of Earth [km]	
4. Relief Globe Equatorial Diameter [cm]	
5. Correct Scale for Relief Globe Height of Mt. Everest [cm]	
6. Percent Error for the Relief Globe Height of Mt. Everest [nearest whole percent]	

SHOW ALL WORK

Correct Scale for Relief Globe Height of Mt. Everest [cm]	Percent Deviation [Error] for the Relief Globe Height of Mt. Everest [nearest whole percent]

Lab Activity: Earth's Size and Shape

DISCUSSION QUESTIONS:

1. Using your calculations, which is closer to a perfect sphere, Earth or the average classroom globe?

2. How does Earth's polar diameter compare with its equatorial diameter?

3. How does your data confirm that Earth in not a perfect sphere?

4. Explain why you think the earth is, or is not, smoother than the average classroom relief globe.

5. Calculate Mars's roundness ratio [Polar Diameter = 6,752 km / Equatorial Diameter = 6,792 km].

CONCLUSION: Describe the true shape and smoothness of Earth.

Name: ____

Date: ________________________ Period: __________

Lab Activity: Latitude and Longitude

INTRODUCTION:

The system that is used to locate and describe your position on Earth's surface is latitude and longitude. Originally used by cartographers for creating maps and captains for navigation on the open ocean, latitude and longitude has become a part of nearly everyone daily life. Whether using turn-by-turn directions with your GPS device or locating a friend's location, latitude and longitude are the basis for many different applications in every day life.

OBJECTIVE:

You will learn how to locate the star Polaris in the nighttime sky and to determine positions on Earth using the coordinate system of latitude and longitude.

VOCABULARY:

Latitude -

Equator -

Polaris -

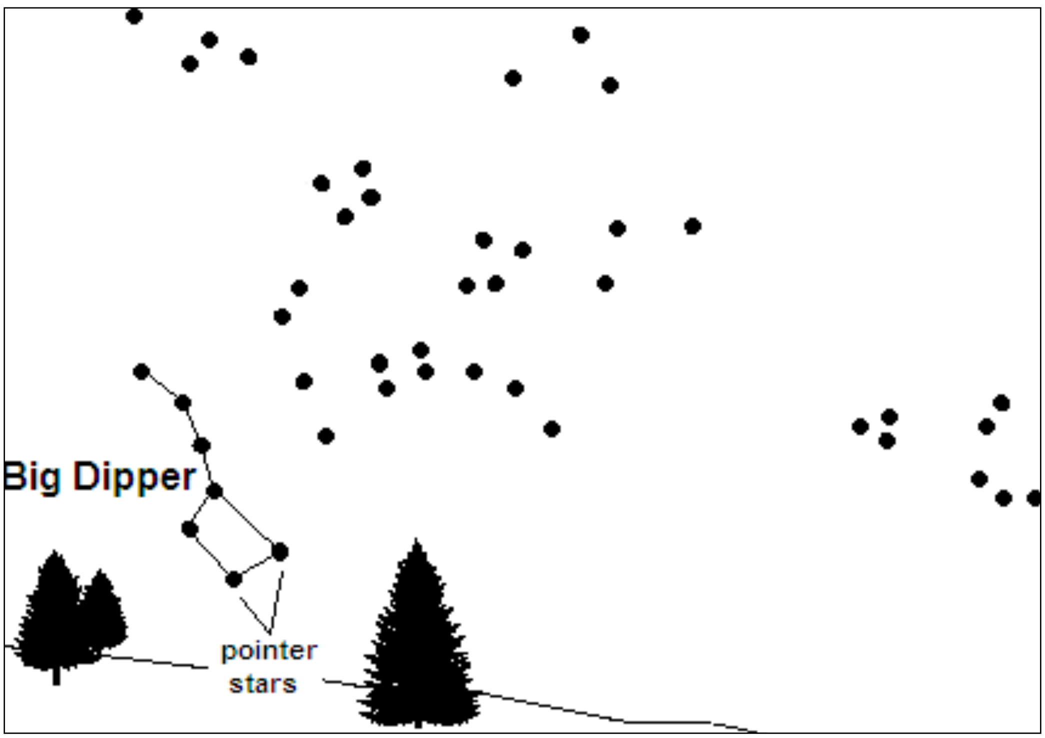
Longitude -

Prime Meridian -

Lab Activity: Latitude and Longitude

PROCEDURE A:

1. Locate the big dipper [bright group of stars in the constellation Ursa Major].
2. Following the pointer stars, move five times the distance that separates the pointer stars.
3. Circle the star and label it Polaris.
4. Label on the diagram [in the space provided] the direction an observer would be facing.

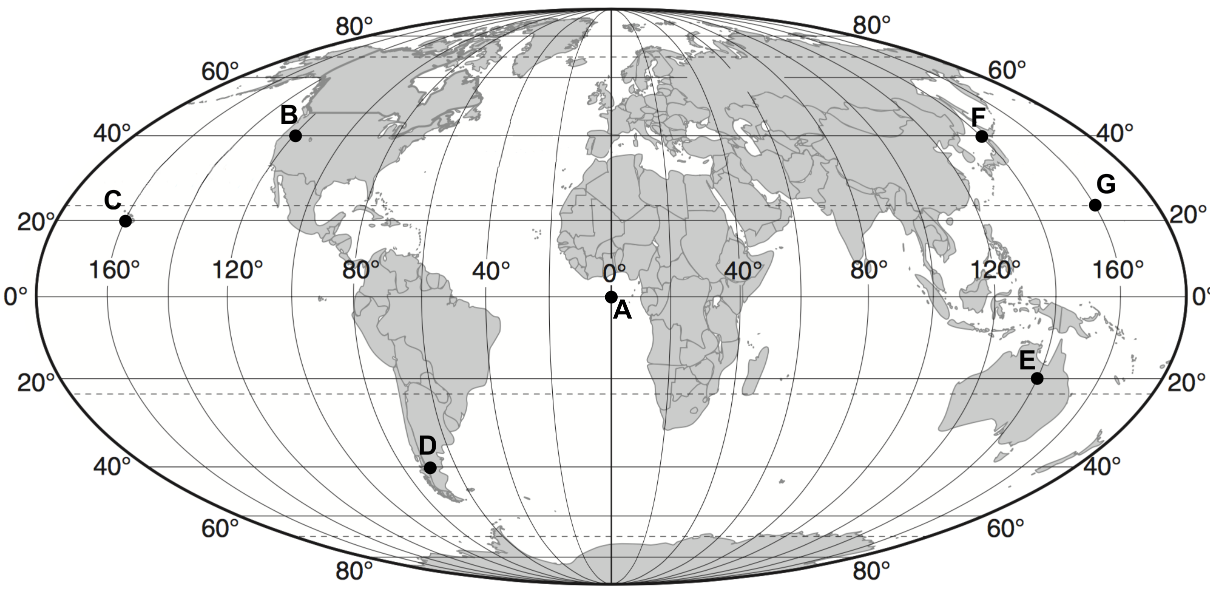


Observer's Direction: ___________________________________

Lab Activity: Latitude and Longitude

PROCEDURE B:

1. Trace over the Equator and Prime Meridian.
2. Use the World Map below to locate and record the approximate latitude and longitude coordinates on to Report Sheet 2 [include compass directions].



REPORT SHEET 1

Location	Latitude	Longitude
A		
B		
C		
D		
E		
F		
G		

Lab Activity: Latitude and Longitude

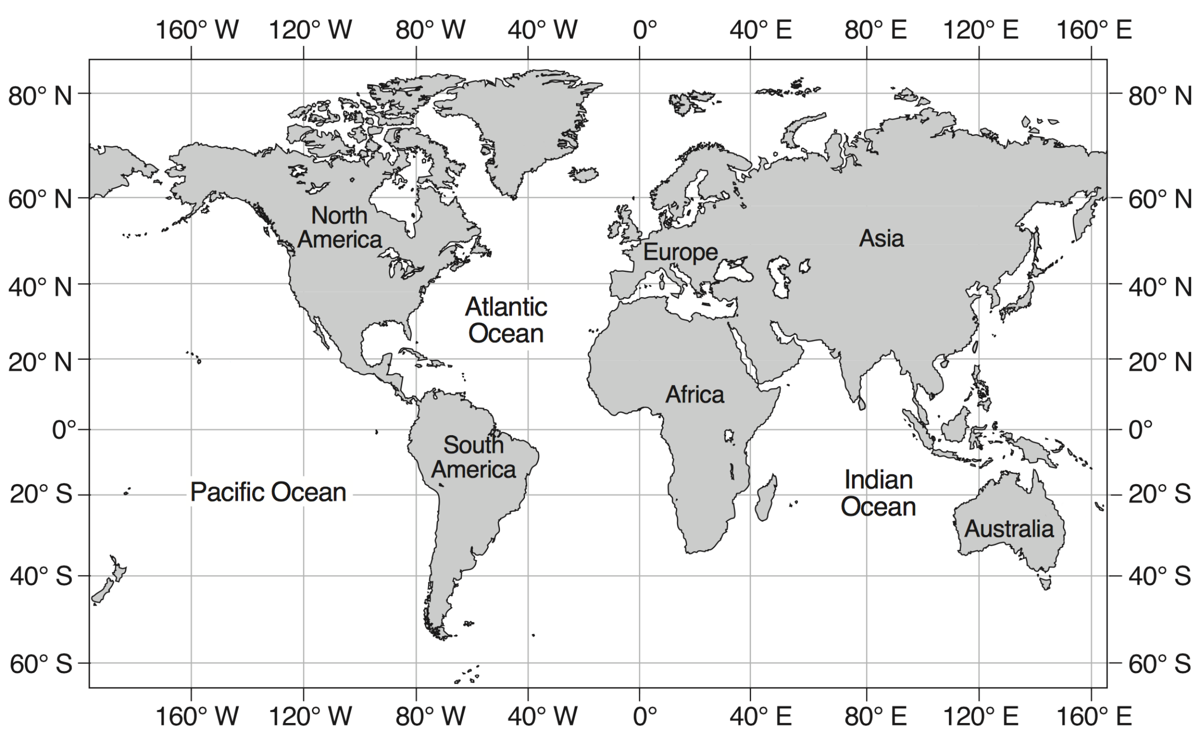
PROCEDURE C:

1. Trace over the Equator and Prime Meridian.
2. Use the Data Chart and World Map provided below to plot the following latitude and longitude coordinates. Be sure to label each point with the correct letter.

DATA SHEET

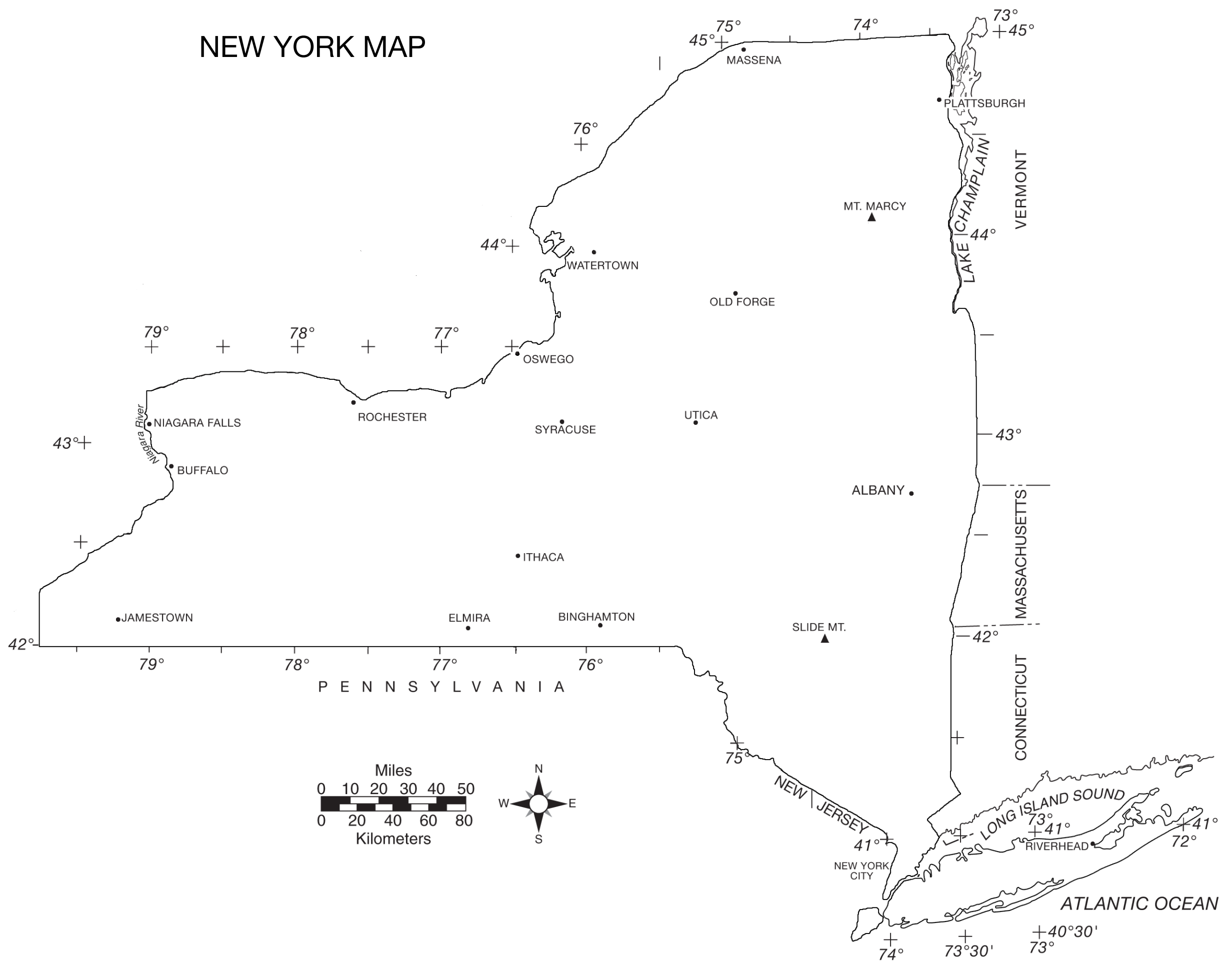
Location	Latitude	Longitude
A	40º N	160º W
B	40º S	40º E
C	20º S	80º W
D	80º N	120º W
E	0º	0º

WORLD MAP



PROCEDURE D:

Use the New York Map to locate and record the approximate latitude and longitude coordinates of the listed cities and geologic features on to Report Sheet 2 [include compass directions].



REPORT SHEET 2

Location	Latitude	Longitude
Watertown		
Mt. Marcy		
Slide Mountain		
Oswego		

Lab Activity: Latitude and Longitude

DISCUSSION QUESTIONS:

1. What is the maximum number of degrees of latitude possible?

2. Explain why two circles of latitude never touch?

3. What is the maximum number of degrees of longitude possible?

4. Explain why the distance between two meridians at the North Pole is zero miles?

5. If it is approximately 6,200 miles from the equator to the North Pole or South Pole, how many miles is it between two parallels 1° apart?

CONCLUSION: Describe how latitude and longitude coordinates are used to locate positions on Earth?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Field Maps and Isolines

INTRODUCTION:

A field is a region in which there is a definite physical property that can be measured at every point. On Earth's surface there are hundreds of different measurable quantities. Some examples of measurable field quantities are; air pressure, temperature, elevation, rainfall amounts, and humidity.

During your course of study you will see many different types of field maps. In this lab we will be introduced to field maps using temperature data in the classroom.

OBJECTIVE:

You will use data from temperature values for two different days in a classroom and construct isotherms to interpret the field map.

VOCABULARY:

Field -

Isoline-

Isotherm -

Isobar -

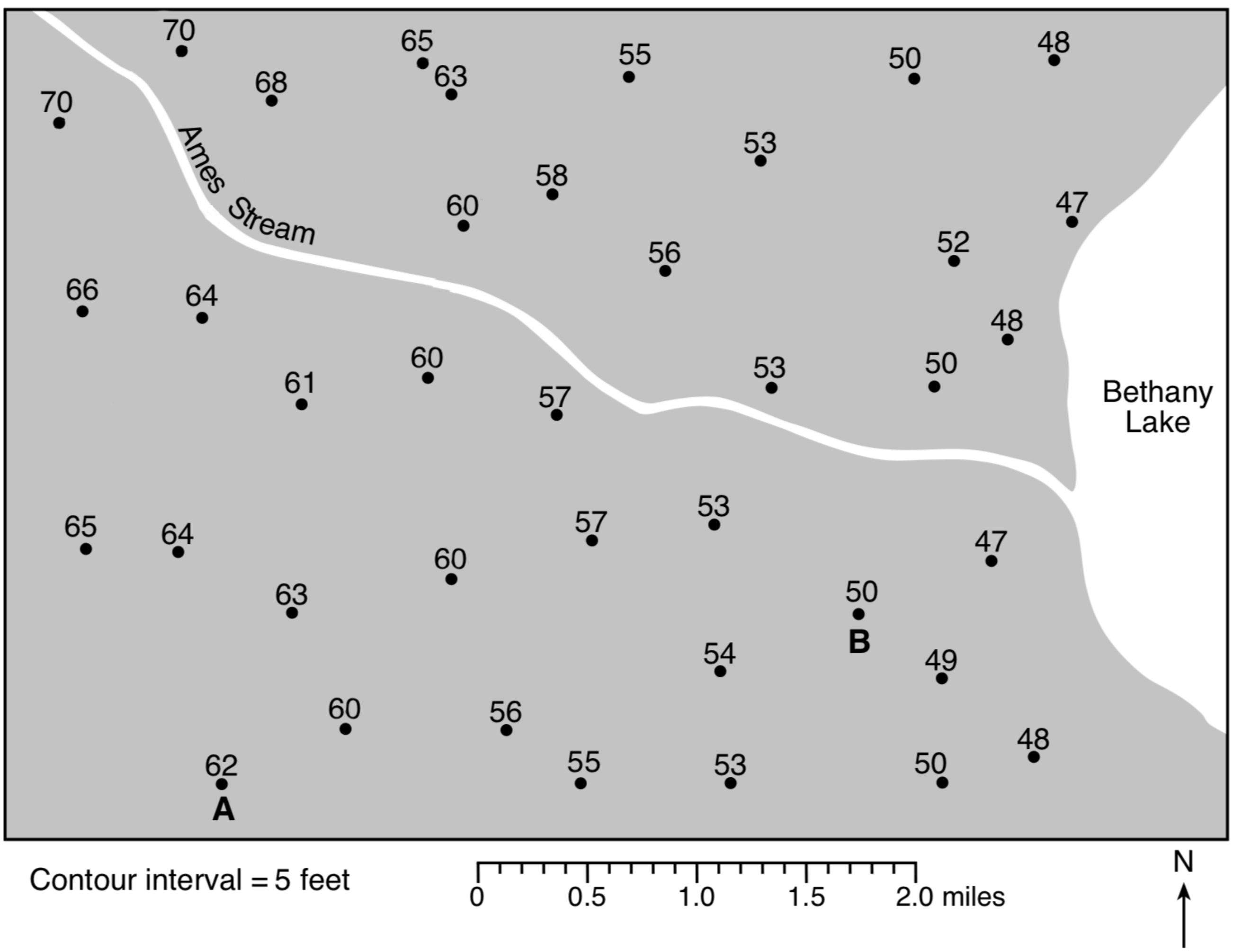
Isohyet -

Lab Activity: Field Maps and Isolines

PROCEDURE A:

Using the Ames Stream Map below, draw in all the contour lines at 5 foot intervals on the map. Letter A and B will be used in the discussion questions. Be sure to extend the contour lines to the edges of the map.

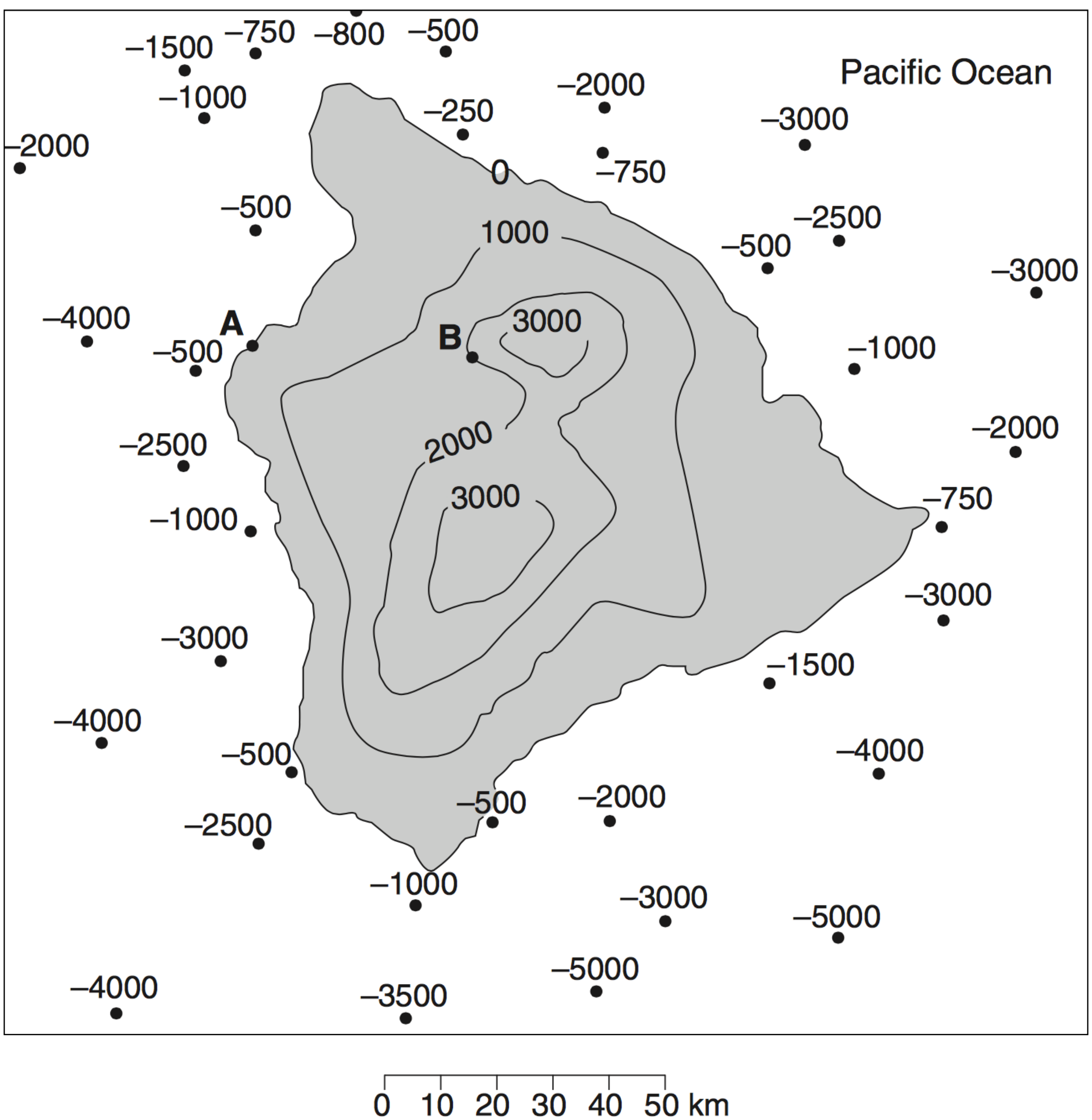
AMES STREAM MAP



PROCEDURE B:

Using the Hawaii Map, construct ocean floor depths using 1000 meter intervals on the map. Letter A and B will be used in the discussion questions. Be sure to extend the contour lines to the edges of the map or form complete rings. Elevations are in meters.

HAWAII MAP



Lab Activity: Field Maps and Isolines

DISCUSSION QUESTIONS:

1. How many dimensions are represented on a standard isoline map?

2. Other than an elevation field map, name three other types of field maps.

3. List three rules that you should follow when constructing isolines.

4. Using the Ames Stream Map, calculate the gradient between points A and B.

5. Using the Hawaii Map, calculate the gradient between points A and B.

CONCLUSION: Describe, step by step, how we can map the field of a variable quantity?

Lab Activity: Topographic Maps

INTRODUCTION:

Topographic maps are models that represent a portion of the Earth's surface. The relief, or topography, such as hills and valleys can be shown by using isolines called contour lines. A contour line is a line drawn through points of equal elevation, or distance above sea level. Contour lines show both the shape and relief of the feature or area being mapped.

The difference in elevation between adjacent, or successive contour lines is the contour interval. Usually, contour intervals are expressed in meters and feet.

OBJECTIVE:

You will see how contour maps are drawn and how they represent topography.

VOCABULARY:

Topographic Maps -

Contour Line -

Contour Interval -

Contour Index -

Depression Contour Lines -

Lab Activity: Topographic Maps

PROCEDURE:

1. Fill the shoebox with water, stopping when the water level reaches the 0 centimeter marking. This is sea level which is equal to 0 meters in elevation.

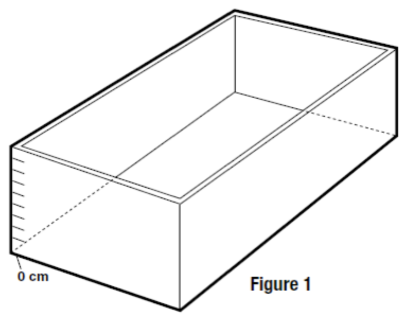


Figure 1

2. Have your teacher place in food coloring or dye to make the shoreline more visible.
3. Place the clear plastic lid on top of the shoebox. Using a marker trace the shoreline. Be sure to keep your eye directly over the shoreline as you trace it onto you clear plastic lid.
4. Take the clear plastic lid off and fill to the next centimeter marking line.
5. Replace the lid and retrace the shoreline.
6. Repeat steps 4 and 5 for every centimeter marking until you get to the top centimeter marking line. The contour line at the top of the volcano should be marked with with hachure lines.

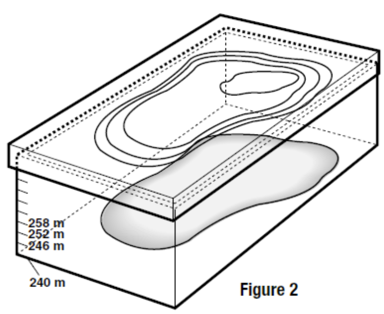


Figure 2

7. After you have completed drawing all the lines, every member of your group should trace your contour lines from the clear plastic lid onto a white sheet of paper.
8. Label each contour starting with the first marker line. The first line represents 0 meters.

Lab Activity: Topographic Maps

DISCUSSION QUESTIONS

1. What do contour lines represent on a topographic map?

2. Why is it unlikely that two contour lines will ever cross?

3. Referring to your contour map, how does a topographic map show areas of steep gradient?

4. How do contour lines indicate streamflow on a topographic map?

5. Would a topographic map of a mountain today have the same appearance in the future?

CONCLUSION: To accurately create a topographic map, what types of data do you need to collect?

Name: ____

Date: ________________________ Period: __________

Solar System

Earth Science

Lab Activity: Apparent Motions

INTRODUCTION:

Many times you have observed the Sun rising in the morning, moving across the sky during the day, and setting in the evening. You must realize, however, that this is only an apparent motion. The real motion of Earth's rotation is responsible for this apparent motion of the Sun. In this lab you will examine this apparent motion of the Sun more closely and look for evidence of change.

OBJECTIVE:

You will learn how the Sun's path changes on the celestial sphere during the period of one year.

VOCABULARY:

Horizon -

Altitude -

Azimuth -

Solstice -

Equinox -

Lab Activity: Apparent Motions of the Sun

PROCEDURE:

1. Place the transparent hemisphere onto the azimuth template.
2. Be sure to place a mark onto the hemisphere at the north, east, south, and west directions.
3. Using the external protractor and a transparence marker, place the data for the azimuth and altitude of the Sun onto the clear plastic hemisphere.
4. Be sure to connect the points with a line as you move along.
5. After you have completed one line be sure to date it before you move on to the next date.
6. Finish placing all the points on the hemisphere for the remaining dates given before moving on.

June 21st		
Time	Azimuth	Altitude
5:00	60°	0°
7:00	73°	16°
9:00	91°	39°
11:00	117°	60°
13:00	184°	73°
15:00	246°	59°
17:00	271°	36°
19:00	290°	16°
21:00	300°	0 °

March 21st		
Time	Azimuth	Altitude
7:00	90°	0°
9:00	113°	25°
11:00	142°	43°
13:00	185°	50°
15:00	225°	40°
17:00	252°	20°
19:00	270°	0°

December 21st		
Time	Azimuth	Altitude
8:00	120°	0°
10:00	152°	20°
12:00	182°	25°
14:00	211°	20°
16:00	240°	0°

September 21st		
Time	Azimuth	Altitude
7:00	90°	0°
9:00	113°	25°
11:00	142°	43°
13:00	185°	50°
15:00	225°	40°
17:00	252°	20°
19:00	270°	0°

Lab Activity: Apparent Motions of the Sun

REPORT SHEET

June 21

Total degrees that the Suns path takes: ____________

Time the Sun takes to move through its path: ____________

Calculate the rate at which the Sun appears to move across the sky: ____________

Do calculations here:

December 21

Total degrees that the Suns path takes: ____________

Time the Sun takes to move through its path: ____________

Calculate the rate at which the Sun appears to move across the sky: ____________

Do calculations here:

March 21

Total degrees that the Suns path takes: ____________

Time the Sun takes to move through its path: ____________

Calculate the rate at which the Sun appears to move across the sky: ____________

Do calculations here:

September 21

Total degrees that the Suns path takes: ____________

Time the Sun takes to move through its path: ____________

Calculate the rate at which the Sun appears to move across the sky: ____________

Do calculations here:

Lab Activity: Apparent Motions of the Sun

DISCUSSION QUESTIONS:

1. How is the amount of daylight related to the Sun's apparent path?

2. According to your calculations, what is the rate the Sun appears to move across the sky?

3. At the rate determined in question 2, how many hours would it take the Sun to travel 360°?

4. What day[s] does the Sun rise directly in the east and set directly in the west.

5. Describe how the angle of sunlight changes from December 21 through June 21?

CONCLUSION: Describe how the Sun's apparent path across the sky changes over a year?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Ellipses

INTRODUCTION:

The earth revolves around the sun in an orbit which is a special geometric figure called an ellipse. An ellipse has two "center points". Each one is called a focus. The Sun is not in the exact middle of the earth's orbit, rather the Sun is found at one of the focal points.

OBJECTIVE:

You will create an series of ellipses and compare the shape of the Earth's orbit and orbits of other planets with the shape of a circle.

VOCABULARY:

Ellipses -

Focus [foci] -

Major Axis -

Circle -

Line -

Lab Activity: Ellipses

PROCEDURE:

1. Carefully cut out the Ellipse Worksheet located on page 26.
2. Place the Ellipse Worksheet on three pieces of cardboard and place a thumbtack in each point labeled #1.
3. Loop the string around the thumb tacks and draw the ellipse by placing your pencil inside the loop and label this ellipse #1.
4. Measure the distance between the thumbtack holes. Record this as “d” on your Report Sheet.
5. Measure the length of the major axis. Record this as “L” on the Report Sheet.
6. Move each thumbtack to the points labeled #2 and draw a new ellipse. Measure and record the distance between foci and the length of the major axis for ellipse #2.
7. Move each thumbtack to the points labeled #3 and draw a new ellipse. Measure and record the distance between foci and the length of the major axis for ellipse #3.
8. Move each thumbtack to the points labeled #4 and draw a new ellipse. Measure and record the distance between foci and the length of the major axis for ellipse #4.
9. Place one thumbtack at the pointed labeled #5 and draw a new ellipse. The distance between the foci is 0. Measure and record the length of the major axis for ellipse #5.
10. Using the equation below, calculate the eccentricity [e] of each of the five figures. Show ALL work on your report sheet. Round your answers to thousandths place.

$$\text{Eccentricity} = \frac{\text{distance between focus}}{\text{length of major axis}}$$

REPORT SHEET

Ellipse	Calculations:
Ellipse #1 d = __________ L = __________ e = __________	Calculations:
Ellipse #2 d = __________ L = __________ e = __________	Calculations:
Ellipse #3 d = __________ L = __________ e = __________	Calculations:
Ellipse #4 d = __________ L = __________ e = __________	Calculations:
Ellipse #5 [circle] d = __________ L = __________ e = __________	Calculations:

Lab Activity: Ellipses

DISCUSSION QUESTIONS:

1. As you increase the distance between the foci, what change takes place in the eccentricity?

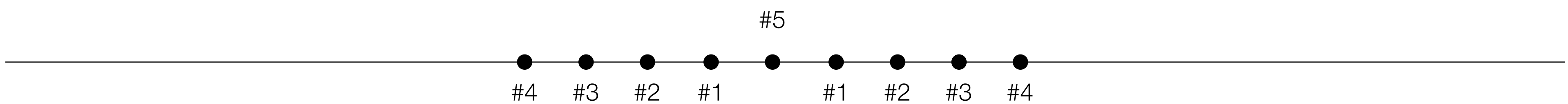
2. Which of the four ellipses you drew (not counting the circle) was the most eccentric?

3. Which of the four ellipses you drew (not counting the circle) was the least eccentric?

4. What is the minimum eccentricity an ellipse can have and the name of that geometric figure?

5. Where is the sun located on a diagram of the earth's orbit?

CONCLUSION: Describe the true shape of Earth's orbit?



ELLIPSE WORKSHEET

Lab Activity: Earth's Moon

INTRODUCTION:

Earth's only natural satellite is our Moon. While the Sun is the dominant celestial object during the daytime sky, it is the Moon that is the major attraction at night. Throughout the month, the moon appears to change shape and its direction of rising and setting. There are even days when it is visible during the daytime.

OBJECTIVE:

In the following activity you will investigate the actual and apparent motions of the moon and determine the different phases as it move throughout our sky over a month.

VOCABULARY:

Waxing Moon -

Waning Moon -

New Moon -

Crescent Moon -

Gibbous Moon -

Lab Activity: Earth's Moon

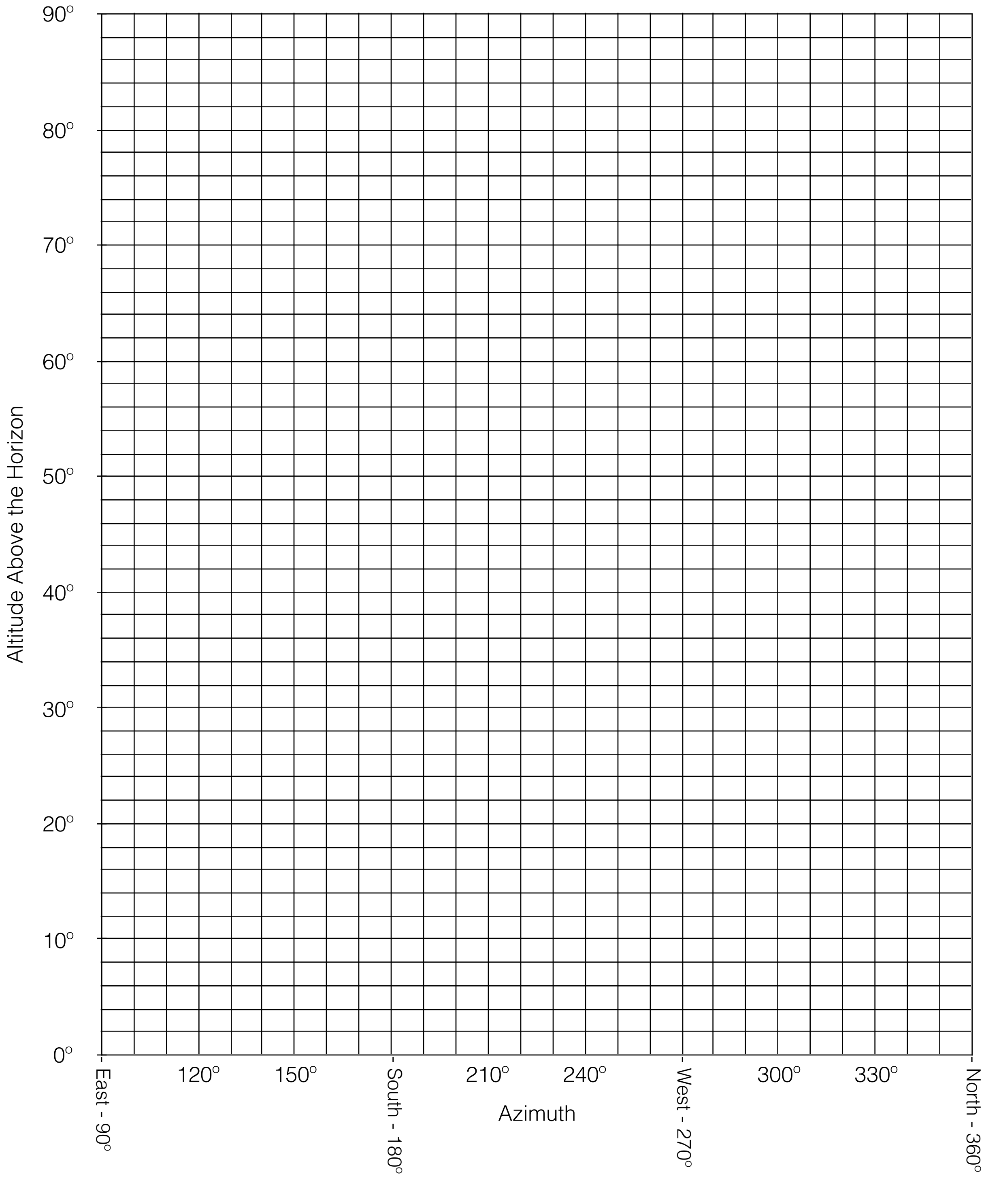
PROCEDURE A:

1. Fill in the chart with the Moon Phase for each viewable portion of the Moon that was observed.
2. Observations of the Moon were taken every night at 9:00 pm for about a month. Using the Moon Observation Chart, plot an "x" for the altitude and azimuth onto the Earth's Horizon Chart.

MOON OBSERVATION CHART

Date	Altitude	Azimith	Viewable Portion	Moon Phase
Feb 27	0º	290º	1%	
Feb 28	10º	285º	17%	
March 1	20º	280º	27%	
March 2	34º	275º	36%	
March 3	46º	270º	47%	
March 4	58º	260º	59%	
March 5	68º	230º	70%	
March 6	72º	200º	80%	
March 7	66º	160º	88%	
March 8	56º	140º	94%	
March 9	46º	130º	99%	
March 10	34º	120º	100%	
March 11	20º	110º	99%	
March 12	0º	100º	95%	

EARTH'S HORIZON CHART

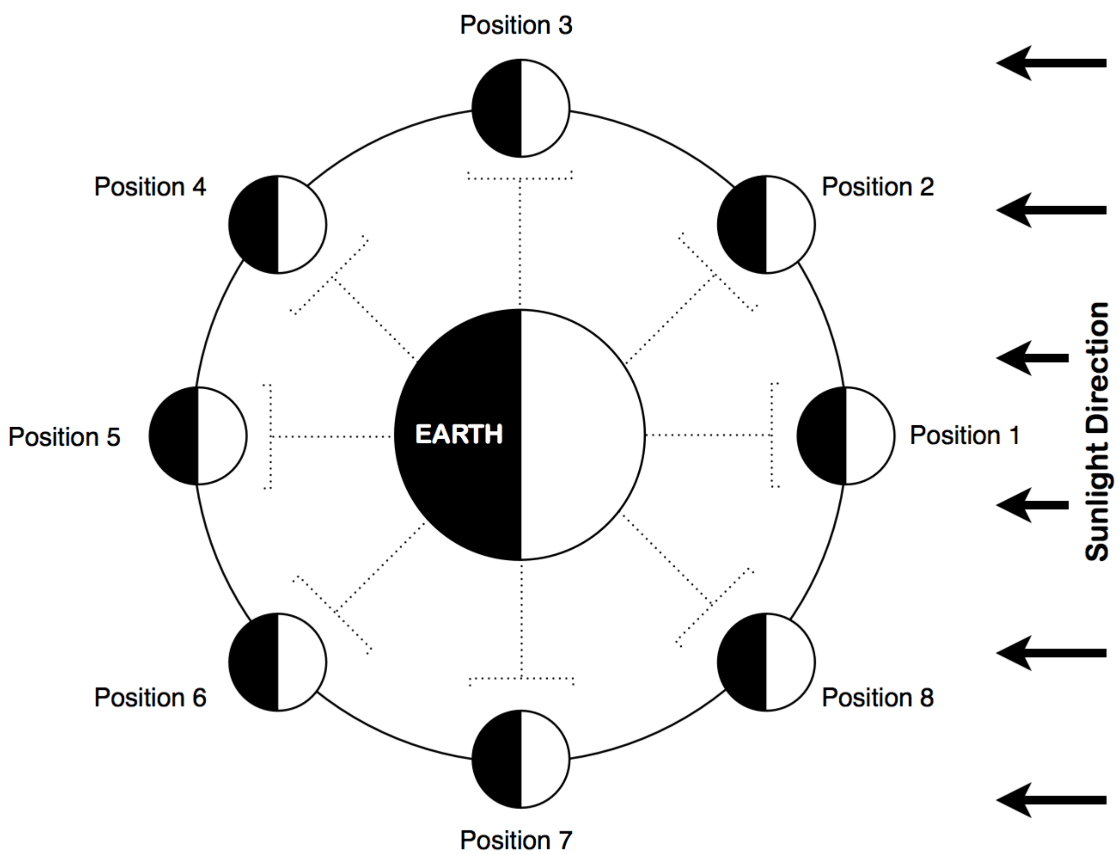


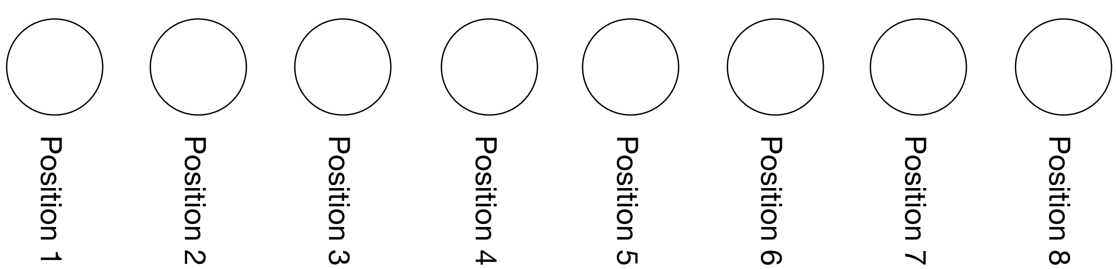
Lab Activity: Earth's Moon

PROCEDURE B:

1. Using the Positions of the Moons Diagram and your knowledge of Earth's Moon, sketch the visible portion of the moon for positions 1 through 8 below.
2. Be sure to shade in the portion of the moon that you do not see.

POSITIONS OF THE MOON DIAGRAM



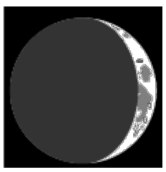


Lab Activity: Earth's Moon

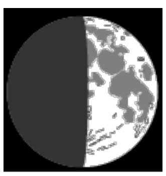
PROCEDURE C:

1. Using the Moon Phase Images, label the proper moon phase.
2. Be sure to check if it is a waxing moon or waning moon.
    - Remember: "Light on right… moon grows bright!"

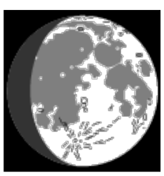
☐ Waxing ☐ Waning Moon Phase: ______________________________



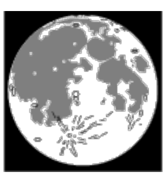
☐ Waxing ☐ Waning Moon Phase: ______________________________



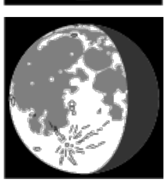
☐ Waxing ☐ Waning Moon Phase: ______________________________



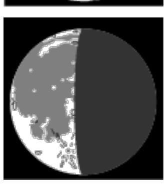
☐ Waxing ☐ Waning Moon Phase: ______________________________



☐ Waxing ☐ Waning Moon Phase: ______________________________



☐ Waxing ☐ Waning Moon Phase: ______________________________



☐ Waxing ☐ Waning Moon Phase: ______________________________

☐ Waxing ☐ Waning Moon Phase: ______________________________

Lab Activity: Earth's Moon

DISCUSSION QUESTIONS:

1. What is meant when the Moon is said to be waxing?

2. What is meant when the Moon is said to be waning?

3. What is the phase of the moon just before and just after the New Moon?

4. What is the phase of the moon just before and just after the Full Moon?

5. Are the phases of the moon cyclic?

CONCLUSION: Describe the change in the Moon's phase that takes place over the span of one cycle.

Lab Activity: The Sun

INTRODUCTION:

Constructing and interpreting graphs are an integral part of Earth Science. When data is collected and plotted a pattern can emerge. The picture-like representation makes it easier to see relationships that are not obvious from a column of data. This section focuses on graphing trends and the different types of patterns that can help extrapolate data to predict an event.

OBJECTIVE:

You will see how graphing a natural phenomenon can aid in predicting future events.

VOCABULARY:

Sunspot -

Cyclic Relationship -

Direct Relationship -

Inverse Relationship -

Extrapolate -

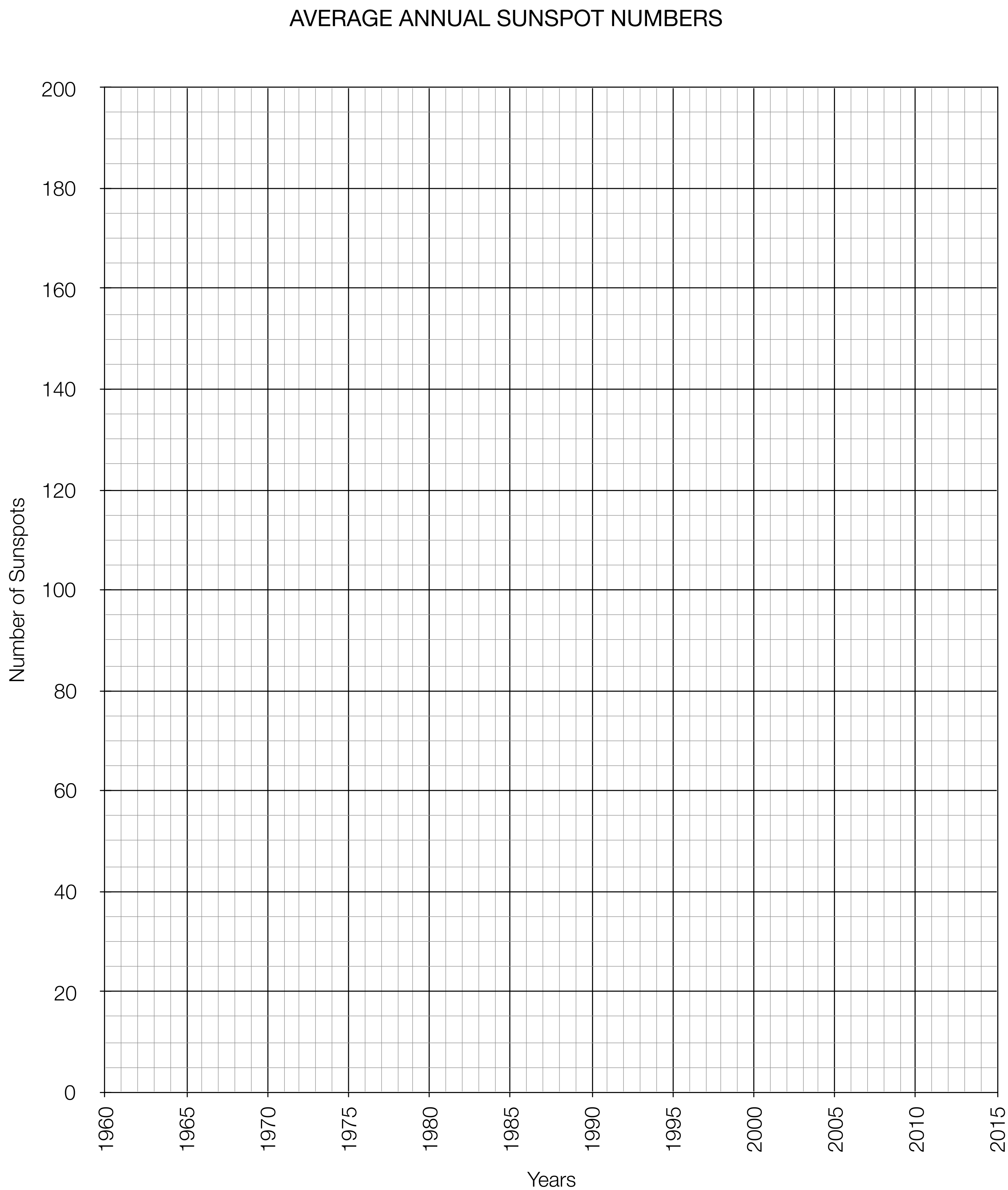
Lab Activity: The Sun

PROCEDURE:

1. Using the data given, graph the number of sunspots in the years from 1960 to 2003.
2. Be sure to connect the points with a line.

Year	Number of Sunspots
1960	112
1961	54
1962	38
1963	28
1964	10
1965	15
1966	47
1967	94
1968	106
1969	105
1970	105
1971	67
1972	69
1973	38
1974	34
1975	16
1976	13
1977	27
1978	93
1979	155
1980	146
1981	134
1982	116
1983	72
1984	46
1985	18
1986	13

Year	Number of Sunspots
1987	29
1988	50
1989	145
1990	155
1991	150
1992	94
1993	55
1994	30
1995	18
1996	7
1997	21
1998	64
1999	93
2000	120
2001	111
2002	104
2003	64
2004	40
2005	30
2006	15
2007	8
2008	2
2009	3
2010	17
2011	56
2012	58
2013	65


AVERAGE ANNUAL SUNSPOT NUMBERS
Number of Sunspots
200
180
160
140
120
100
80
60
40
20
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Years

Lab Activity: The Sun

DISCUSSION QUESTIONS:

1. What type of relationship does this graph show?

2. Each peak represents a sunspot maximum. In which years do these maxima occur?

3. What is the average time span (to the nearest tenth of a year) between maxima?

4. How long does it take to complete one sunspot cycle?

5. Extrapolate the graph to determine how many sunspots will occur in 2007?

CONCLUSION: Describe the advantages of plotting data in graph form.

Name: ____

Date: ________________________ Period: __________

Lab Activity: Planets and Parts

INTRODUCTION:

The planets range in size from our smallest terrestrial planet Mercury to the gigantic gaseous planet Jupiter. The volume of Jupiter is about 200,000 times that of Mercury the smallest inner planet. If one is to appreciate the sizes of the inner planet versus the outer planet, it is necessary to make scale models of the planets. Scale is the ratio between the dimensions of a representation and those of the object.

OBJECTIVE:

Using the planetary data and scale conversion you will construct diagrams that show the relative sizes of the planets.

VOCABULARY:

Planet -

Solar System -

Jovian -

Terrestrial -

Asteroid Belt -

Lab Activity: Planets and Parts

PROCEDURE A:

1. Complete Data Table 1 below using the scale 1 cm = 7000 km. Be sure to round to the nearest tenths place.
2. Using the scale diameters calculated in Data Table 1, construct circles to represent the planet on a separate piece of paper.
    - For the terrestrial planets, draw a straight line that is equal to the diameter and approximate the circle by drawing it free-hand.
    - For the Jovian planets, use a safety compass to draw the circle [be sure to use the radius when using the compass].
3. Label each circle with the name of the planet.

DATA TABLE 1

Planet	Equatorial Diameter [km]	Scale Diameter [cm]
Mercury	4,880	
Venus	12,104	
Earth	12,756	
Mars	6,787	
Jupiter	142,800	
Saturn	120,000	
Uranus	51,800	
Neptune	49,500	

PROCEDURE B:

1. Complete Data Table 2 below using the scale 1 cm = 10,000,000 km. Be sure to round to the nearest tenths place.
2. Obtain 5 meters of cash register tape and spread it out along the desks or floor.
3. Measure 10 cm from the end of the cash register tape and label it “Sun”. This will represent the Sun’s surface and will be your starting point for all your measurements.
4. Using a meter stick, measure all the distances of the planets from the line labeled “Sun”.
5. Label each line with the name of the planet.

DATA TABLE 2

Planet	**Scale Distance from the Sun** [km]	**Scale Distance from the Sun** [cm]
Mercury	57,900,000	
Venus	108,200,000	
Earth	149,600,000	
Mars	227,900,000	
Jupiter	778,300,000	
Saturn	1,427,000,000	
Uranus	2,869,000,000	
Neptune	4,496,000,000	

Lab Activity: Planets and Parts

DISCUSSION QUESTIONS:

1. Which are the two largest planets?

2. Which planet is closest to the size of the Earth?

3. How do the sizes of the inner planets [terrestrial] compare to the sizes of the outer planets [jovian]?

4. How do the distances between the inner planets differ from that of the outer planets?

5. Which two planets are closest to Earth?

CONCLUSION: Compare the sizes of the planets and the distances between them.

Name: ____ The Universe

Date: ________________________ Period: __________ Earth Science

Lab Activity: Classification of Stars

INTRODUCTION:

A star's actual brightness is related to its temperature and size. In the beginning of the 20th Century, two independent astronomers developed a graph of this relationship. This graph has been named the Hertzsprung-Russell (H-R) Diagram after these two scientists.

Stars are classified based upon their luminosity, color, temperature, and size. While the temperature of the star is related to its color, the apparent brightness varies with distance from Earth.

OBJECTIVE:

You will plot the location of stars on the H-R Diagram and determine some of their characteristics.

VOCABULARY:

Star -

Nuclear Fusion -

H-R Diagram -

Luminosity -

Main Sequence -

Lab Activity: Classification of Stars

PROCEDURE A:

1. Using Data Chart A, plot and label each star's position on the Hertzsprung-Russell Diagram.
2. Using Data Chart B, lightly color in vertical bands on the Hertzsprung-Russell Diagram that represent the temperatures of the stars.
3. In the blank boxes provided on the H-R Diagram, label the location of the following groups of stars using your Earth Science Reference Tables.

DATA CHART A

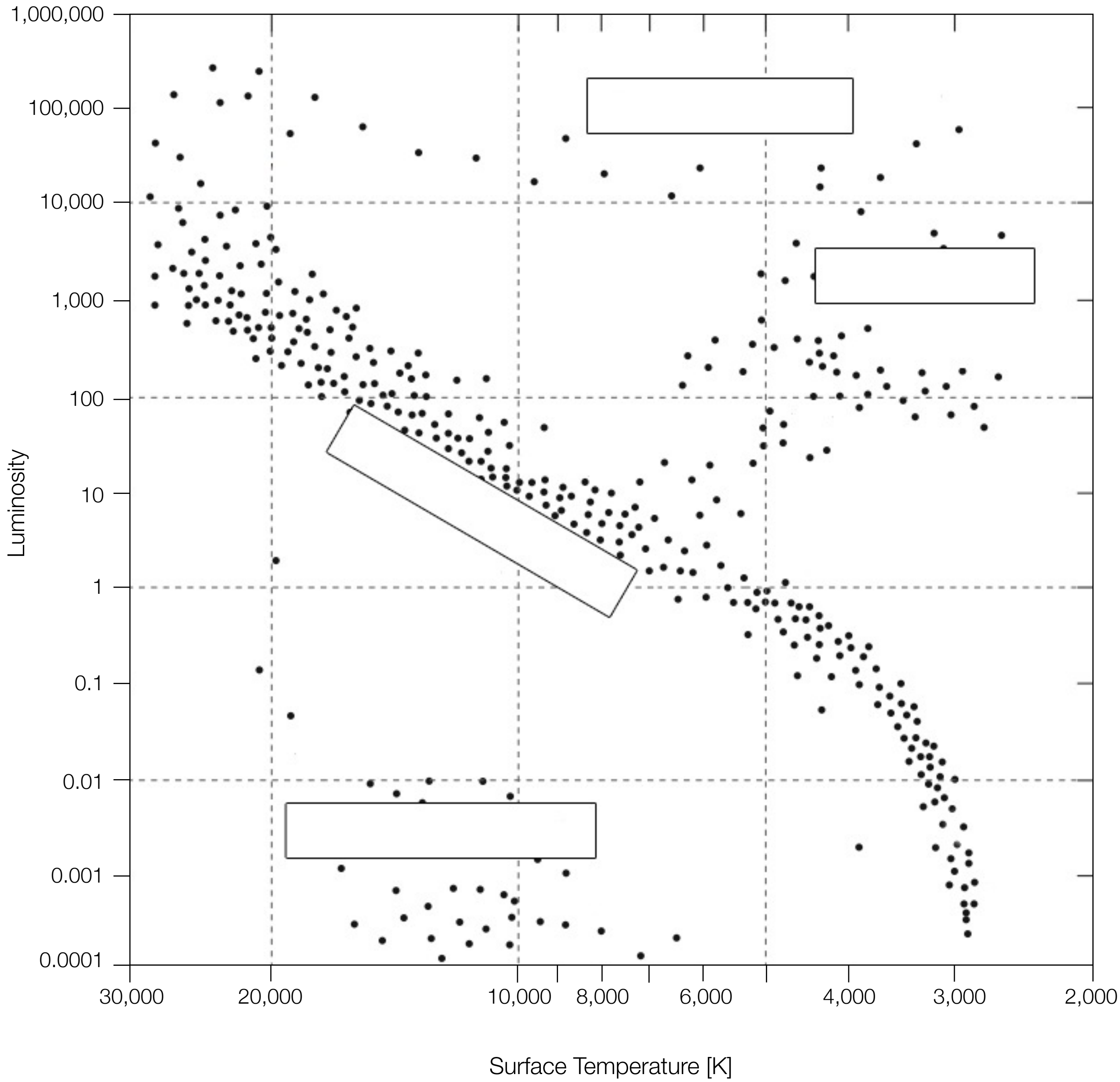
Star	Temperature [K]	Luminosity
Sun	5,700	1
Spica	25,000	50,000
Bellatrix	18,000	1000
Beta Centauri	21,000	1,000
Sirius	9,000	20
Vega	9,500	90
Alpha Centauri A	5,700	5
Pollux	4,700	75
Ross 248	2,500	0.0001
Proxima Centauri	2,800	0.001
Beta Carinae	9,500	100

Star	Temperature [K]	Luminosity
Aldebaran	4,000	500
Rigel	11,000	100,000
Deneb	8,800	900,000
Betelgeuse	3,200	100,000
Epsilon Indi	4,800	0.1
Polaris	6,000	5,000
Barnard's Star	3,100	0.005
Altair	7,500	10
40 Eridani B	18,000	0.01
Procyon B	8,900	0.001
Antares	3,200	7,500

DATA CHART B

Star Temperature [K]	Star Color
2,000 - 3,500	Red
3,500 - 5,000	Orange
5,000 - 7,500	Yellow
7,500 - 11,000	White
11,000 - 30,000	Blue

HERTZSPRUNG-RUSSELL DIAGRAM



Lab Activity: Classification of Stars

DISCUSSION QUESTIONS:

1. Describe the Sun in terms of luminosity, temperature, and color?

2. What is the relationship between star temperature and luminosity in the Main Sequence?

3. What would be the luminosity of a main sequence star with a temperature of 25,000 K?

4. Why do supergiant stars, such as Betelgeuse, have high luminosity?

5. Why do white dwarf stars, such as Procyon B, have low luminosities?

CONCLUSION: How can stars be classified using the Hertzsprung-Russell Diagram?

Name: ____

Date: __________________________ Period: ___________

Lab Activity: The Doppler Shift

INTRODUCTION:

The Doppler effect [or the Doppler shift] is the change in frequency or wavelength of a wave in relation to an observer who is moving relative to the wave source. It is named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842.

The Doppler effect for electromagnetic waves such as light is of great use in astronomy and results in either a so-called redshift or blueshift. It has been used to measure the speed at which stars and galaxies are approaching or receding from an observer.

OBJECTIVE:

You will be creating and analyzing spectral lines from a laboratory and five distant galaxies to determine their relative motions and speeds at which they are moving.

VOCABULARY:

Universe -

Big Bang -

Doppler Effect -

Red Shift -

Blue Shift -

Lab Activity: The Doppler Shift

PROCEDURE:

1. Using Data Table A, color in each of the six blank spectra on the Report Sheet to show the colors of the visible spectrum.
2. Label each wavelength less than 390 nm "Ultraviolet" and each wavelength longer than 700 nm "Infrared". Do not color this part of the spectra.
3. Using Data Table B, determine the location of each spectral line for the standard spectra and for several distant galaxies. Mark with a dark, black vertical line, the location of each of the spectral lines in each spectrum. Please note that some of the galaxies may have spectra that are shifted entirely off the portion we are studying. You do not draw any lines that are off the spectra provided on your handout.

DATA CHART A

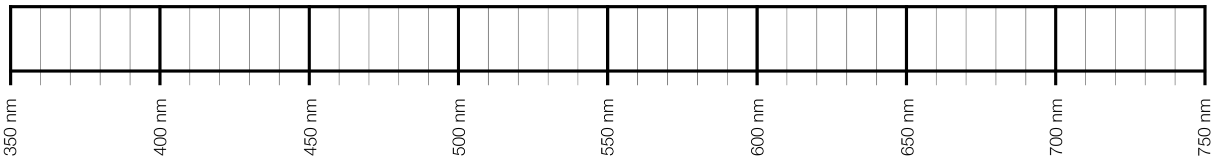
Violet	390 - 455 nm
Blue	455 - 492 nm
Green	492 - 577 nm
Yellow	577 - 597 nm
Orange	597 - 622 nm
Red	622 - 700 nm

DATA CHART B

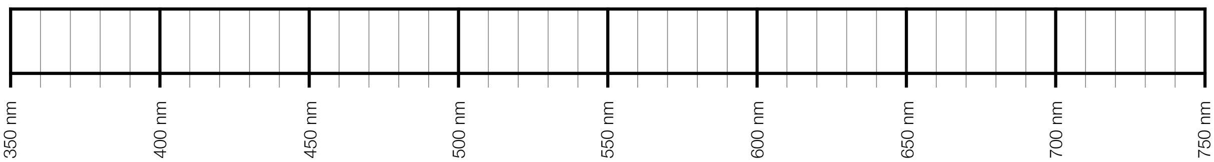
Standard Spectrum	420, 450, 530, 640, 656
Virgo A Galaxy	440, 470, 550, 660, 676
Coma Pinwheel Galaxy	470, 500, 580, 690, 706
Andromeda Galaxy	380, 410, 490, 600, 616
Cetus A Galaxy	430, 460, 540, 650, 666
M65 Spiral Galaxy in Leo	620, 650, 730, 840, 856

REPORT SHEET

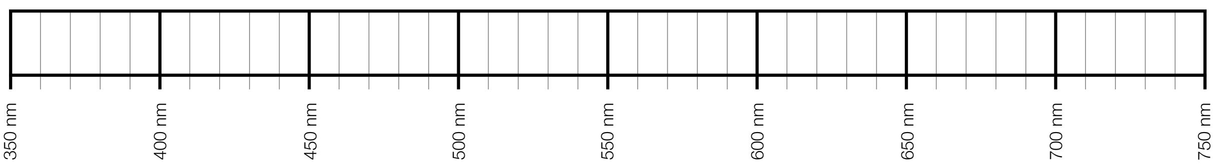
STANDARD SPECTRUM



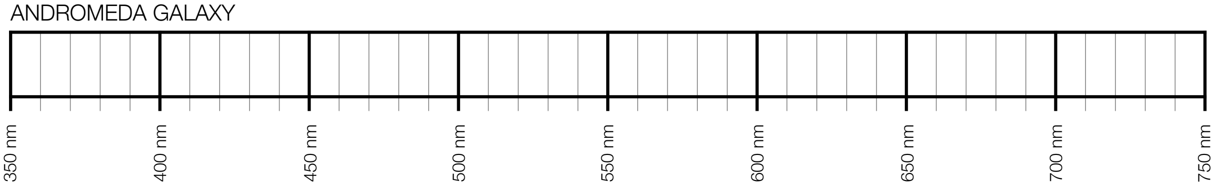
VIRGO A GALAXY



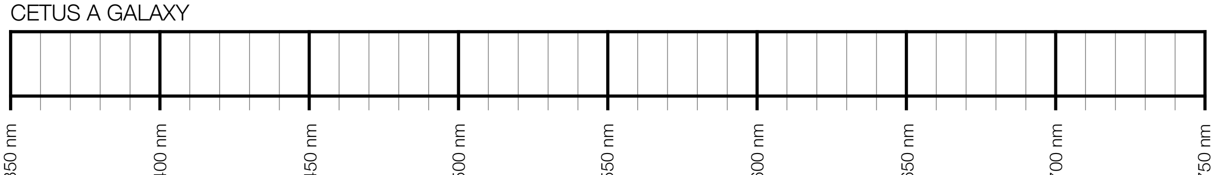
COMA PINWHEEL GALAXY



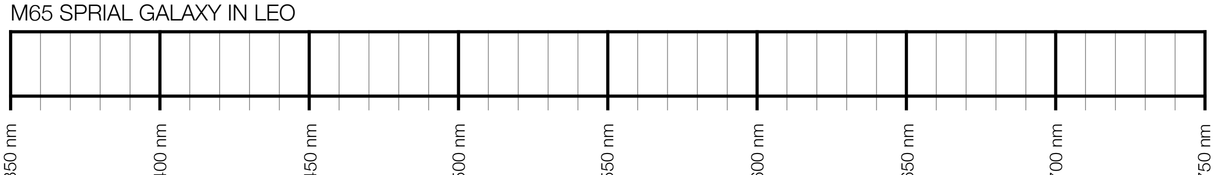
ANDROMEDA GALAXY



CETUS A GALAXY



M65 SPRIAL GALAXY IN LEO



Lab Activity: The Doppler Shift

DISCUSSION QUESTIONS:

1. When the wavelength increases, what end of the visible light spectrum does it move toward?

2. When the wavelength increases, what is the object's motion relative to Earth?

3. What did the results of your analysis of the galaxies reveal about their motion relative to Earth?

4. How does the Andromeda galaxy differ from the other four galaxies you examined.

5. How is the amount of the red-shift related to how fast the object is moving away?

CONCLUSION: Explain how your data supports the expanding Universe?

Name: ____ Weather

Date: ________________________ Period: __________ Earth Science

Lab Activity: Severe Weather

INTRODUCTION:

Hurricane season runs from June 1 to November 30 every year as thunderstorms form over the hot moist air of the Atlantic Ocean. Sometimes these storms come across the ocean, intensifying before they run into the islands of the Caribbean and coastal areas of the United States.

When hurricanes make landfall they bring with them severe winds and intense flooding. Often times these winds can exceed 155 mph in a Category V storm [Hurricane Katrina]. Sometimes hurricanes can cause coastal flooding with a storm surge [Hurricane Sandy].

OBJECTIVE:

Students will plot latitude and longitude coordinates on a map to see the how hurricanes typically track and the conditions that cause it to develop and die out. They will also see how the weather variables associated with a hurricane are related.

VOCABULARY:

Tropical Depression -

Tropical Storm -

Hurricane -

Saffir-Simpson Scale -

Southwesterly Winds -

Lab Activity: Severe Weather

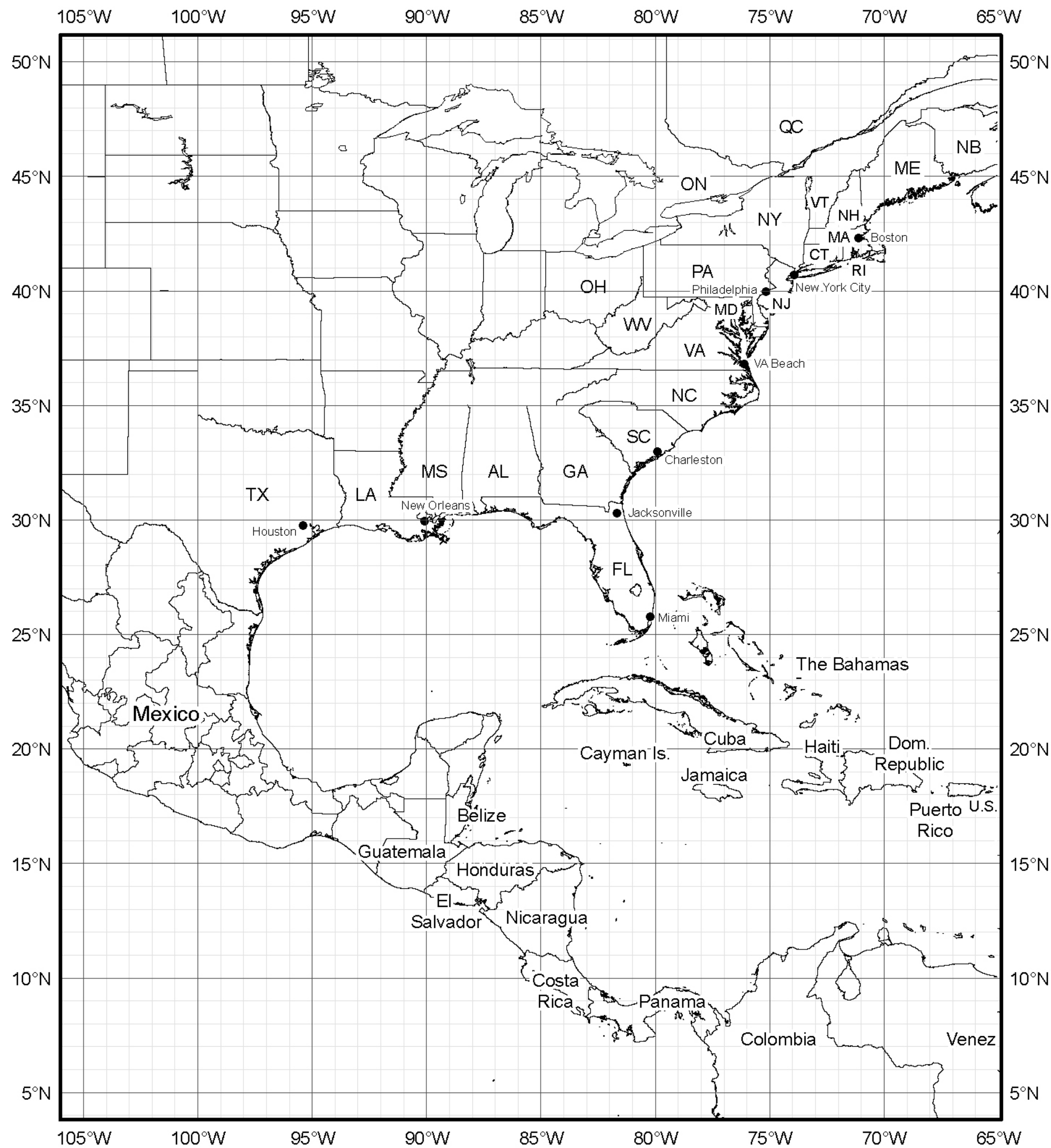
PROCEDURE A:

1. Using a Saffir-Simpson Hurricane Scale, fill in the Type and/or Category Storm column located in the Katrina Data Chart.
2. Using the Katrina Data Chart, plot the storm track using the latitude and longitude coordinates.

KATRINA DATA CHART

Date / Time	Latitude [° N]	Longitude [° W]	Wind Speed [mph]	Pressure [millibars]	Type and/or Category Storm
8/24 - 1200	24.5	76.5	35	1006	
8/25 - 0000	26	77.7	45	1000	
8/25 - 1200	26.2	79	55	994	
8/26 - 0000	25.9	80.3	70	983	
8/26 - 1200	25.1	82	75	979	
8/27 - 0000	24.6	83.3	90	959	
8/27 - 1200	24.4	84.7	100	942	
8/28 - 0000	24.8	85.9	100	941	
8/28 - 1200	25.7	87.7	145	909	
8/28 - 1800	26.3	88.6	150	902	
8/29 - 0000	27.2	89.2	140	905	
8/29 - 1200	29.5	89.6	125	913	
8/30 - 0000	32.6	89.1	50	961	
8/30 - 1200	35.6	88	30	985	
8/31 - 0000	38.6	85.3	30	994	

KATRINA STORM TRACK



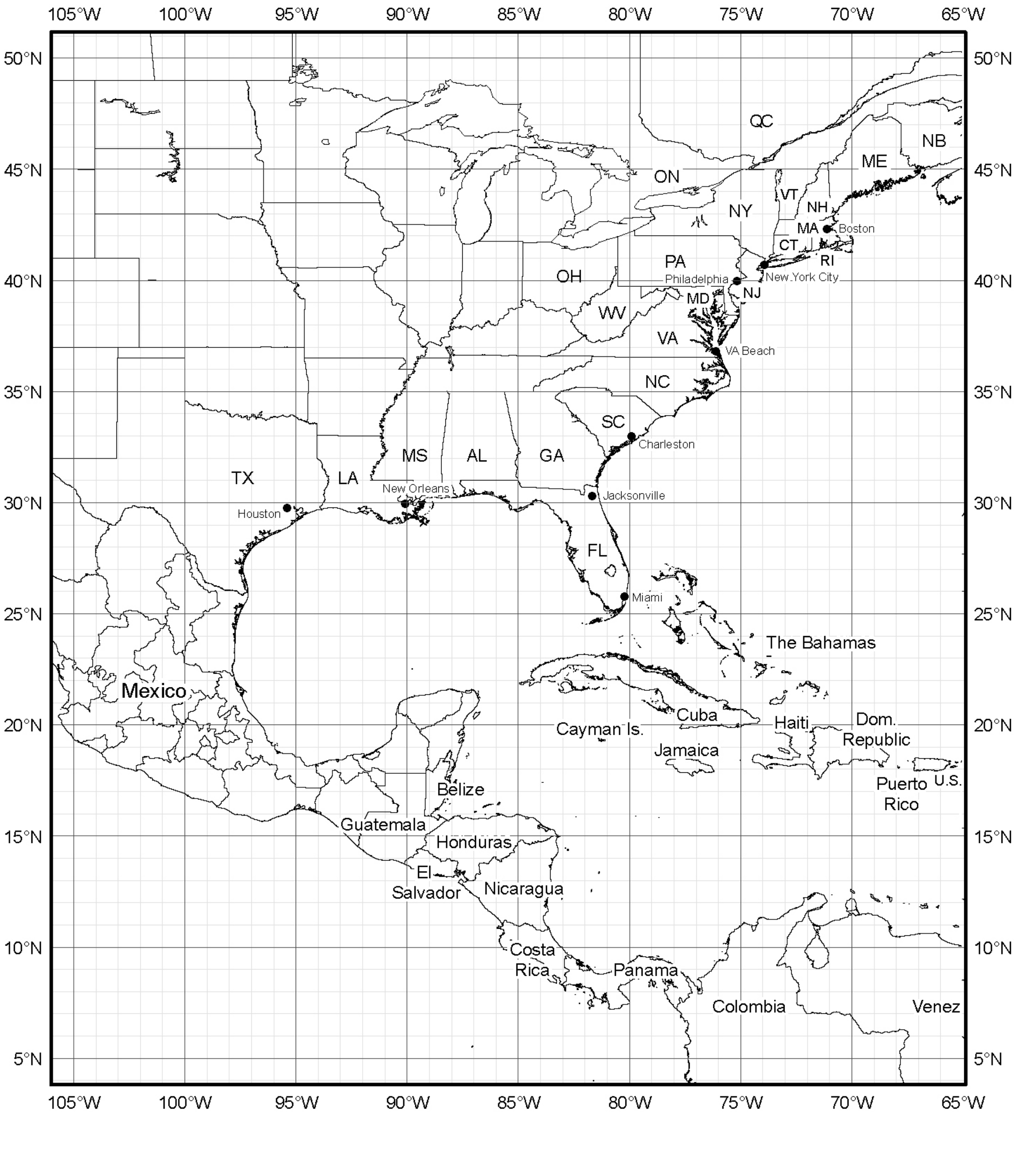
PROCEDURE B:

1. Using a Saffir-Simpson Hurricane Scale, fill in the Type and/or Category Storm column located in the Sandy Data Chart.
2. Using the Sandy Data Chart, plot the storm track using the latitude and longitude coordinates.

SANDY DATA CHART

Date / Time	Latitude [° N]	Longitude [° W]	Wind Speed [mph]	Pressure [millibars]	Type and/or Category Storm
10/24 -1300	17.6	76.8	80	973	
10/25 - 0100	20.1	75.9	110	957	
10/25 - 1300	23.5	75.4	105	963	
10/26 - 0100	25.8	76.5	85	968	
10/26 - 1300	27.1	77.1	75	971	
10/27 - 0100	28.1	76.9	75	969	
10/27 - 1300	29.7	75.6	75	961	
10/28 - 0100	31.5	73.7	75	960	
10/28 - 1300	32.8	71.9	75	951	
10/29 - 0100	35.2	70.5	75	950	
10/29 - 1300	38.3	73.1	90	940	
10/29 - 1600	38.8	74.4	90	940	
10/29 - 2200	39.8	75.4	75	952	
10/30 - 0400	40.5	77.0	65	960	
10/30 - 1000	40.2	78.4	45	983	

SANDY STORM TRACK



Lab Activity: Severe Weather

DISCUSSION QUESTIONS:

1. Where in the United States are hurricanes likely to strike?

2. What is the source of a hurricane's energy?

3. What is the relationship between air pressure and wind velocity?

4. Why do hurricanes change direction at 30° North latitude?

5. Name two things that you and your family can do to prepare for a hurricane?

CONCLUSION: What information do we need to provide advanced warning of a hurricane?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Weather Instruments

INTRODUCTION:

Throughout the country weather variables are observed, measured and recorded every hour. Some of the weather variables include: temperature, dew point, cloud cover, visibility, height of cloud base, amount of precipitation, wind speed, and wind direction.

The challenge for meteorologists is being able to place the large amount of weather data collected at that location and share it with other locations around the country. Due to a lack of space on weather maps, the weather information needs to be coded, highly organized and standard.

OBJECTIVE:

To manipulate station models to record and decode the large amounts of weather data that are recorded at a variety of stations around the country.

VOCABULARY:

Thermometer -

Barometer -

Sling Psychrometer -

Anemometer -

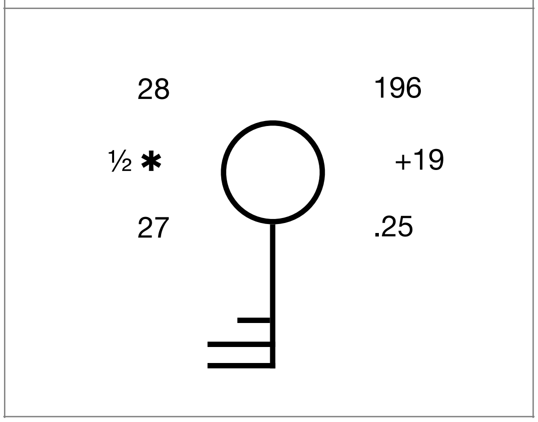
Weather Vane -

Lab Activity: Weather Instruments

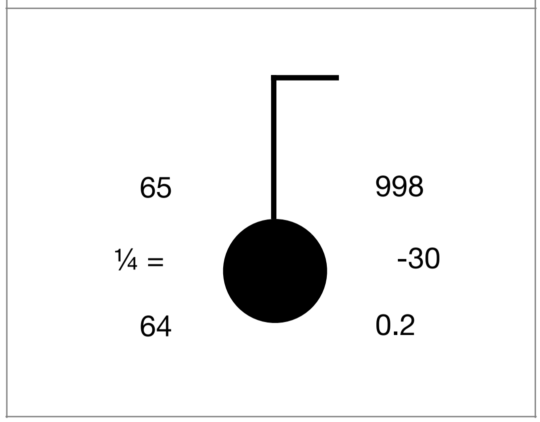
PROCEDURE A:

1. Using you Earth Science Reference Tables and the station models below, decode the weather conditions and record the information on Report Sheet 1.
2. When coding air pressure on a station model, use the following rule:
    - If the air pressure on the station model is 500 or more, place a 9 in front of this number and put a decimal point in front of the last number. Example: 588 = 958.8 millibars.
    - If the air pressure on the station model is 500 or less, place a 10 in front of this number and put a decimal point in front of the last number. Example: 320 = 1032.0 millibars.

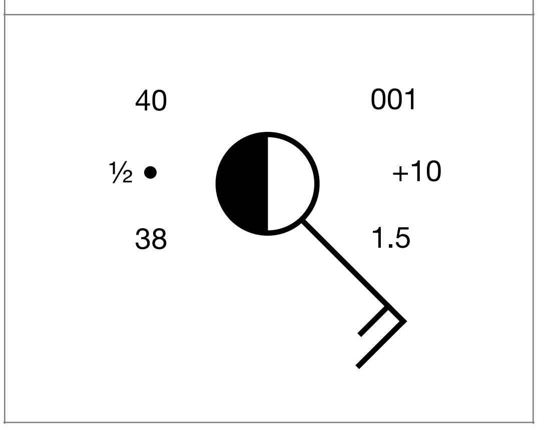
Station 1



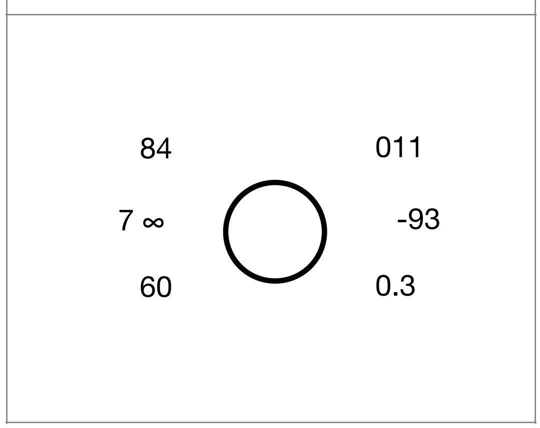
Station 2



Station 3



Station 4



Lab Activity: Weather Instruments

REPORT SHEET 1

Weather Element	Station 1	Station 2	Station 3	Station 4
Temperature [ºF]				
Temperature [ºC]				
Barometric Pressure [millibars]				
Barometric Pressure [inches og Hg]				
Barometric Trend [millibars]				
Percent of Cloud Coverage [%]				
Wind Direction				
Wind Speed [knots]				
Visibility [mi]				
Dew Point [ºF]				
Present Weather				

Lab Activity: Weather Instruments

PROCEDURE B:

Using the weather data below, add the information onto the correct city's station model. Be sure to use the shorthand code form and the appropriate symbols.

City	Temperature [ºF]	Dewpoint [ºF]	Wind Speed & Direction	Air Pressure [millibars]	Cloud Cover [%]	Present Weather
Rochester	69	58	SW 15	1016.9	50	none
Buffalo	60	45	NE 5	1030.1	25	none
Syracuse	70	69	SW 20	998.2	25	drizzle
New York	72	72	W 30	986.4	100	thunderstorm
Binghamton	71	69	NW 35	999.1	100	rain
Albany	32	32	S 10	1000.0	100	snow

Lab Activity: Weather Instruments

Rochester

Buffalo

Syracuse

New York

Binghamton

Albany

Lab Activity: Weather Instruments

DISCUSSION QUESTIONS:

1. What weather instrument is used to measure air pressure?

2. What weather instrument is used to measure relative humidity and dewpoint?

3. What weather instruments are used to measure both wind direction and speed?

4. What is the air pressure when a station model's pressure reads 024?

5. Convert the current outdoor air temperature to Celsius and Kelvin.

CONCLUSION: Why do meteorologist use station models?

Name: ____ Weather

Date: ________________________ Period: __________ Earth Science

Lab Activity: Weather Variables

INTRODUCTION:

A meteorologist is an individual with specialized education who uses scientific principles to explain, understand, observe or forecast the earth's atmospheric phenomena and/or how the atmosphere affects the earth and life on the planet.

To make an accurate weather forecast, meteorologists observe and record all different type of weather variable. Some of these variables include temperature, air pressure, wind velocities, wind directions, and precipitation amounts. When these weather variables are mapped together on a synoptic map a picture of past and present conditions emerges.

OBJECTIVE:

To construct field maps to and learn how weather variables help identify a pattern that can help forecast future weather events.

VOCABULARY:

Isotherm -

Isobar -

Low Pressure -

High Pressure -

Gradient -

Lab Activity: Weather Variables

PROCEDURE A:

1. On Map A: Temperature, use a pencil and lightly draw isotherms at 10-degree intervals.
2. Answer the following questions based off of Map A: Temperature.

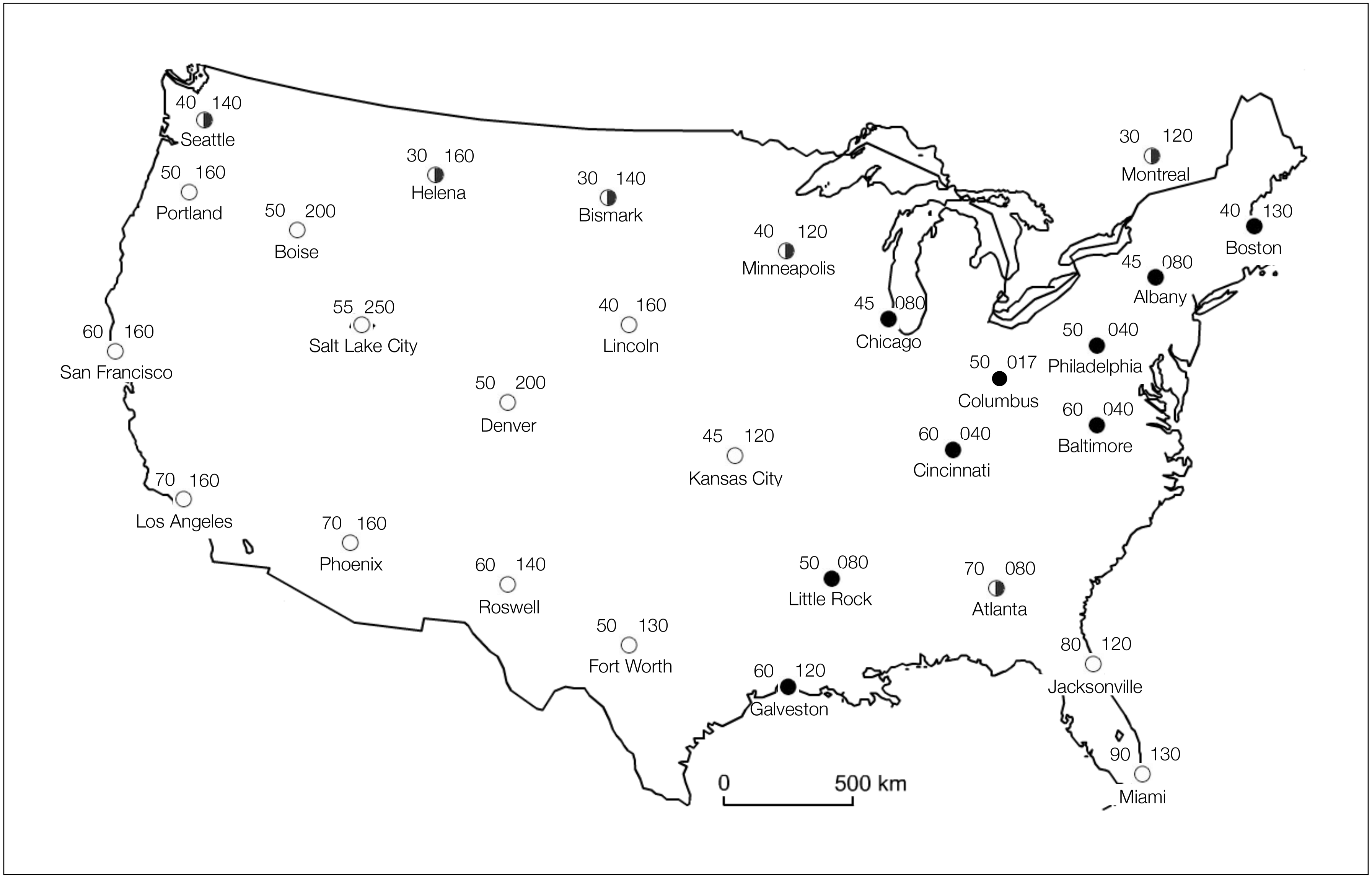
QUESTIONS:

1. How does the temperature change from north to south?

2. Calculate the gradient between Seattle and Los Angeles [be sure to use proper units].

3. Calculate the gradient between Atlanta and Philadelphia [be sure to use proper units].

Map A: Temperature



Lab Activity: Weather Variables

PROCEDURE B:

1. On Map B: Pressure, use a pencil and lightly draw isobars at 4-millibar intervals.
2. Please be reminded that if the air pressure on the station model is 500 or more, place a 9 in front of this number and a decimal point in front of the last number. If it is less then 500, place a 10 in front and a decimal point in front of the last number.
3. Label the centers of the high pressure and the low pressure with H and L.

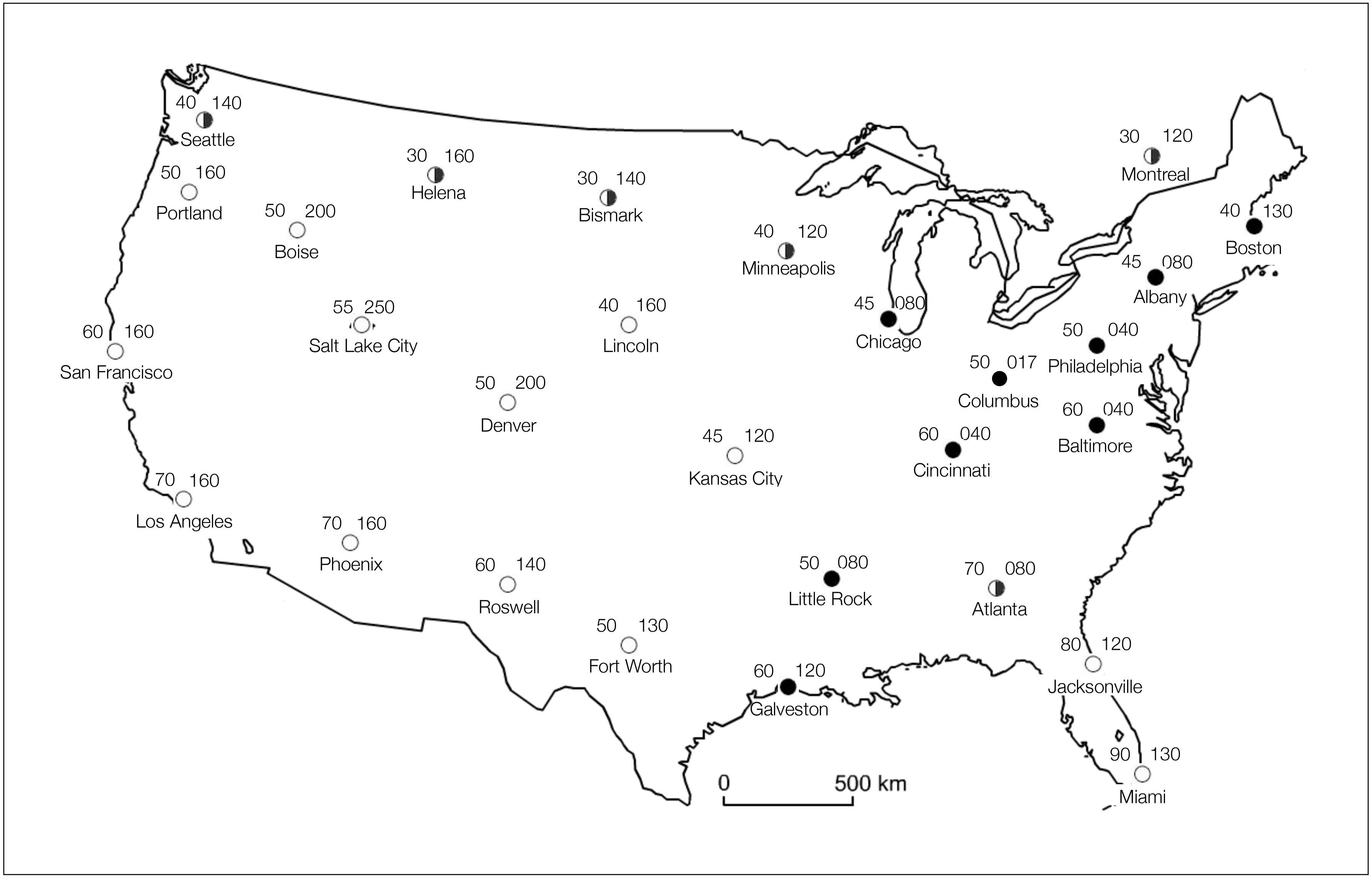
QUESTIONS:

1. Near which city is the low pressure and high pressure located?

2. What is the highest air pressure on the map [be sure to convert the shorthand form]?

3. As you travel fro Salt Lake City to Seattle, what change in air pressure would you observe?

Map B: Pressure



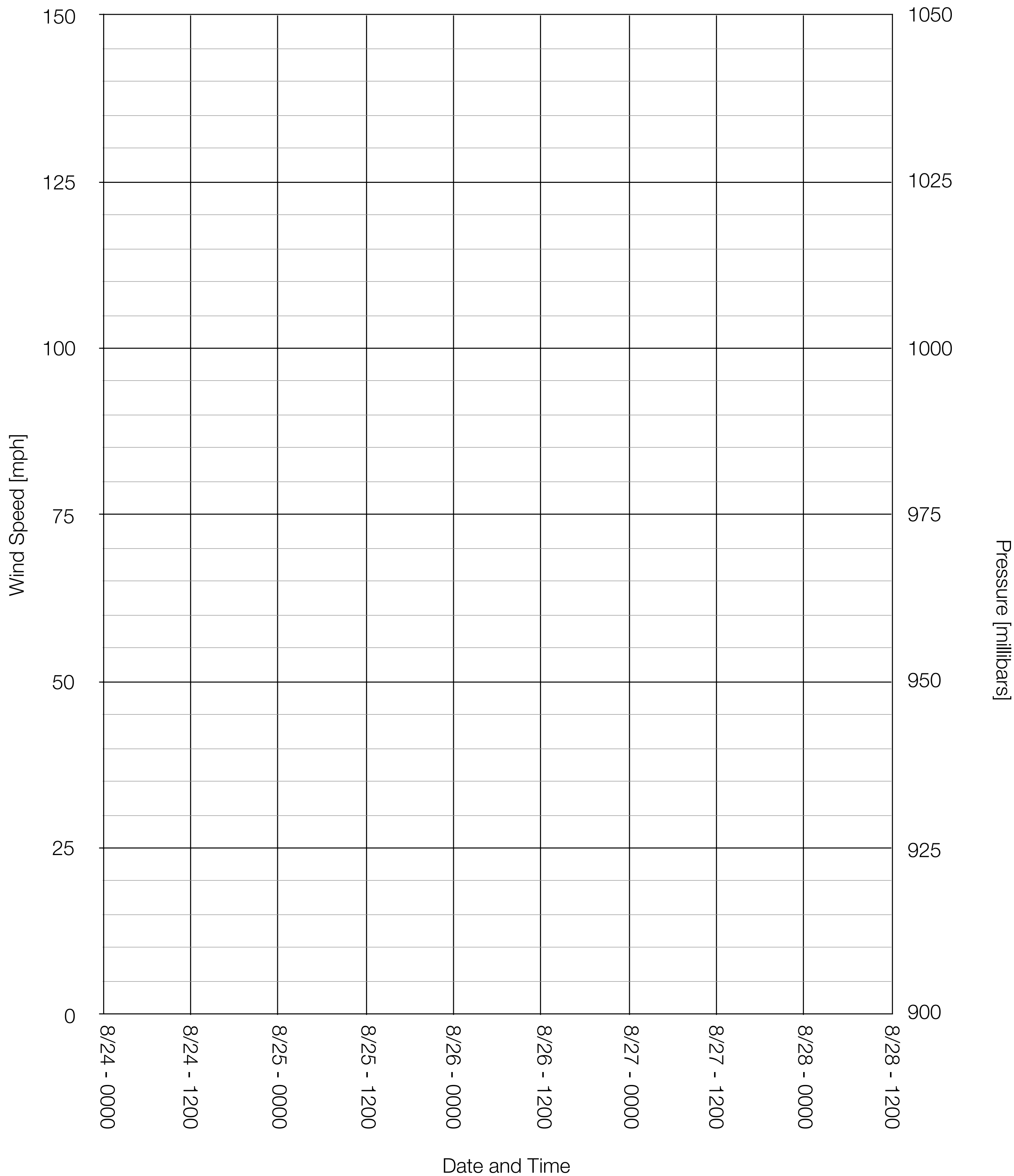
PROCEDURE C:

Using the Hurricane Katrina Data Chart below, plot the air pressure and wind speed on the Hurricane Katrina Graph. Please note that the windspeed in on the left hand x-axis and the pressure is on the right hand side of the x-axis.

HURRICANE KATRINA DATA CHART

Date / Time [2005]	Wind Speed [mph]	Pressure [millibars]
8/24 - 0000	30	1007
8/24 - 1200	35	1006
8/25 - 0000	45	1000
8/25 - 1200	55	994
8/26 - 0000	70	983
8/26 - 1200	75	979
8/27 - 0000	90	959
8/27 - 1200	100	942
8/28 - 0000	100	941
8/28 - 1200	145	909

HURRICANE KATRINA GRAPH



Lab Activity: Weather Variables

DISCUSSION QUESTIONS:

1. What type of pressure is associated with cloudy skies or bad weather?

2. What type of pressure is associated with clear skies and fair weather?

3. Is the weather for a region static or dynamic? Explain your answer.

4. What type of relationship exists between wind speed and pressure?

5. List some variables that meteorologist can use to help forecast weather?

CONCLUSION: How can synoptic weather maps help us forecast weather patterns?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Air Masses and Fronts

INTRODUCTION:

An air mass is characterized by the weather variables that it takes from a source region. When unlike air masses collide a front is established and based on the type of air mass different weather patterns will be created.

Meteorologist follow and track air masses very carefully. As air masses move across our country meteorologist look to see where different air masses will collide. From that they can better predict a locations weather.

OBJECTIVE:

To see where air masses originate as well as how different air masses act when they collide.

VOCABULARY:

Air Mass -

Cold Front -

Warm Front -

Stationary Front -

Occluded Front -

Lab Activity: Air Masses and Fronts

PROCEDURE:

1. On the "Cut Out Page", color the cold air masses light blue, the warm air masses red and the colder air mass dark blue.
2. On the "Cut Out Page", cut out the air mass pieces and construct a profile of how the unlike air masses appear. Glue or tape down the piece once you are sure of frontal boundary profile.
3. In the "Symbol" box fill in the appropriate air mass symbol.
4. In the "What Happens" box give a brief description of the interaction at that frontal zone.

COLD FRONT

Frontal Boundary Profile:

Symbol:	What Happens:

WARM FRONT

Frontal Boundary Profile:

Symbol:	What Happens:

Lab Activity: Air Masses and Fronts

STATIONARY FRONT

Frontal Boundary Profile:

Symbol:

What Happens:

OCCLUDED FRONT

Frontal Boundary Profile:

Symbol:

What Happens:

Lab Activity: Air Masses and Fronts

DISCUSSION QUESTIONS:

1. How do frontal boundary symbols show the direction of movement?

2. With respect to a cold front, where does precipitation occur?

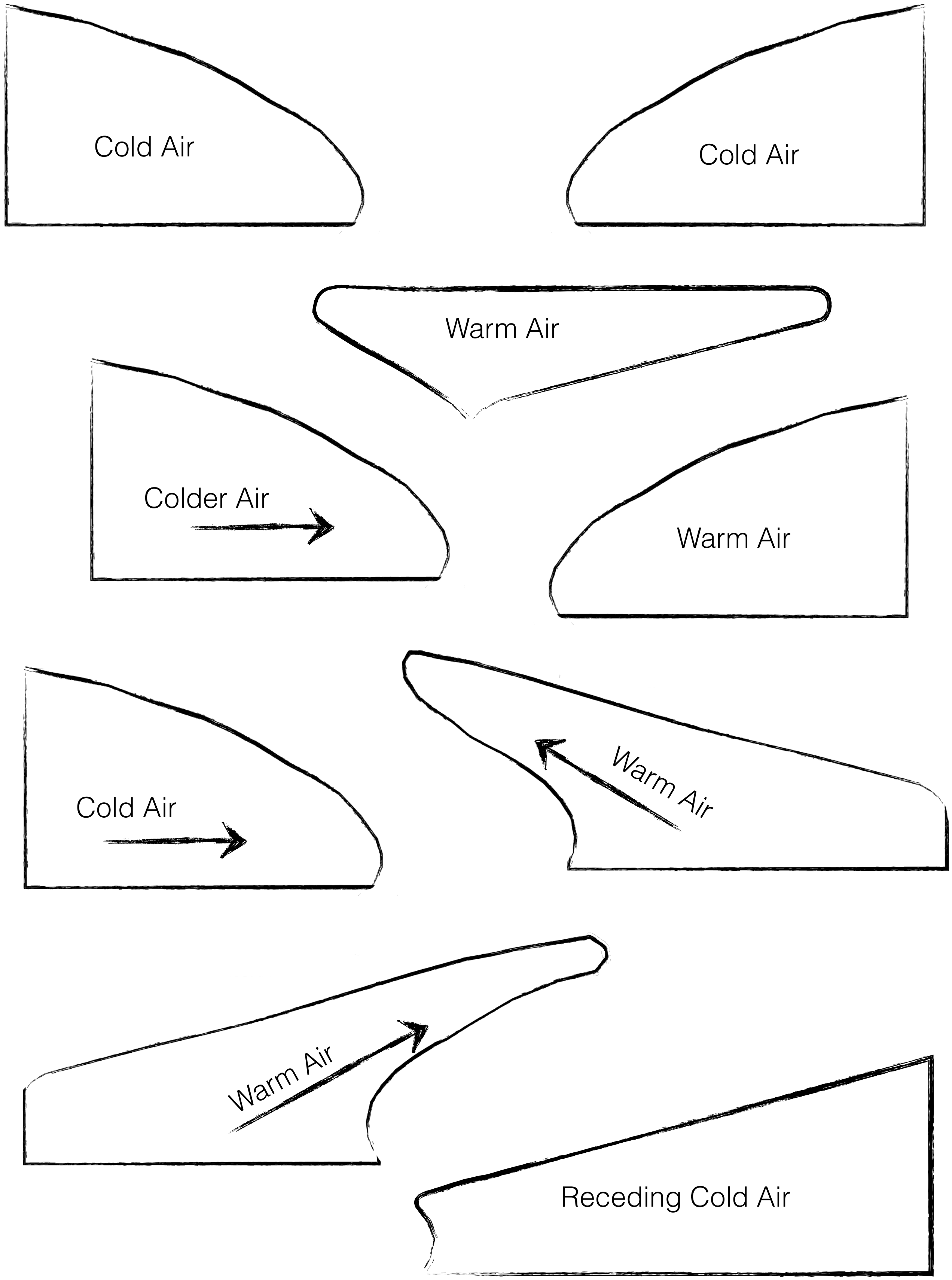
3. With respect to a warm front, where does precipitation occur?

4. How does density play a part in determining how unlike air masses react?

5. What type of weather front experiences a decrease in temperature?

CONCLUSION: Compare the temperature and moisture conditions on either side of the cold front.

CUT OUT PAGE


Cold Air
Cold Air
Warm Air
Colder Air
Warm Air
Cold Air
Warm Air
Warm Air
Receding Cold Air

Name: ____

Date: ________________________ Period: __________

Water & Climate

Earth Science

Lab Activity: Climate Variables

INTRODUCTION:

The state of the atmosphere continually changes over time in response to the uneven distribution of energy in the atmosphere. The short-term changes in temperature and precipitation are fundamental controls of weather, and their long-term averages are called climate. Since climate is averaged weather, we must take a look at the average temperature and average precipitation in a particular region to determine the climate.

We know that there are many different climates on Earth. From tropical regions near the equator to the frozen deserts at the poles, each climate varies tremendously and is characterized by its long term weather conditions.

OBJECTIVE:

You will determine particular climate variables that control a region's average temperature and precipitation and be able to recognize trends in data that help establish a regions climate.

VOCABULARY:

Climate -

Greenhouse Effect -

Insolation -

Radiative Balance -

Intensity -

Lab Activity: Climate Variables

ANGLE OF INSOLATION:

There are variations in the angle at which the sun's rays strike Earth's surface. You have observed the changing altitude during the day and annual variations of the noon Sun, but there is also a change with your latitude. This change produces differences in intensity of insolation at Earth's surface.

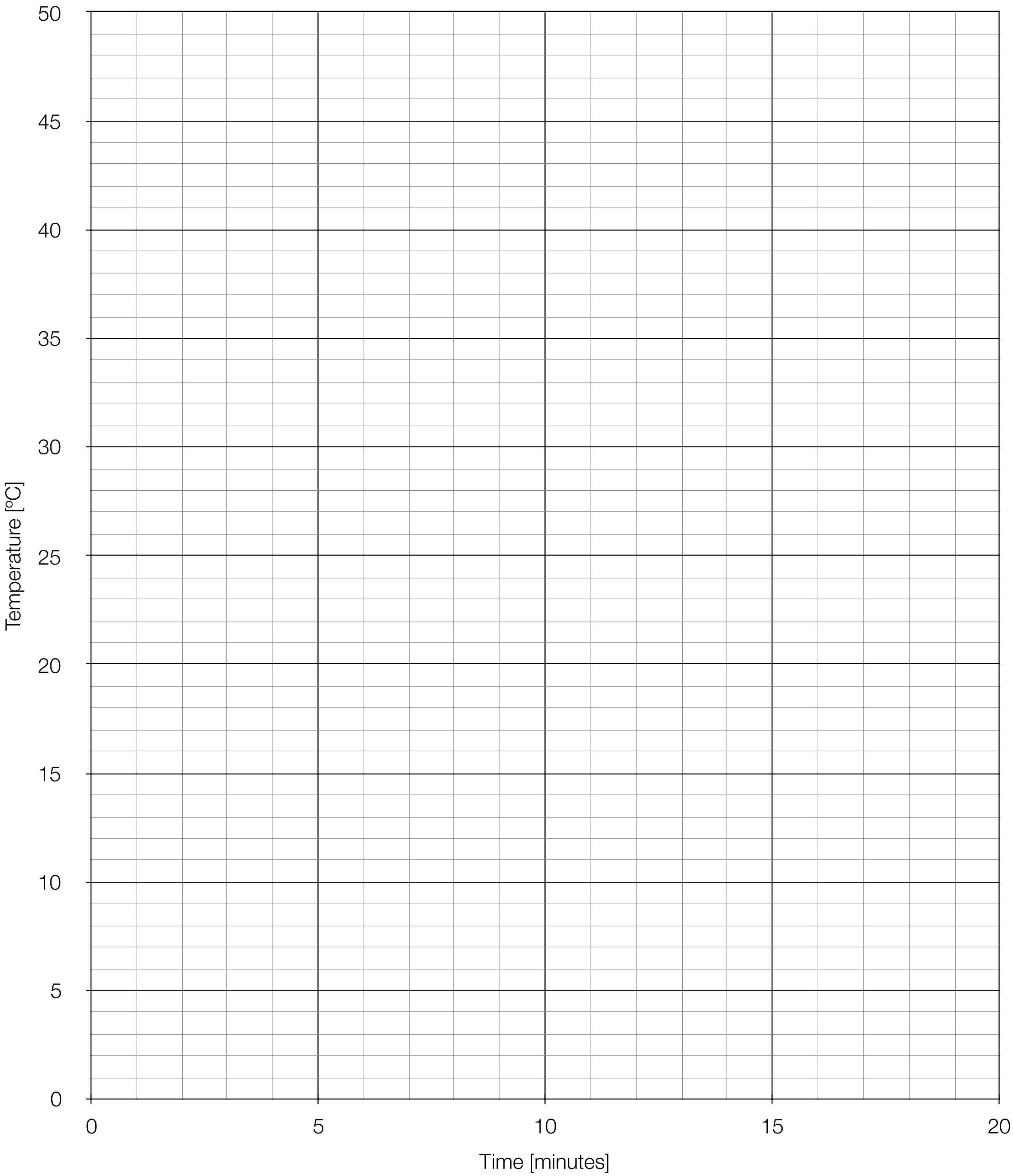
Data was obtained from an experiment that is used to show how angle of insolation can effect the temperature over a period of time.

PROCEDURE A:

Use the data table below to construct a graph on the following page for the different angles of insolation and the temperatures they received over a 15 minute period. Be sure to construct three separate line with different colors and to label them appropriately.

30º		60º		90º	
Time [min]	Temp. [ºC]	Time [min]	Temp. [ºC]	Time [min]	Temp. [ºC]
0	20	0	20	0	20
1	22	1	23	1	24
2	22.5	2	24	2	26
3	23.5	3	26	3	28
4	24	4	27	4	30.5
5	25	5	28.5	5	32.5
6	25.5	6	29.5	6	34
7	26	7	30.5	7	35.5
8	26.5	8	31.5	8	37
9	27	9	32.5	9	38
10	27.5	10	33	10	38.5
11	28	11	33.5	11	39.5
12	28.5	12	34	12	40
13	29	13	34.5	13	40.5
14	29.5	14	35	14	41
15	30	15	35.5	15	41.5

GRAPH A: ANGLE OF INSOLATION



Lab Activity: Climate Variables

ABSORPTION AND RADIATION BY LAND AND WATER:

Approximately 70 percent of Earth's surface is covered by water. The unequal rates of heating of land and water cause temperature conditions that impact local and world-wide weather patterns.

Data was obtained from an experiment that compares the rates at which water and land heat up over a period of time. During the first 10 minutes the materials were allowed to heat up, then the heat source was then removed and allowed to cool for the next the ten minutes.

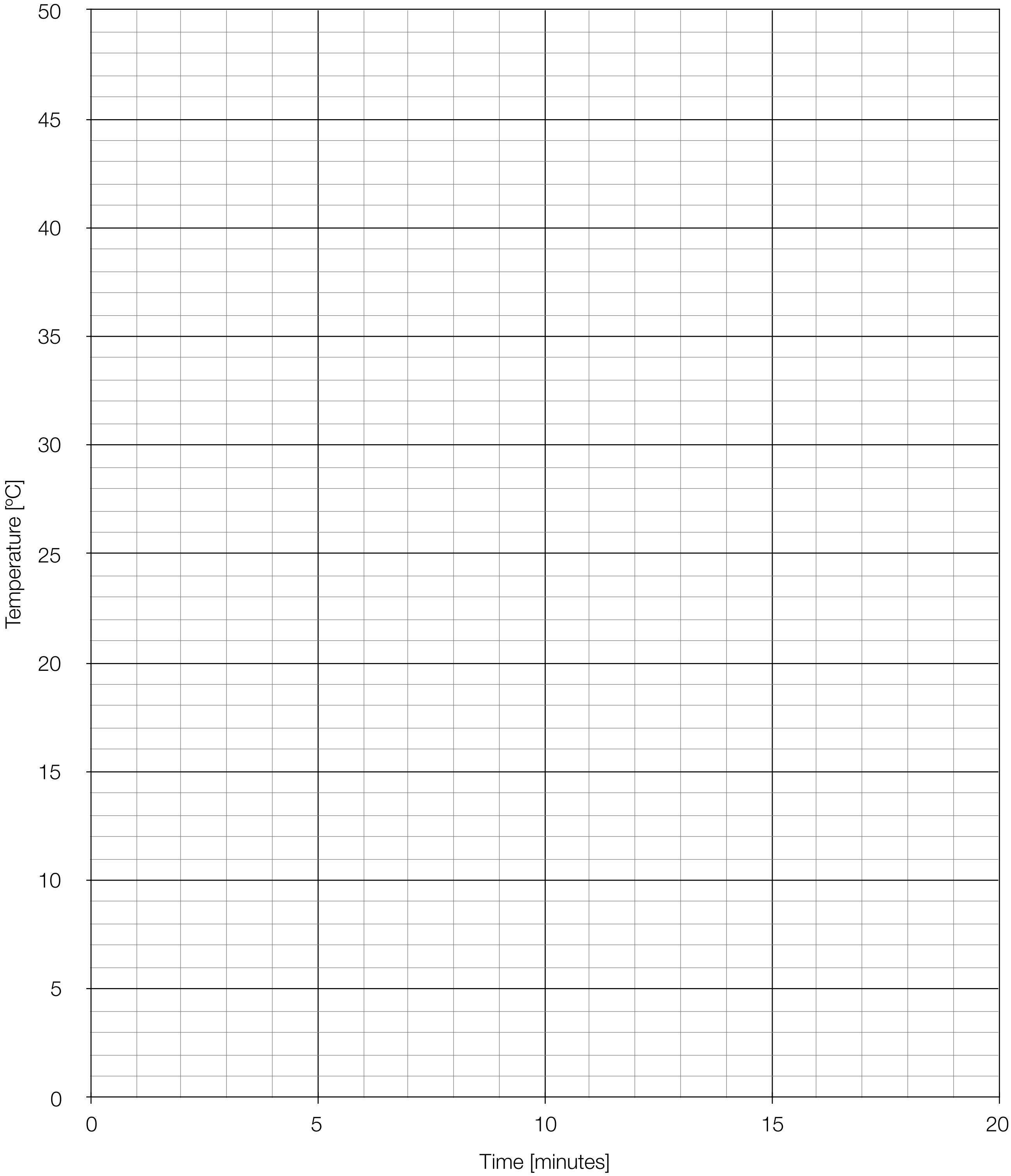
PROCEDURE B:

Use the data table below to construct a graph on the following page for the absorption and radiation by land and water. Be sure to construct two separate lines with different colors and to label them appropriately.

Time [min]	Soil Temp. [ºC]
0	21.0
1	23.0
2	26.0
3	28.0
4	30.5
5	33.0
6	35.0
7	36.5
8	37.5
9	38.5
10	39.0
11	37.5
12	35.0
13	34.0
14	32.0
15	30.5
16	29.0
17	28.0
18	26.5
19	25.5
20	24.5

Time [min]	Water Temp. [ºC]
0	21.0
1	21.5
2	22.5
3	23.0
4	23.5
5	24.0
6	25.0
7	25.5
8	25.5
9	26.0
10	26.0
11	26.0
12	26.0
13	25.5
14	25.5
15	25.0
16	24.5
17	24.5
18	24.0
19	23.5
20	23.0

GRAPH B: ABSORPTION AND RADIATION BY LAND AND WATER



Lab Activity: Climate Variables

COASTAL AND CONTINENTAL TEMPERATURE RANGES:

There are large variations in average monthly temperatures among cities located at the same latitude. This suggests that factors other then latitude are responsible for a regions climate. A major influence other then the angle of insolation is the location of a city relative to a large body of water.

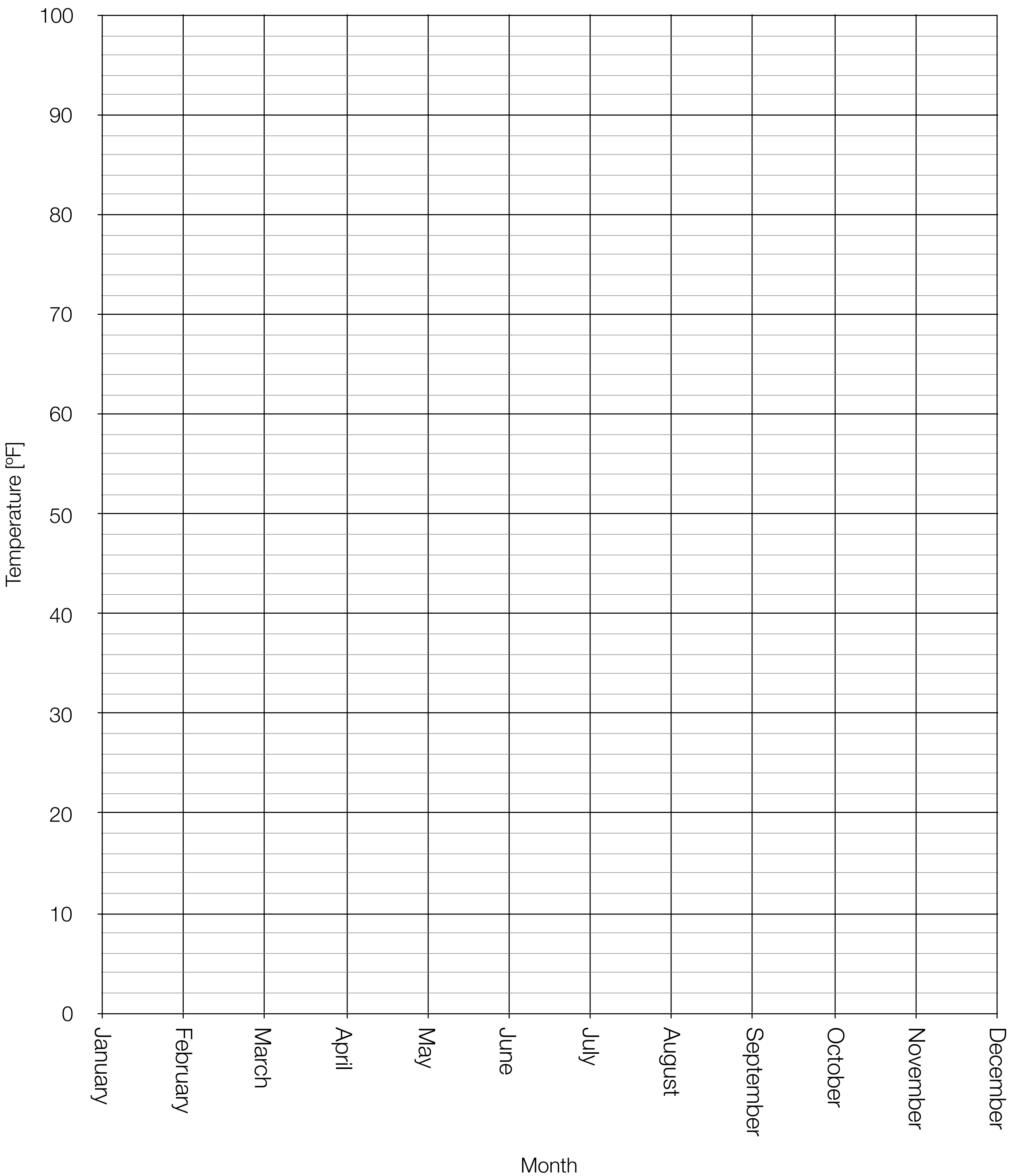
The average monthly temperature was obtained from two different cities in the United States for the span of one year.

PROCEDURE C:

Use the data table below to construct a line graph of the following four cities average monthly temperature. Be sure to label each line with the appropriate city and use different colors.

Month	Temperature [°F]	
	Eureka, California	Omaha, Nebraska
January	46	20
February	48	26
March	50	36
April	52	50
May	54	60
June	56	72
July	58	76
August	60	74
September	56	66
October	54	54
November	52	38
December	50	24

GRAPH C: COASTAL AND CONTINENTAL TEMPERATURE RANGES



Lab Activity: Climate Variables

DISCUSSION QUESTIONS:

1. Which angle of insolation received the most direct rays and heated to the highest temperature?

2. What is the relationship between the angle of insolation and the rate of temperature changes?

3. Which was a better absorber and radiator of heat energy?

4. How could you tell from the temperature data that both cities are in the Northern Hemisphere?

5. Describe the differences in annual temperature ranges between coastal and inland regions.

CONCLUSION: Other then the variable studied in this lab, what other variable might influence climate?

Name: ____ Water & Climate

Date: ________________________ Period: __________ Earth Science

Lab Activity: Rainfall Patterns

INTRODUCTION:

When prevailing winds travel across an ocean they picking up moisture along the way. When the encounter a mountain barrier, such as the Big Island of Hawaii, the mountains help play a significant role in modifying the distribution of rainfall.

On the Big Island of Hawaii, the windward side causes the prevailing winds to be pushed upward. This creates a rainy side due to the rising, expanding, cooling, and condensing air. The leeward is the exact opposite. The air sinks, contracts, and warms creating an arid region.

OBJECTIVE:

You will compare the topographic map and a precipitation map of the Big Island of Hawaii to see how mountain barriers play a role in rainfall patterns.

VOCABULARY:

Orographic Effect -

Isohyet -

Windward -

Leeward -

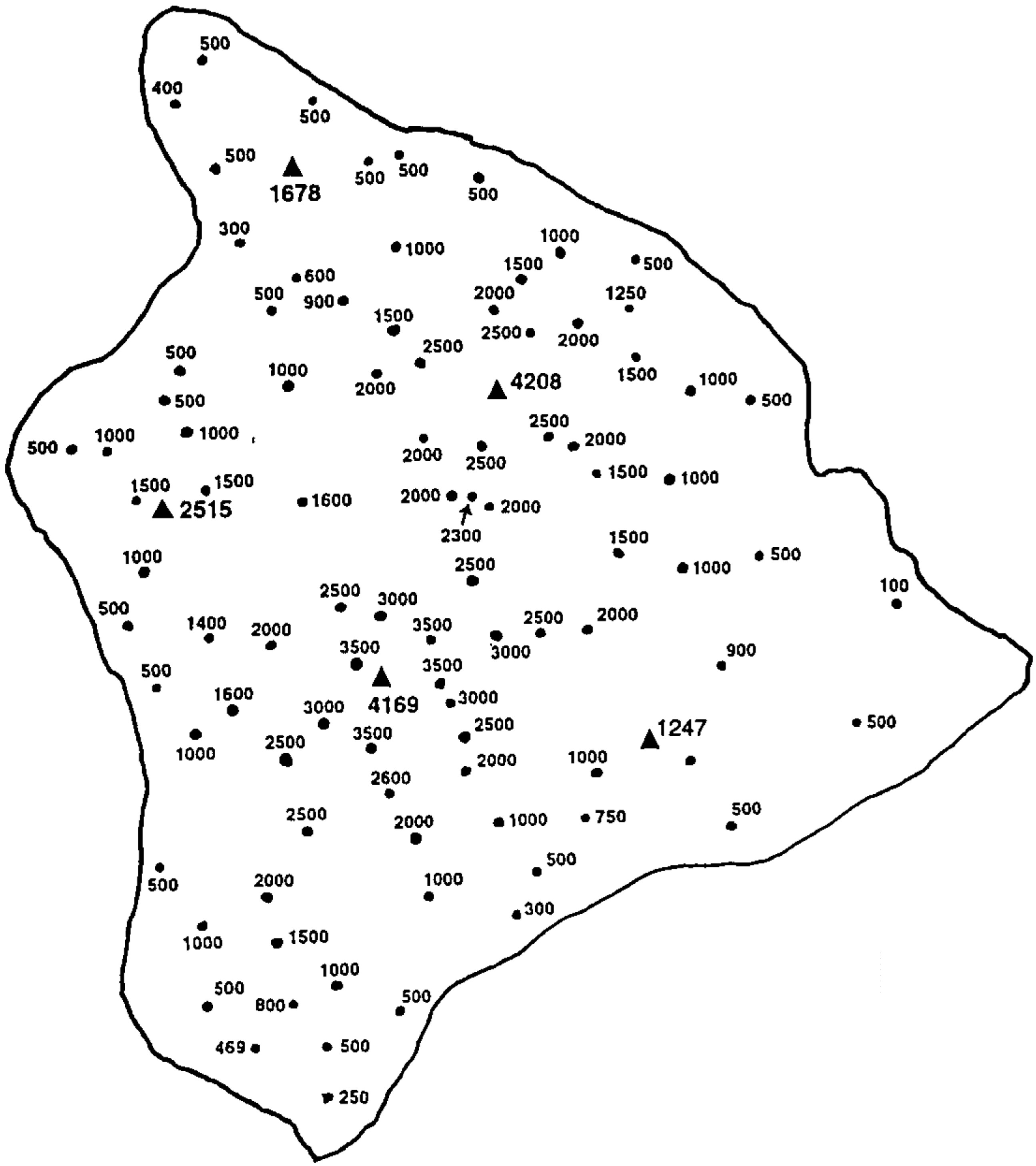
Trade Winds -

Lab Activity: Rainfall Patterns

PROCEDURE A:

1. Using the elevation data on “Map A: The Big Island of Hawaii Contour Map” construct contour lines at an interval of 500 meters.
2. Label the following volcanic mountains with their names according to their elevations:
    - Kilauea - 1,247 meters
    - Mauna Loa - 4,169 meters
    - Mauna Kea - 4,208 meters
    - Kohala - 1,678 meters
    - Hualalai - 2,515 meters

MAP A: THE BIG ISLAND OF HAWAII CONTOUR MAP

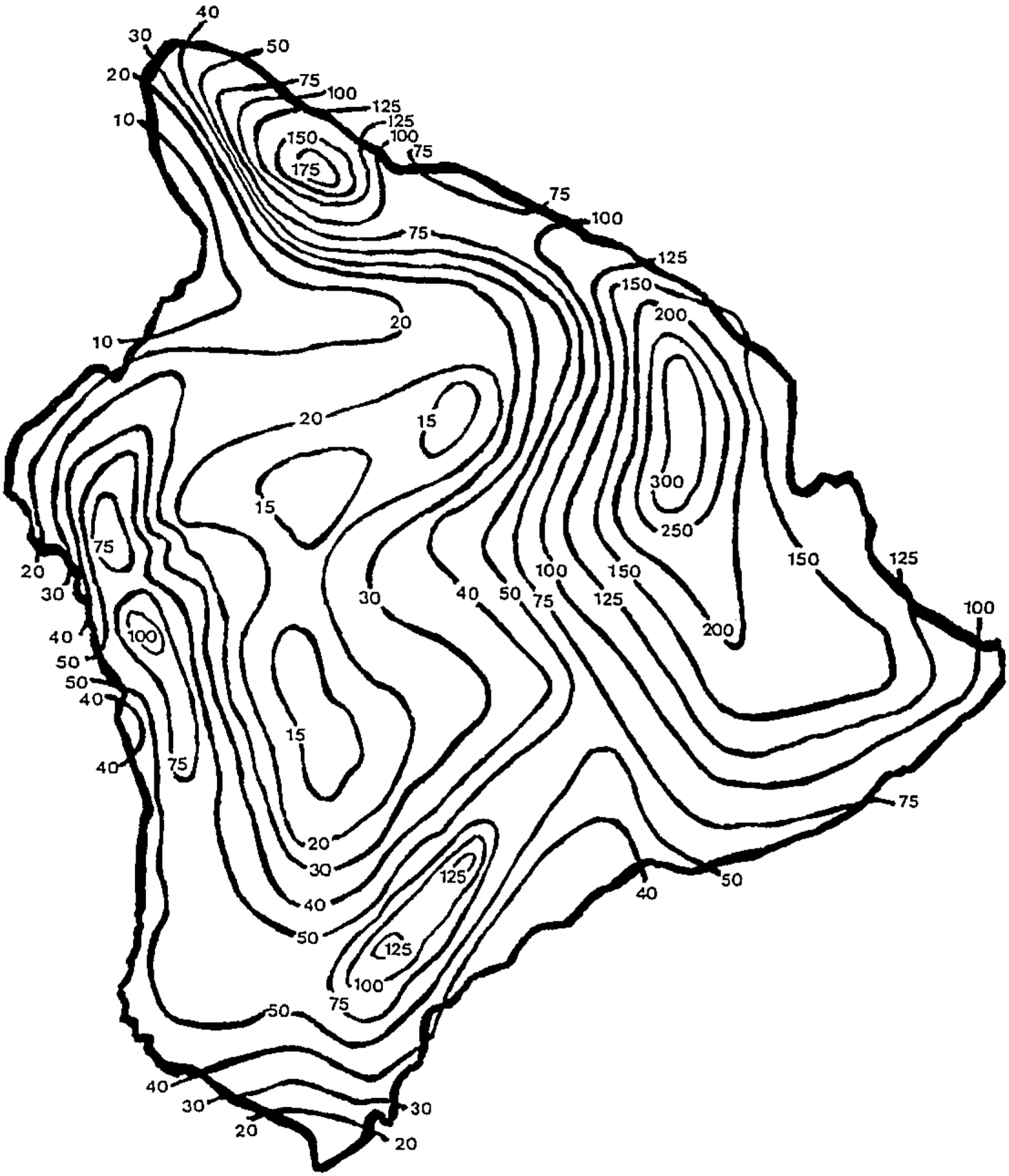


PROCEDURE B: RAINFALL PATTERNS

1. Using “Map B: The Big Island of Hawaii Rainfall” trace over and darken the 20 inch, 50 inch, 100 inch and 200 inch isohyets.
2. Using the color key below, shade the following intervals.

Rainfall	Color
Greater than 200 inches	blue
100 to 200 inches	green
50 to 100 inches	brown
20 to 50 inches	orange
Less than 20 inches	yellow

MAP B: THE BIG ISLAND OF HAWAII RAINFALL



Lab Activity: Rainfall Patterns

DISCUSSION QUESTIONS:

1. Which coastline of Hawaii has the most annual rainfall?
2. Which side of the Big Island of Hawaii has the least rainfall?
3. Describe the most likely direction of the prevailing winds across the Big Island of Hawaii?
4. Where is the rainshadow area on the Big Island of Hawaii?
5. Why is the rainfall pattern different on the Mountains of Kohala and Mauna Kea?

CONCLUSION: How do mountain barriers modify rainfall patterns on Hawaii's Big Island?

Lab Activity: Mineral Identification

INTRODUCTION:

Of the known 4,000 minerals in existence, only about a dozen can be found at or near Earth's surface. These common rock forming minerals have characteristics that are remarkably consistent and can easily be identified using observations, physical tests and chemical test.

OBJECTIVE:

Learn how to identify minerals based on their physical and chemical properties.

VOCABULARY:

Luster -

Streak -

Hardness -

Cleavage -

Fracture -

PROCEDURE:

1. For each unknown mineral, identify the key physical characteristics using the mineral identification kits. Record your answers on the Mineral Identification Chart.
2. Determine the name of the mineral based on the observed characteristics and the Earth Science Reference Tables.

Lab Activity: Mineral Identification

MINERAL IDENTIFICATION CHART

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
1	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:			Mineral Name:	

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
2	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:			Mineral Name:	

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
3	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:			Mineral Name:	

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
4	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:			Mineral Name:	

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
5	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:			Mineral Name:	

Lab Activity: Mineral Identification

MINERAL IDENTIFICATION CHART

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
6	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:		Mineral Name:		

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
7	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:		Mineral Name:		

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
8	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:		Mineral Name:		

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
9	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:		Mineral Name:		

Mineral	Luster	Hardness	Cleavage / Fracture	Streak
10	☐ Metallic ☐ Non-Metallic	☐ Soft ☐ Hard	☐ Cleavage ☐ Fracture	☐ Colored ☐ Colorless/White
Composition:		Mineral Name:		

Lab Activity: Mineral Identification

DISCUSSION QUESTIONS:

1. What is the difference between cleavage and fracture?

2. Why is color alone not a reliable property to identify a mineral?

3. Why is streak a more reliable property than the actual color of the mineral?

4. How is the hardness of a mineral determined?

5. What mineral can usually be identified by using the acid test?

CONCLUSION: List the properties which are most useful in identifying a mineral.

Name: ______________________________________

Date: _______________________ Period: __________

Lab Activity: Igneous Rocks

INTRODUCTION:

Mineral composition and molten rock cooling rates results in the different types of igneous rocks.

Igneous rocks that form deep within the Earth form from magma and have larger crystal sizes. Adversely, igneous rocks that form on the outside tend to have smaller crystal sizes, glassy appearances and can sometimes have tiny gas pockets.

OBJECTIVE:

Learn how to identify igneous rocks based on their properties.

VOCABULARY:

Intrusive -

Extrusive -

Felsic -

Mafic -

Vesicular -

PROCEDURE:

1. For each unknown igneous rocks, identify the key observable characteristics.
2. Determine the name of the igneous rock based on the observed characteristics and the Earth Science Reference Tables.

Lab Activity: Igneous Rocks

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Lab Activity: Igneous Rocks

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Crystal Size	Texture		Color	Density	Composition
☐ non-crystalline	☐ Glassy	☐ Non-vesicular	☐ Lighter	☐ Lower	☐ Felsic
☐ less than 1 mm	☐ Fine	☐ Vesicular	☐ Darker	☐ Higher	☐ Mafic
☐ 1 mm - 10 mm	☐ Coarse				
☐ 10 mm or larger	☐ Very Coarse				
Environment of Formation:	☐ Intrusive / Plutonic		☐ Extrusive / Volcanic		
Mineral Composition:	☐ Potassium feldspar ☐ Plagioclase feldspar		☐ Quartz ☐ Biotite	☐ Pyroxene ☐ Olivine	☐ Amphibole
Rock Name:					

Lab Activity: Igneous Rocks

DISCUSSION QUESTIONS:

1. How is the size of the mineral crystals affected by the rate at which molten rock cools?

2. How can you determine if an igneous rock has an intrusive or extrusive origin?

3. How does the density of a light colored igneous rock differ from that of a dark?

4. What is the main difference between lava and magma?

5. How is a vesicular texture created?

CONCLUSION: On what basis are igneous rocks classified?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Sedimentary Rocks

INTRODUCTION:

Sedimentary rocks are formed from an accumulation of sediments at or near Earth's surface. Typically, the individual characteristics of the sediments and method of lithification determine the classification. Some sedimentary rocks are formed chemically or can be composed of former living things.

OBJECTIVE:

Learn how to identify sedimentary rocks based on their properties.

VOCABULARY:

Clastic -

Crystalline -

Bioclastic -

Lithification -

Sediments -

PROCEDURE:

1. For each unknown sedimentary rocks, identify the key observable characteristics.
2. Determine the name of the sedimentary rock based on the observed characteristics and the Earth Science Reference Tables.

Lab Activity: Sedimentary Rocks

Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
☐ Bioclastic	☐ Microscopic to very coarse		
Method of Lithification:	☐ Burial and Compaction	☐ Burial and Cementation	☐ Precipitation / Evaporation

Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
☐ Bioclastic	☐ Microscopic to very coarse		
Method of Lithification:	☐ Burial and Compaction	☐ Burial and Cementation	☐ Precipitation / Evaporation

Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
☐ Bioclastic	☐ Microscopic to very coarse		
Method of Lithification:	☐ Burial and Compaction	☐ Burial and Cementation	☐ Precipitation / Evaporation

Lab Activity: Sedimentary Rocks

Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
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Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
☐ Bioclastic	☐ Microscopic to very coarse		
Method of Lithification:	☐ Burial and Compaction	☐ Burial and Cementation	☐ Precipitation / Evaporation

Texture	Texture	Observations	Rock Name
☐ Clastic	☐ Various sizes ☐ Sand sized: 0.006 - 0.2 cm ☐ Silt sized: 0.0004 - 0.006 cm ☐ Clay sized: less than 0.0004 cm		
☐ Crystalline	☐ Fine to coarse		
☐ Bioclastic	☐ Microscopic to very coarse		
Method of Lithification:	☐ Burial and Compaction	☐ Burial and Cementation	☐ Precipitation / Evaporation

Lab Activity: Sedimentary Rocks

DISCUSSION QUESTIONS:

1. What is the maximum and minimum size of a cobble?

2. How can you distinguish a clastic rock from that of a bioclastic rock?

3. Describe the sequence of events in the lithification of sandstone?

4. Why are sedimentary rocks only found on or close to Earth's surface?

5. Why does the sedimentary rock limestone react with HCl acid?

CONCLUSION: On what basis are sedimentary rocks classified?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Metamorphic Rocks

INTRODUCTION:

Metamorphic rocks are rocks that change form from preexisting rock as a result of heat and/or pressure. Regional metamorphism occurs over large areas and are under extreme temperature and pressures. Contact metamorphism is more localized and changes only due to heat altering the rocks when it is adjacent to magma or lava.

OBJECTIVE:

Learn how to identify metamorphic rocks based on their properties.

VOCABULARY:

Banding -

Foliation -

Nonfoliated -

Contact Metamorphism -

Regional Metamorphism -

PROCEDURE:

1. For each unknown metamorphic rocks, identify the key observable characteristics. Record your answers on the Metamorphic Rock Identification Chart.
2. Determine the name of the metamorphic rock based on the observed characteristics and the Earth Science Reference Tables.

Lab Activity: Metamorphic Rocks

METAMORPHIC ROCK IDENTIFICATION CHART

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Lab Activity: Metamorphic Rocks

METAMORPHIC ROCK IDENTIFICATION CHART

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Texture	Grain Size	Type of Metamorphism	Composition
☐ Foliated [mineral alignment] ☐ Foliated [banding]	☐ Fine ☐ Fine to medium ☐ Medium to coarse	☐ Regional ☐ Contact ☐ Both	
☐ Nonfoliated	☐ Fine ☐ Fine to coarse ☐ Coarse	☐ Regional ☐ Contact ☐ Both	
Rock Name:			

Lab Activity: Metamorphic Rocks

DISCUSSION QUESTIONS:

1. Why are rocks formed by contact metamorphism usually not that dense as regionally formed.

2. Why is it rare to find fossils in metamorphic rocks?

3. Why do minerals rearrange into layers within a metamorphic rock?

4. Why is quartzite extremely hard and more resistant than its parent rock?

5. Why does the metamorphic rock marble react with HCl acid?

CONCLUSION: On what basis are metamorphic rocks classified?

Name: ____ Minerals & Rocks

Date: ________________________ Period: __________ Earth Science

Lab Activity: The Rock Cycle

INTRODUCTION:

The rock cycle is a never-ending process that in constantly recycling rock. Igneous rocks form from magma or lava that solidifies into sold rock. Weathering breaks those igneous rock into sediments [pebbles, sands and silts]. These smaller pieces are then buried and undergo compacted and/or cemented from overlaying layers. If they get buried deep enough, heat and pressure from inside the Earth changes the sedimentary rocks into metamorphic rocks. Still deeper the rocks remelt into lava or magma and being the process over again.

OBJECTIVE:

Identify the different mechanisms that create the three rock types and show how they are interrelated.

PROCEDURE A:

Fill in key words that are associated with the three rock types.

Igneous Rocks	Sedimentary Rocks	Metamorphic Rocks

PROCEDURE B:

1. For each of the unknown three rocks at your station, look for an observable characteristic and identify the rock type. Afterwards, use your Earth Science Reference Tables to select the method of formation. Record your results in the appropriate data table.
2. When time is called, move to the adjacent station and repeat step 1. Be sure to record your results in the appropriate data table.
3. Repeat procedure steps one and two until you have completed all six stations.

Lab Activity: The Rock Cycle

DATA TABLE #1

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

DATA TABLE #2

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

DATA TABLE #3

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

Lab Activity: The Rock Cycle

DATA TABLE #4

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

DATA TABLE #5

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

DATA TABLE #6

	Observable Characteristics	Rock Type	Method of Formation
Rock A		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock B		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure
Rock C		☐ Igneous ☐ Sedimentary ☐ Metamorphic	☐ Melting and Solidification ☐ Compaction and/or Compaction ☐ Heat and Pressure

Lab Activity: The Rock Cycle

DISCUSSION QUESTIONS:

1. How are igneous rocks formed?

2. How are sedimentary rocks formed?

3. How are metamorphic rocks formed?

4. Why do limestone and marble react with hydrochloric acid [HCl]?

5. Describe the steps in which the rock shale changes into the rock gneiss.

CONCLUSION: What do igneous, sedimentary and metamorphic rocks all have in common?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Continental Drift

INTRODUCTION:

Since the early 19th century people have thought about the jigsaw fit of the continents. South America and Africa appear as though they could fit together.

In 1912, Alfred Wegener proposed his idea of Continental Drift that built upon the puzzle-like fit of the continent with even more evidence. Unfortunately, he could not explain the mechanism on how the crust moved and his theory was not taken seriously.

OBJECTIVE:

You will see how the continents appeared to fit together and how the outline of the continents supports the Theory of Continental Drift.

VOCABULARY:

Continental Drift -

Alfred Wegener -

Pangaea -

Mesosaurous -

Glossopteris -

Lab Activity: Continental Drift

PROCEDURE:

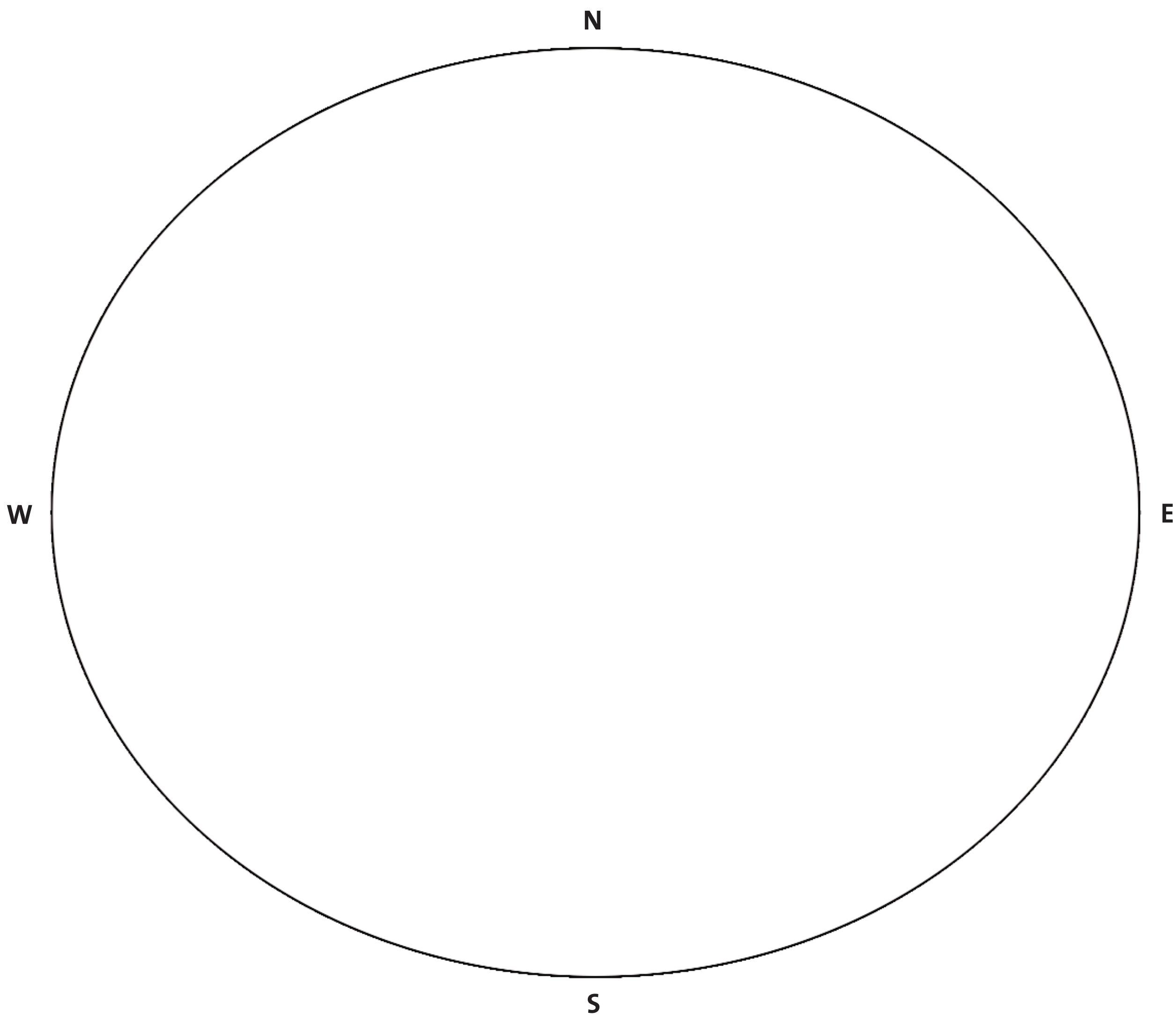
1. On the “Continental Drift Cut-out Page” located on page 100, cut out the continents. Be sure to keep the “Below Sea Level” on the puzzle piece.
2. On the report sheet, fit the continents together to form one large landmass. Use the legend to match up similar counterparts on the other continents.
3. Glue or tape the continents down to your report sheet.

LEGEND

❶ Europe & Asia	Below Sea Level
❷ North America	Above Sea Level
❸ South America	Basalt
❹ Africa	Desert
❺ India	Amphibians
❻ Antarctica	Plateosaurus
❼ Australia	Rhynchosaur
	Mesosaurous

Lab Activity: Continental Drift

REPORT SHEET



Lab Activity: Continental Drift

DISCUSSION QUESTIONS:

1. Who was responsible for developing the Theory of Continental Drift?

2. What was the inferred motion of North America relative to Africa over the past 200 million years?

3. How has the climate of northeastern United States changed over the past 200 million years?

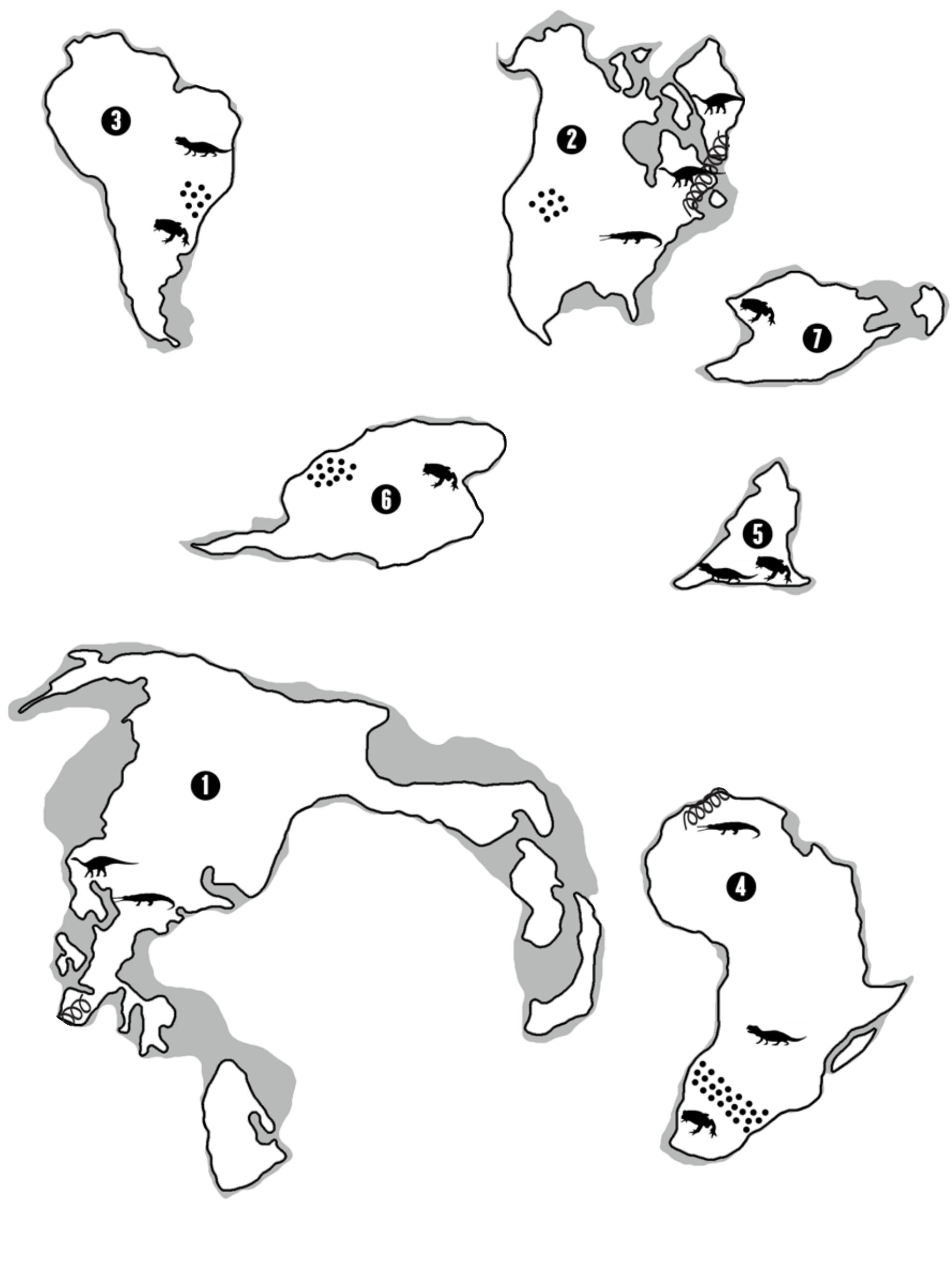
4. Where in the United States is there measurable evidence that the continents are moving?

5. What could explain the existence of coal deposits in Antarctica?

CONCLUSION: What evidence is there that the present-day continents were once a single landmass?

Lab Activity: Continental Drift

CONTINENTAL DRIFT CUT-OUT PAGE



Name: ______________________________________

Date: ________________________ Period: __________

Lab Activity: Crustal Activity

INTRODUCTION:

Earth's crust has been shifting and adjusting for billions of years. Recently scientists discovered that these crustal movements were linked to earthquakes, volcanoes and mountain ranges. It also gave them the ability to define the shapes of all the world's major plates.

OBJECTIVE:

You will plot the areas in which earthquakes occur most frequently and identify other crustal activities that appear related to these zones.

VOCABULARY:

Plate Tectonics -

Lithosphere -

Asthenosphere -

Volcano -

Ring of Fire -

Lab Activity: Crustal Activity

PROCEDURE:

1. On the Map: Crustal Activities, darken in the lines that represent the Equator, Prime Meridian, and the International Date Line.
2. Using a "✘", plot all the "World's Major Earthquakes" onto Map: Crustal Activities in pencil.
3. Using a "▲" plot all the "World's Active Volcanoes" onto Map: Crustal Activities in red colored pencil,. Be sure to label the names of all volcanoes.

WORLD'S MAJOR EARTHQUAKES

Dates	Latitude	Longitude
January 12, 1998	10º S	180º
January 2, 1998	20º S	180º
March 29, 1998	10º S	160º W
April 2, 1998	40º N	140º E
May 1, 1998	50º N	180º
May 21, 1998	1º N	120º E
June 1, 1998	50º N	160º E
July 17, 1998	3º S	140º E
August 4, 1998	1º S	80º W
November 29, 1998	2º S	130º E
Dec 5, 1998	50º N	130º W

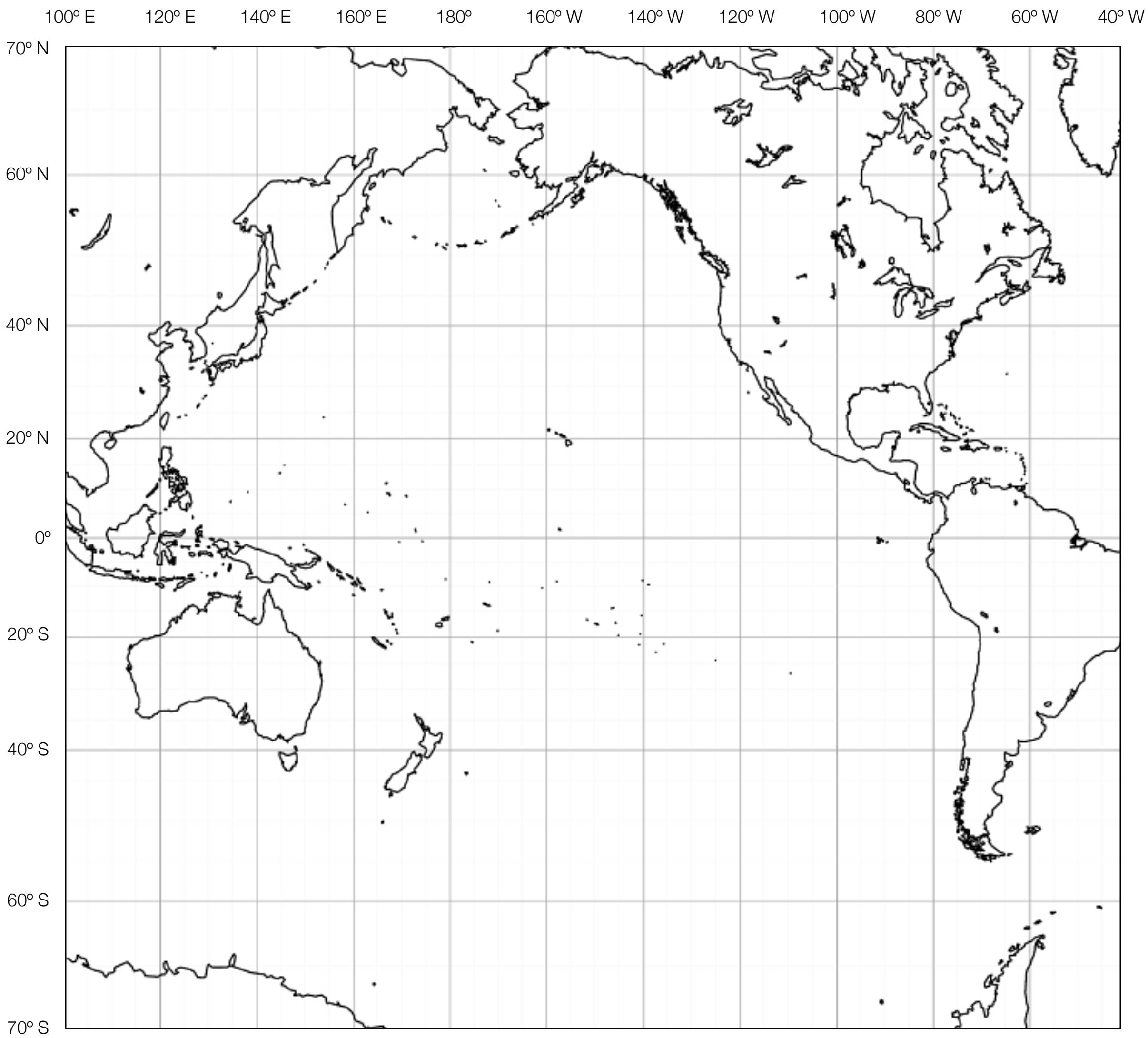
Dates	Latitude	Longitude
March 4, 1999	20º N	120º E
March 28, 1999	30º N	130º E
April 13, 1999	50º N	170º W
June 15, 1999	20º N	100º W
September 20, 1999	35º N	120º W
October 13, 1999	60º N	140º W
November 29, 1999	20º S	70º W
December 10, 1999	40º S	75º W
December 12, 1999	30º S	70º W
December 30, 1999	10º S	80º W
December 30, 1999	40º S	180º

WORLD'S ACTIVE VOLCANOES

Date	Latitude	Longitude
Krakatau	6º S	105º E
Nevado del Ruiz	5º N	75º W
Katmai	58º N	155º W
Mt. Rainier	47º N	122º W
Paricutin	20º N	102º W

Date	Latitude	Longitude
Fuji	35º N	138º E
Mt. St. Helens	46º N	122º W
Mauna Loa	20º N	156º W
Lokon	1º N	125º E
Tambora	8º S	118º E

MAP: CRUSTAL ACTIVITIES



Lab Activity: Crustal Activity

DISCUSSION QUESTIONS:

1. Describe the pattern of earthquakes on your map?

2. Describe the pattern of volcanoes on your map?

3. What regions of North and South America show the greatest crustal activity?

4. What is the probability of having major earthquakes or volcanoes occur in New York State?

5. Why is the perimeter around the Pacific Ocean referred to as the “Ring of Fire”?

CONCLUSION: Compare the patterns of earthquakes, volcanoes, and mountain ranges on Earth?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Crustal Boundaries

INTRODUCTION:

According to the plate tectonic theory, Earth's surface is divided into moving plates. A large, mobile slab of rock that is part of Earth's rigid outer shell known as the lithosphere. This includes rocks of the upper crust and upper mantle.

The boundaries between plates are of three general types. The boundaries between plates that are moving apart is termed diverging, while a boundary between plates that are moving toward each other is called converging. A transform boundary is found where two plates are moving horizontally past one another.

OBJECTIVE:

You will distinguish between diverging, converging, and transform tectonic plate boundaries. You will also use ocean floor depth data to construct a ocean bottom profile and identify the key features of a specific type of plate boundary.

VOCABULARY:

Diverging Boundary-

Sea-floor Spreading -

Converging Boundary -

Subduction -

Transform Boundary -

Lab Activity: Crustal Boundaries

PROCEDURE A:

1. Using a blue colored pencil, draw a horizontal line across the "North Atlantic Ocean Bottom Profile" at a depth of 0 km. This represents the ocean surface (sea level).
2. Construct and ocean bottom profile on the graph titled "North Atlantic Ocean Bottom Profile" using the ocean depth data provided.
3. Color the area below the constructed ocean bottom profile brown. This represent the lithosphere (Earth's crust) under the ocean.
4. Color the area between the blue ocean surface line and the lithosphere blue.
5. Label the following ocean floor features:
    - Mid-Atlantic Ridge
    - Rift Valley
    - Continental Shelf
    - Deep Ocean Floor
6. Based on your knowledge of Earth Science, draw arrows at the bottom of the "North Atlantic Ocean Bottom Profile" to indicate the direction of plate movement.

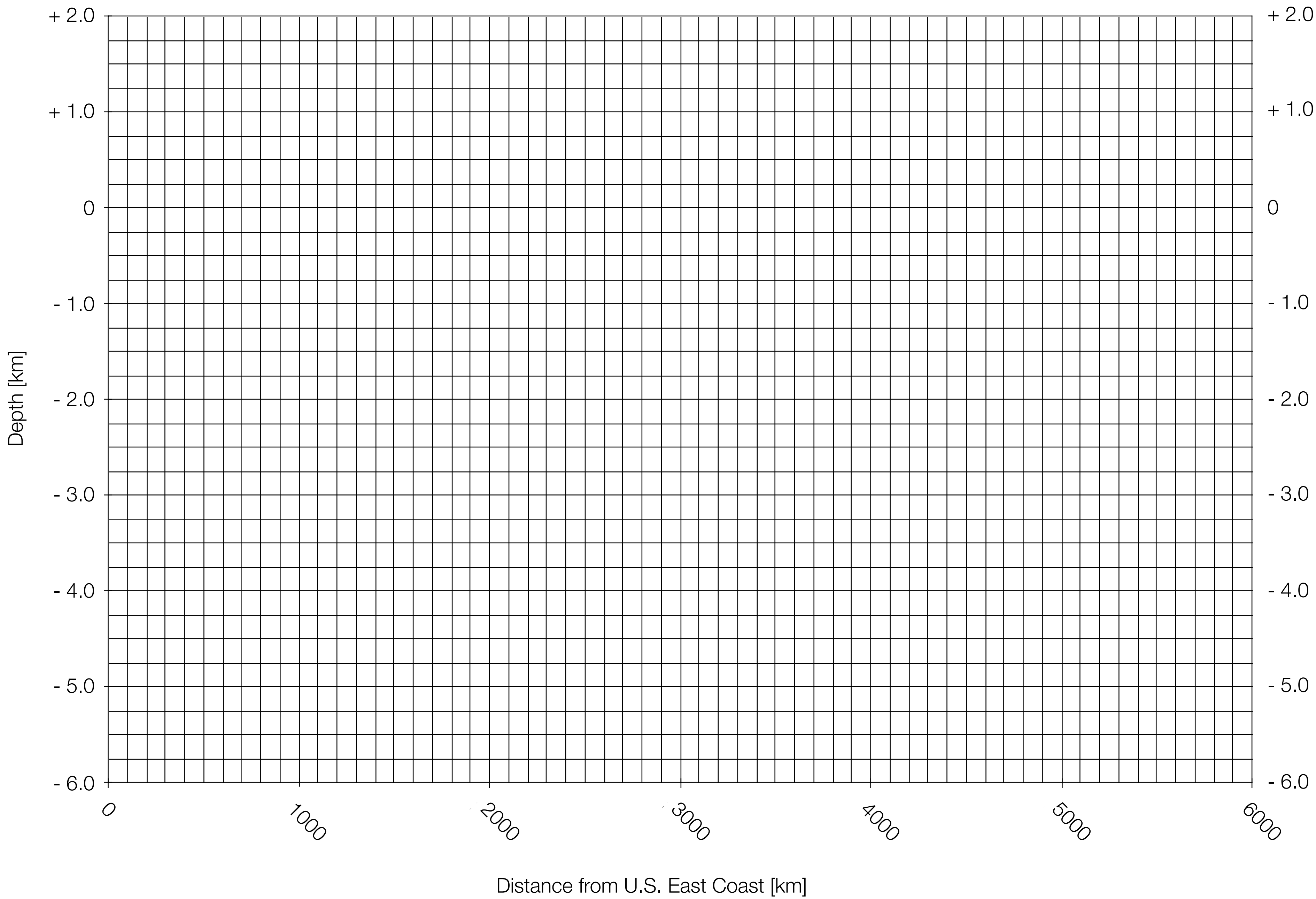
OCEAN DEPTH DATA

Distance [km]	Depth [km]
0	0
100	-0.25
200	-2.75
400	-3.75
500	-3.75
600	-4.5
2000	-4.5
2500	-4.0

Distance [km]	Depth [km]
2900	-2.75
3000	-1.75
3050	-3.0
3100	-2.5
3200	-3.0
3500	-3.5
3600	-3.75
3650	-3.75

Distance [km]	Depth [km]
4000	-4.0
4500	-4.5
5000	-5.0
5300	-4.5
5800	-3.75
5900	-0.25
6000	0
-	-

North Atlantic Ocean Bottom Profile



Lab Activity: Crustal Boundaries

PROCEDURE B:

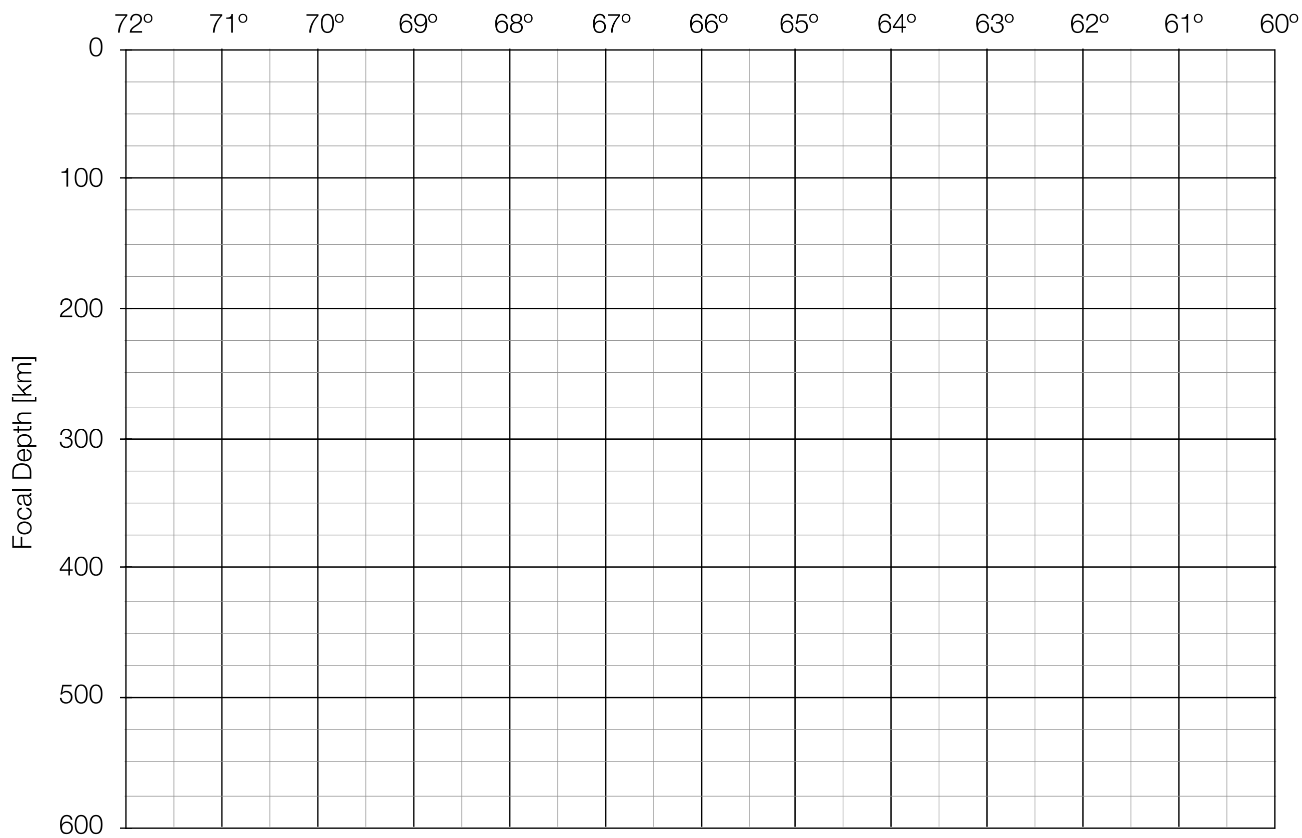
1. Plot the “Earthquake Depth Data” below onto the “Peru-Chile Trench” graph on the next page.
2. Draw a best-fit line for the plotted points showing the trend in data.
3. Assuming the best-fit line is the upper surface of a subducting plate, label the following:
    - South America Plate
    - Nazca Plate
    - Continental Crust Density
    - Oceanic Crust Density
    - Arrows showing subduction

EARTHQUAKE DEPTH DATA

Longitude [ºW]	Focus Depth [km]
67.0	175
63.5	325
69.5	75
62.5	475
70.5	25
61.5	525
68.5	125
70.0	25
69.0	100
65.5	300
64.0	350
70.5	75

Longitude [ºW]	Focus Depth [km]
66.5	225
68.5	150
67.5	200
67.5	125
69.5	100
68.0	100
68.0	150
67.5	175
68.5	75
70.0	100
65.0	275
70.0	50

PERU-CHILE TRENCH



Lab Activity: Crustal Boundaries

DISCUSSION QUESTIONS:

1. At what type of plate boundary is new oceanic crust formed?

2. What prominent sea-floor feature is located in the central Atlantic Ocean?

3. As distance form the mid-ocean ridge increases what happens to the age of the sea-floor?

4. Describe the pattern of earthquake depth along the Peru Chile Trench?

5. Name two geologic features that can be found at a subduction zone.

CONCLUSION: List and describe the three types of plate boundaries.

Name: ____

Date: ________________________ Period: __________

Lab Activity: Hawaiian Hot Spot

INTRODUCTION:

The Emperor Hawaiian chain of islands consists of 107 volcanoes. They extend from the Big Island of Hawaii towards the northwest due to the Pacific plate slowly moving over a stationary hole in the lithosphere. For over 80 million years the Hawaiian Hot Spot has been providing a fresh supply of magma used to create the chain of islands.

OBJECTIVE:

You will use information about the formation and age of the Emperor Hawaiian chain of islands to determine the direction and rate of movement for the Pacific Plate.

VOCABULARY:

Volcano -

Hot Spot -

Mantle Plume -

Seamount -

Guyot -

Lab Activity: Hawaiian Hot Spot

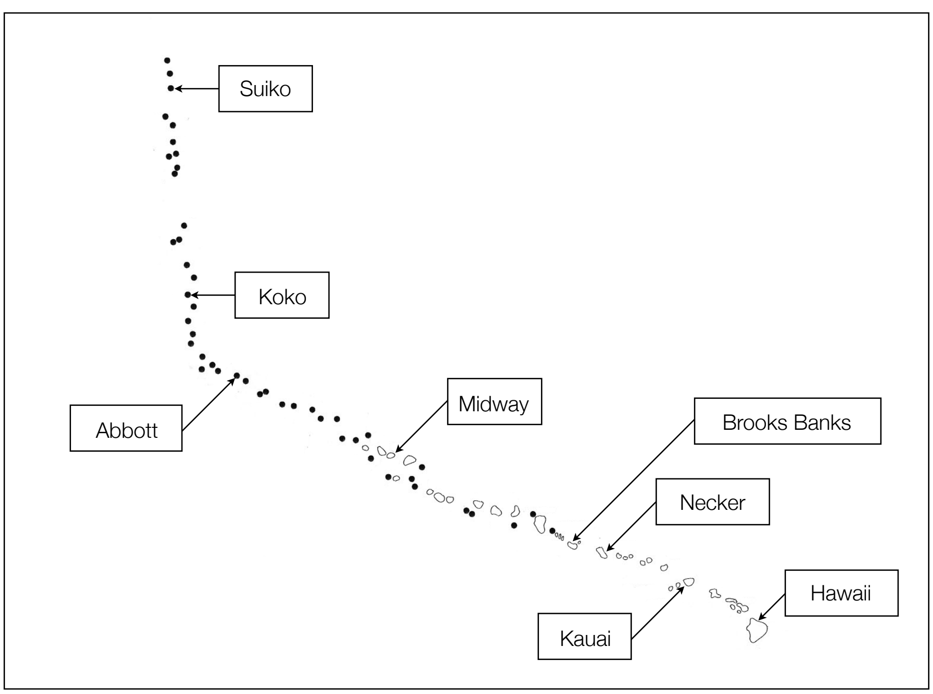
PROCEDURE A:

Using the data table below create a graph on the “Hawaiian Island Graph” to show the relationship with the age of the islands and distance from the hot spot. Be sure to connect the points with a line.

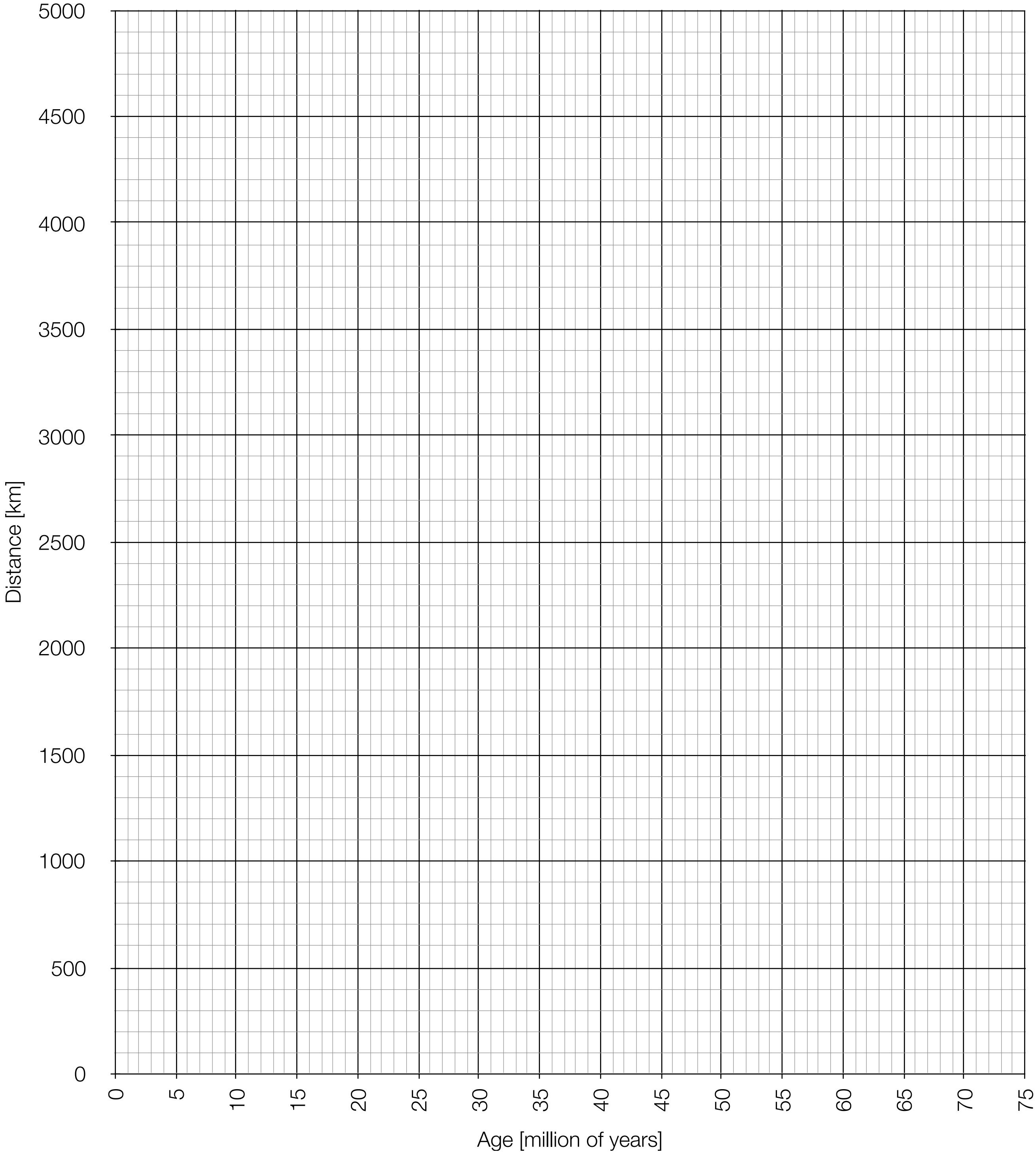
HAWAIIAN ISLANDS DATA

Island	Age [millions years old]	Distance from Hot Spot [kilometers]
Hawaii	0	0
Kauai	4	500
Necker	9	1000
Brooks Bank	13	1200
Midway	27	2400
Abbott	39	3300
Koko	48	3800
Suiko	65	4900

EMPEROR HAWAIIAN CHAIN OF ISLANDS



HAWAIIAN ISLAND GRAPH



Lab Activity: Hawaiian Hot Spot

PROCEDURE B:

Calculate the rate of change for the plate movement between the two island pairs and record your answers on the “Rate of Plate Movement” chart. Be sure to round to the nearest tenths place.

$$\text{Rate of change} = \frac{\text{change in field value}}{\text{time}}$$

RATE OF PLATE MOVEMENT CHART

Island Pairs	Rate of Plate Movement [km/millions of years]
Suiko to Koko	
Koko to Midway	
Midway to Necker	
Necker to Kauai	
Kauai to Hawaii	

Lab Activity: Hawaiian Hot Spot

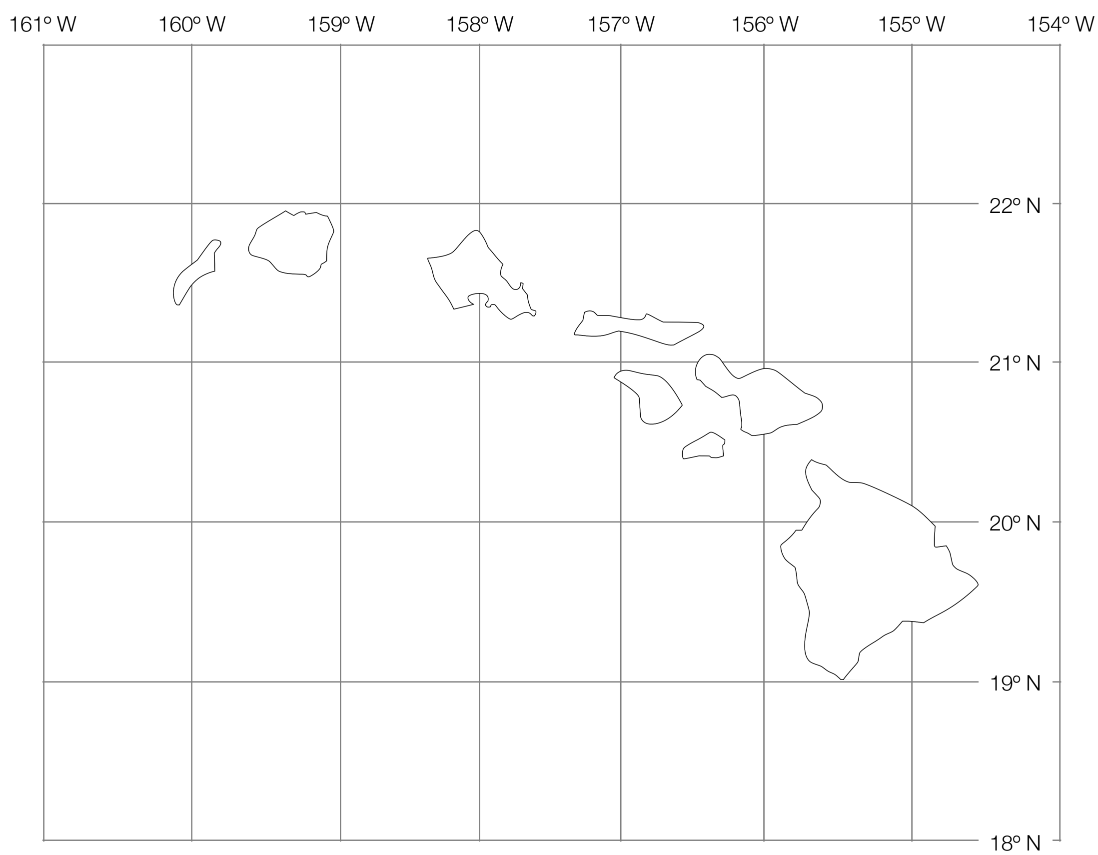
PROCEDURE C:

Plot and label the name of the island and the approximate age using the “Hawaiian Island Ages and Locations” data chart onto the “Hawaiian Islands" map.

HAWAIIAN ISLAND AGES AND LOCATIONS

Island	Approximate Age [millions of years]	Latitude	Longitude
Hawaii	0.5	19.5° N	155.5° W
Kauai	4.7	21.8° N	159.5° W
Maui	1.1	20.8° N	156° W
Molokai	1.6	21.2° N	157° W
Oahu	2.5	21.6° N	158° W

HAWAIIAN ISLANDS MAP



Lab Activity: Hawaiian Hot Spot

DISCUSSION QUESTIONS:

1. Using your data, has the rate of plate motion remained constant throughout time?

2. In the event you find a 55 million year old rock, how far from the hot spot would it be located?

3. Based on your calculations, what happened to the rate of plate movement over time?

4. Based on your data, where do you expect the next Hawaii island to form?

5. Why are the Hawaiian Islands towards the northwest generally smaller than the Big Island.

CONCLUSION: Describe how the Hawaiian islands have formed.

Name: ____

Date: _________________________ Period: ___________

Lab Activity: NYS Earthquake Analysis

INTRODUCTION:

An earthquake's strength depends on how much of the energy stored in the rocks is released. There are two methods of identifying the intensity of an earthquake. One is quantitative [a measurement involving quantity, or amount, of energy released during an earthquake], the other is qualitative [a description of the observations made during an event].

You are most likely familiar with the Richter Scale which is a quantitative analysis of an earthquake, but before Mr. Richter developed his scale, damage reports were based on a comparison of observations of intensity. Mercalli's scale made it possible to rank earthquakes by intensity. However, his scale is not adequate for distinguishing an extremely strong earthquake that occurred far away from a less severe event that occurred close by.

OBJECTIVE:

You will see how using observation and Mercalli's scale can help locate the earthquake's epicenter.

VOCABULARY:

Earthquake -

Epicenter -

Focus -

Seismograph -

Mercalli Scale -

Lab Activity: NYS Earthquake Analysis

PROCEDURE:

1. Using the Mercalli Intensity Scale below, complete the Earthquake Observations data table for an earthquake that occurred in New York State.
2. Plot the intensities on the NYS Earthquake Map, using the appropriate Roman numeral.
3. Plot isolines showing areas of equal intensity.
4. Place a 'X' on the map to indicate the location of the epicenter of the earthquake.

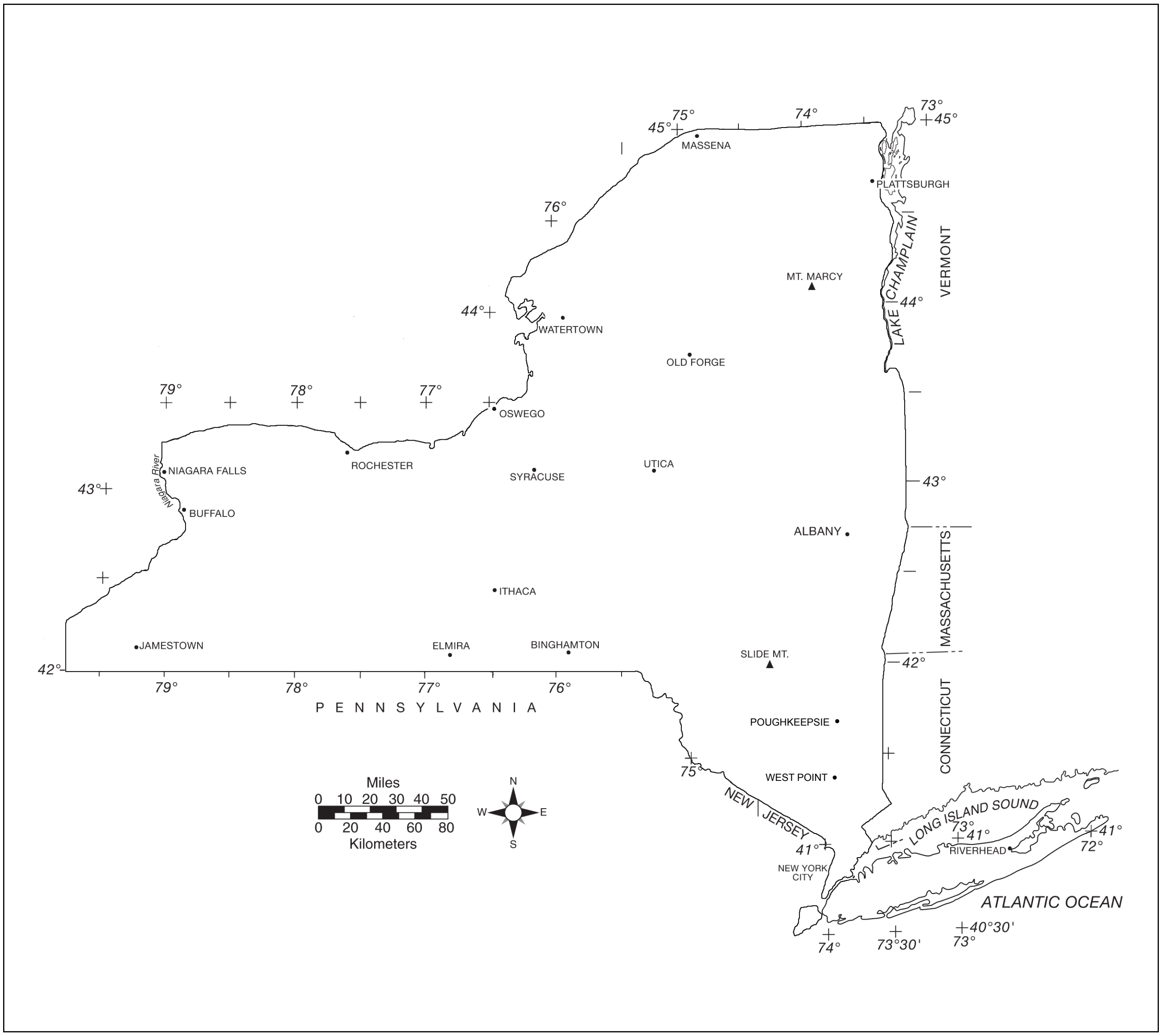
MERCALLI INTENSITY SCALE

Intensity	Descriptions and Observations
I	Not felt [except by a very few under certain circumstances].
II	Felt only by a few persons on upper floors. Delicately suspended objects may swing.
III	Felt by all persons on upper floors. Vibration like passing of truck.
IV	Felt by all persons indoors and a few outdoors. Dishes, windows, door disturbed Walls creak.
V	Felt by nearly everyone [many awakened]. Some dishes, windows, and so on broken. Cracked plaster in a few places.
VI	Felt by all [many frightened]. Some heavy furniture moves. Damaged to chimneys.
VII	Everyone runs outdoors. Damage negligible in buildings of good design. Some chimneys broken.
VIII	Damage slight in specially designed structures. Chimneys and factory stacks fall. Heavy furniture overturned.
IX	Heavy damage to designed structures. Buildings shifted off foundations. Ground cracked.
X	Some well-built wooden structures destroyed. Rails on railroads bent. Landslides.
XI	Few, if any, structures remain standing. Bridges destroyed. Earth slumps.
XII	Waves seen on ground surface. Lines of sight and level distorted. Objects thrown into the air.

EARTHQUAKE OBSERVATIONS

Location	Lat / Long	Observation	Mercalli Intensity
Slide Mountain	42º N, 74º 30’ W	Felt by nearly everyone [many awakened].	
Syracuse	43º 10' N, 76º 10’ W	Damaged to chimneys.	
Oswego	44º N, 76º 30’ W	Felt by all [many frightened].	
Poughkeepsie	41º 45’ N, 73º 55’ W	Felt by all persons on upper floors.	
Plattsburgh	44º 45' N, 73º 30' W	Some heavy furniture moves.	
Watertown	44º N, 76º W	Heavy damage to designed structures.	
Mt. Marcy	44º 10' N, 74º W	Buildings shifted off foundations.	
West Point	41° 20’ N, 75° W	Delicately suspended objects may swing.	
Utica	43º 10’ N, 75º 20’ W	Ground cracked.	
Elmira	42º N, 77º W	Felt only by a few persons on upper floors.	
Binghamtom	42º N, 76º W	Felt by all persons on upper floors.	
Rochester	43º 10’ N, 77º 40’ W	Vibration like passing of truck.	
Massena	45º N, 75º W	Cracked plaster in a few places.	
Albany	42º 40' N, 73º 50’ W	Damaged to chimneys.	
Old Forge	43º 45’ N, 75º W	Landslides.	
Buffalo	42º 50' N, 78º 40’ W	Felt only by a few on upper floors.	
Riverhead	40º 50' N, 72º 30’ W	Not Felt.	
Niagara Falls	43º 05’ N, 79º W	Delicately suspended objects may swing.	
Jamestown	42º 10’ N, 79º 15’ W	Not felt.	
Ithica	42º 10’ N, 76º 30’ W	Some dishes broken.	

MAP: NYS EARTHQUAKES
Mercalli Scale Intensities



Lab Activity: NYS Earthquake Analysis

DISCUSSION QUESTIONS:

1. What is the closest location to the epicenter of the earthquake.

2. East Islip reported feeling nothing. Suggest a possible explanation for this observation.

3. Which landscape region of New York State was the epicenter of this earthquake.

4. Which type of bedrock is located under the epicenter of this earthquake.

5. Why might the Mercalli Scale not be the most accurate procedure used to locate an epicenter?

CONCLUSION: What in the Mercalli Scale and what is it based upon?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Locating Epicenters

INTRODUCTION:

Geologists who study earthquakes are called seismologists. If you were a seismologist, you would receive earthquake data from all across the country. Within minutes, seismologists would record the times of arrival of the P waves and S waves. From the seismic wave data collected, they can than use this data to zero in on the exact location of the earthquake's epicenter.

OBJECTIVE:

You will learn how to interpret a seismogram and use the data from three different seismograms to locate the epicenter of an earthquake.

VOCABULARY:

Epicenter -

Focus -

Focal Depth -

P-wave -

S-wave -

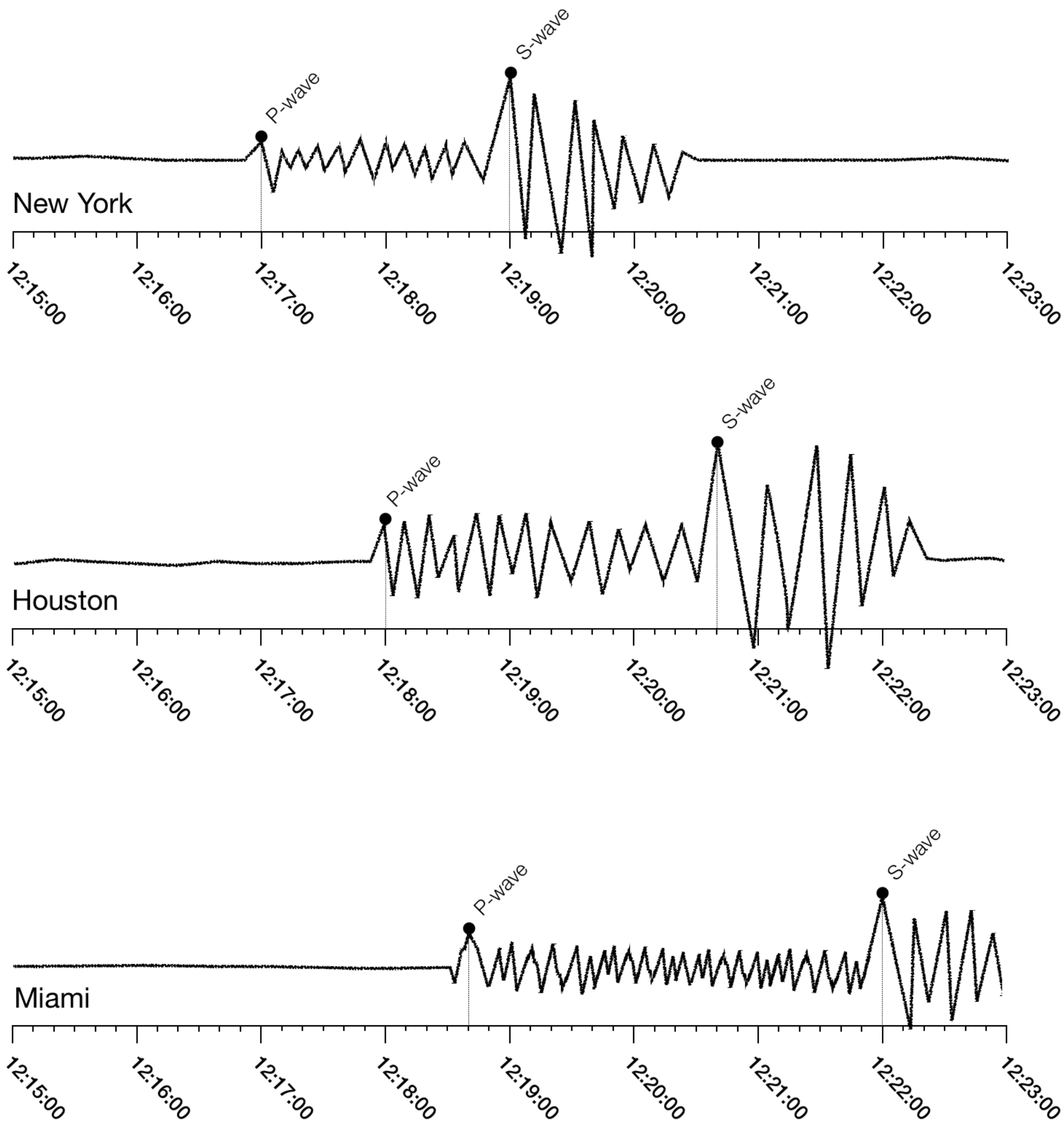
Lab Activity: Locating Epicenters

PROCEDURE A:

1. Use “Seismograms A” to calculate the following for each city and fill in the chart below:
    - The arrival time for the P-wave and S-wave.
    - The difference in the arrival time between P-wave and S-waves.
    - The distance in kilometers of the epicenter from each city.
    - The length of time it took for the P-wave to travel from the epicenter to each city.
    - Calculate the time at which the P-wave started.
2. Using Map A on page 122, locate the epicenter by constructing a circle whose radius is equal to the distance from the city to the epicenter for all three cities.
3. Where all three circles meet, draw a “✘” and label it “epicenter”.

Station	Arrival Time		Difference in Arrival Time	Distance to the Epicenter	P-wave Travel Time	Time of Origin
	P-wave	S-wave				
New York						
Houston						
Miami						

SEISMOGRAMS A



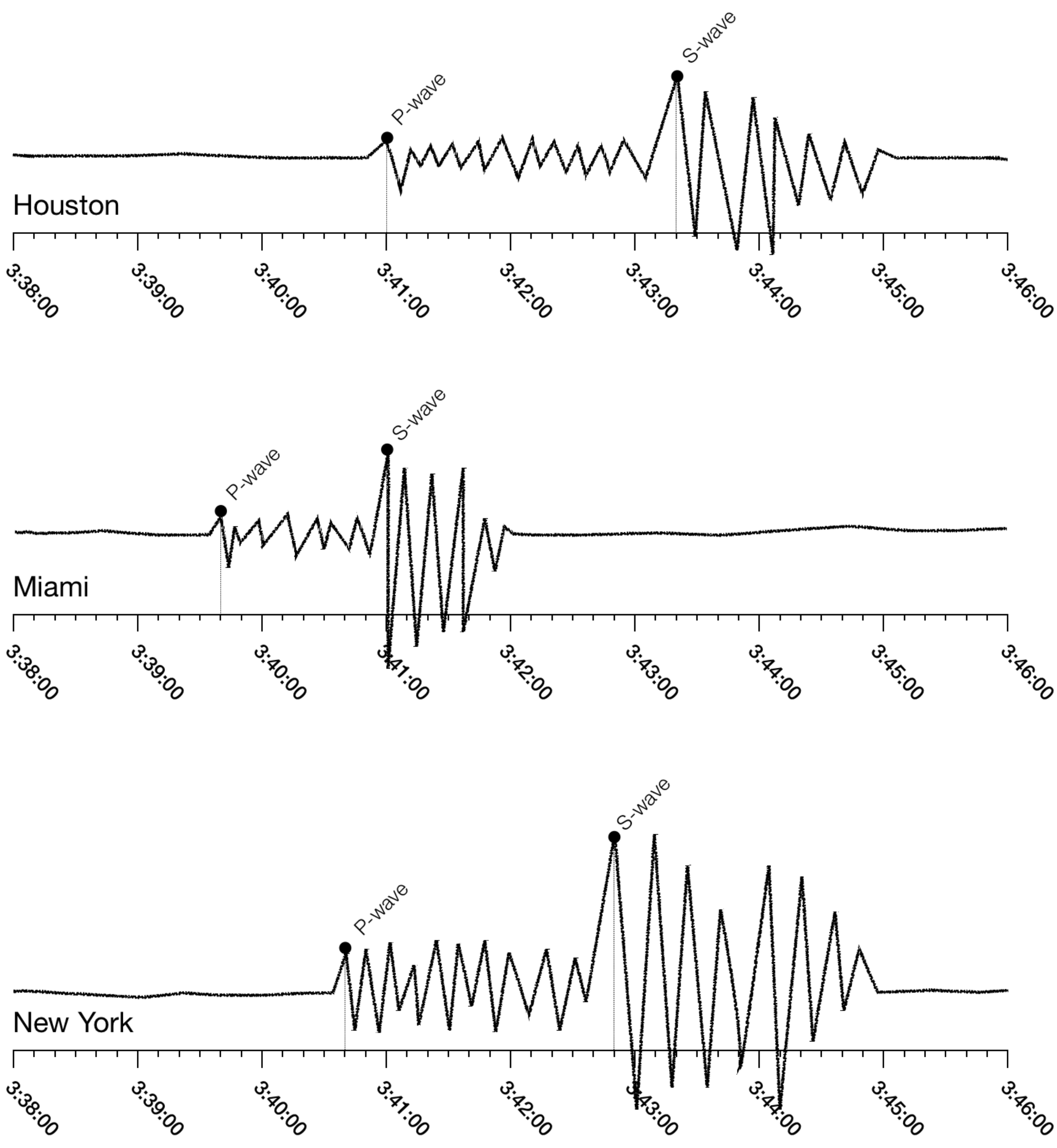
Lab Activity: Locating Epicenters

PROCEDURE B:

1. Use “Seismograms B” to calculate the following for each city and fill in the chart below:
    - The arrival time for the P-wave and S-wave.
    - The difference in the arrival time between P-wave and S-waves.
    - The distance in kilometers of the epicenter from each city.
    - The length of time it took for the P-wave to travel from the epicenter to each city.
    - Calculate the time at which the P-wave started.
2. Using Map B on page 123, locate the epicenter by constructing a circle whose radius is equal to the distance from the city to the epicenter for all three cities.
3. Where all three circles meet, draw a “✘” and label it “epicenter”.

Station	Arrival Time		Difference in Arrival Time	Distance to the Epicenter	P-wave Travel Time	Time of Origin
	P-wave	S-wave				
Houston						
Miami						
New York						

SEISMOGRAMS B



Lab Activity: Locating Epicenters

DISCUSSION QUESTIONS:

1. What is the approximate location of the epicenter for the seismograms A?

2. What is the approximate location of the epicenter for the seismograms B?

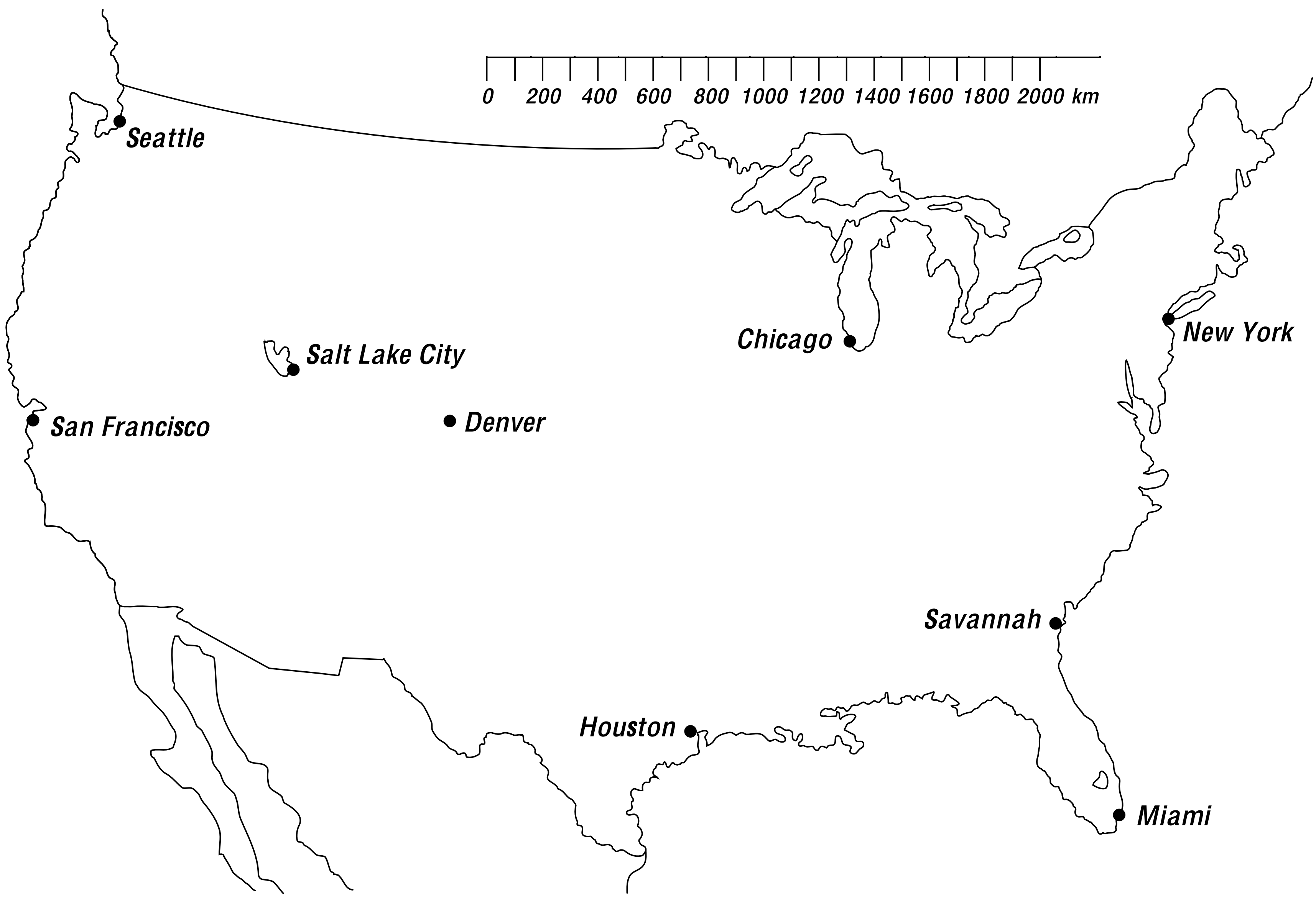
3. Why does the p-wave always arrive at a seismic station prior to the s-wave?

4. Why is three the minimum number of stations necessary to locate an epicenter?

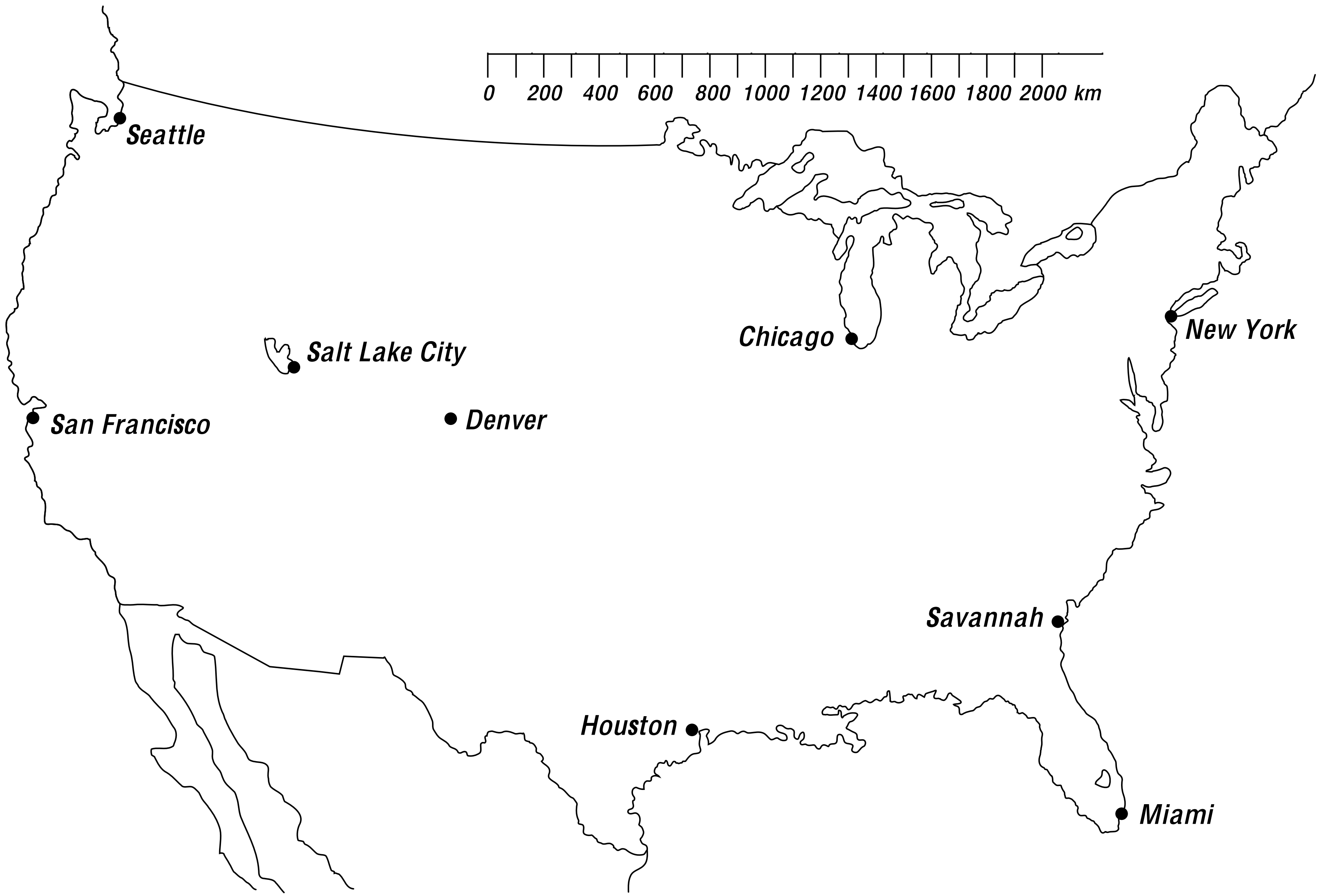
5. Why does the arrive time difference become greater as distance increases?

CONCLUSION: Describe, step by step, how the epicenter of an earthquake can be located?

MAP A


0 200 400 600 800 1000 1200 1400 1600 1800 2000 km
Seattle
Salt Lake City
San Francisco
Denver
Chicago
New York
Savannah
Houston
Miami

MAP B


0 200 400 600 800 1000 1200 1400 1600 1800 2000 km
Seattle
San Francisco
Salt Lake City
Denver
Chicago
New York
Savannah
Houston
Miami

Name: ____ Surface Processes

Date: ________________________ Period: __________ Earth Science

Lab Activity: Abrasion

INTRODUCTION:

Running water wears down Earth's surface and breaks up sediments along the way. The weathering of rock fragments causes the edges to be rounded as they roll and bounce along a stream channel. Running water also can dissolve some minerals in solution.

OBJECTIVE:

You will determine some factors that control the rate of weathering in a moving stream.

VOCABULARY:

Abrasion -

Weathering -

Erosion -

Hardness -

Soluble -

Lab Activity: Abrasion

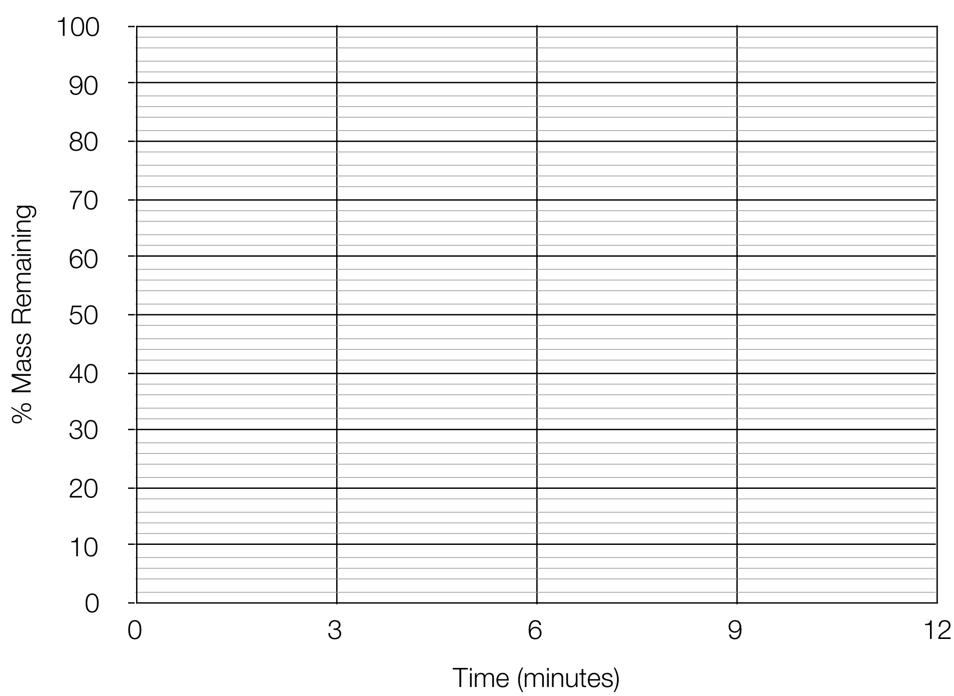
PROCEDURE A:

1. Weight 100 grams of limestone chips and place the chips in the clear plastic container.
2. Add 200 mL of water, tightly secure the cap, and shake at an even tempo for three minutes.
3. Drain the limestone chips and dry with a paper towel. Be sure not to lose any of the limestone.
4. Weigh all the chips to the nearest tenth. Be sure to record the new mass at “Weathering Time 3”.
5. Return the limestone chips to the container and repeat 3 more times.
6. Calculate the percent of mass remaining after each 3 minute interval and graph your results.

LIMESTONE CHIPS GRAPH

Weathering Time	Mass Remaining	% Mass Remaining
0	100 grams	100%
3		
6		
9		
12		

LIMESTONE CHIPS GRAPH



Lab Activity: Abrasion

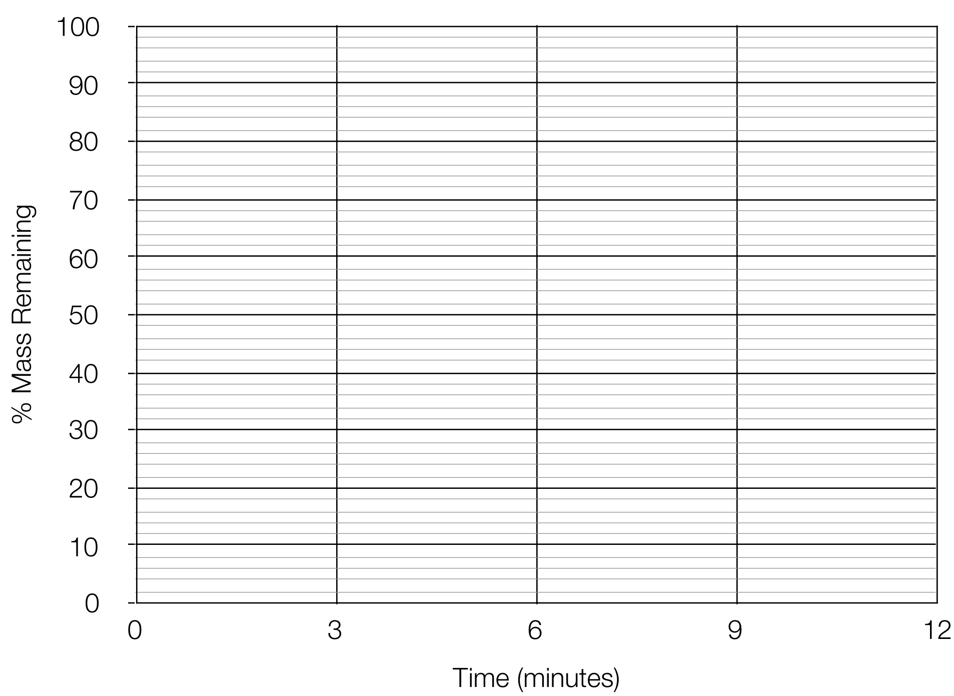
PROCEDURE B:

1. Weight 100 grams of quartz chips and place the chips in the clear plastic container.
2. Add 200 mL of water, tightly secure the cap, and shake at an even tempo for three minutes.
3. Drain the quartz chips and dry with a paper towel. Be sure not to lose any of the limestone.
4. Weigh all the chips to the nearest tenth. Be sure to record the new mass at “Weathering Time 3”.
5. Return the quartz chips to the container and repeat 3 more times.
6. Calculate the percent of mass remaining after each 3 minute interval and graph your results.

QUARTZ CHIPS GRAPH

Weathering Time	Mass Remaining	% Mass Remaining
0	100 grams	100%
3		
6		
9		
12		

QUARTZ CHIPS GRAPH



Lab Activity: Abrasion

DISCUSSION QUESTIONS:

1. What percent of limestone remained after three minutes?

2. What percent of halite remained after three minutes?

3. Describe the effect on the size as time of abrasion increased?

4. Describe the effect on the shape as time of abrasion increased?

5. What effect does hardness have on the rate at which rock abrades?

CONCLUSION: What are some factors that affect the rate at which rocks abrade in a stream?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Depression

INTRODUCTION:

Streams that are moving quickly can carry larger amounts of sediment and larger fragments. When a stream enters a quite body such as a lake or shelter lagoon they no longer have the ability to transport sediment. This is the point at with erosion stops and deposition begins.

OBJECTIVE:

You will see the different factors that contribute to the varying settling rates of particles.

VOCABULARY:

Deposition -

Sediment -

Horizontal Sorting -

Vertical Sorting -

Suspension -

EQUIPMENT SETUP:

1. Take the clear plastic tube and secure a stopper into the bottom.
2. Using a ring stand and test tube clamps, secure the plastic tube with the stopper vertically.
3. Fill the tube with water using a beaker to transfer the water from the sink to the clear plastic tube. Make sure that the top marking line is below the surface of the water.

Lab Activity: Deposition

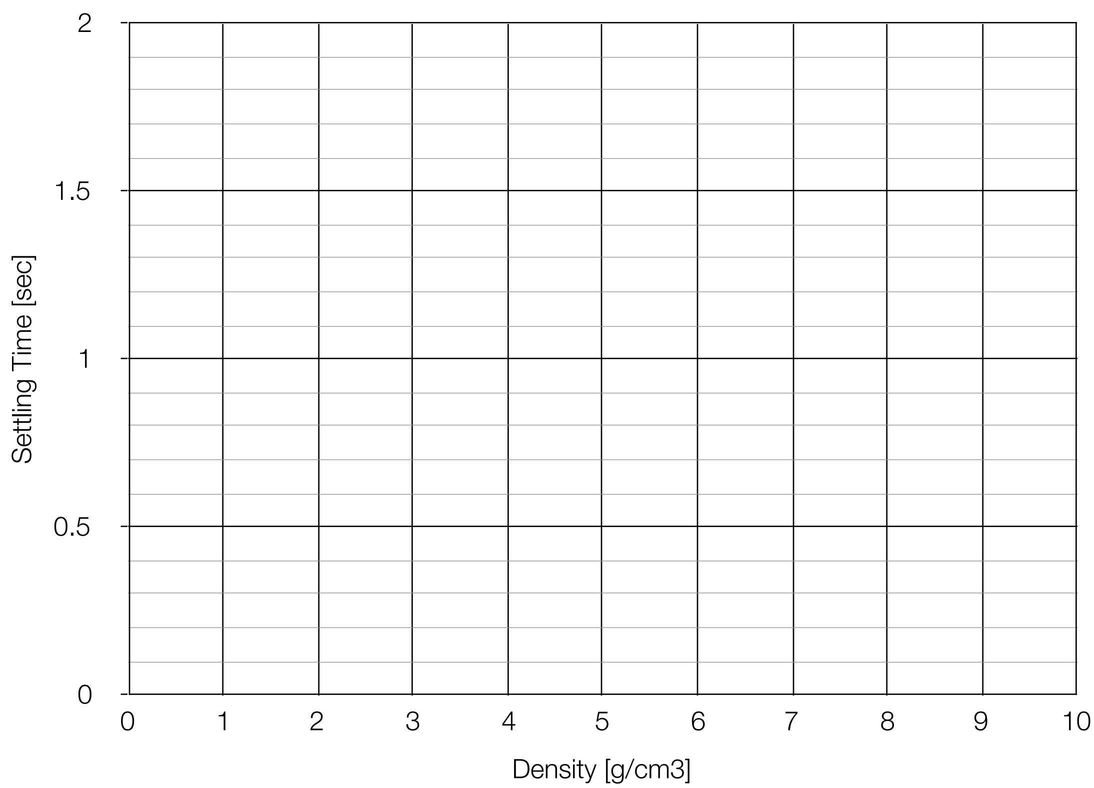
PROCEDURE A:

1. Using the different density spheres provided, drop the glass and steel spheres separately into the column of water. Start the watch when the particle passes the top line and stop the watch as it passes the bottom line. Record your time on Data Chart A.
2. Calculate the settling rate by dividing the distance between the lines by the settling time.
3. On Graph A, plot your results.

DATA CHART A

PARTICLE & SIZE	DENSITY [g/cm^3]	SETTLING TIME [sec]	SETTLING RATE [cm/sec]
Glass [1.0 cm]	2.5		
Steel [1.0 cm]	7.5		

GRAPH A



Lab Activity: Deposition

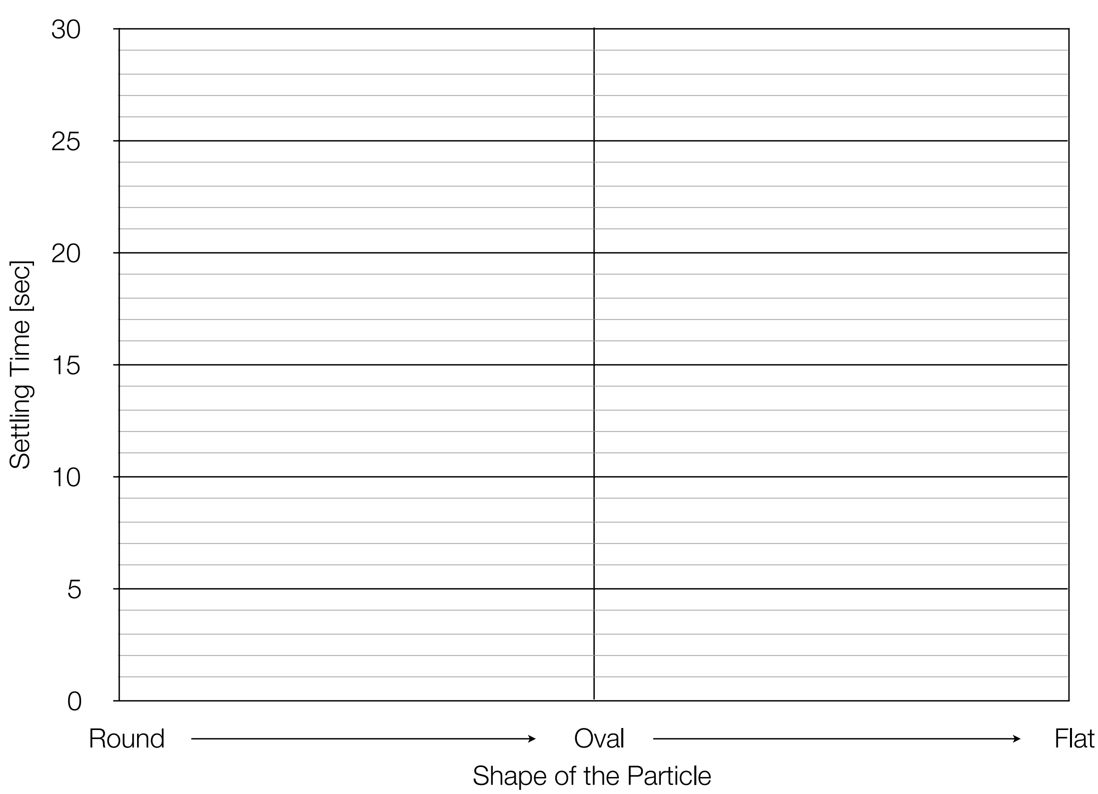
PROCEDURE B:

1. Measure three separate pieces of clay. Each individual one should have a mass of 1.0 g. Take one of the pieces and mold it into a flat disk, another into an oval, and the other into a sphere.
2. Using the different shaped particles created, drop the them separately into the column of water. Start the watch when the particle passes the top line and stop the watch as it passes the bottom line. Record your time on Data Chart B.
3. Calculate the settling rate by dividing the distance between the lines by the settling time.
4. On Graph B, plot your results.

DATA CHART B

PARTICLE & SIZE	Mass [grams]	SETTLING TIME [sec]	SETTLING RATE [cm/sec]
Round	1.0		
Oval	1.0		
Flat	1.0		

GRAPH B



Lab Activity: Deposition

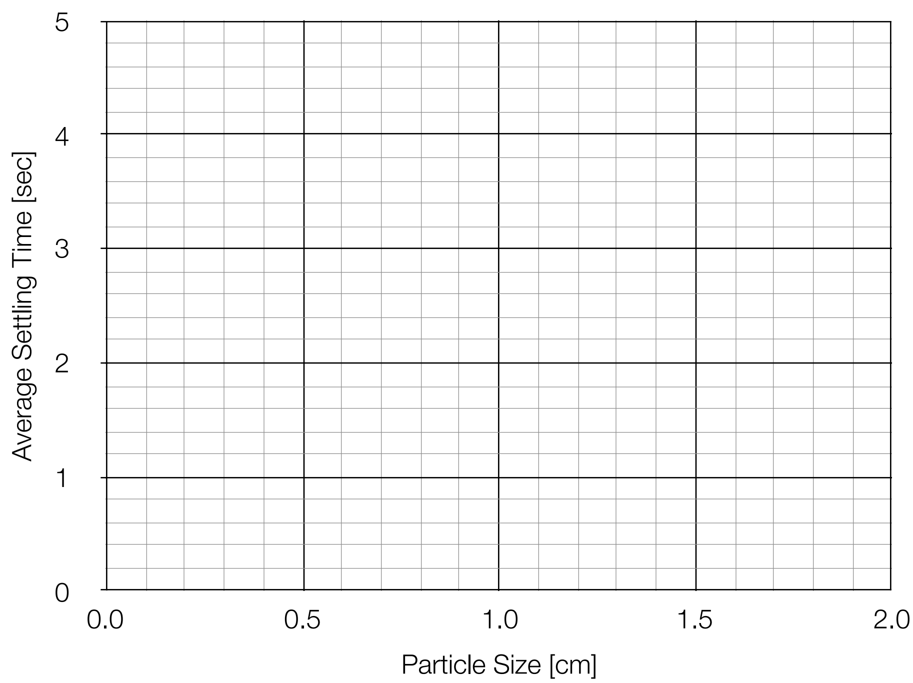
PROCEDURE C:

1. Using clay, create three particles for each trial size - three small particles [0.5 cm], three medium particles [1.0 cm], and three large particles [1.5 cm].
2. Beginning with the smallest particle, drop the three trials individually into the column of water. Start the watch when the particle passes the top line and stop the watch as it passes the bottom line. Record your times for the trials on Data Chart C. Repeat for the medium and large size particles.
3. Calculate the settling rate by dividing the distance between the lines by the average settling time.
4. On Graph C, plot your results.

DATA CHART C

PARTICLE SIZE	SETTLING TIME [sec]				SETTLING RATE [cm/sec]
	Trial 1	Trial 2	Trial 3	Average	Calculation
Small [0.5 cm]					
Medium [1.0 cm]					
Large [1.5 cm]					

GRAPH C



Lab Activity: Deposition

DISCUSSION QUESTIONS:

1. What is the relationship between the density and the settling time of a particle in quite water?

2. What is the relationship between the shape and the settling time of a particle in quite water?

3. What is the relationship between the size and the settling time of a particle in quite water?

4. Using the sedimentation tube, describe the appearance of the particles from bottom to top.

5. Besides the properties of the particle itself, what other factors can affect the settling rate?

CONCLUSION: List the factors which determine the rate at which sediments are deposited.

Name: ____

Date: ________________________ Period: __________

Lab Activity: Stream Flow

INTRODUCTION:

Running water is the most powerful agent shaping our planet. The constant flow of water has worn down mountains into small pieces and carried them off to be deposited elsewhere. The constant flow of water continuously shapes our landscapes and erode our surface.

Water flows downhill due to the pull of gravity. Its velocity and ability to abrade the stream channel is dependent on other factors such as gradient, channel shape, discharge and supply of rock fragment.

OBJECTIVE:

You will determine the relationship between stream velocity, volume, and slope to its ability to transport sediment.

VOCABULARY:

Clinometer -

Discharge -

Meandering Stream -

V-Shape Valley -

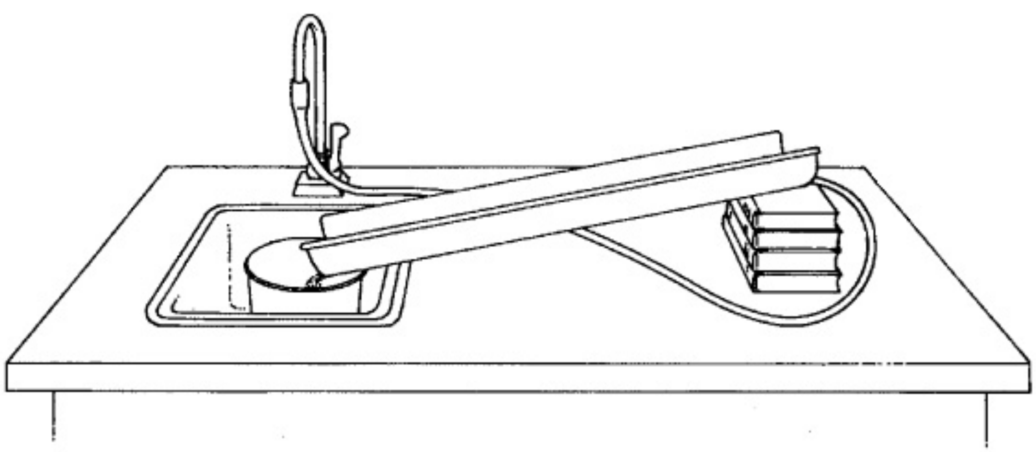
Tributary -

Lab Activity: Streamflow

PROCEDURE:

1. Place a streamflow trough on the lab table so that one end hangs over the sink. Using the clinometer, measure the angle between the through and the table until you have a 5º angle.
2. Measure 10 cm from the end of the through and mark it with a line. Measure 80 cm from that line and draw another line indicating the source.
3. Attach one end of the rubber tube to the faucet and the other to the source of the trough. Slowly turn the water velocity to low.
4. Using a hole punch, time how long it takes to travel the length of the trough.
5. Using a small amount of silt, time how long it takes the majority to travel the length of the trough.
6. Using a small pebble, time how long it takes to travel the length of the trough.
7. Repeat steps 4, 5 , and 6 at low velocity, but increase the angle to 10º.
8. Finally repeat steps 4, 5, and 6 one more time, but increase the angle to 20º.
9. At this point turn the faucet up to increase the water velocity and repeat the entire exercise at the 5º, 10º, and 20º intervals for the hole punch, silt, and sand. Record your data on the data chart.
10. After completing the procedure calculate the velocity for the hole punch and record the answer in the data table. Graph your data on the Velocity vs. Slope Graph.

LAB ACTIVITY SETUP

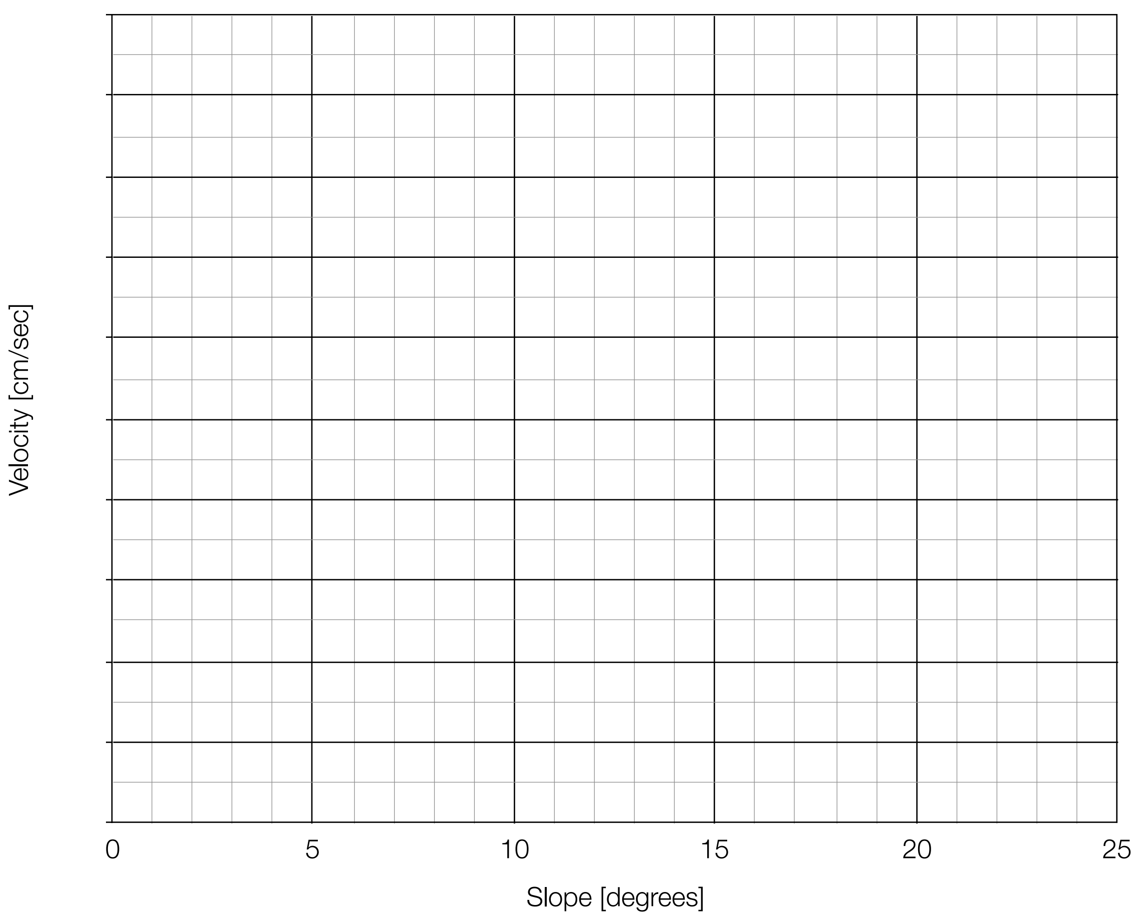


Lab Activity: Streamflow

DATA CHART

SLOPE	FAUCET SETTING	TRAVEL TIME [sec]	VELOCITY [cm/sec]	EROSION TIME [sec]	
				SILT	SAND
5^{o}	LOW				
	HIGH				
10^{o}	LOW				
	HIGH				
20^{o}	LOW				
	HIGH				

VELOCITY VS. SLOPE GRAPH



Lab Activity: Streamflow

DISCUSSION QUESTIONS:

1. How did you increase the discharge in this experiment?

2. At a 5º slope, what happened to the velocity as you increased the flow?

3. As slope increases, what happens to the rate of stream erosion?

4. As volume of flow increases, what happens to the rate of stream erosion?

5. Explain why stream velocity may change from season to season?

CONCLUSION: What effects do slope and discharge of a stream have on its ability to transport sediment?

Name: ____

Date: _________________________ Period: ___________

Lab Activity: Glaciers

INTRODUCTION:

The two major types of glaciers are valley glaciers and continental glaciers. Valley glaciers form at high elevations and move due to the slope of the mountain valley and under their own weight. Continental glaciers are sheets of ice that cover large surface areas and move radially from the zone of accumulation due to their own weight

Glaciers carry large amounts of sediment under, within, or on top of the ice. As a glacier melts, sediments are deposited forming a variety of glacial features. Unsorted deposits are formed from sediments dropped directly by the ice, whereas meltwaters flowing from the base form sorted deposits.

OBJECTIVE:

You will gain understanding of glaciers, glacial movement, and their depositional features.

VOCABULARY:

Glacier -

Glacial Grooves -

Terminal Moraine -

Outwash Plain -

Kettle Lake -

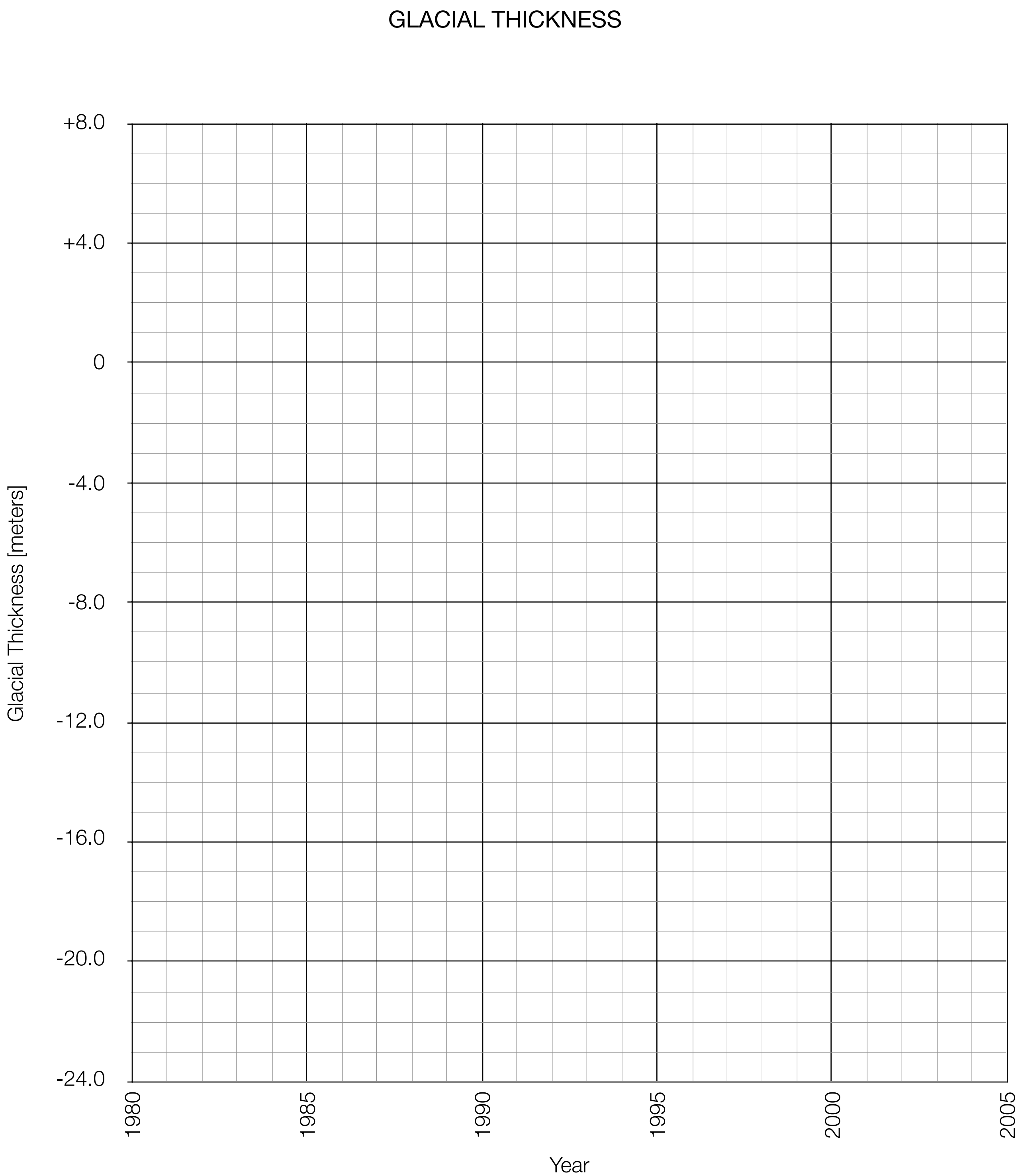
Lab Activity: Glaciers

PROCEDURE:

Using the data table below create a double line graph that will show the changes in glacier thickness, in meters, for both glaciers over the 40 year record from 1980 to 2005. Be sure to make a key for the graph using a different color line for each glacier.

Year	Gulkana Glacier Thickness
1980	-3.5
1981	-3.5
1982	-3.5
1983	-3.5
1984	-3
1985	-3
1986	-3
1987	-3.5
1988	-4
1989	-4
1990	-4.5
1991	-4.5
1992	-4.5
1993	-6.5
1994	-7.5
1995	-8
1996	-8.5
1997	-10
1998	-11
1999	-12.5
2000	-12.5
2001	-13
2002	-13
2003	-13
2004	-16
2005	-17

Year	Wolverine Glacier Thickness
1980	-4.5
1981	-2.5
1982	-3
1983	-2.5
1984	-3
1985	-3
1986	-3
1987	-1.5
1988	0
1989	-1.5
1990	-4.5
1991	-5
1992	-6
1993	-6.5
1994	-6.5
1995	-7
1996	-7.5
1997	-10
1998	-10
1999	-11
2000	-11.5
2001	-12
2002	-11.5
2003	-12
2004	-12
2005	-14.5


GLACIAL THICKNESS
Glacial Thickness [meters]
+8.0
+4.0
0
-4.0
-8.0
-12.0
-16.0
-20.0
-24.0
1980
1985
1990
1995
2000
2005
Year

Lab Activity: Glaciers

DISCUSSION QUESTIONS:

1. Based on the data, what has happened to the glaciers over the 25 year period?

2. Based on the data, what has happened to the rate at which glaciers are melting?

3. What could be an explanation for the data collected on the Gulkana and Wolverine glaciers?

4. Where can continental glacier be found today?

5. Describe the shape of a glacial valley?

CONCLUSION: What are some of the depositional features that are associated with glaciers?

Lab Activity: NYS Landscapes

INTRODUCTION:

Different landscapes result from the interaction of erosional forces and uplift forces upon various bedrock types and the bedrock types differ in their resistance under certain climatic conditions.

New York State has an extremely diverse landscape with varying climatic conditions. The different rock structures and ages have helped shaped the way New York looks today.

OBJECTIVE:

Students will interpret New York State maps to see the influences of rock types and climatic conditions over the landscape. They will also be able to identify the different regions based on the changes in elevation throughout the state.

VOCABULARY:

Landscape -

Mountain -

Plateau -

Plains / Lowlands -

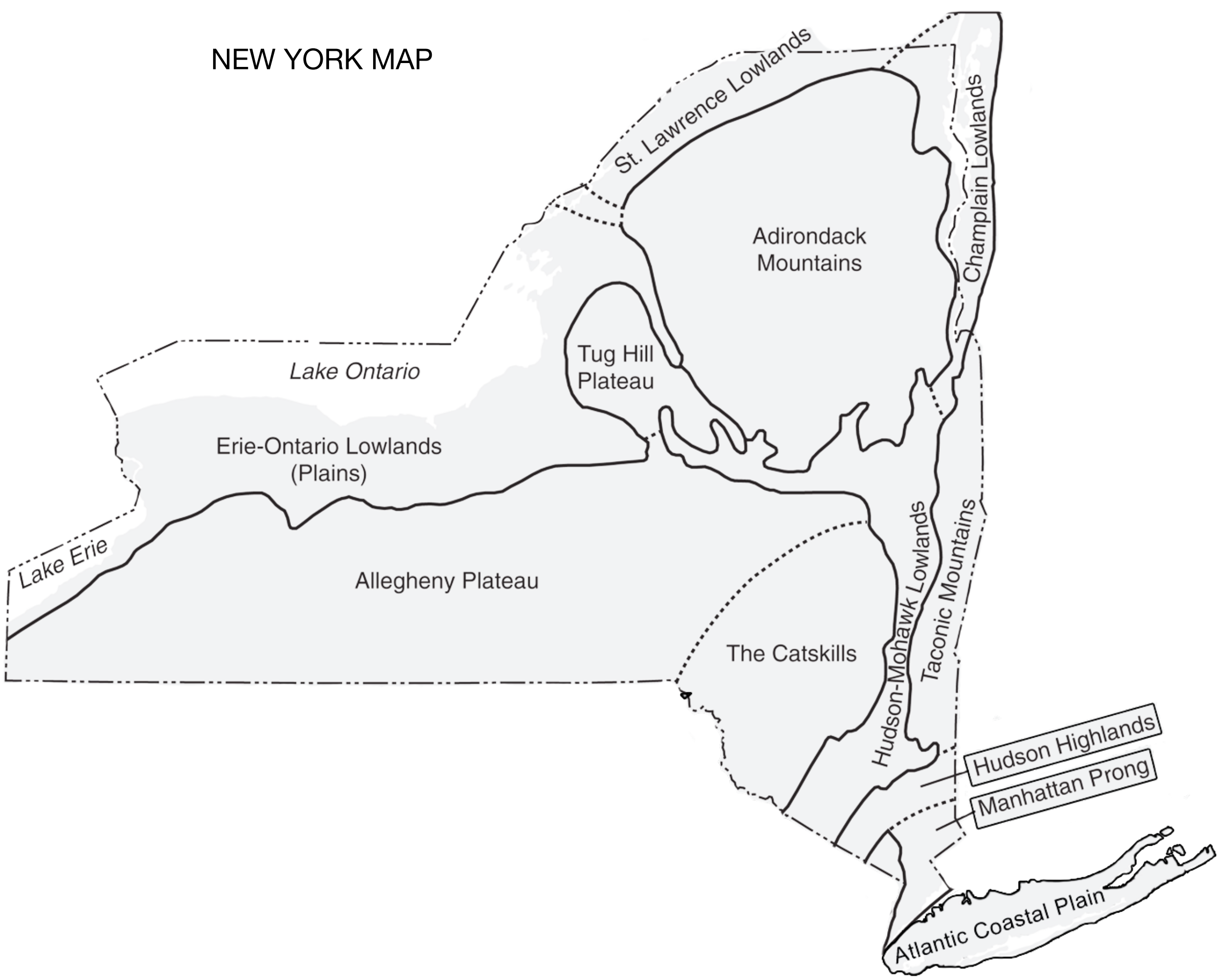
Prong -

Lab Activity: NYS Landscapes

PROCEDURE A:

6. Fill in the chart below with the type of landscape regions associated with the elevations.
7. On the New York Map below, lightly color the high elevation, middle elevation, and low elevation using the following color key:

Elevation	Color	Landscape Type
High	red	
Middle	yellow	
Low	green	



Lab Activity: NYS Landscapes

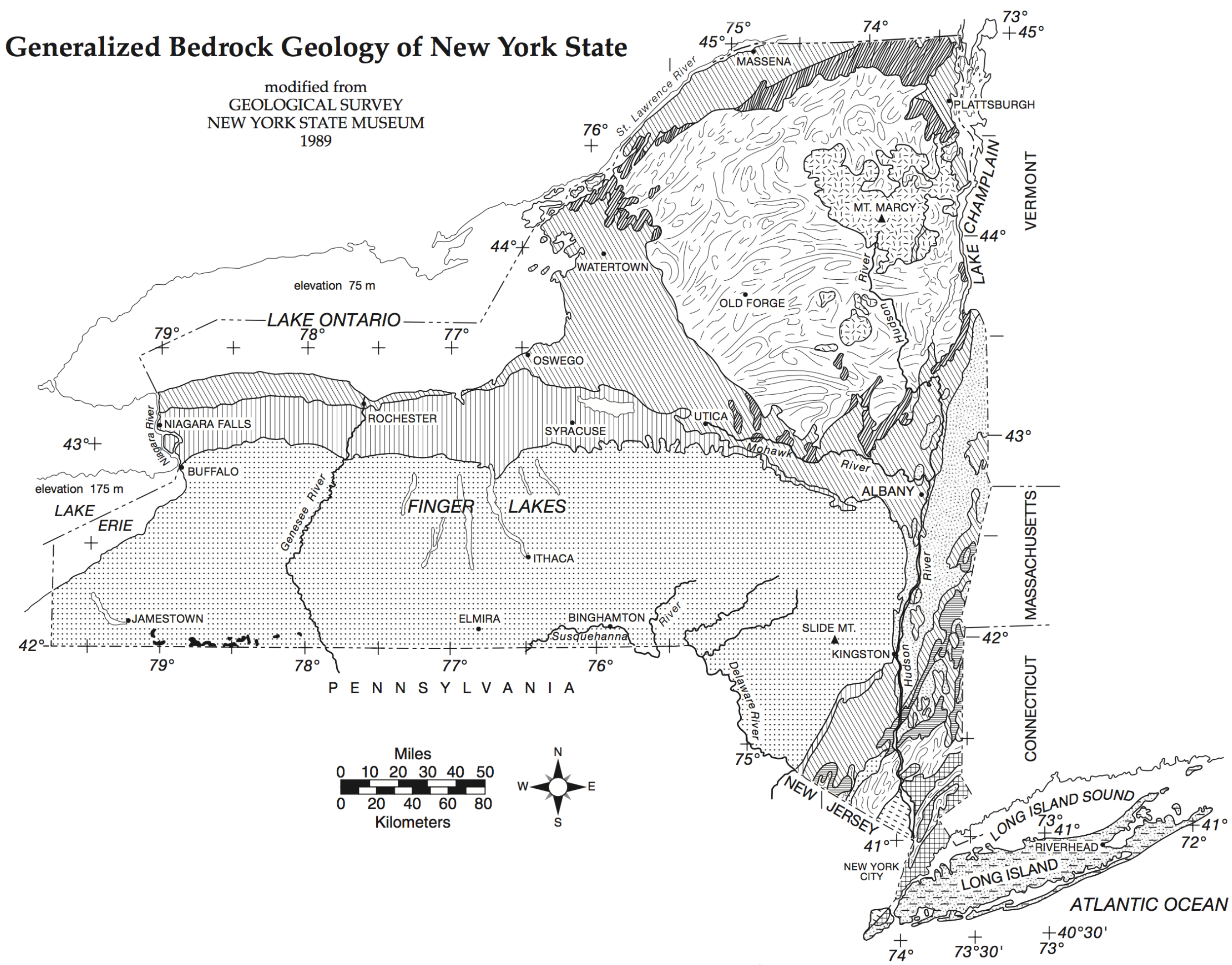
PROCEDURE B:

1. Find and color in blue the following bodies of water listed below:

   - ☐ Lake Champlain
   - ☐ The Finger Lakes
   - ☐ Lake Ontario
   - ☐ Lake Erie
   - ☐ Atlantic Ocean
   - ☐ The Long Island Sound

2. Find and color in blue the following rivers listed below:

   - ☐ Hudson River
   - ☐ Mohawk River
   - ☐ St. Lawrence River
   - ☐ Niagara River
   - ☐ Genesee River
   - ☐ Susquehanna River



Lab Activity: NYS Landscapes

DISCUSSION QUESTIONS:

1. What landscape region does the Hudson River originate?

2. The Genesee River drains into what body of water?

3. The Catskills are part of what New York State landscape region?

4. In which landscape region is the most resistant bedrock found?

5. Which regions show evidence that crustal uplift was dominant over erosional forces?

CONCLUSION: What factors led to the different landscape regions of New York State?

Name: ____________________________________ Earth's History

Date: ______________________ Period: _________ Earth Science

Lab Activity: Relative Dating

INTRODUCTION:

When observing a road-cut the different stratum of rocks becomes obvious. Geologic events such as deposition, erosion, volcanism and faulting are preserved in the rock and it is possible to determine the sequence of events from oldest to most recent. Sequencing events establishes a relative age of a stratum.

The process of showing that rocks or geologic events occurring at different locations are the same age is called correlation. Index fossils and similar rocks types help geologists establish correlations between distance rock outcrops.

OBJECTIVE:

Using cross sections you will infer the logical sequence of geologic events and establish relative age for a series of rock layers for one or many different locations.

VOCABULARY:

Unconformity -

Superposition -

Original Horizontality -

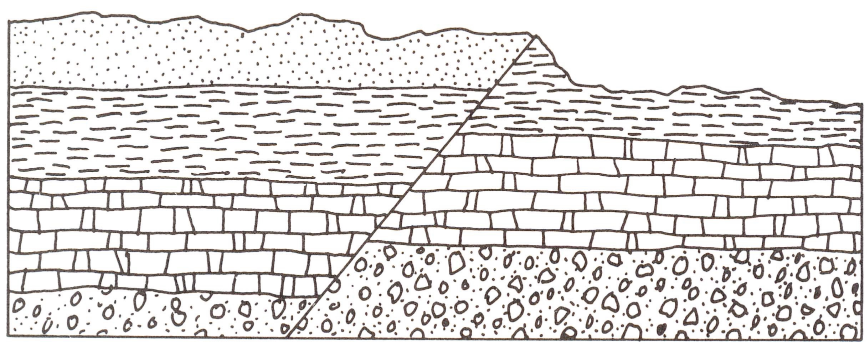
Correlation -

Index Fossil -

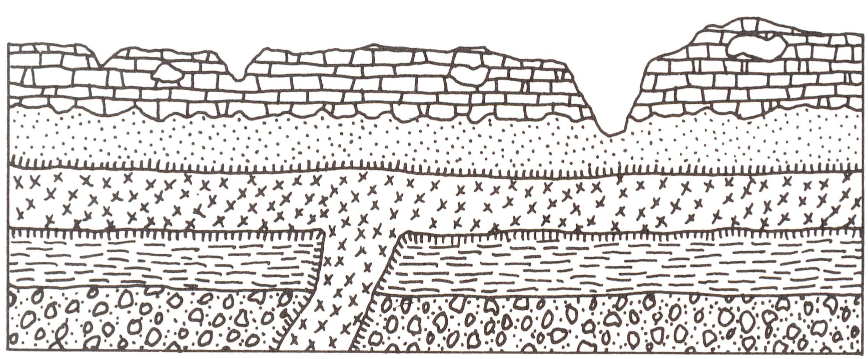
PROCEDURE A:

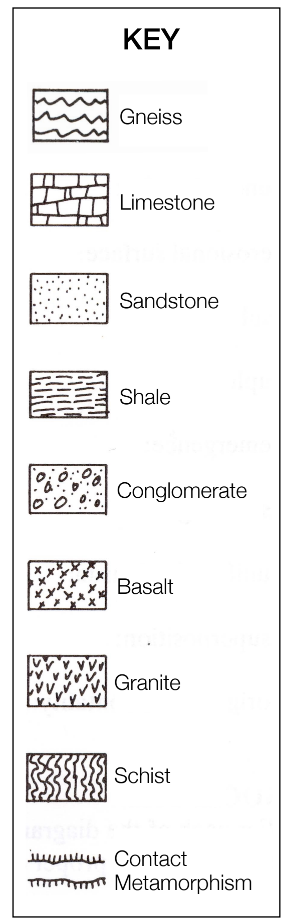
Using Cross Sections 1 and 2, determine the sequence of events and order them from oldest to most recent on the Report Sheet. In addition to determining the relative age of the different strata, you need to determine the relative age of unconformities, cross-cuttings and intrusion.

CROSS SECTION 1



CROSS SECTION 2



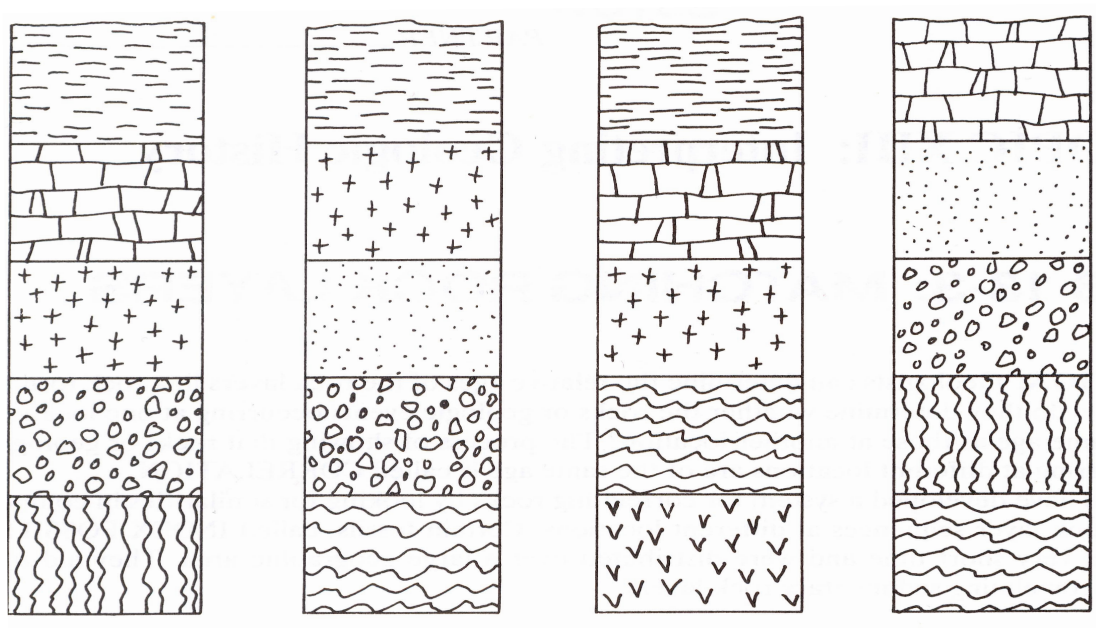


Lab Activity: Relative Dating

PROCEDURE B:

Cross-sections 3 is from four different locations in New York State. Reconstruct the complete sequence of events. Assume that the oldest rocks are on the bottom and the youngest are on the top. Draw in the strata in the column on the Report Sheet. Each rock type is used only once.

CROSS SECTION 3



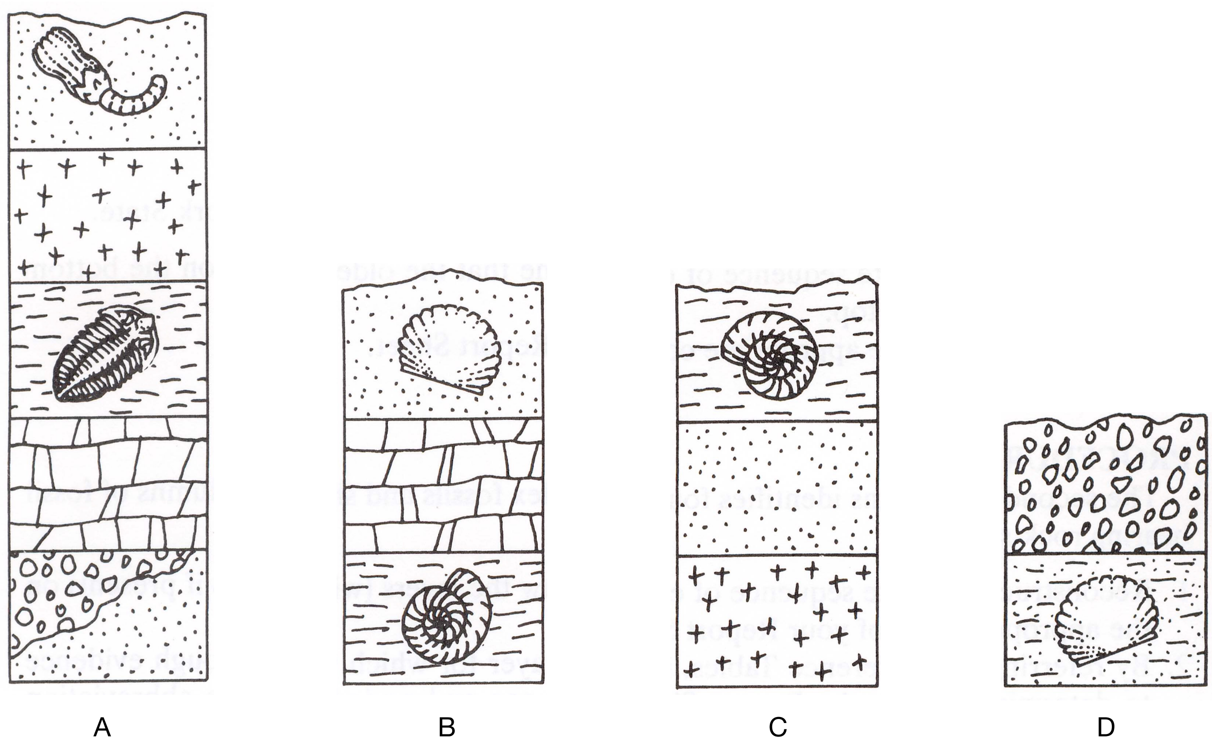
A B C D

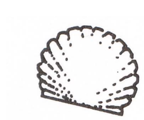
Lab Activity: Relative Dating

PROCEDURE C:

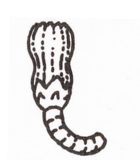
The sketches below are of index fossils from specific geologic time periods. Cross Section 4 is from four different locations in New York State. The Reference Table will help you determine the age of the index fossils. Record the age range of each index fossil in the Results section. Once you determine the oldest fossil it is possible to determine which location has the oldest strata. Reconstruct the complete sequence of events and draw the strata in the column on the Report Sheet. Some rock types may be used more than once.

CROSS SECTION 4





Pecten
[Paleogene Period]



Crinoid
[Mississippian Period]

Ammonite
[Cretaceous Period]

Trilobite
[Devonian Period]

REPORT SHEET

PROCEDURE A
CROSS SECTION 1

[YOUNGEST]
[OLDEST]

PROCEDURE A
CROSS SECTION 2

[YOUNGEST]
[OLDEST]

PROCEDURE B
CROSS SECTION 3

PROCEDURE C
CROSS SECTION 4

Lab Activity: Relative Dating

DISCUSSION QUESTIONS:

1. How is the Law of Superposition used to determine relative age of rock layers?

2. What is a possible explanation for why some rock layers can be missing from some outcrops?

3. Explain how an older rock layer could appear on top of a younger rock layer.

4. Why is the age of a fault younger than the rock in which it is found?

5. List two characteristics of a fossil that would make it a good index fossil.

CONCLUSION: What relative dating methods do we use to date rocks found in cross sections?

Name: ____

Date: ________________________ Period: __________

Lab Activity: Absolute Dating

INTRODUCTION:

Some isotopes spontaneously emit particles or energy to yield a different element or isotope. This is called radioactive decay. This decay occurs naturally and is not affected by temperature, pressure, or chemical change.

Radioactive decay takes place at a random rate. Although you cannot predict just when any given atom will decay, you can predict that the billions of atoms within a small piece of a radioactive element, a given number will decay at a regular and predictable rate.

OBJECTIVE:

To become familiar with the process of radioactive decay, the factors that affects radioactive decay, and the different decay rates of various elements.

VOCABULARY:

Element -

Isotope -

Half-Life -

Stable Product -

Unstable Product -

Lab Activity: Absolute Dating

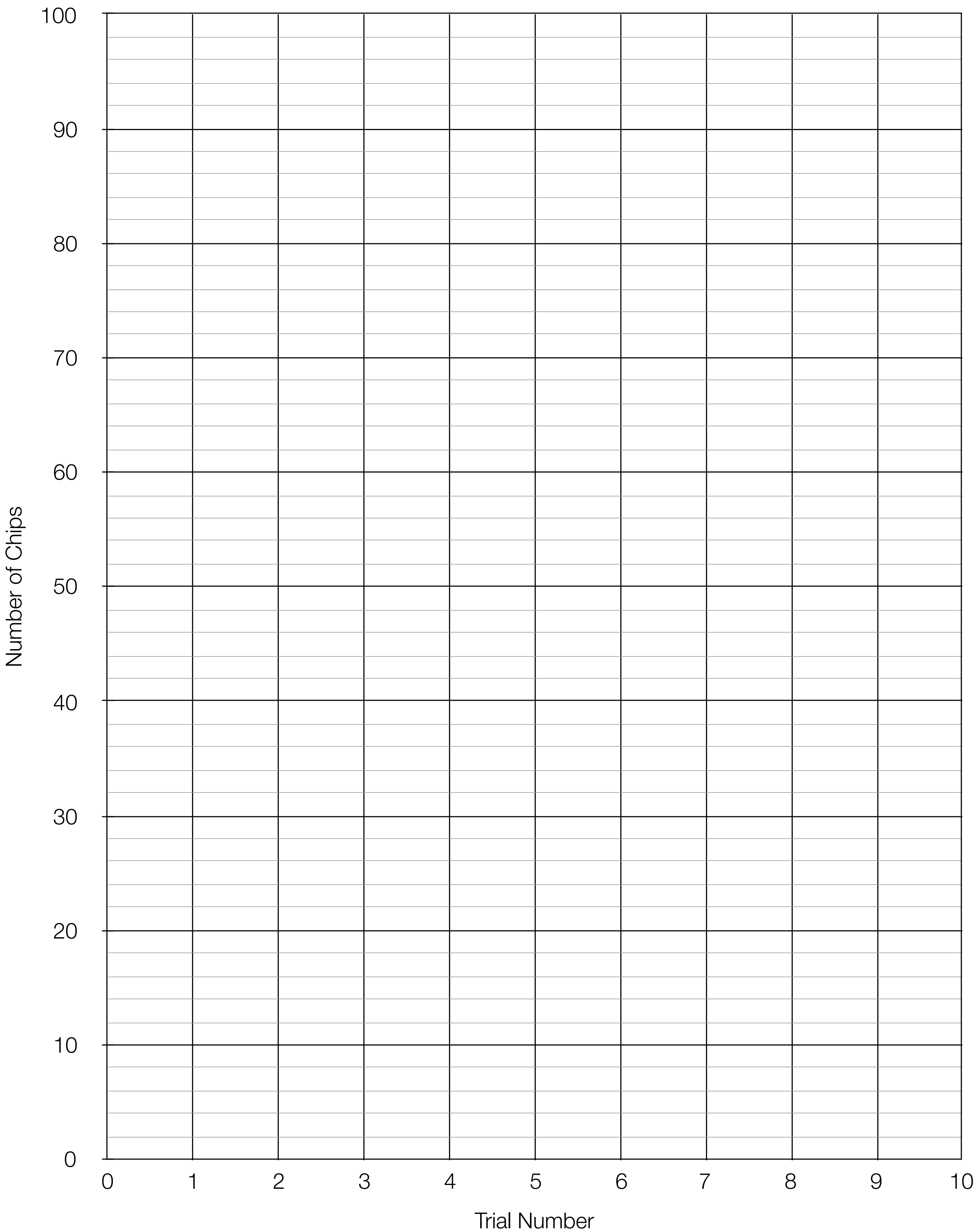
PROCEDURE:

1. Count the chips in your contain and make sure that you are starting with 100.
2. Place the chips inside the container with the lid secured fastened and shake vigorously.
3. Open the container and carefully dump the chips out on a tabletop [don't lose any].
4. Separate the chips into two piles and count the number of "red" and "yellow" chips. Be sure to record the number of each on the Report Sheet.
5. Keep the "yellow" chips on the side and place the "red" chips back in the container.
6. Repeat steps 2 though 5 for ten total trials or until there is only one "red" chip remaining. Be sure to count the total number of yellow chips after each trial.
7. Create a double line graph with two different colors on Radioactive Decay Rate Graph.

REPORT SHEET

Trial Number	Red Chips	Yellow Chips
0	100	0
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

RADIOACTIVE DECAY RATE GRAPH



Lab Activity: Absolute Dating

DISCUSSION QUESTIONS:

1. What did the chips represent in the laboratory activity?

2. What did the trials represent in the laboratory activity?

3. Describe what happened to the amount of “red” chips during the activity?

4. Describe what happened to the amount of “yellow” chips during the activity?

5. If we did this experiment with billions of chips, would it be likely that we would ever get to zero?

CONCLUSION: Explain why a radioactive rock will never become completely stable?

Name: ____

Date: __________________________ Period: ___________

Lab Activity: Geologic Time

INTRODUCTION:

It is difficult to comprehend the age of the Earth and the time that various geologic events occurred in the past. A model drawn to scale is often helpful to visualize accurate time spans between events in history.

Since geologic time of Earth dates back over 4500 million years ago and most life only became abundant 544 million years ago, it is necessary to create a timeline that will be measured in meters.

OBJECTIVE:

To create a scale model of the entire history of the Earth and to compare the length of man's existence to the span of geologic time.

VOCABULARY:

Eon -

Era -

Period -

Epoch -

Extinction -

Lab Activity: Geologic Time

PROCEDURE A:

1. Fill in the Report Sheet 1 using the scale 1 cm = 10 million years
2. Measure and cut 5 meters of cash register tape and secure it to the ground or desk
3. Measure 10 centimeters from one end and label "TODAY"
4. Measure 4.6 meters from the "TODAY" line and label it "FORMATION OF THE EARTH"
5. Using Report Sheet 1, place all the Eras on the timeline. Be sure to lightly shade in each Era according to your color key and label it appropriately.

REPORT SHEET 1

Name of Event	Age of Event	Length on Timeline	Color Key
Beginning of the Precambrian	4600 mya		
End of the Precambrian	544 mya		
Beginning of the Paleozoic	544 mya		
End of the Paleozoic	251 mya		
Beginning of the Mesozoic	251 mya		
End of the Mesozoic	65 mya		
Beginning of the Cenozoic	65 mya		
End of the Cenozoic	0		

PROCEDURE B:

1. Fill in the Report Sheet 2 using the same scale 1 cm = 10 million years
2. Using Report Sheet 2, place all the events on the timeline. Be sure to label each event with the appropriate date and name.

REPORT SHEET 2

Name of Event	Age of Event	Length on Timeline
Oldest known rocks	4100 mya	
Earliest trilobites	540 mya	
Extensive coal forming forests	330 mya	
Extinction of land & marine organisms	251 mya	
Earliest dinosaurs	232 mya	
Earliest birds	147 mya	
Extinction of dinosaurs	65 mya	
First humans	2.4 mya	

Lab Activity: Geologic Time

DISCUSSION QUESTIONS:

1. What percent of the timeline falls in the Precambrian Era?

2. What percent of the Earth's history has man been in existence?

3. What percent of the Earth's history has there been abundant fossils?

4. Compare the age of the Earth to the age of the oldest known rocks found?

5. Using the same scale, how much register tape would you need for the age of the Universe.

CONCLUSION: How does the existence of humans on Earth compare with the length of Earth's history?

GLOSSARY

Abrasion
The act of rock particles scraping or wearing away against other rock.

Absolute Dating
Using radioactive decay to determine the exact age of a rock, fossil, or event.

Agents of Erosion
Forces that are set in motion by gravity that causes sediments to move.

Air Currents
The rising or sinking movement of air perpendicular to the ground.

Air Mass
Characteristics of the air identified by temperature and moisture.

Air Pressure
The force exerted on a unit of area by the air that is exerted equally in every direction.

Altitude
The angular distance measured above the horizon in degrees.

Anemometer
An instrument used to measure the speed of the wind.

Asthenosphere
A partially melted layer that allows for parts of the lithosphere to move.

Asteroid Belt
A region between Mars and Jupiter where most of the asteroids are found orbiting the Sun.

Astronomy
The study of Earth's motions and celestial objects in outer space.

Atmosphere
Layer of gases that surround Earth or any other planet.

Azimuth
Angular distance along the horizon measured from due north.

Banding
Type of foliation where pressure separates minerals into alternating light and dark layers.

Barometer
An instrument used to measure atmospheric pressure.

Big Bang
Leading theory of the origin of the Universe as observed from the expanding Universe.

Bioclastic
Sedimentary rock type that forms from the remains of plants and animals.

Celestial Object
Natural objects that can be seen in the sky that is above Earth's atmosphere.

Cementation
The act or process of holding sediment or pieces of rock together.

Chemical Weathering
The breakdown of rock through a change in mineral or chemical composition.

Circle
A perfect geometric figure with one center point.

Clastic
Sedimentary rock type that forms from the fragments or pieces of other rocks.

Cleavage
The tendency of a mineral to break along zones of weakness and form flat or parallel surfaces.

Climate
Overall view of a regions weather conditions over a long time span.

Climatology
The study of Earth's weather variables and patterns over long periods of time.

Clinometer
An instrument that is used to measure an incline.

Cold Front
A boundary where more dense cold air advances under less dense warm air pushing it up.

Colloid
A small particle that remains suspended indefinitely.

Compaction
The consolidation of sediments resulting from the weight of overlying deposits.

Condensation
The process which atmospheric water vapor turns into precipitation [gas to a liquid].

Contact Metamorphism
Localized metamorphism resulting from the heat of an igneous intrusion.

Continental Drift
The theory that Earth's continents are moving.

Continental Glacier
Huge sheets of ice that cover entire land masses.

Contour Index
Lines that are bolder and have an elevation labeled.

Contour Interval
The difference in elevation between two side by side contour lines.

Contour Line
Lines drawn on a map that connect equal points of elevation.

Convection
Driving force of plate movement.

Convergent Boundary
Boundary where two lithospheric plates are coming together.

Coordinate System
A system which uses one or more numbers to locate a position.

Coriolis Effect
The tendency of particles to be deflected from a straight line.

Correlation
The process of showing that rocks or geologic events from different places are similar in age.

Crescent Moon
Figure of the moon resembling a segment of a ring tapering to points at the ends.

Crystalline
A naturally occurring solid that is formed as and composed of crystals.

Cyclic Change
A repeating pattern that occurs over and over again.

Density
The degree of compactness of a substance which is the ratio of mass to its volume.

Dependent Variable
The variable that is measured and affected in an experiment.

Deposition
The process by which sediments are released from erosion.

Depression Contours
Contour lines marked with hachured lines that signify a depression.

Dewpoint
The temperature at which air must be cooled for water vapor to condense.

Direct Relationship
When the x-axis and y-axis increase.

Divergent Boundary
Boundary where two lithospheric plates are moving apart.

Drumlin
A low oval mound consisting of glacial till.

Earthquake
A natural shaking of the lithosphere caused by a release of energy stored in rocks.

Eccentricity
The degree of flatness or "ovalness" of an ellipse.

Ecology
The study of how living things interact with their environments.

Electromagnetic Energy
Energy that is radiated through space in the forms of transverse waves.

Element
A substances that cannot be separated into simpler substances by chemical means.

Elevation
The vertical distance or height above or below sea level.

Ellipse
Special geometric shape with two center points and is the oval shape of a planet's orbits.

Eon
A longest division of geologic time that is further subdivided.

Epicenter
Location on the surface directly above the focus.

Epoch
A division of time that is a subdivision of a period that is based on fossil records.

Equator
The horizontal main reference line of latitude [0°].

Era
A major division of time that is a subdivision of an eon and is based on fossil records.

Erosion
Process where rock fragments are transported.

Erratics
Transported rock fragments that are carried on top or within a from glacier and deposited.

Esker
A long winding ridge of gravel and sediment deposited by meltwater from a retreating glacier.

Evolution
The gradual development from a simple to a more complex form.

Extinction
The state or process of a species no longer existing.

Extrapolate
To infer or estimate by projecting known information.

Extrusive
A type of igneous rock that forms on the outside of Earth's surface.

Fault
A break in rock layers that is marked by the relative displacement on either side.

Felsic
Light colored rocks that have a high aluminum [Al] content.

Field
A region with a measurable quantity at all locations.

Focal Depth
The depth at which an earthquake originates.

Foci
The two fixed center points of an ellipse.

Focus
The point inside the Earth where the earthquake originates.

Foliation
Type of texture when minerals rearrange in flat layers due to pressure.

Fossil
A remnant or trace of an organism of a past geologic age.

Fracture
A texture that causes minerals to break irregularly or unevenly.

Frost Action
Weathering process caused by cycles of freezing and thawing of water in rock openings.

Full Moon
The phase of the moon in which its whole disk is illuminated.

Galaxy
A collection of billions of stars and various amounts of gas held together by gravity.

Geocentric Universe
The idea that Earth was at the center of the solar system.

Geology
The study of the rocky portion of Earth.

Geographic Poles
Two points on the surface of a rotating planet where the axis of rotation meets the surface.

Glacial Grooves
Parallel scratches from sediment embedded under glaciers.

Glacier
A naturally formed mass of ice and snow that moves downhill under the force of gravity.

Gibbous Moon
Any moon that appears more than half lighted but less than full.

Glossopteris
A tree fossil that is found in South American and Africa, India and Antarctica.

Gradient
A slope that is calculated by dividing the change in field value divided by the distance.

Greenhouse Effect
The trapping of the sun's heat energy in a planet's lower atmosphere.

Half-life
The time required for half of a radioactive product to decay to a stable product.

Hardness
The resistance to a mineral being scratched to other minerals or object.

Heliocentric Model
A model of the solar system where the Sun is at the center.

High Pressure
Fair weather with wind patterns that are outward and clockwise.

Horizon
The edge of the visible portion of the celestial sphere.

Horizontal Sorting
Sorting from a decrease in stream velocity where particles are deposited from largest to smallest.

H-R Diagram
A chart used to classify stars according to their luminosity, mass, color and temperature.

Hurricane
A low pressure tropical storm that reaches winds above 74 mph.

Hydrology
The study of Earth's fresh water system in relation to land.

Hydrosphere
A layer of Earth above the lithosphere that is in the liquid phase.

Igneous Rock
Rock type that forms when molten material solidifies.

Independent Variable
The variable that stands alone and isn't changed by other factors.

Index Fossil
Fossil used to define and identify geologic periods.

Infiltration
The process which water penetrates into soil or rock.

Inner Core
The solid inner most zone of Earth's core composed of iron [Fe] and nickel [Ni].

Insolation
Term to describe incoming solar radiation from the Sun [sunlight].

Intrusion
Magma cools and solidifies before it reaches Earth's surface.

Intrusive
Igneous rock that forms deep inside of Earth.

Inverse Relationship
When the x-axis increases and y-axis decreases

Island Arc
A curved belt of volcanic islands lying above a subduction zone.

Isobar
Lines that are drawn on a map that connect all equal points of air pressure.

Isoline
Lines that are drawn on a map that connect all equal points of data.

Isotherm
Lines that are drawn on a map that connect all equal points of temperature.

Isotope
Variations of an element that have the same atomic number but differing atomic masses.

Isohyet
Lines that are drawn on a map that connect all equal points of rainfall amounts.

Jovian Planet
The outer gaseous planet with larger diameters and lower densities.

Kettle Lake
Depression left in the ground that is filled with glacial melt water.

Landscape
A collection of landforms, such as mountains, hills, plains, and plateaus

Latitude
Measuring lines, north or south, from the equator.

Lava
Molten rock that is outside the Earth.

Leeward
On or toward the side sheltered from the wind or toward which the wind is blowing.

Lightyear
A unit of astronomical distance equivalent to the distance that light travels in one year.

Lithification
The processes and methods in which sedimentary rocks form.

Lithosphere
Layer of Earth that is the rigid outer part of the earth, consisting of the crust and upper mantle.

Long Shore Current
Ocean current that flows parallel and close to the shore.

Longitude
Measuring lines, east or west from the prime meridian.

Lowlands
Landscape that is of lower elevation.

Low Pressure
Stormy weather with wind patterns that are inward and counterclockwise.

Luminosity
A measure on how bright a star is compared to our Sun.

Luster
The shine of an unweathered mineral or the way it looks in reflected light.

Mafic
Dark colored rocks that have a high iron [Fe] or magnesium (Mg) content.

Magma
Molten rock inside the Earth.

Main Sequence
Star classification not the H-R Diagram where most stars spend their stellar lives.

Major Axis
The longest straight lined distance across an ellipse.

Mantle
The thickest layer of Earth that makes up approximately 80% of Earth's volume.

Map
A representation of an area of land or sea showing physical features.

Mass
The amount of matter in an object.

Mass Movement
The pulling of rock and sediment downhill by the force of gravity.

Meander
As a stream gets older it begins the shift its course in a series of bends.

Mesosaurus
A dinosaur fossil found in South American and South Africa.

Mercalli Scale
The effect of an earthquake on the Earth's surface based on observations.

Metamorphic Rocks
Rocks that have been altered by an increases in temperature and pressure.

Meteorology
The study of weather and the atmosphere.

Mid-Ocean Ridge
Underwater mountain range created from a divergent plate boundary.

Mineral
Naturally occurring, inorganic solid with a definite structure where atoms are in a repeating pattern.

MOHO
A thin interface between the lithosphere from the asthenosphere.

Moon
A body that orbits a planet or asteroid as they orbit the Sun.

Mountain
A large natural elevation of the earth's surface.

New Moon
The phase of the moon when it is in conjunction with the sun and invisible from earth.

Nonfoliated
Type of metamorphic rock texture where there is no mineral alignment.

Nuclear Fusion
A reaction in which two atomic nuclei combine to form one atomic nuclei while releasing energy.

Oceanography
The branch of science that deals with the physical and biological properties of the ocean.

Original Horizontality
The idea that rocks are deposited in parallel layers to Earth's surface.

Orographic Effect
The effect of rising air causing it to expand, cool and condense resulting in precipitation.

Outer Core
Liquid layer of Earth's interior.

Outgassing
The outpouring of gases from the earth's interior that collected in the atmosphere.

Outwash Plain
Glacial feature of smaller sediment carried from the melting water of a retreating glacier.

Oxidation
When iron combines with oxygen to create rust.

P-wave
The fastest earthquake wave that travels through the earth [compressional].

Pangaea
Name given to the super continent that existed 200 million years ago meaning "all Earth".

Parent Rock
Preexisting rock from which rocks are formed.

Physical Weathering
The breakdown of rock into smaller pieces without chemical change.

Planet
A celestial body moving in an elliptical orbit around a star.

Plains
Landscape that is of lower elevation.

Plate
Section of the lithosphere that move due to convection currents.

Plate Tectonics
Study of the formation and movements of plates.

Plateau
Landscape that is of medium elevation and have a flat top.

Plutonic Rock
Igneous rocks that solidify slowly below the surface of Earth.

Polar Star
Star directly above the North or South Pole.

Prevailing Winds
Wind from the direction that is predominant at a particular place or season.

Prime Meridian
The main reference line of longitude [0°] that runs through Greenwich, England.

Prong
Landscape that is of lower elevation.

Radiative Balance
Balancing out of incoming and outgoing radiation.

Radioactive Decay
The disintegration of an isotope over time that enables dating.

Rainshadow Effect
Typically the leeward side of a mountain that experience minimal to no rainfall.

Rate of Change
The speed at which a variable changes over a specific period of time.

Recrystallization
The act of a rock crystallizing again.

Regional Metamorphism
Large scale metamorphism resulting from the heat and pressure below Earth's surface..

Relative Dating
The sequencing of rocks or events in relation to the ages of other rocks or events.

Relative Humidity
The amount of water vapor in the air at any given time.

Revolution
The motion of one body around another in an orbit.

Ring of Fire
Isolated belt around the Pacific Ocean where 90% of the world's volcanoes exist.

Rock
A naturally formed solid that is part of Earth or any other celestial object.

Rotation
The movement of an object around a line of axis.

S-wave
The slower earthquake wave that travels through the earth (shear).

Saffir-Simpson Scale
A system for classifying hurricanes based on wind speed.

Sea-floor Spreading
The process where ocean floor is extended when two plates move apart.

Sedimentary Rock
Rock type from an accumulation of sediment from preexisting rocks and/or organic material.

Sediments
Smaller pieces of rock that have undergone weathering.

Seismogram
A record of the seismometer.

Seismograph
An instrument used to measure and record movements in the ground.

Sling Psychrometer
An instrument used to measure dew point and relative humidity.

Solar System
All the objects that orbit the Sun under its gravitational influence.

Soluble
The ability for a substance to be dissolved, especially in water.

Source Region
A location over which an air mass gets its characteristics.

Southwesterly Winds
Prevailing winds between 30° N and 60° N.

Stable Product
A nonradioactive element after decay.

Star
Large ball of gas held together by gravity that produces energy and shines.

Station Model
A symbol on a weather map that illustrates all the weather conditions at that location.

Storm Surge
A dome of water that moves onto shore near the landfall point of the hurricane.

Storm Track
The path that a hurricane takes.

Streak
The color of finely crushed powder when a mineral is dragged across a porcelain plate.

Stream
Running water that is confined to a channel.

Subduction
The process where one plate is pushed below another and consumed in the mantle.

Sunspot
A spot appearing on the Sun's surface, usually darker by contrast than its surroundings.

Superposition
The idea that the bottom layer is the oldest and each overlying layer gets progressively younger.

Suspension
When a particle remains floating.

Temperature
The heat energy present in the atmosphere.

Terminal Moraine
A mound of till deposited along the leading edge of a glacier

Terrestrial Planet
Solid surfaced planet with smaller diameters and higher densities.

Thermometer
An instrument used to measure temperature at a specific location.

Topographic Map
A model of an elevation field of Earth’s surface.

Topographic Profile
A side view of a geologic feature.

Tornado
A rotating column of whirling air with destructively high winds.

Trade Winds
Prevailing winds between 30° N and 0°.

Transform Boundary
Boundary where two lithospheric plates are sliding past one another.

Tributary
A smaller stream that feeds a larger stream or lake.

Tropical Depression
Low pressure that produces sustained circular winds below 39 mph.

Tropical Storm
Low pressure that produces sustained circular winds above 39 mph, but less than hurricane.

U-Shaped Valley
The result of glacial erosion on the sides of valley walls.

Unconformity
A break in the rock record or sequence that usually occurs from erosion.

Uniformitarianism
Idea that forces working on our planet today worked on our planet in the past in the same way.

Universe
All the space, matter, and energy in existence.

Unstable Product
A radioactive element.

V-Shaped Valley
Shape of valley walls from stream erosion.

Valley Glacier
Glaciers that form in high elevations in mountain valleys.

Vesicular
Texture that consists of gas pockets that give the appearance of having holes.

Volcanic Rock
Rock that formed on Earth's surface.

Volcano
A vent in the crust of the earth from which molten material and steam is ejected from

Volume
The amount of space that an object occupies.

Waning Moon
When the moon decreases in size and becomes less brilliant.

Warm Front
A boundary where less dense warm air advances over top of more dense cold air.

Waxing Moon
When the moon increases in size and becomes more brilliant.

Weather
The present condition of the atmosphere with respect to changing weather variables.

Weather Vane
An instrument used to measure wind direction.

Weathering
The breakdown of rock at or near Earth's surface.

Weight
The effect of gravity on weight.

Wind
The horizontal movement of air parallel to the surface.

Windward
The side or direction from which the wind is blowing

Zenith
The highest point on the celestial sphere.

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