ABOUT THIS LABORATORY HANDBOOK

Welcome to Earth Science. You are about to embark on an exciting course of study to help you understand the workings of your home planet. Earth Science is an applied science. That means you will learn about your home using many different science disciplines. There will be physical science, geography, chemistry, and physics.

There are forty investigations in this book related to and intrinsically linked to the Physical Setting Earth Science. Each investigation is just that, a puzzle that must be solved with information from your knowledge of Earth Science.

Each investigation is followed by ten questions. Each question is more in depth than the previous one. All questions are to be answered in complete sentences. Single word answers do not fully explain your understanding of the material.

Terms to know for the Handbook:

Essential Question: What is this investigation about? Why are we conducting the experiment? An example of the essential question is "Why is the sky blue?"

Hypothesis: *Hypo* means less than and *Thesis* is a statement that must be proved. Therefore, a hypothesis is not quite a full theory. The hypothesis attempts to answer the essential question. An excellent format is the "If…then…because".

> *"If the various qualities of the minerals are tested <u>then</u> the minerals can be identified <u>because</u> minerals have very specific qualities."*

Variables: There are two types of variables which are tested. The *independent variable* is the variable that is being manipulated. The *dependent variable* is the variable that changes as the result of the change in the independent variable. If you were conducting an experiment in the Living Environment on plant growth, the *amount* of water would be the *independent variable* because you control it. The plant *growth* would be the *dependent variable*. Time is a quality of the independent variable.

Free Response Questions: The free response questions are based on the results of your investigation as well as the pre-lab readings. Some questions call on your knowledge of Earth Science and your ability to read the Earth Science Reference Table.

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Physical Setting Earth Science Laboratory Investigation Handbook

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19 Landscapes

A landscape is a region on Earth's surface. The shape and makeup of the landscape is formed by the climate, local bedrock, and human activities. The relief of landscapes is described as mountains, plateaus and plains. In New York State, the landscape is not only determined by geology and climate but has also been deeply affected by the glaciers. When we look at the landscape regions of New York State, we must look to see the underlying geology. Mountainous regions have metamorphosed bedrock in New York State. What appear to be mountains may not, in fact, be mountains and areas that appear to be small foothills are the remains of once tall mountains. To truly determine the landscape region, we must look underneath the surface.

Objective:

The objective of this lab is to apply information on landscapes of New York State and to understand the topography of the state.

Essential Question:

_____

_____

Hypothesis:

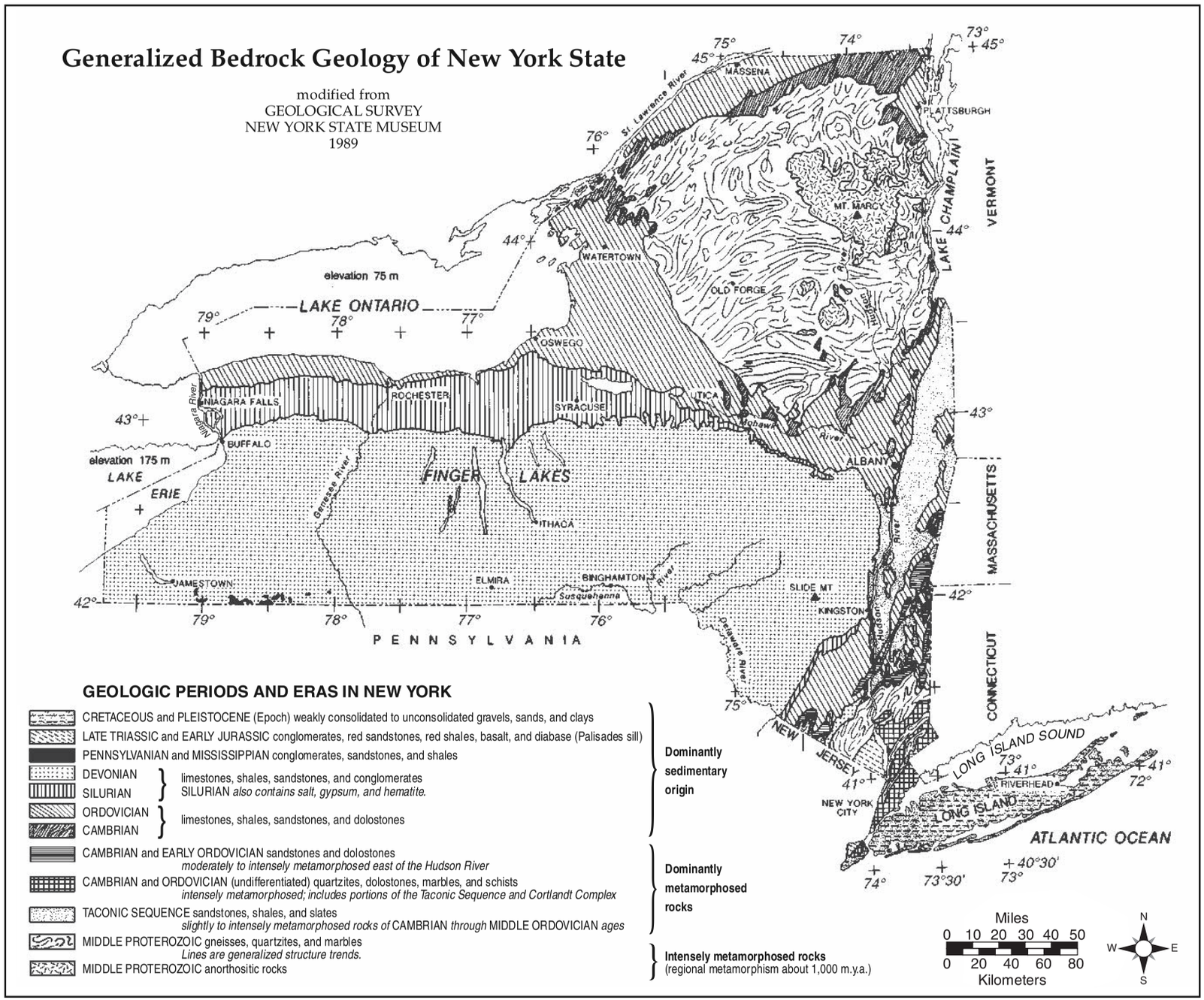
_____

_____

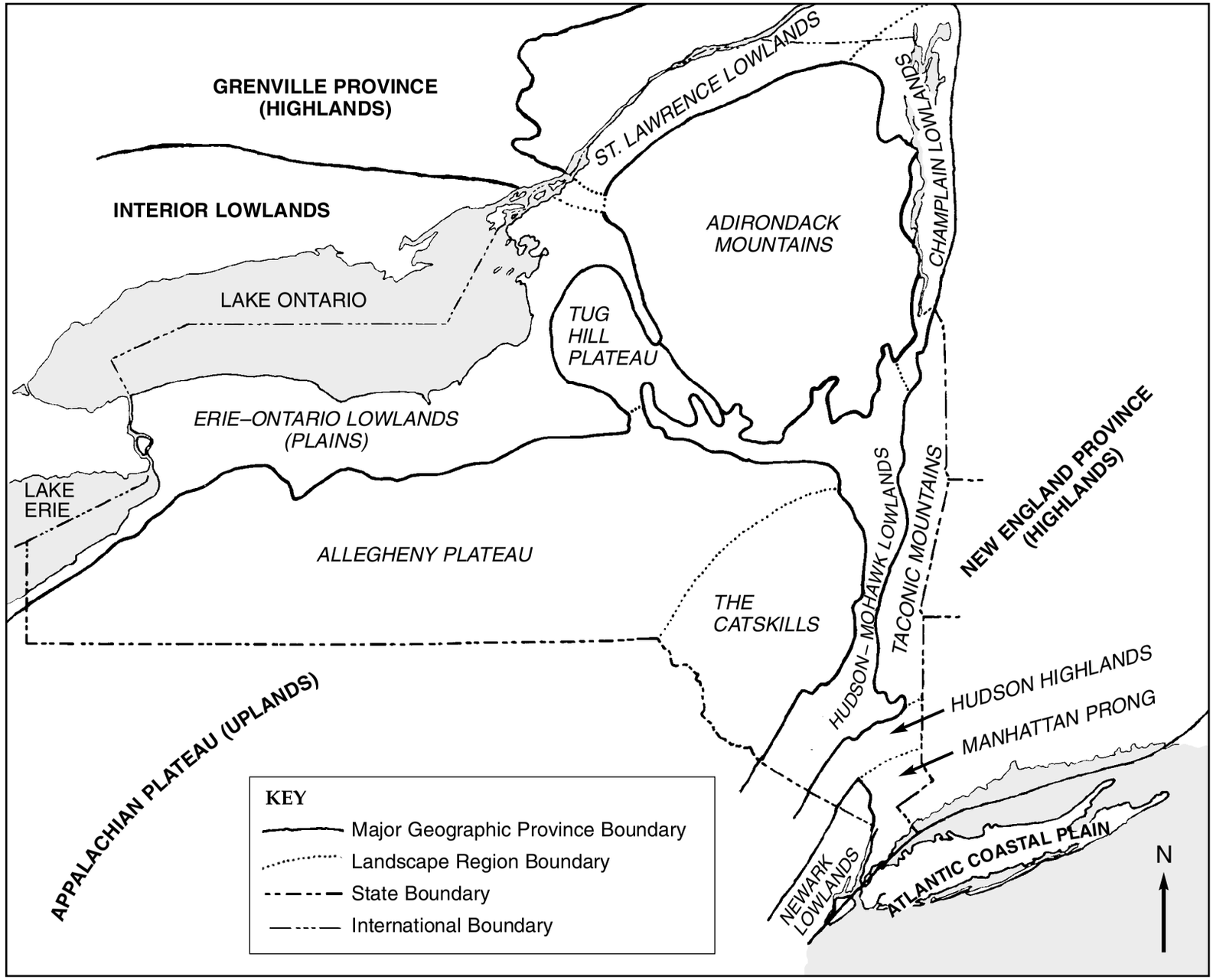
Materials: • Colored pencils

Procedure:

1. In the following inquiry, compare the bedrock of various areas of New York State.
2. Compare the landscape regions based on the underlying bedrock.
3. On the Landscape Regions map on page 91, color the mountain regions red, the plateau regions green and the plains regions blue.



Generalized Landscape Regions of New York State



Observations:

1. Describe the type of bedrock in a mountainous region.

_____

_____

_____

2. Describe the stream valleys associated with mountains.

_____

_____

_____

3. Describe the type of bedrock in a plateau region.

_____

_____

_____

4. Describe the stream valleys associated with plateaus.

_____

_____

_____

5. Describe the type of bedrock in a plains region.

_____

_____

_____

6. Describe the stream valleys associated with plains.

_____

_____

_____

7. What geologic features would one find in a mountain in New York State?

8. Explain why the term Catskill Mountains is misleading.

9. Is New York a mountainous state? Explain your answer.

10. Describe the landscape region where you live. Explain and defend your statement citing your local bedrock.

NAME _____

33 A Tale of Two Lighthouses

The coastal areas of oceans have features that are created by wave action. The beaches are accumulations of sediment deposited by this wave action.

Long Island is the largest island in the contiguous United States. It lies in southeastern New York State. It is also a very young island. It was formed during glacial period as terminal moraines. Long Island was created in two depositional events. What is now Long Island Sound was a flooded valley when sea levels rose after the melting of the last ice age.

The island is still undergoing changes today. Recall from deposition and erosion, that when depositional forces and erosional forces occur at roughly equal rates, it is called dynamic equilibrium. This means that no one force is greater than the other and so the landform is more or less unchanged. In this investigation we will look at two concerns on the Island. The Montauk Lighthouse and Fire Island Lighthouse were both built over one-hundred years ago. Today, their relation to the ocean is much different then when they were first built.

Objective:

The objective of this investigation is to gain an understanding of coastal processes.

Essential Question:

_____

_____

Hypothesis:

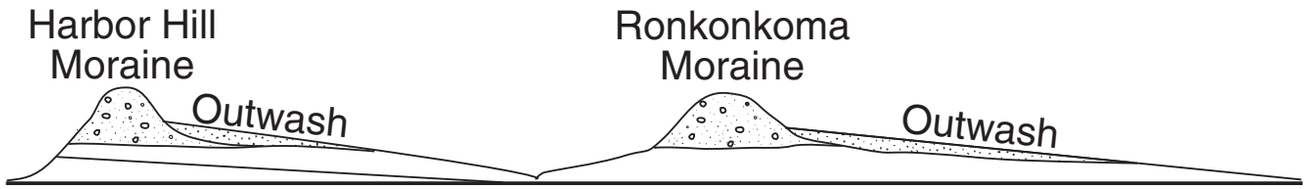
_____

_____

Materials: • Coastline Chart • Pencil

Pre-lab:

First, let's look at the formation of the coastline. This diagram depicts the Atlantic Coastal Plain.



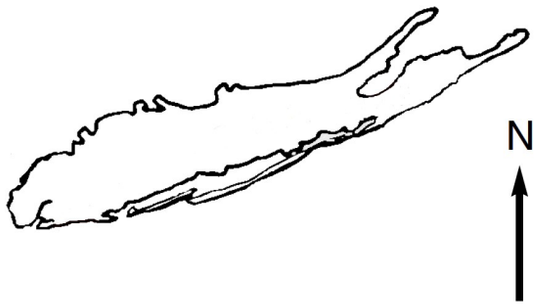
a. Referring to your Earth Science Reference Table on page 205, what type of bedrock would you expect to see in this area? _____

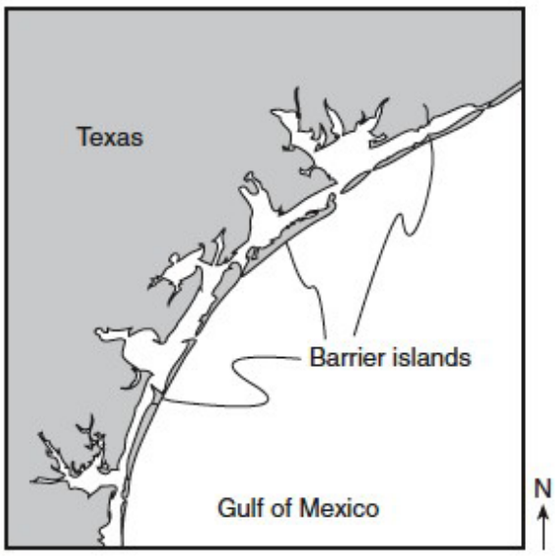
b. Looking at the area labeled Harbor Hill Moraine, what do think the material in the moraine is made from? _____

c. In the outwash plain, what would you expect the particle size to be?

_____

d. In the image below of Long Island, there appears to be two areas of deposition that created this island. Looking at the east end, label the Harbor Hill and the Ronkonkoma Moraine.





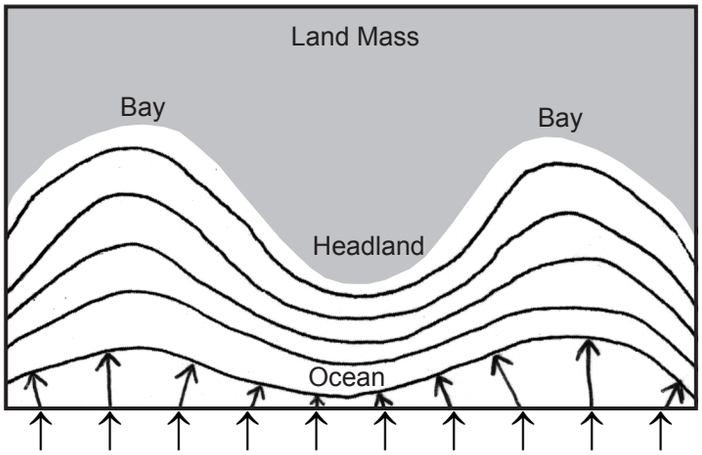
Barrier islands are islands that form along coastal regions where there is a lot of sand and a passive continental margin. Padre Island is the longest in the United States, over 112 miles long. As seen to the left, barrier islands are long narrow islands that create a protected water area behind them.

New York's Fire Island is also a barrier island and part of the subject of this investigation. The process of erosion and deposition is called littoral drift. In south facing beaches, littoral drift shifts the sand to the west.

Wave Action

Waves are the driving force of the erosional – depositional action of the shoreline. Waves are energy that passes through the ocean. Like other waves, these waves can be refracted and reflected. As waves driven by wind approach the shore, the wave energy touches bottom, creating a frictional force. The refraction of the waves at the shoreline focuses wave energy.

In the picture below, locate the arrows along the bottom of the picture. Above each arrow, draw another arrow up to the next waveform. The arrow must be perpendicular to the waveform. The first row arrows have been done for you. The arrows will reveal a pattern in the waveform. Observe the pattern it creates and answer the questions below.



a. Where is the energy focused?

_____

b. What do you think is happening at the point(s) of energy focus?

_____

_____

c. Where did the waves refract from?

_____

d. What do you think is happening at the point(s) of refraction?

_____

_____

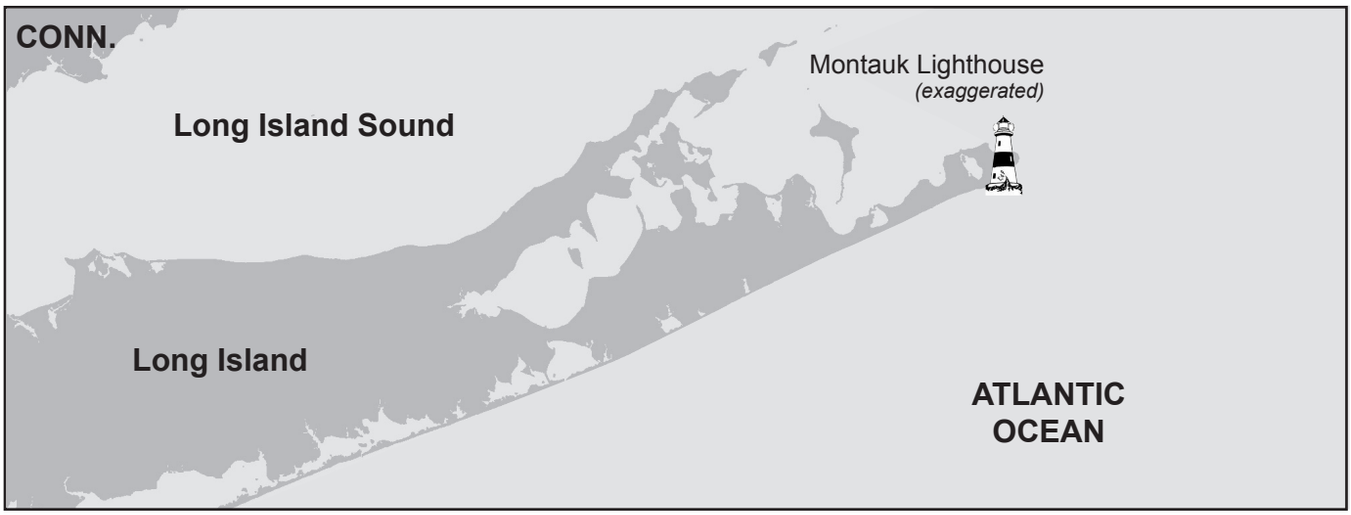
e. What will eventually happen to the shoreline?

_____

_____

Erosion

President George Washington commissioned the Montauk Lighthouse to be built in 1796, The builders knew that Montauk Point was prone to erosion. The original lighthouse was built 300 ft from the sea. 200 years later, the lighthouse stands only 100 feet from the ocean. The lighthouse is in the far eastern end of this point of land. That's 200 feet of erosion in two hundred years. Look at the image below.



a. Storms are more severe in the winter. Winter storms are called nor'easters. They are in the Atlantic Ocean. Where are the winds of the winter storms blowing from?

_____

_____

b. Using your knowledge about points of focus, draw an arrow on the image above that most likely would be the point of focus on this land mass.

c. Explain why Montauk is having a problem with erosion.

_____

_____

d. What would happen if the winter waves were to approach from the southwest?

_____

_____

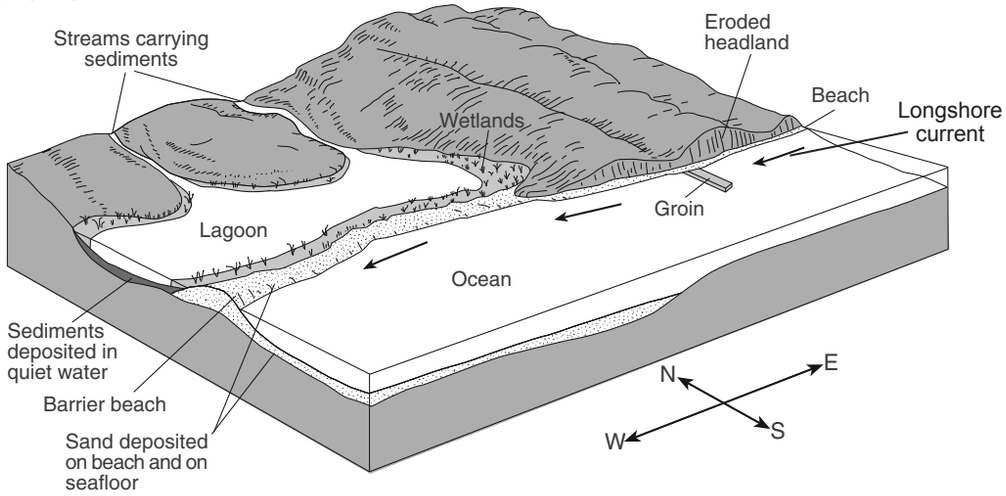
e. Give an example of what can be done to slow the erosion.

_____

_____

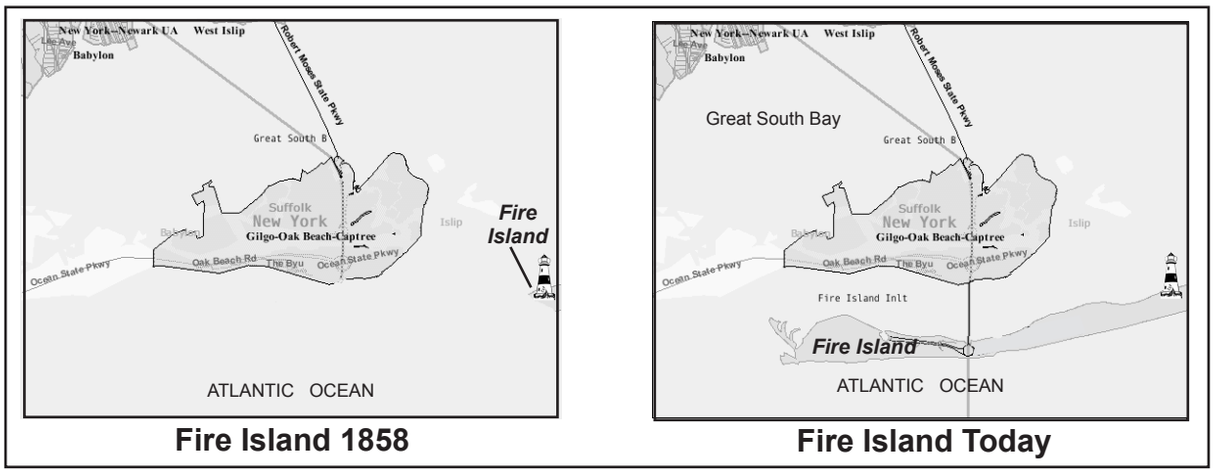
Deposition

Waves approach the beach at the angle the wind is blowing them. Sea breezes bring the waves' upwash onto the shore following the waves' momentum. The backwash to the sea is straight back. This ongoing movement is called swash. As waves approach at an angle, the swash is in a zigzag pattern. This moves sediment. The movement that takes place in a motion that moves parallel to the shore is called longshore current. The movement of sediment is called littoral drift.



Look at Fire Island. Fire Island is a barrier island to the south of Long Island. It protects the estuary of the Great South Bay. The lighthouse was built in 1858 next to the Fire Island Inlet at the western most section of Fire Island. Today, it is located 6 miles away from the Fire Island Inlet.

When strong winter winds blow from the east, they often take beach with them but in this case, they leave behind winter sand; a reddish purple sand that gets deposited during winter storms. It is made of garnets, magnetite and some quartz. In the summer, quartzite and dolomite materials are left behind.



a. How fast is the island "moving"?

_____

_____

b. Why is the island “moving”?

_____

_____

c. How do we know that the island has changed shape?

_____

_____

d. What would happen if the winter waves were to approach from the southwest?

_____

_____

e. Give an example of what can be done to slow the deposition.

_____

_____

Observations:

1. When ocean waves approach the beach what causes them to refract?

_____

_____

_____

2. What will receive more wave energy, a headland or a bay?

_____

_____

3. Why will this area receive more energy?

_____

_____

4. If depositional forces were equal with erosional forces, what would we call that?

_____

5. Why is Montauk Lighthouse in danger of falling into the ocean?

_____

_____

6. Which force is more prevalent in Montauk, erosion or deposition? Why?

_____

_____

_____

_____

7. Where does the winter sand at Fire Island come from?

_____

_____

8. If unchecked, what will happen to Fire Island Inlet?

_____

_____

_____

_____

_____

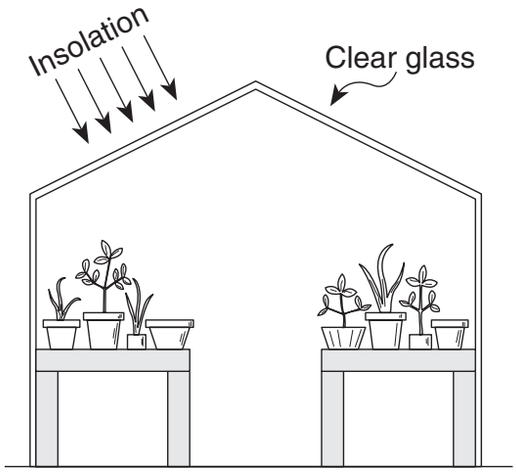
9. Looking at the bedrock of Long Island and the Atlantic Coastal Plain, explain the role of erosional and depositional forces that created and are shaping the island.

10. Describe what changes may happen to this region of New York State.

NAME _____

35 Electromagnetic Spectrum

Light is a form of energy visible to the human eye that is radiated by moving charged particles. Scientists have learned through experimentation that light behaves like a particle at some times and like a wave at other times. The particle features are called photons. When light refracts, or bends slightly as it passes around a corner, it shows wavelike behavior. The waves associated with light are called electromagnetic waves. They consist of changing electric and magnetic fields. Light has many qualities, including energy and wavelength that cannot be seen by human eyes.



Greenhouse

Objective:

The objective of this lab is to gain an understanding of the properties of the electromagnetic spectrum.

Essential Question:

_____

_____

Hypothesis:

_____

_____

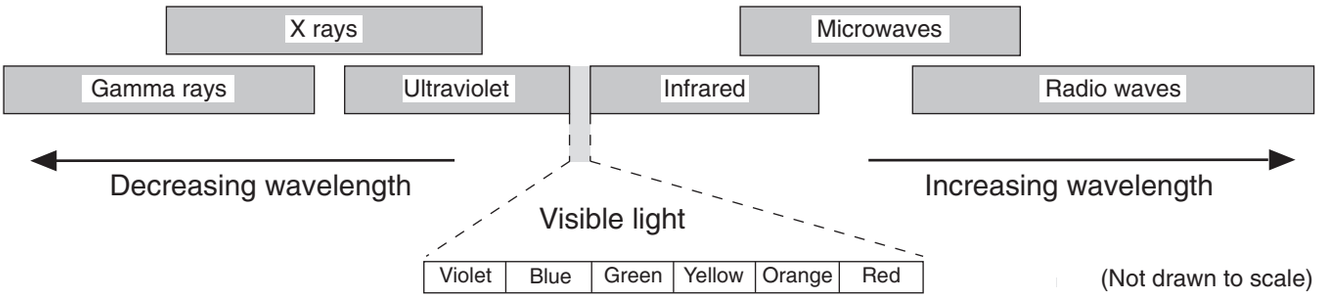
Materials:
- Spectroscope
- UV Security Ink
- Shadow Box
- Laser Pointer
- Hair Spray
- Electromagnetic Spectrum on back cover
- "Ultraviolet Black" Light
- Index Cards
- Infrared Imaging Device (Check with local Fire Department)
- Mirror
- Slinky

Procedure:

Follow the directions listed for each station. With your lab group, go to each station and perform the activity as outlined. You do not need to go in order, but complete all stations.

Under no circumstances are you to look directly into any light source!

Electromagnetic Spectrum



High energy ← → Low Energy

Shorter wavelength ← → Longer wavelength

Station One: Using the spectroscope, observe different light sources. Using your colored pencils, color in the space provided the colors you observed.

	Colors observed (indicate if you cannot see all colors)
1. Sunlight	
2. Fluorescent light	
3. Incandescent light	

Observe:

Compare and contrast the three light sources that you observed.

Infer:

Based on your knowledge of the electromagnetic spectrum, what is the cause of these differences, if any?

_____

_____

_____

Station Two: Place the index card, given by your teacher, under the Ultraviolet light in the light box. Read it.

Observe:

What do you see with UV that you can't see with visible light?

_____

_____

_____

Infer:

Based on your knowledge of the electromagnetic spectrum, what is the cause of these differences, if any?

_____

_____

_____

Station Three: Infrared imaging. Your teacher will assist with this station.

A student walks in stocking feet on the floor. Find footsteps. What do you see?

_____

_____

Look at a student wearing glasses and/or braces. What do you see?

_____

_____

_____

Station Four: Use the back page of this lab book and place a slinky at the edge of the Visible Light Spectrum. Grasp both ends of the slinky so that a small portion of the slinky is on the ruled edge. With your left hand aligned to the beginning of the centimeter ruler, have the coils of the slinky spread so that each coil is 1 cm apart.

With your right hand on 10 cm mark.

1. Pull your right hand to the 25 cm mark.
   a. Did your right hand go toward or away from your left hand? _____
   b. Record any changes in the wavelength.

   _____
   c. What portion of the visible spectrum did the color shift to?

   _____

Put your right hand back to the 10 cm mark.

2. Push your right hand to the 5 cm mark.
   a. Did your right hand go toward or away from your left hand? _____
   b. Record any changes in the wavelength.

   _____
   c. What portion of the visible spectrum did the color shift to?

   _____

Station Five: Reflection

Aim laser pointer at a mirror. Spray hairspray about 15 cm above, not at the mirror, parallel to table. Move the laser pointer at different angles to mirror. Observe results.

_____

_____

Infer:

We know that in every energy transaction, energy is lost in the form of heat. Does reflected light have the same energy as insolation?

_____

_____

_____

Station Six: Research

Use the internet to answer the following questions. Some suggested sites are listed below.
http://science.nasa.gov/headlines/y2004/07jul_bluemoon.htm?list793613
http://www.gi.alaska.edu/ScienceForum/ASF8/861.html
http://www.sciencemadesimple.com/sky_blue.html

1. What is the particle size of material in the atmosphere that scatters red and yellow light?

_____

2. What is the wavelength range that is not scattered by these particles?

_____

3. If we know that the longer wavelengths of the visible spectrum pass readily though the atmosphere, what are the colors that get scattered in the atmosphere?

_____

_____

4. What is the scattering called?

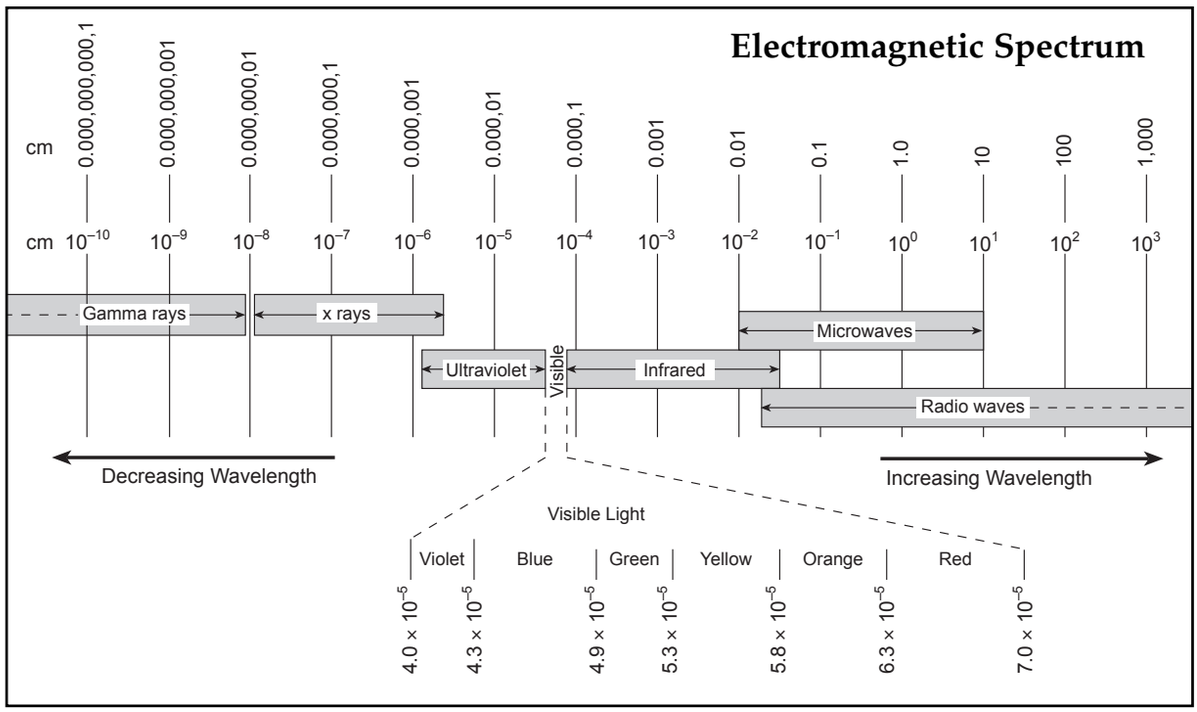
_____

5. Why is the sky blue?

_____

_____

Directions: Use the Electromagnetic Spectrum Chart below to answer questions 1-3.



Observations:

1. What is the wavelength range of X-rays?

   _____

2. What is the approximate range of wavelengths of visible light?

   _____

3. Which has a longer wavelength, ultraviolet rays or infrared rays?

   _____

4. What is the fundamental difference in the properties of the various light groups on the Electromagnetic Spectrum?

   _____

   _____

   _____

5. Referring to station four, question 1, what do you think happens to the light emitted when astronomers see stars moving away from them?

_____

_____

_____

6. Referring to station four, question 2, what do you think happens to the light emitted when astronomers see stars moving toward from them?

_____

_____

_____

7. Referring to station five, inference question, what happens to the incoming solar radiation "white light" as it is reflected off the planet?

_____

_____

_____

8. What does infrared imaging record? How do you think firefighters could use this information?

_____

_____

_____

9. Explain how this shows how objects radiate electromagnetic energy?

_____

_____

_____

_____

10. Assuming your lab partner was absent today, write a brief note to your partner to summarize new information you learned today about the properties of the electromagnetic spectrum.

NAME _____

36 Where is Our Sun?

Ancient people believed that the Sun and all of the celestial objects revolved around the Earth. This is known as the geocentric model. Ancient people closely watched the movement of the Sun. These people built simple devices called sundials, to tell time. The sundial works on the notion that the sun moves at regular speed across the sky. A gnomon is the shadow cast by the sun on a sundial. Knowing the angle of the Sun and your longitude, one can easily determine the local time. Local time is when people determine noon to be when the Sun appears to be at its highest point in the sky. When people need to determine true north, people need to know the difference between where the compass is pointing and the North Pole. This difference is called magnetic declination.

Objective:

The objective of this lab is to determine the angle of the Sun and the local time.

Essential Question:

_____

_____

Hypothesis:

_____

_____

Variables:

Independent:_____

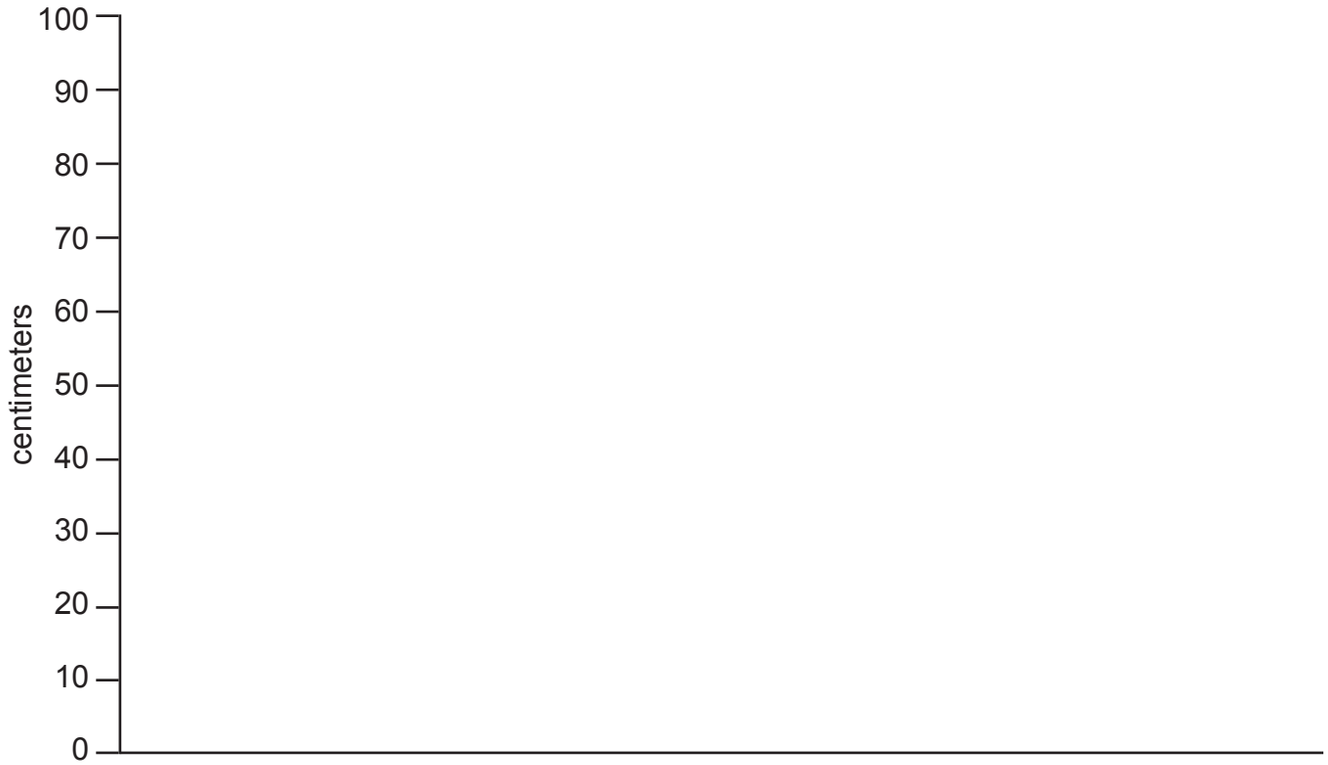
Dependent:_____

Materials:

- Two Meter Sticks
- USGS Quadrangle
- Compass (directional)
- Protractor

Procedure:

1. Find the Magnetic declination on the USGS Quadrangle.
2. Go to an area of direct sunlight (outside)
3. Find a level place of ground.
4. Have one partner hold one end of the meter stick loosely until it touches the ground. This will allow the stick to be perpendicular to the ground.
5. Finding the shadow it casts, place the second meter stick on the ground, along its gnomon. Be sure to place the lower numbers of the meter stick at the vertical meter stick.
6. Place the compass on the ground, next to the meter stick. Make sure your angle is less than 90°. Adjust the dial so that while the compass is still on the ground, the arrow aligns with the needle. This is the arc of the shadow.
7. Measure the gnomon. (Read the line where the shadow falls. Zero is facing the vertical meter stick.)
8. Draw your shadows (scale 1:10) in the space below. We know that the vertical line of the right triangle is 1 meter and the gnomon is the horizontal length.



TIME CHART

Magnetic Declination	Arc of Shadow and magnetic declination	Rotation / hour	What time is it?
	÷		

Remember, there are 60 minutes in an hour, adjust your decimal from division accordingly. If it is morning, subtract hours and minutes from noon. If it is afternoon, add hours and minutes to noon.

Observations:

1. Define magnetic declination.

   _____

   _____

2. What is the local magnetic declination?

   _____

3. Define gnomon.

   _____

   _____

4. What is the length of the gnomon? _____cm.

5. What is the angle of the Sun? _____°

6. How many degrees does the sun appear to travel in an hour? _____°

7. What is the difference between magnetic north and the angle of the gnomon? (The directional compass will show you.)

   _____

   _____

   _____

   _____

8. What is the local time? _____

9. Why is the local time so different than standard time?

_____

_____

_____

_____

_____

_____

10. If we know the time in Greenwich, England, and we know our local time, what else can we find out?

_____

_____

_____

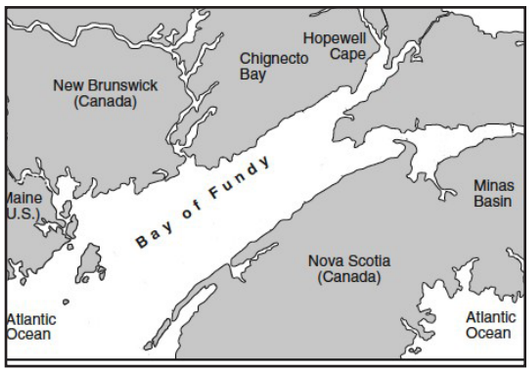
_____

_____

_____

NAME _____

38 Tides and Time



There is an old saying, "Tides and time wait for no man." It means that tides are constant and predictable and most importantly, unstoppable. Tides are the daily changes in the surface level of the Earth's oceans. Each quarter rotation of the Earth causes a major change in tides. Many of us have experienced setting our towel on the sandy beach only to find out later that our things are getting soaked. Different areas of the planet experience tides differently. Some areas have almost no tidal changes and in other areas the tides are dramatic. The Bay of Fundy in Canada has the highest tidal range on Earth.

Tides are caused by the pull of the Moon's gravity. Each day, there are two high tides and two low tides. Because the Moon is closer to the earth than the sun is, the Moon has a stronger gravitational pull on the Earth. During the full Moon and new Moon phases, spring tides occur. Spring tides are simply highest high tides and lowest low tides. During the first- and last-quarter phases of the Moon. Neap tides are where there is not a great tidal range.

Objective:

The objective of this lab is to plot a tide at the Battery in New York Harbor to determine if a pattern exists in tides.

Essential Question:

_____

_____

Hypothesis:

_____

_____

Variables:

Independent:_____

Dependent:_____

Materials: • Tide Chart • Tidal Ranges, New York Harbor

Procedure:

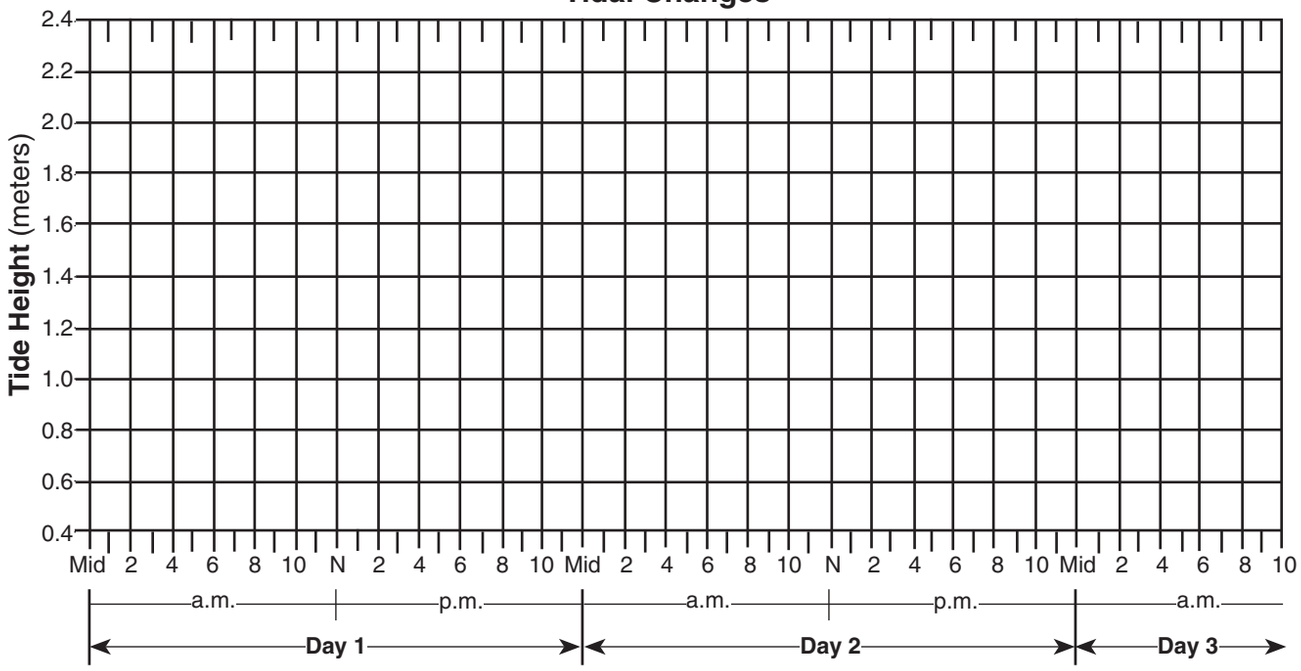
1. Find the tidal predictions in the tidal chart below.
2. Plot the dates on the horizontal axis on the next page.
3. Plot the water level on the vertical axis.
4. Review Lunar Orbit and Phases investigation.

The following is a tidal chart, recorded hourly at the area of New York Harbor known as the Battery, the southern tip of Manhattan Island. It is named the Battery for the artillery battery that protected the early settlement of New York.

Date	Hours	Water Level (meters)
April 10	**00:00:00 am**	**1.4**
April 10	01:00:00 am	1.2
April 10	02:00:00 am	1.0
April 10	03:00:00 am	0.8
April 10	04:00:00 am	0.6
April 10	05:00:00 am	0.5
April 10	06:00:00 am	1.0
April 10	07:00:00 am	1.3
April 10	08:00:00 am	1.7
April 10	09:00:00 am	1.9
April 10	10:00:00 am	2.0
April 10	11:00:00 am	1.7
April 10	12:00:00 pm	1.4
April 10	01:00:00 pm	1.0
April 10	02:00:00 pm	0.7
April 10	03:00:00 pm	0.4
April 10	04:00:00 pm	0.5
April 10	05:00:00 pm	0.6
April 10	06:00:00 pm	0.9
April 10	07:00:00 pm	1.4
April 10	08:00:00 pm	1.8
April 10	09:00:00 pm	2.0
April 10	10:00:00 pm	2.2
April 10	11:00:00 pm	1.9
April 11	**00:00:00 am**	**1.6**
April 11	01:00:00 am	1.2
April 11	02:00:00 am	0.8
April 11	03:00:00 am	0.7
April 11	04:00:00 am	0.5
April 11	05:00:00 am	0.5

Date	Hours	Water Level (meters)
April 11	06:00:00 am	0.7
April 11	07:00:00 am	1.1
April 11	08:00:00 am	1.5
April 11	09:00:00 am	1.7
April 11	10:00:00 am	1.8
April 11	11:00:00 am	1.8
April 11	12:00:00 pm	1.6
April 11	01:00:00 pm	1.2
April 11	02:00:00 pm	0.9
April 11	03:00:00 pm	0.6
April 11	04:00:00 pm	0.4
April 11	05:00:00 pm	0.5
April 11	06:00:00 pm	0.7
April 11	07:00:00 pm	1.2
April 11	08:00:00 pm	1.6
April 11	09:00:00 pm	1.9
April 11	10:00:00 pm	2.1
April 11	11:00:00 pm	2.0
April 12	**00:00:00 am**	**1.8**
April 12	01:00:00 am	1.5
April 12	02:00:00 am	1.1
April 12	03:00:00 am	0.8
April 12	04:00:00 am	0.5
April 12	05:00:00 am	0.4
April 12	06:00:00 am	0.5
April 12	07:00:00 am	0.8
April 12	08:00:00 am	1.2
April 12	09:00:00 am	1.5
April 12	10:00:00 am	1.7

Tidal Changes



Observations:

Key
Mid – Midnight N – Noon

1. Is this graph indicative of a random, direct, inverse or cyclic pattern?

_____

_____

2. Approximately, how much time elapses between high tides?

_____

_____

3. Is one high tide higher than another in a twenty-four hour period? Why?

_____

_____

4. If a complete cycle is from high tide to high tide, how many complete cycles are on your graph?

_____

_____

5. What is the time of the first low tide on your graph?

6. What is the average tidal range on your chart?

7. Is the tidal range increasing or decreasing?

8. What causes tides?

9. Why are there two tidal cycles in a twenty-four hour period?

10. Assuming the chart reflects the maximum range, what can you infer about the lunar cycle in this graph?