Lesson 9 – Which Way to the Sea?

Name:_____ **Date:** _____

Part 1
Where does the water go?

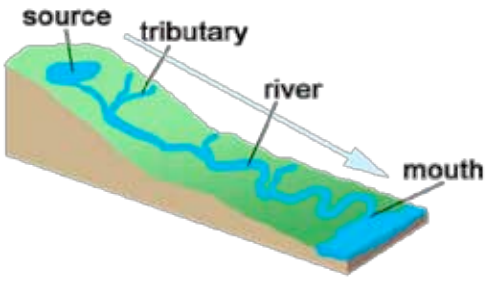
Objectives

- ü To explain the concept of a watershed.
- ü To learn to read and use a topographic map.
- ü To understand how all land is connected to the ocean.
- ü To conduct a scientific investigation of a local body of water.

What's a Watershed?

Whether someone lives 3 miles or 3000 miles from the ocean, all of us are connected to the ocean by the local environment. It is also true that the things that happen in a local area have an effect on the ocean.

The land area that surrounds a body of water is called a **watershed**. Precipitation that falls within a watershed drains to the river, lake, or other body of water in that watershed. The decisions that one makes while living in a watershed affect the cleanliness of the water and the health of the watershed. Those decisions also affect the health of the ocean because *all watersheds eventually drain to the ocean.*



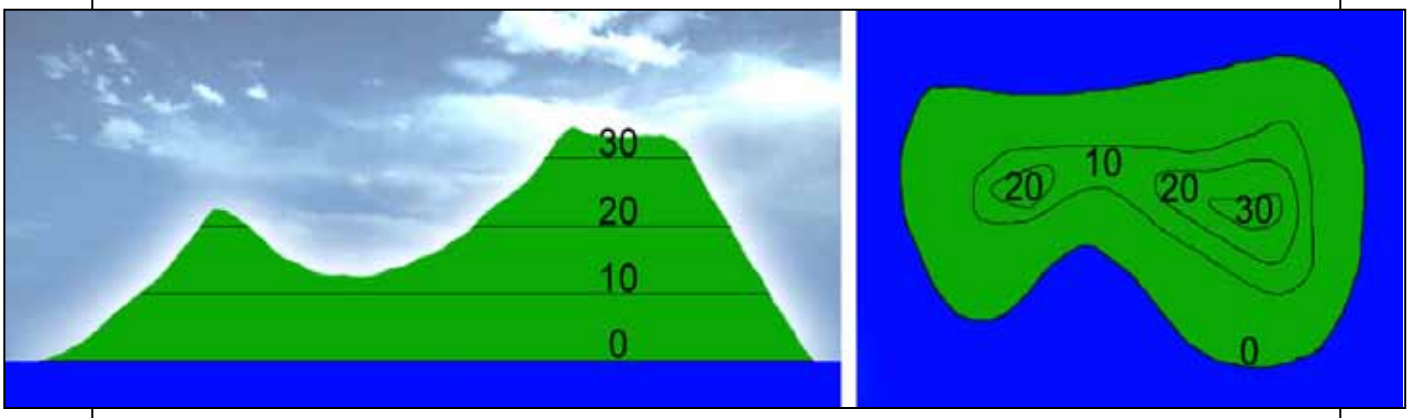
Source: NASA/Landsat and Google, Inc.

Since Earth is covered by one big ocean, that means that all of us are connected to the marine animals that will be studied through the local watershed.

Part 2

Reading Topographic Maps

Topographic maps show the surface, or topography, of the land. There are lines drawn on a map to connect points that are the same elevation or height above sea level. These lines are called **contour lines.** For example, the contour lines on the map below indicate the height above sea level. On this map, the difference in height between two lines that are next to each other is 10 meters.

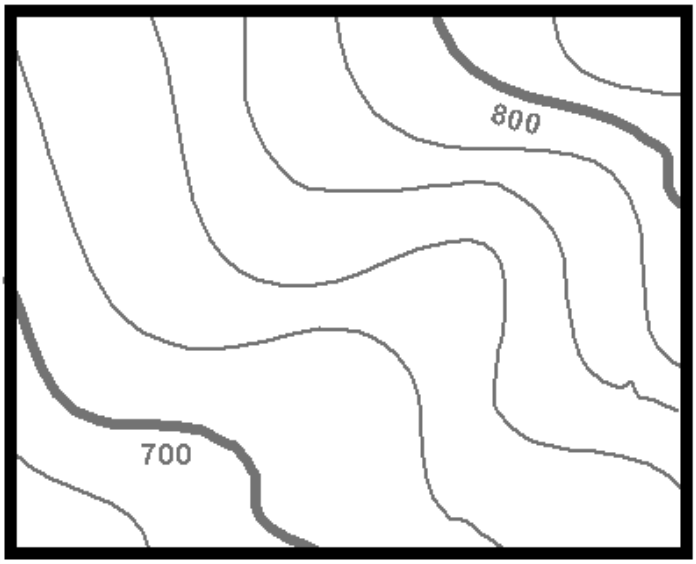


Not all maps use contour lines every 10 meters. You can figure out the difference in elevation between the lines by using the information given. For example, the map below gives the elevations for 800 meters above sea level and 700 meters above sea level. To know the elevation of point A, pretend that you must climb from 700 meters to 800 meters. You would have to cross 5 lines to do that.

Follow these steps to calculate the value of each contour line:

1. Find the difference between the given elevations.
   800-700=100 meters

2. Divide the difference by the number of lines separating the given values.
   100/5=20 meters



In this example, each contour line represents 20 meters above sea level.

Using contour lines, maps show all kinds of land forms including mountains, valleys, rivers, streams, and oceans.

Obtain a topographic map of your area from one of the websites found on the Signals of Spring – ACES website or use the one provided by the teacher.

1. Identify two contour lines that are labeled with meters above sea level.

   a. Using that information, figure out the change in elevation for each contour line. Is it 10 meters, 20 meters, 30 meters, or another value?

_____

2. Now that the change from one contour line to the next is known, identify three different landmarks and their elevations.

_____

_____

_____

Now you are ready to identify a watershed.

_____

3. Using a colored pencil, shade the body of water for the study. If it is a stream, simply darken the line on the map. If it is a pond or lake, shade the area.

4. Start on one side of the river, lake, etc.. Find the highest elevations on the map that surround the body of water. Place an "X" at each high point.

5. When the body of water is completely surrounded with "X's" connect them with a solid line. The line represents the highest elevations surrounding the body of water. The land area between the line and the body of water is called a watershed.

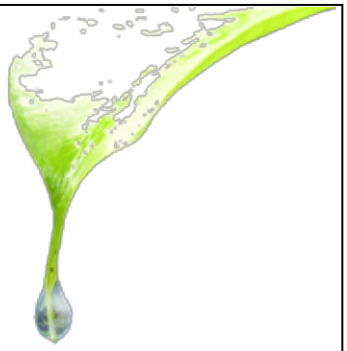
   a. What will happen to rainwater that falls between the line and the body of water that is being studied?

   b. What will happen to rainwater that falls outside that area?

Part 3

Lab activity: Local water sampling

Why sample the water?



Scientists sample water bodies to study the health of the environment. Scientists use biological, physical, and chemical tests. The observations tell scientists if the environment will support living organisms or if there is something causing the environment to be unhealthy.

When studying biological conditions, scientists collect and identify organisms in the water. Different organisms need different conditions to survive. For example, if there are many organisms that need very clean water in a certain area, scientists know that the water is clean.

Physical conditions include: 1) the size and depth of the stream, lake, bay, etc 2) the velocity of the water, 3) the condition of the surrounding land, and, 4) other factors that impact water quality.

Lastly, chemical tests help scientists identify the presence of minerals, nutrients, and oxygen in the water. If levels of these things get too high or too low, some organisms may be unable to survive.

Water Quality parameter	Why is the parameter important to living things in the water?	
	What do you already know?	What else did you learn?
Nitrogen		
Phosphorus		
Turbidity		
Temperature		
pH		
Dissolved oxygen		

Read the following information about the different tests and then add to the last column of the chart.

The following was modified from the EPA website: *http://www.epa.gov/owow/monitoring/volunteer/stream/*

What is nitrogen and why is it important?

Nitrogen is found in several different forms on land and in bodies of water. Plants and other organisms need nitrogen to survive. However, too much nitrogen can cause serious problems, especially in water. Too much nitrogen can cause something called eutrophication, out of control algae growth. Algae are another name for producers that live in water, most of which are phytoplankton. When there is eutrophication, there is out of control growth, a bloom, and then all of the algae die at once. When the algae die, decomposers begin breaking them down into basic compounds. The decomposers use up the oxygen supply very quickly. Other organisms like fish cannot live in the water without oxygen. Therefore, too much nitrogen and eutrophication can cause organisms in the water to die from lack of oxygen.

According to the Environmental Protection Agency (EPA), the natural level of nitrogen in surface water is typically less than 1 milligram per liter (mg/L). Levels above 1 mg/L can cause eutrophication. Possible sources of nitrogen include wastewater treatment plants, runoff water from fertilized lawns and croplands, leaking septic and waste systems, runoff from animal manure storage areas, and runoff from industrial areas.

What is phosphorus and why is it important?

Both phosphorus and nitrogen are necessary nutrients for the plants and animals in the water. Phosphorus usually exists in small amounts. Therefore, even a small increase in phosphorus can, under the right conditions, set off a whole chain of undesirable events in a stream, pond or bay. Negative events include algae blooms, low oxygen, and the death of certain fish, invertebrates, and other aquatic animals.

There are many sources of phosphorus, both natural and human. These sources include soil and rocks, wastewater treatment plants, runoff from fertilized lawns and croplands, failing septic or waste systems, runoff from animal manure storage areas, disturbed land areas, drained wetlands, water treatment, and commercial cleaning products, including some detergents.

Phosphorus is measured in milligram per liter (mg/L).

What is turbidity and why is it important?

Turbidity is a measure of how clear the water is. It is measured by how much the 'suspended material' in water stops light from shining through it. Suspended materials include sediment (like sand, silt, and soil), algae including phytoplankton and other tiny organisms and substances that float in the water. Turbidity affects the color of the water. When a stream has a high turbidity level it can look like flowing chocolate milk.

High turbidity means that less light can enter the water. That means that there is not as much photosynthesis going on. Some organisms cannot live in very turbid water. The suspended materials in the water can clog fish gills and when the materials fall to the bottom they can smother eggs and bottom dwelling creatures.

Sources of turbidity include soil erosion, waste discharge, runoff from cities and roads, eroding stream banks, and the overgrowth of algae.

Turbidity is measured using a disk or tube that allows a scientist to view the amount of light reaching beneath the surface of the water.

What is temperature and why is it important?

Temperature is a measure of the amount of heat energy stored in the water. Temperature is a very important parameter for organisms. All organisms all require a certain temperature range to survive. If the temperature is too high or too low, an organism will become stressed and either die or leave the environment to find better conditions.

Causes of temperature change include weather, removal of plants along the edge of the stream or lake, building of dams and structures that slow the flow of water, the addition of cooling water from industry, urban storm water, and groundwater entering the environment.

Temperature is measured in degrees Fahrenheit (°F) or degrees Celsius (°C).*

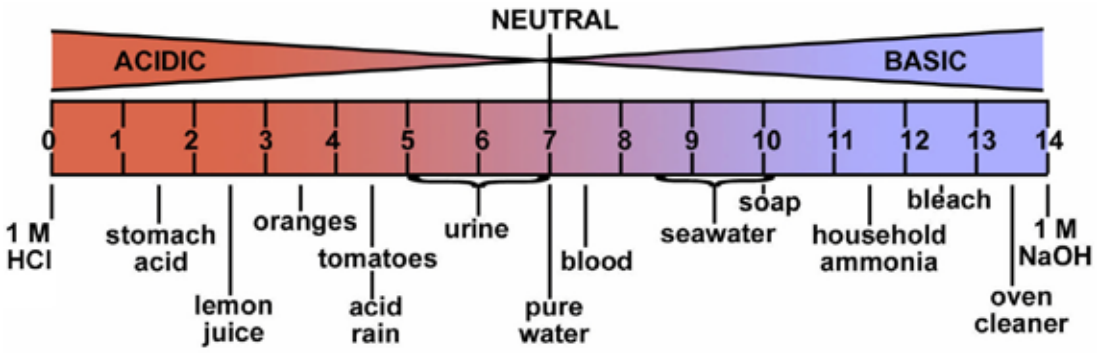
*** You will be recording temperature in Celsius.**

What is pH and why is it important?

pH is a measure of how acidic or basic a substance is. Below 7.0, the water is acidic. When the pH is above 7.0, the water is alkaline, or basic. The chart below gives the pH of common substances.

pH affects many chemical and biological processes in the water. For example, different organisms survive best within different ranges of pH. Most organisms in the water like a range of 6.5-8.0. pH outside this range reduces the number of different types of organisms in the water and can affect the food web and health of the environment. Changes in acidity can be caused by atmospheric deposition (acid rain), surrounding rock, and wastewater entering the environment.

pH of selected liquids



What is Dissolved Oxygen, and why is it important?

Oxygen is measured in water as dissolved oxygen (DO). This means that oxygen molecules are mixed with water molecules. Running water, because of its churning, dissolves more oxygen than still water, such as in a still reservoir behind a dam. In addition, cold water holds more dissolved oxygen than warm water.

Oxygen enters the water from the atmosphere and from plants as a result of photosynthesis. Aquatic organisms go through respiration, decomposition, and other chemical reactions which use oxygen.

Dissolved oxygen levels can decrease as a result of human activity. Wastewater from sewage treatment plants contains materials that are decomposed by microorganisms in the water. This increase in the decomposition uses up dissolved oxygen. Other sources of oxygen-consuming waste include stormwater runoff from farmland or urban streets, farms, and failing septic systems.

The units of measurement for dissolved oxygen are milligram per liter (mg/L).

Name:	
Date:	
Name of water body:	
Type of Water Body (i.e. river, stream, bay, ocean, etc.)**:**	
Select one: □ fresh □ salt □ brackish (mixture of salt and fresh)	
Water Quality Parameter	**Measurement**
Nitrogen (mg/L)	
Phosphorus (mg/L)	
Turbidity	
Temperature (ºC)	
pH	
Dissolved oxygen (mg/L)	
Notes / Other Observations:	

Now, as a class, calculate the class average for each measurement. Go to the Signals of Spring – ACES website. In Participant Resources, select ***My Class Water Study***. Have a class representative enter the averages. After the data are entered, you will be able to see them plotted on a Google map along with other participating schools'!

IMPORTANT: Make sure you use the correct units for each measurement when entering the data online.

Website Data Entry Instructions

- As a class, go to www.signalsofspring.net/aces.
- Select ***My Class Water Study*** under ***Participant Resources***.
- If your teacher is registered for the ACES program, enter your teacher's email address. If your class is participating in the water study only, select ***Enter as Guest***.
- Select the ***Enter Data*** icon.
- Complete the form with your class averages. **Note:** Remember the password you enter. This will enable you login to edit your data.
- Click **Submit**.

Part 4

Human Impacts from Far Away

Credit: NASA, GSFC

The image on the left shows the mouth of the mighty Mississippi, where this longest river in the United States meets the Gulf of Mexico. The Mississippi Watershed is the largest watershed in the United States. Nearly 80% of the country's land area (all or parts of 31 states) drains into the Mississippi.

The darker areas around the river's mouth indicate high phytoplankton growth, a bloom, in late spring and early summer. This bloom does not necessarily indicate the waters' health, however. Each year, by late July, a huge (nearly 20,000 square km or 8,000 square miles) part of the Gulf of Mexico becomes a 'dead zone.' Millions of organisms, including numerous species of fish, shrimp, oysters, clams, and other animals turn up dead.

The Flower Garden Banks National Marine Sanctuary is located100 miles off the coast of Texas and protects fragile coral reefs. How do you think this watershed affects the coral?

1. How can you explain what is happening each summer? Discuss the question with your group and write at least a paragraph.

Part 5
Understanding Measurements

1. When sampling your local stream you discover that the temperature and turbidity levels are high. Which water quality parameter might you expect to be low?

2. While visiting the beach in April you notice a phytoplankton bloom at the mouth of the river where it enters the bay and flows to the ocean.

   a. If you were to investigate the source of this phytoplankton bloom, where might you begin?

   b. What harm can a phytoplankton bloom do to the marine ecosystem?

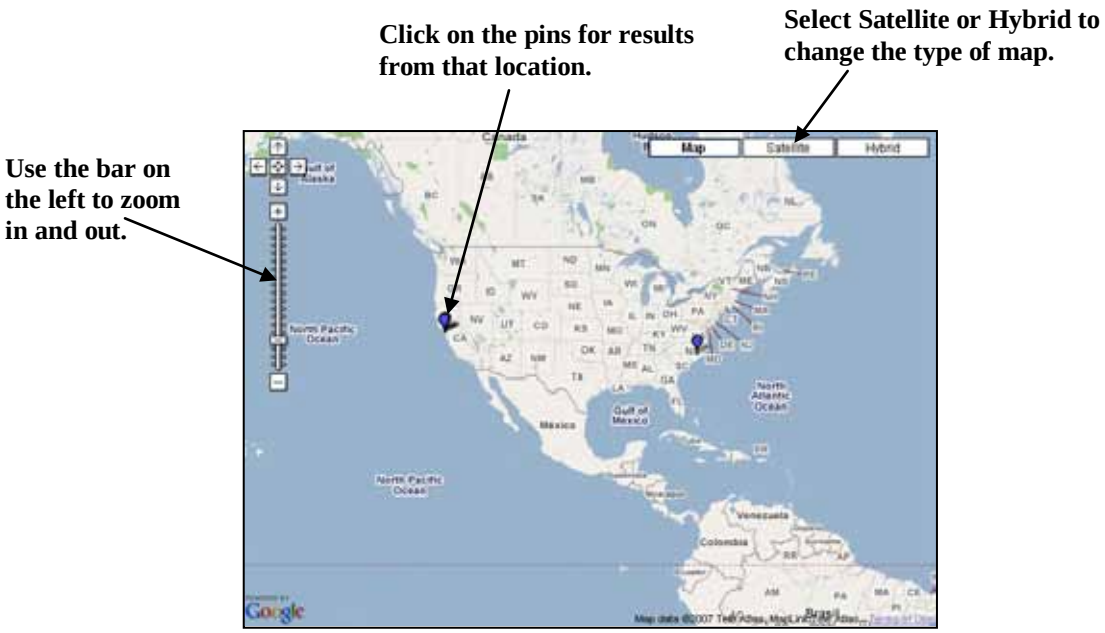
3. Kelly, a 10th grade student in Indiana, is very interested in Leatherback sea turtles. She has never seen one but knows a lot about them. For example, she knows they can live in the Gulf of Mexico. Kelly understands that even through she does not live near the Gulf of Mexico, things that happen in her local area impact the Leatherback sea turtle. Explain why this is true.

Part 6
Comparing Different Places

Now that you have taken your own measurements, it is time to look at the observations that other ACES students have entered.

Google Map Instructions

- As a class, go to www.signalsofspring.net/aces.
- Select ***My Class Water Study*** under ***Participant Resources***.
- If your teacher is registered for the ACES program, enter your teacher's email address. If your class is participating in the water study only, select ***Enter as Guest***.
- Select the ***View Google Map*** icon.



1. With a partner, choose two sites from the Google map to compare. (One may be the site that your class used.)

2. Use the tools available to you on the Google map. Describe the surrounding areas of each site.

   (Hint: For example, click the 'satellite' button on the top right and zoom in so that you can get a good look at the surrounding area. For example, is the area a beach, forested, or an urban area? Do you see a lot of concrete or a big, open field? Be very descriptive.)

   Site 1 Name/Description:

   Site 2 Name/Description:

3. Complete the chart below as best you can with the information provided. It will help you to easily compare data for the two sites.

	Site 1	Site 2
Name of Site		
Latitude		
Longitude		
Date Measurements Taken		
Type of Water Body (river, stream, bay, ocean, etc.)		
Nitrogen (mg/L)		
Phosphorus (mg/L)		
Turbidity		
Temperature (ºC)		
pH		
Dissolved oxygen (mg/L)		

4. Why do you think the two sites data differ in terms of the measurements? Explain why you have come to this hypothesis.

5. Which parameters are similar?

6. Which parameters are different?

7. How can you explain any differences that you found?