The Ocean's Effect on Climate, 1

Strand	Matter	
Topic	Investigating rates of cooling and heating of water and air and the effect on climate	
Primary SOL	6.5	The student will investigate and understand the unique properties and characteristics of water and its roles in the natural and human-made environment. Key concepts include d) the ability of large bodies of water to store thermal energy and moderate climate.
Related SOL	6.3	The student will investigate and understand the role of solar energy in driving most natural processes within the atmosphere, the hydrosphere, and on Earth's surface. Key concepts include a) Earth's energy budget.

Background Information

Due to its high specific heat, water is able to absorb large amounts of thermal energy without showing a significant change in temperature. Therefore, large bodies of water act to moderate the climate of surrounding land areas by absorbing a large amount of the sun's thermal energy in summer and slowly releasing that thermal energy in the winter. For this reason, the climate of land areas near large bodies of water is generally slightly milder than it would be if there were no large bodies of water nearby.

If your class period is not long enough to accommodate this lab activity, which will last longer than 60 minutes, set up and start the activity before students come into the classroom. Record the starting temperature, and turn on the light. As students arrive, have them examine the setup and identify the independent and dependent variables and constants.

Materials

- Identical containers with lids
- Celsius thermometers
- Copies of the attached handout
- Water
- Paper towels
- Lamps
- Heat-producing light bulbs
- Hot plate
- Aluminum pie pan
- Food coloring
- Goggles

Vocabulary

climate, convection

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

Introduction

1. Discuss the difference between weather and climate, using the following questions:
   - What is weather?
   - What conditions create our weather?
   - Why is the atmosphere so important?
   - Why does the Northern Hemisphere experience summer while the Southern Hemisphere has winter?
   - How does the sun influence weather?
   - What is climate?
   - What is the difference between weather and climate?
   - What are some different climates that occur around the Earth?

Procedure

1. Organize students into lab teams of four or five students each. Distribute copies of the attached The Ocean's Effect on Climate, 1 lab sheet, and tell students to read over the steps and identify the variables. Then, have each team form their statement of purpose and hypothesis.
2. Have teams conduct the experiment as directed on the lab sheet. Have each team designate one student to keep track of the time, another to check the temperature every 10 minutes, and yet another to record the temperatures.
3. While students are waiting during the 10-minute intervals, ask the following questions, and perform the following demonstration. Display a globe or large world map, and point out that all the oceans are connected. Ask, "Where do you think the water would be warmer? Why? Where would the water be colder? Why?" Then, perform this demonstration to show how the colder water near the poles and the warmer water near the equator move, thus creating ocean currents.
   - Place an aluminum pie pan on a burner or hot plate.
   - Fill the pan half-full with water and heat the water for two to three minutes.
   - Put a drop of food coloring in the water at the edge of the pan. Tell students to observe the path the food coloring takes. They should observe that the coloring (representing cold water) moves along the bottom of the pan toward the warm center. Once the coloring reaches the center of the pan, it begins to heat up and rises to the surface, where it curls back toward the edge.

Assessment

- **Questions**
  - What does the cold food coloring do?
  - What happens to the food coloring as it warms near the center?
  - What type of heat transfer is this? (*convection*)
  - How might this relate to ocean currents?"
- **Other**
  - Examine as a class the data from the lab, especially the completed line graphs. The data should show that the air increased in temperature rapidly while the light was on, and it

also decreased rapidly after the light went off. The water was slower to increase in temperature, and it retained heat much longer so that it cooled off more slowly.

- Assess the completed lab reports.

Extensions and Connections (for all students)

- Extend the lab activity to include a container of soil and lead into a lesson on land breezes and sea breezes. (Soil also increases and decreases in temperature more rapidly than water. Since land heats faster than water during the day, warmer air over land rises and cooler air over the nearby sea moves in over the land to take its place—i.e., a sea breeze. At night, land cools faster than water, so cooler air from land moves out over the sea to push the warmer sea air up—i.e., a land breeze.)

Strategies for Differentiation

- Review independent and dependent variables prior to undertaking this lesson.
- Have pairs of students work cooperatively to answer the questions in step one of the Student/Teacher Actions.
- Provide hands-on materials such as Unifix cubes to model 3-D components of a graph.
- Have students use newspaper weather maps to identify regional differences in temperature.
- Have students view color-coded temperature maps available on the Internet.
- Invite a meteorologist to talk about the difference between climate and weather and variation in average winter temperatures within Virginia.
- Have students work in pairs or small groups to answer the Reflection Questions.
- Have students work with partners or in small groups to complete the procedure.
- Provide students with a concept map to link and organize vocabulary words.
- Have students use a graphic organizer to compare and contrast climate and weather.
- Have students collect information and results in an interactive notebook.

The Ocean's Effect On Climate, 1

Name: _____ **Date:** _____ **Class:** _____

Purpose

Hypothesis

Materials

Two identical containers with lids, two Celsius thermometers, water, paper towels, lamp, heat-producing light bulb

Procedure

Independent Variable:

Dependent Variable:

Constants:

Steps

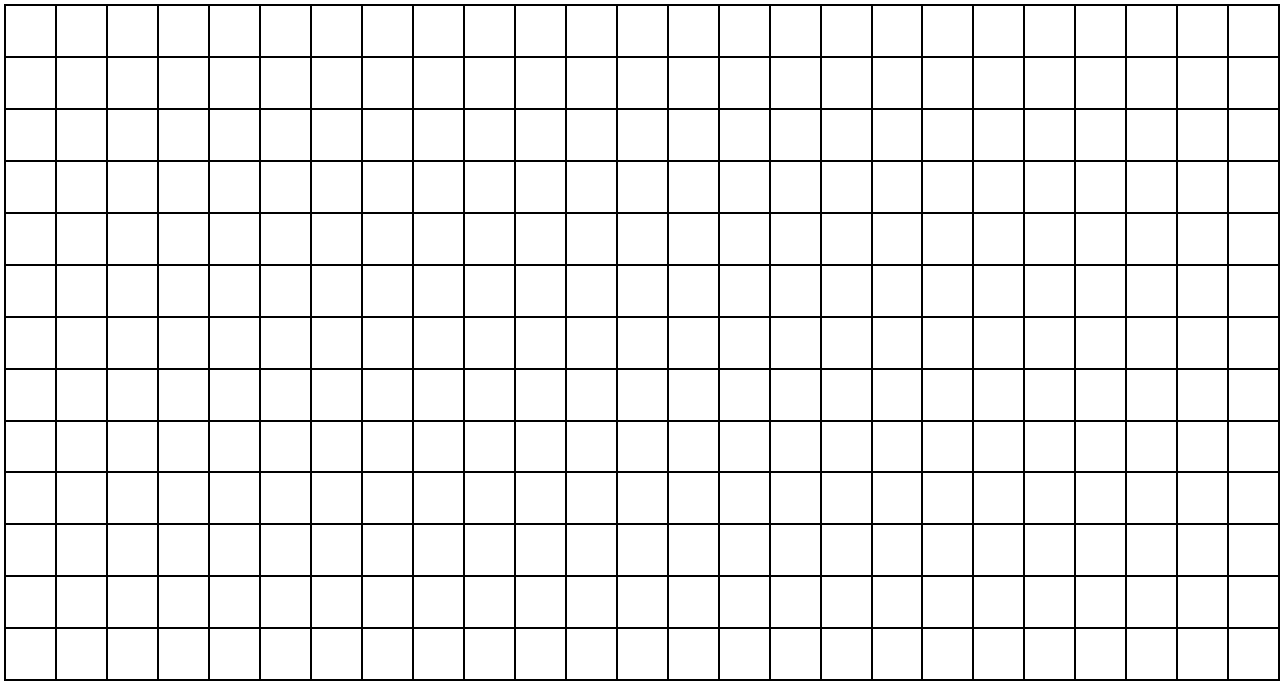
1. Put a hole in the lid of each container so that a thermometer will fit through.
2. Pour room-temperature water into one of the containers until it is high enough to cover the bulb of one of the thermometers.
3. Place the lid on each container, and gently put a thermometer through the hole in each of the container lids. Be sure the bulb of the thermometer in the jar with the water is below the surface of the water. *CAUTION! Be very careful! If the thermometer breaks, do not touch the glass. Tell your teacher immediately.*
4. After a few minutes have passed, read the initial temperature in each container, and record these temperatures in the data table below.
5. Place the containers side by side under the light, and turn it on.
6. Observe and record temperature every 10 minutes for 30 minutes.
7. Turn the light off, and continue to observe and record temperature for 30 more minutes.

Data Table

Independent Variable (IV)	Dependent Variable (DV)							
	0 min.	10 min.	20 min.	30 min.	Light out	10 min.	20 min.	30 min.
Air Temperature								
Water Temperature								

Graph

Construct line graphs of each set of data. Label the *x*-axis "Time" and the *y*-axis "Temperature." Use one color for the container with air and another color for the container with water. Make a key.



Reflection Questions and Conclusions

1. Which container had the greatest degree of temperature change while the light was on?

2. Which container retained (held) its heat longer?

3. How would you use this information to help explain the difference between the average winter temperatures of the Virginia coastal climate (35°F to 48°F) and the average winter temperatures of the climate of central and western Virginia (24°F to 45°F)?

4. The climates of the North and South Poles are never warm even though they are covered or surrounded by oceans. How would you explain this?