

Visit to an Ocean Planet



COASTAL VERSUS INLAND TEMPERATURES

OVERVIEW

Students will use the weather section of the newspaper to help discover why coastal regions have relatively moderate climates. They will construct *models* of the ocean and the land to measure the different cooling and warming rates of each.

CONCEPTS

- Water has a higher *heat capacity* than soil and rock, so the ocean takes much longer to heat and to cool than the land.
- Coastal areas will generally have more moderate *temperatures* than inland areas because of the heat capacity of the ocean.

MATERIALS (PER GROUP OF FOUR)

- 2 Buckets (or foil steamer trays)
- 2 Thermometers
- Water
- Sand
- Weather section of a major newspaper
- Clips (to hold thermometer in water bucket)

PREPARATION

Set up equipment trays for each group. Each tray should include two buckets, two thermometers and some sand. The students will need to access water. The bucket with water is a model of the ocean and that the bucket with sand is a model of the land.

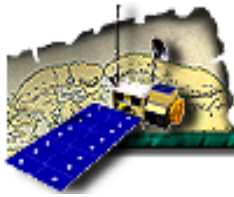
Major newspapers generally have very extensive weather and almanac sections. Examples of those that include coastal areas include the Los Angeles Times, New York Times and USA Today. Finding the appropriate weather information might make an interesting research project for you students. It is also possible to find the information that you need on the Internet.

HINT: You might wish to have the students set up the models on one day and complete the observations on the next day. Also, this activity may need to be performed over two class periods: one to heat the buckets, the other to cool the buckets.

PROCEDURE

Engagement

Check the newspaper weather section, and identify two cities that are relatively close to each other: one must be on the coast and the other must be several miles inland. This activity is best done using regions where the wind blows from ocean to land on sunny days. Chart the temperature range (highs and lows) of each for a week. Have the students write a hypothesis that explains why the temperature range of the cities by the beach seems to be smaller than that of the inland city.



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Activity

1. Have the students fill one bucket with sand and one bucket with water. Make sure the buckets are filled to the same level. Push the thermometer 2.5 cm (1 in) into the soil and clip the thermometer 2.5 cm (1 in) into the water. Leave both buckets in the shade until they reach the same temperature.
2. Once the temperature in both buckets is the same, put them in direct sunlight. Check and record the temperature every five minutes until a clear trend in the data is seen. Plot and graph the temperatures versus time. Which bucket heated more quickly? What does this tell us about the *heat capacity* (heat energy required to raise the temperature) of water and of land?
3. Move the buckets back into the shade (into a refrigerator is better, if available). Measure and record the temperature every five minutes until a clear trend is seen. Plot and graph the data. Which bucket cooled more quickly? Is it the same bucket that heated more quickly? What does this tell us about the heat capacity of water and of land?
4. Review the weather information and your hypothesis. Does the activity that you just completed help to explain the differences in temperature range between coastal and inland cities? Use your graphs to compare and, if necessary, modify your hypothesis.

Explanation

Every day the land heats much faster than the sea, and every night the land cools faster. When the land heats up, the air above it heats up as well. On the other hand, the ocean heats up and cools down relatively slowly. Therefore, areas near the ocean generally stay cooler during the day and have a more moderate temperature range than inland areas.

Heat capacity is the amount of energy required to raise the temperature of a substance by 1°C. This activity demonstrates that water has a higher heat capacity than sand. Likewise, larger bodies of water have higher heat capacities than smaller bodies. To compare substances directly, scientists often refer to the heat capacity per unit mass, known as the *specific heat*.

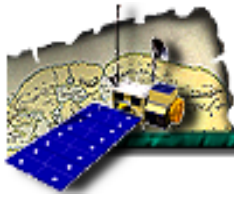
EXTENSION

The farther a region is from the ocean, the more extreme its climate is likely to be. A continental summer is hotter than a coastal summer, and a continental winter is colder than a coastal winter. Coastal climates tend to be more moderate. Some ocean currents bring cool water and some bring warm water, which also influences coastal climates (see *Ocean Currents and Coastal Temperatures* activity).

Large lakes, such as the Great Lakes, can also influence the temperatures at lakeside cities in similar ways, though generally not as much as the ocean.

Do your students live near or far away from a large body of water (i.e., an ocean or very large lake)? Have them adopt a city in the “opposite” climate region at about the same latitude. (In other words, students who live near an ocean or large lake should find a city that is far from an ocean or large lake, and vice versa). Using newspaper weather data, the Internet, and/or an almanac, have them compare their weather and climate to that of their adopted city over time. What factors influence different weather in each place? Is proximity to a large body of water the main driver of weather in your regions?

Your students may wish to do this exercise with a number of cities. If so, be sure to include cities on both the west and east coasts of a continent (this may be easiest for North American cities). How does the relative temperature of major currents of each coast affect each coastal city’s climate?



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LINKS TO RELATED CD ACTIVITIES, IMAGES, AND MOVIES

Activity *Ocean Currents and Coastal Temperatures*

VOCABULARY

heat capacity

model

specific heat

temperature

SOURCE

Adapted from Allaby, Michael. *How the Weather Works*. Reader's Digest Association, Inc. 1995. p. 146 - 147.