ACTIVITY 10

A CHANGE IN THE WEATHER?

WHICH CHANGES TEMPERATURE FASTER: WATER OR AIR? DOES VOLUME MAKE A DIFFERENCE IN HOW FAST A BODY OF WATER CHANGES TEMPERATURE?

SCIENCE SKILLS:
- measuring
- organizing
- experimenting
- communicating

CONCEPTS:
- Under the same conditions, water changes more slowly than air.
- In terms of temperature, aquatic habitats more stable than land habitats.
- The larger the volume of water, the slower it changes temperature.

MATH AND MECHANICAL SKILLS PRACTICED:
- reading thermometers
- averaging numbers
- graphing data

SAMPLE OBJECTIVES:
- Students will be able to read a thermometer.
- Students will be able to compare temperature changes in water and air.
- Students will be able to graphically display results.

INTRODUCTION:

This exercise ties into earth science in that much weather is dependent on the fact that water absorbs more heat than air for each degree of temperature change. Bodies of water therefore change temperature more slowly and have more stable temperatures than land. Lakes and oceans warm adjacent land in winter and cool it in summer.

This activity depends on having access to a cold place: a refrigerator, ice chest or outside on a winter day. If you teach several sections of science, one class may start and others continue this project. Data analysis can be done on the following day. During test teaching, students reported liking to share a project with other classes.

Data manipulation will take several class periods if the students have not done averaging and graphing before. This is a good project to practice these skills because they will generate lots of numbers.

MATERIALS:

For class:

- a cold (33-40°F) place - a refrigerator or ice chest
- for each group:
- 3 clear containers (two of same size and one three to four times as big)
- such as two pint plastic or glass jars and a 2 liter plastic soft drink bottle or glass fruit jar; each set of 3 must be of the same material
- lids or aluminum foil to cover tops of containers
- 3 safe, breakproof thermometers (see Recipes for sources)
- water at room temperature

LESSON PLAN:

BEFORE THE CLASS DAY:

In selecting containers, you try not to mix glass and plastic. One group may have an all glass set and another, all plastic. Children should not try to handle large glass containers of water. In the interest of safety, you may need to carry the containers. Use containers that allow data collection without opening the jars. Modify the top of plastic containers to accept the thermometers. The thermometers need to fit inside, but may stick out through holes in the lids if necessary. Use cheap, small thermometers that are hard to break, not the long "scientific" glass ones. They should not break if dropped, nor should they contain mercury. My personal system is slightly off the 1:4 ration of size recommended here. I use tall jelly jars (12 oz) and quart fruit jars (32 oz) because they have good lids, are tall enough for the thermometers, and can be used for many other activities.

Have the students practice reading the thermometers the day before the experiment. Use tap water of several temperatures for practice.

The night before, fill one of the smaller containers and the larger container with cold temperature water, leaving a space at the top in case it freezes. Leave the third container filled with room air. Add thermometers to each. Put lids on loosely or cover top with foil. Put them in a cold location: a refrigerator, outside on a cold, but not freezing, in an ice chest. I prefer an ice chest that can come to class unless you have a refrigerator near your room.

DURING CLASS:

METHODS: Introduce the exercise by asking the students which they think would be warmer on a hot day, a fish living in a big lake or a turtle sitting on a log next to the lake? How about in the dead of winter when snow is piled up, would it be colder to be under the ice in the pond or sitting on its shore? Generally, the temperature is more moderate in water than on land. Have they ever thought about why the climate is more moderate under water? Try a test to find out.

Bring out the cold jars and put in groups on student desks with data sheets. Record the time and temperature of each immediately. Periodically record time and temperature in each (about every 10-15 minutes).

Graph the results for one set. Lump results and compare graphs. Students can also calculate rates of change for each sample by:

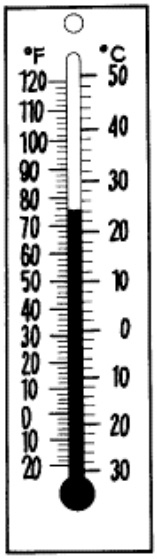
total temp. change (difference from start to finish) divided by
total elapsed time (minutes or hours the experiment ran)

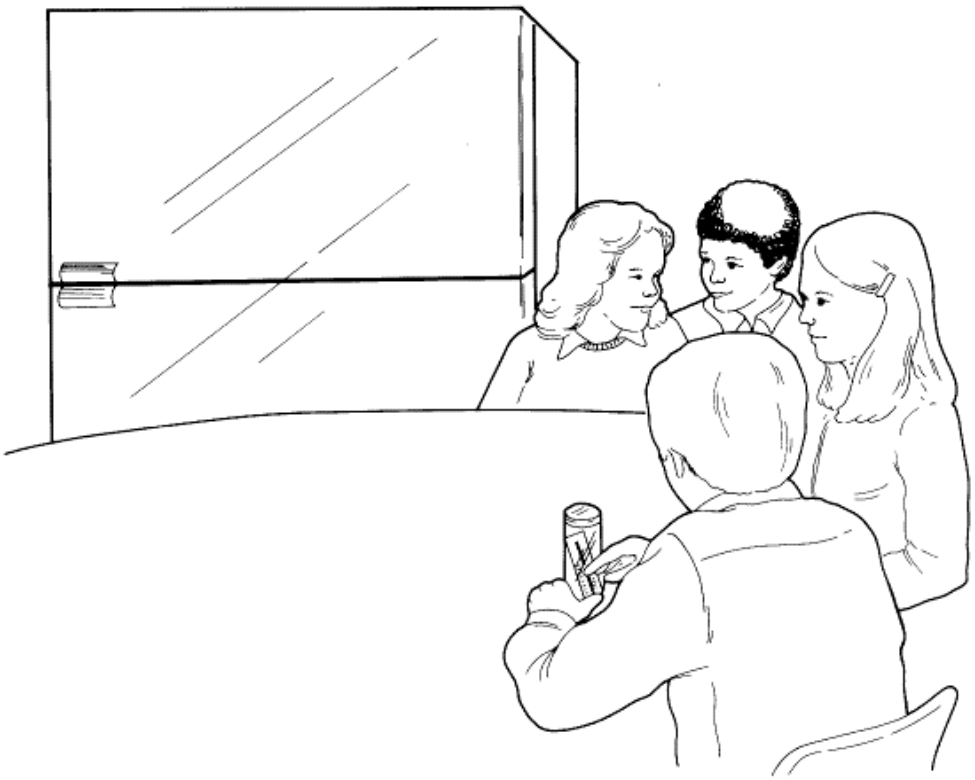
RESULTS:
The large body of water should change more slowly than the smaller one. Water should change more slowly than if you used small jars with lots of surface area, the water may not seem much different from air.

CONCLUSIONS:
What would this mean for you if you lived in water? In air? Generally, animals and plants living in water are subjected to temperature changes that are not as radical as those that land-living organisms face.

If an animal needs to stay at nearly the same temperature all year, would it prefer to spend the winter and the summer in a big body of water or a little pond? The bigger the body of water, the smaller the changes with season. Can you make any generalizations about the relative seasonal temperature changes likely to be found in a pond, a lake, the ocean. Small ponds show greater changes in temperature with the seasons. Lakes show less, and oceans even less. But even oceans, at least at the surface, have temperature changes.

USING YOUR CLASSROOM AQUARIUM:
If your classroom experiences temperature changes during the night or over the weekend and you do not have a heater in your aquarium, have your students keep a log of the temperature changes that occur in the aquarium during the day from the time they arrive until they leave. Does it change temperature much during the day? If you have a maximum/minimum thermometer, leave it out at night or over the weekend to see how cold the room gets then. Does the room's temperature change? Record these temperatures also. Graph the temperature changes of both room and aquarium on the same chart. Is the amplitude of the change greater in the aquarium or the room? How does this compare with your findings in this activity?





EXTENSION:

1. The most famous temperature change in the ocean is the periodic El Nino events in which the western tropical Pacific experiences much higher than normal temperatures. The warming of the sea surface has profound consequences for both sea life and weather all around the Pacific. Have students research these events and their consequences in the library.
2. Students on the East Coast might be interested in studying the impact of the Gulf Stream, a warm ocean current, one their weather.

ACTIVITY 10 Name Possible answers

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What is the question that this experiment will answer?

Actually, we can answer two questions: which changes temperature faster - air or water and which changes temperature faster - a big body of water or a small one?

Record the TEMPERATURES for your group here:

	time in minutes since starting										
container	start	5	10	15	20	25	30	35	40	45	50
air	10°	14.5°	18°	22°	25°						
small water	10°	13°	15°	18°	20°						
large water	10°	11°	12°	14°	16°						

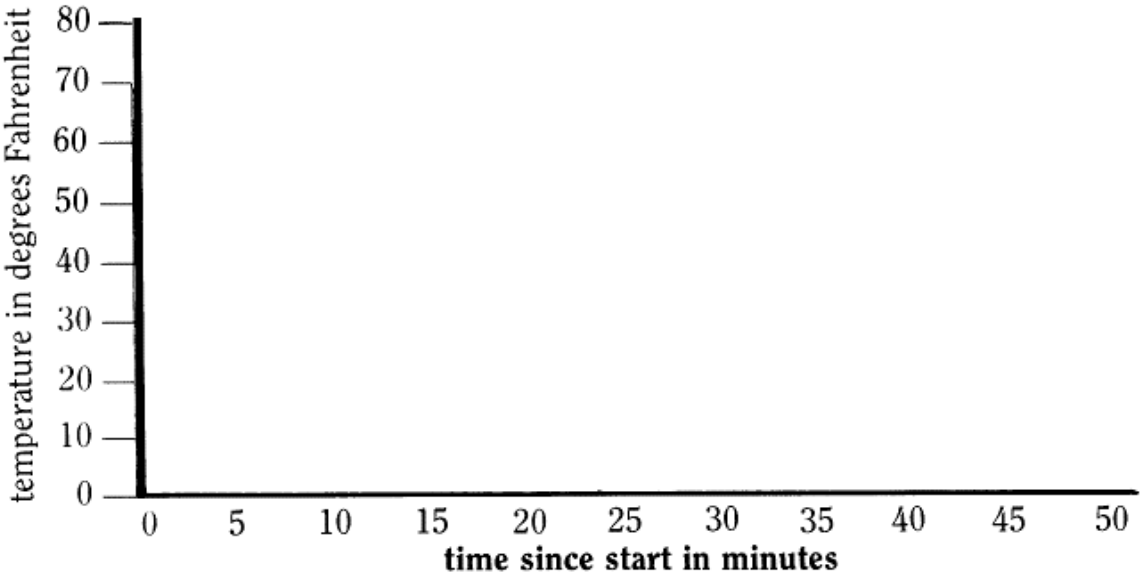
These temperature readings are in Farenheit _____
Centigrade ✓

Calculate the average temperature for all groups and record here:

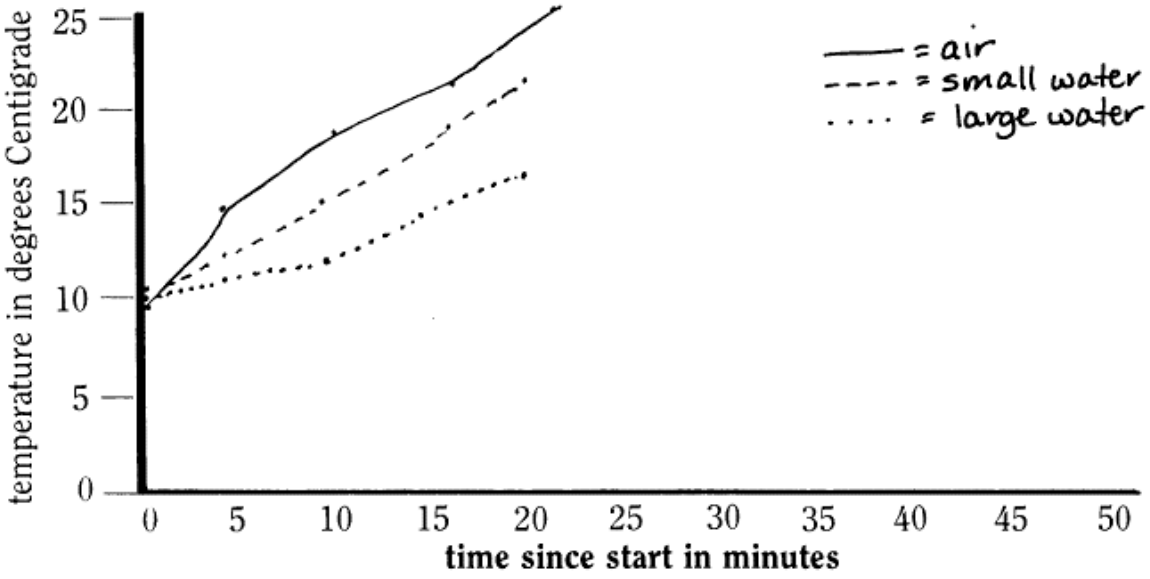
	time in minutes since starting										
container	start	5	10	15	20	25	30	35	40	45	50
air	9.8	14.7	18.3	22.4	24.9						
small water	10.1	12.9	14.8	18.1	20.2						
large water	9.9	11.1	12.2	14.1	15.4						

These temperature readings are in Farenheit _____
Centigrade ✓

Graph the temperature changes with a line graph here for Farenheit scale:



Or graph here in Centigrade or Celsius scale:



Which container changed temperature fastest? The container of air changed temperature fastest.

Which changed most slowly? The large water jar changed slowest

Based on your experiment, which of these would change temperatures through the seasons least? Most? Middle?

ocean least pond most lake middle