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Islands in the Stream 2002: Exploring Underwater Oases

An Ocean of Weather

Focus
The close relationship between the ocean and the atmosphere in the South Atlantic Bight

Grade Level
5-6

Focus Question
Does the ocean affect the Earth's weather in the South Atlantic Bight region?

Learning Objectives
Students will learn that the ocean and atmosphere work together as a system.

Students will experiment to find out that heat transfer from the ocean is a cause of much of Earth's weather.

Students will make and explain an ocean water cycle.

Additional Information for Teachers of Deaf Students
There are no formal signs in American Sign Language for any of the key words and many are difficult to lipread. If some of these topics have not already been covered in your class you may need to add an additional class period to teach vocabulary prior to the activity. This activity is very visual and should be very easily understood by the students.

Materials
- ❒ 10 six-ounce baby food jars - one per group
- ❒ 10 disposable aluminum loaf pans (8″ x 3 3/4″ x 2 3/8″) - one per group
- ❒ 10 12-inch balloons - one per group
- ❒ 10 centimeter rulers
- ❒ 2 hot plates or one double hot plate
- ❒ 1 pitcher
- ❒ 1 funnel
- ❒ 10 clear bottles with small mouths (soda bottles or water bottles) - one per group
- ❒ Ice cubes (These need to be wider than the small mouth opening of the water bottle or soda bottle.)
- ❒ 1 small cooler (8 or 10 quart size) for storing the ice cubes
- ❒ Student Graph Sheet (one per student)
- ❒ Student Science Journals or other paper for individual student reflections during activity

Audio/Visual Materials
Computers to access web sites
Television to access the Weather Channel

Teaching Time
Three 45-minute periods

Seating Arrangement
Groups of two or three students

Maximum Number of Students
25 to 30

Key Words

Evaporation
Atmosphere
Condense
Condensation
Radiation
Moisture
Precipitation
Convection
Water cycle
Heat transfer
Ocean
Hurricane
Current
Vapor

Background Information

The weather on Earth is caused by the interaction of heat, moisture, pressure, and wind in the atmosphere. Because 70% of the Earth's surface is covered by water, the heating of the ocean's surface can cause many types of weather to form over the ocean and affect places on land. During the summer and fall months, weather can vary greatly in the South Atlantic Bight. This region is influenced by the Gulf Stream current that pulls up warm water from the Equator. This in turn creates warm air (heat transfer). Also, warm, summer/fall heating by the sun causes movement of the water and air in the South Atlantic Bight. As the surface of the ocean becomes heated during a warm sunny day, water begins to evaporate in the form of vapor (heat transfer). Because the air above the ocean also gets warm (heat transfer) due to traditional heating from the water, it begins to rise because it is lighter and has less pressure than cooler air. When the warm air rises, more air moves in to take its place. This produces wind. Since warm air is able to hold more moisture than cold air, the rising, low-pressure air becomes full of moisture. As it reaches higher, cooler altitudes it begins to condense, and releases heat. If enough vapor condenses quickly, a violent thunderstorm with large amounts of precipitation can form. A hurricane can form if this process takes place over a long period of time and over a long distance.

Learning Procedure

The following experiment is based on the activity, Hurricanes-Lab Time, from the book, *Best of Science*.

1. Put the baby food jars in the refrigerator or cooler for at least 30 minutes prior to the activity.

2. Put the water and pot(s) on the hot plate(s). Turn the heat to high.

3. Give groups or pairs of students the following supplies: an empty 6-ounce baby food jar, a 12-inch balloon, a disposable loaf pan, and their science journals.

4. Students should write and draw in their science journal during each step of this experiment.

5. Students should observe the temperature of the jar with their hands.

6. One student should stretch the balloon over the mouth of the baby food jar. Stretching the balloon before putting it on the jar may help it go on easier. Make sure there is not much air in the bulb of the balloon before it is put on the jar. Center the bulb of the balloon over the mouth of the jar. Make sure the opening of the balloon is not stuck together. The bulb of the balloon should hang somewhat limp over the side of the jar.

7. Students should put the jar with the balloon on top in the aluminum loaf pan.

8. Tell students that you are going to add some very hot water to the loaf pan. They should move back as you pour the water in the pan. The teacher should pour water into the pans using a pitcher with a spout. Have students put a ruler in the pan. The students should let the teacher know when 3 cm of water has been poured into the pan.

9. Students should make observations of the jar and balloon. They should continue recording observa-

tions in their science journals. The balloon should slowly inflate somewhat during the period of a few minutes.

10. After the balloon inflates some, have students feel the jar again. Record their observations.

11. Ask students what they think has caused this to happen. Record it in their journal.

12. Discuss with the class what just happened to the balloon. Explain that the inflation had to do with the temperature of the air in the jar. The hot water in the pan warmed the jar, which warmed some of the air in the jar. Since warm air rises, that air rose to partially inflate the balloon. Have students write their conclusions in their journals. Have students make hypotheses in their journals about what would happen if the size of the jar were changed? What if the size of the balloon were changed? What if the temperature of the water was cold instead of hot? Have students try these inquiries at home and report back to school what happened and why.

13. Ask students what they think these experiments have to do with weather. Guide the discussion to lead them to the conclusion that air warmed by the warm ocean rises. Have students locate the South Atlantic Bight on a map. It is the area from the coast to the continental rise from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Talk about what temperature the surface of ocean at the South Atlantic Bight might be in August and September. Have students do research to find out what the temperature of the Atlantic is in this region during this time of year. This South Atlantic Bight air, warmed by the sun, rises as well. This evaporation of water and rising of air causes clouds to begin to form over the Atlantic Ocean.

14. Students will begin another experiment. The students should make observations in their journals throughout this experiment.

15. Before the experiment starts, the teacher should have a pot of about 6 cups of water boiling on the hot plate. Take the pot off the burner a few minutes before you pour it. Then put the water in a pitcher.

16. The teacher should give each group one small-mouthed bottle and an ice cube.

17. The teacher should pour hot water in the small-mouthed bottle using a funnel. The water should be measured to be about 3 cm. high. Have one student hold the funnel and one student hold the bottle and ruler.

18. As soon as the water is in the bottle, have one student put an ice cube on top of the mouth of the bottle.

19. Students should record their observations in their journals. They should also record their ideas about the reason for what happened.

20. The teacher should begin a discussion about the procedure and the results. Explain to the students that the water and air in the bottle began to rise because of the heat. When it reached the ice cube, it began to cool and condense inside and on the sides of the bottle. Ask the students if they think the results would be the same if cold water was used instead of hot water? What if there was no ice cube on the top of the bottle? Have students test some of these questions. Make a chart of these results. What happened in the bottle is a model of what happens to the air and vapor above the warm ocean in the South Atlantic Bight. As the warm, moist air rises, more air comes in to take its place, causing wind. Clouds are formed here as well as other places in the middle of the Atlantic Ocean. This can happen over the ocean near Africa. Here, clouds can form and move across the warm Atlantic collecting more warm, light rising moisture-holding air. The clouds become thunderstorms. Like in the bottle, the cooled condensed air begins to

precipitate. This cycle of warm air rising, cooling off, then sinking, is called convection. As convection occurs, the clouds begin to turn in a counter-clockwise movement because of the rotation of the Earth. Where the air is rising, the pressure becomes lower and lower, because the air is not pressing down here. It is rising up. This is the beginning of a hurricane. In a hurricane, the warm air rises higher and higher to let more warm, moist air rise up in the storms, which makes it stronger and stronger. These strong storms often move into the South Atlantic Bight region. Check the Weather Channel or a weather web site to see if they are any formations of hurricanes in the Atlantic Ocean.

21. Students should record their thoughts about the discussion in their journal.

22. Students can research surface temperatures of the ocean in the South Atlantic Bight. Go to the following website to find ocean temperatures on different buoys at sea: http://www.ndbc.noaa.gov/os.shtml. Click on a point on the map to go to that latitude and longitude. Several current ocean temperature measurements are available for each position. Take an average of the temperature readings and then graph it. Then graph five different positions in the South Atlantic Bight.

The BRIDGE Connection

http://www.vims.edu/bridge/ Go to the "Ocean Science Topics." Then go to "Atmosphere."

The "Me" Connection

Have students track storms or hurricanes on a weather map. Track storms or hurricanes near their home city or state or near an area where a friend or relative lives.
Students should make a list of storm safety rules.

Connections to Other Subjects

English/Language Arts - Read books about storms or hurricanes. Students write about their experiment observations.

Mathematics - Make number grids using degrees of latitude and longitude. Graph seven ocean temperatures in the South Atlantic Bight.

Geography - Tracking hurricanes using latitude and longitude.

Evaluation

- Grade each student's journal entries for accurate observations, procedures and results. Check for reasonable hypotheses and conclusions.
- Evaluate student's ability to perform the experiments again and explain what they mean in writing and drawings.
- Grade the ocean temperature graph for accuracy.

Extensions

Have students visit the Ocean Explorer website http://oceanexplorer.noaa.gov during the South Atlantic Bight Expedition to find out what kind of weather the scientists are experiencing on the ship. Find out how the weather affects the submersible dives and daily life on the ship.

Research the Internet to find wind speeds that occur in a tropical depression, tropical storm, and hurricane.

Resources

http://oceanexplorer.noaa.gov - follow the South Atlantic Bight Expedition daily logs to find out the new discoveries taking place every day.

http://www.ndbc.noaa.gov/educate/educate.shtml - National Data Buoy Center Science Education Pages. Information about the ocean and the atmosphere that is collected from ocean buoys. Great questions, answers and graphs.

http://www.pfeg.noaa.gov/research/climatemarine/cmfoceanatm/cmfoceanatm.html – This Web site contains great information about ocean and atmosphere interactions.

http://www.ucar.edu/learn/1_1_1.htm - This Web site is intended for middle school teachers, but it is a great site for middle school students as well. It has great explanations and illustrations of the interactions of the ocean and atmosphere.

Robinson, W. *Incredible Facts About the Ocean*. Minneapolis: Dillon Press, 1990.

Skranbanek, D.W. *Best of Science*. Orlando: Steck-Vaughn, 2001.

Young, Greg. *A Guide for Using The Magic School Bus Inside a Hurricane in a Classroom*. Westminster: Teacher Created Materials, 1996.

National Science Education Standards

Content Standard A: Science As Inquiry

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Content Standard B: Physical Science

- Transfer of energy

Content Standard D: Earth and Space Science

- Structure of the Earth system

For More Information

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