Density Differences: Air

Objectives:

Students will understand that air has different densities at different temperatures. They will recognize that these density differences drive global and local patterns of air movement as wind.

Concept:

Temperature-dependent gradients of density drive the movement of air, which in turn creates winds. As hot air or water rises, cool air moves in to fill the space left behind. Marine debris and ocean pollution is transported by both winds and currents.

Materials:

- Science notebooks
- Pencils
- Tape
- Small strips of paper
- 2 or more thermometers
- Computer/laptop and projector or SmartBoard

Preparation:

Identify a door or window to the outside that can be opened and move furniture for easy access to this spot. Set up computer and projector or SmartBoard to show the Majestic Plastic Bag mockumentary (http://www.youtube.com/watch?v=GLgh9h2ePYw).

Introduction:

Begin by showing the "Majestic Plastic Bag" mockumentary on YouTube: http://www.youtube.com/watch?v=GLgh9h2ePYw.

At the conclusion of the video, ask students to write their reaction in their science journal.

As a group, brainstorm different pathways plastics follow to the ocean.

Have students sketch a quick flow chart of a piece of plastic's journey to the ocean.

Procedures & Activities:

Explain to students that marine debris is transported by both winds and currents, which are driven by temperature differences in water and air masses. This lesson focuses on air and wind patterns.

Explain to students that hot and cold air have different densities. Because molecules in cold air are less energetic and move more slowly, it is denser than warm air, where molecules are more energetic. The more dense cold air sinks as less dense hot air rises.

Conduct a temperature demonstration by asking for two volunteers.

Crack open a door or large window that leads outside.

Have one volunteer hold a thermometer at the top and another person hold one at the bottom.

Read and record the temperatures. *(The top temperature should be higher than the lower temperature.)*

Explain that as air warms, it rises. This creates a sort of vacuum below, which is filled by cool air.

Build simple 'draftometers' with students by having them tape a small strip of paper hanging vertically from a pencil.

Density Differences: Air *Continued*

Allow students a few minutes to measure drafts around the classroom and see for themselves how small air masses are flowing throughout the classroom based on differences in temperature and thus density.

If you have extra thermometers, have them measure the temperature in low-lying drafty areas and compare it to the temperature above these drafty areas.

Wrap-Up:

Ask students to revisit the flow chart they created at the beginning of the lesson. Have them identify the different physical factors that affected the transport of their plastic piece to the ocean. These physical factors will include the movement of air as winds, but students should also consider such factors as currents, tides and gravity.

Ask them also to identify three ways that they could interrupt this flow of plastic to the ocean (examples include proper disposal of plastic, recycling, reusable bags, cleaning up litter, filtering technology, etc.).

Extensions & Lesson Connections:

This activity is designed to be followed by the "Density Differences: Water" lesson. The "Currents & Coriolis" and "Predicting the Path of Marine Debris" lessons are also excellent lessons to pair it with for slightly older classes.

Evaluation:

The initial flow charts serve as a pre-assessment, while the revised flow charts should illustrate student understanding of how wind drives the movement of marine debris. Review the science journals for understanding of basic concepts of density-based movement air and how this concept can be applied to an understanding of wind.