Currents & Coriolis

Objectives:
Students will understand that density differences drive global and local patterns of wind and water currents. They will recognize how Coriolis effect influences wind and current patterns, and how this can create ocean gyres.

Concept:
Temperature-dependent gradients of density drive the movement of water in currents. As warm water rises, cool water moves in to fill the space left behind. This movement is deflected by the rotation of the earth, called the Coriolis effect. Marine debris is transported by both winds and currents. Debris large and small tends to accumulate in ocean gyres, such as the North Pacific and North Atlantic.

Materials:
- Science notebooks
- Pencils
- Computer/laptop and projector or SmartBoard
- Globe or map of Earth
- Handout: Blank World Map
- Handout: Predominant Surface Currents in the Ocean
- Sphere or cylinder that can be drawn on
- Dry-erase markers

Preparation:

Load NOAA's Ocean Explorer video on currents: http://oceanexplorer.noaa.gov/edu/learning/player/lesson08.html

Make copies of the world map and "Predominant Surface Currents in the Ocean" hand out for students.

Introduction:

Ask students to consider what direction wind usually comes from in your area. You may find it is easiest to think about winds during a particular season. For example, "What direction does most of the wind come from here in Homer during the summer?"

Designate the North-East-South-West areas of your classroom and also local landmarks (North is where the mountains are, South is where the Bay is) and ask students to move to the area of the classroom where they feel most winds come from locally.

Is there consensus? Based on their knowledge of how cold air moves to fill in areas where hot air rises, why might local wind patterns be like this? Does it make sense? Does it seem like cold air is coming straight toward warmer areas?

Explain that there is a notorious effect at work – the Coriolis effect.

Procedures & Activities:

Introduce a globe or map of the Earth. Ask the class to consider which areas of the earth are warm and cold and what would happen to the air and water in those areas.

Pass the maps with ocean/continent outlines out to students and ask them to mark areas of the globe that are warm and cold.

Then have students draw predicted movement of air and surface water based on their knowledge of how water and air move based on density differences.

Currents & Coriolis *Continued*

Once all students have made their predictions, explain that the warm equatorial water/air rises and moves toward the poles and the cool polar air/water flows along the surface toward the equator.

The zones where warm and cold converge are the areas that create the main currents and winds on earth.

Show students a map of actual currents. Does it match what they predicted?

Explain that the Coriolis effect changes the movement of air and water from what you would expect.

Demonstrate the Coriolis effect by using a cylinder or sphere that can be drawn on with a dry erase marker.

Spin the object and have a student draw a line from the center to the top and then from the center to the bottom. *(The lines should be curved-pointing the same direction.)*

This shows how objects moving across the rotating earth are deflected by the rotation of the Earth. This is called the Coriolis effect, and deflects winds to the right of their path in the northern hemisphere and to the left of their path in the southern hemisphere.

The Coriolis effect becomes even more apparent when winds affect surface currents. The winds, which have already been deflected to the right by the Coriolis effect, start moving water in one direction, but this movement is deflected too!

Show NOAA's Ocean Explorer video about Currents: http://oceanexplorer.noaa.gov/edu/learning/player/lesson08.html. This provides an excellent overview of what drives surface currents and the effects of Coriolis on surface currents. The last few minutes are about deepwater ocean circulation, so you may choose to skip them.

Wrap-Up:

Ask students to take the Coriolis effect into consideration and redraw their surface current map.

Provide them with a copy of the "Predominant Surface Currents in the Ocean" handout. And as them to describe how their redrawn map compare to oceanographers' observations of predominant surface currents.

Explain that these general current and weather patterns are changed by phenomenon such as El Nino and La Nina.

When this happens, changes in sea surface temperatures along the equatorial Pacific shift currents, winds, and weather patterns.

Ask students to explain why changes in the surface temperature of the ocean would affect currents, winds, and weather.

Currents & Coriolis *Continued*

Extensions & Lesson Connections:

To learn more about El Nino, watch the El Nino video from National Geographic: http://education.nationalgeographic.com/education/activity/the-ocean-and-weather-el-nino-and-la-nina/?ar_a=1.

Or use the El Nino activities that accompany the Ocean Explorer Currents video: http://oceanexplorer.noaa.gov/edu/learning/player/lesson08/l8la1.htm.

As an extension, test students' ability to apply the Coriolis effect to important decisions by using the basic flight plan simulator: http://oceanexplorer.noaa.gov/edu/learning/player/lesson08/l8ex1.htm. In this simple animation, students are pilots and must decide how to correct for the Coriolis effect to land successfully on an aircraft carrier.

This lesson can be followed by "Predicting the Paths of Marine Debris."

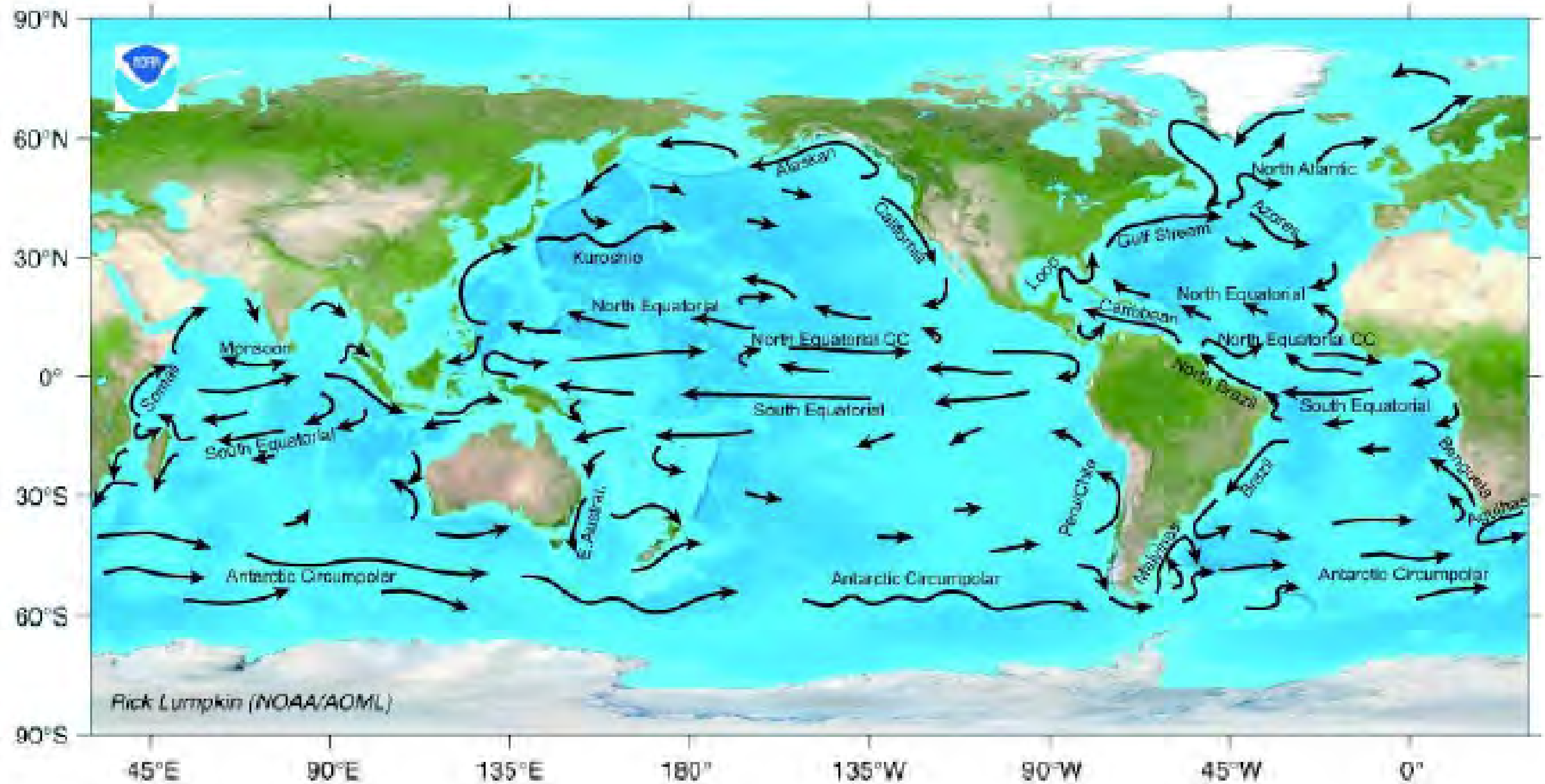
Evaluation:

The initial map predictions serve as a pre-assessment, while the revised maps should illustrate student understanding of how the Coriolis effect deflects winds and currents.

Blank Map

Name ____ Date ____

Predominant Surface Currents in the Ocean



Note: No one can predict exactly what the surface currents will do at any one time. Some surface currents shift seasonally, and others change even more frequently due to a variety of factors such as local winds and water temperatures. This image represents the best effort of oceanographers to show general trends in surface currents that have been observed over time.