RESOURCE LIBRARY
ACTIVITY : 1 HR 15 MINS

Follow the Friendly Floatees

In this activity, students follow the path of the Friendly Floatees, a shipment of 29,000 rubber ducks that spilled overboard in 1992. First, students predict where the ducks landed. Then they observe the role of the Earth's rotation in creating ocean currents. Finally, students update their *Ocean Plastics Movement Models* with real Friendly Floatees data.

GRADES

6 - 8

SUBJECTS

Conservation, Earth Science, Climatology, Oceanography, Geography

CONTENTS

3 PDFs

OVERVIEW

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For the complete activity with media resources, visit:
http://www.nationalgeographic.org/activity/follow-friendly-floatees/

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DIRECTIONS

***Plastics: From Pollution to Solutions* unit driving question:** *How can humans solve our plastic problem in the ocean?*

***Plastics, Plastics, Everywhere* lesson driving question:** *How do plastics get into and move around the ocean?*

1. Introduce students to the story of the Friendly Floatees.

- Show a rubber duck, which may be made of rubber or plastic.
- Explain the story of the Friendly Floatees: In 1992, a cargo ship in the North Pacific lost a shipping container on its way from China to the United States that spilled nearly 29,000 rubber ducks and other bath toys into the ocean.
- Show the location of the spill.
    - Project the *Marine debris map from ArcGIS*.
    - In the field that says *Find address or place* in the upper right corner, type the coordinates of the Friendly Floatees spill: 44.7 N, 178.1 E. When the point appears on the map, click the link that says *Add to Map Notes*. A marker should appear, indicating the spot.
    - On the left side of the screen, you should now see the *Content* menu, with *Map Notes* and *Major Ocean Currents* checked. (If you do not see the *Content* menu, click *Details* in the upper left corner and then select *Content*.)
    - Ensure that *Major Ocean Currents* is not checked. The only *Content* layer that should have a check is *Map Notes* showing the location of the spill. Once everything else is unchecked, zoom out so that you can see the whole map, including the pin showing the location of the spill.
- Ask students to predict, based on what they know about the movement of plastic in oceans, where these 29,000 ducks would end up.
- Tell students that although the ocean is large and always changing, there are certain predictable patterns of water movement that scientists have studied. These patterns are not perfect, and the path of the Friendly Floatees has shown us that we still have a lot to learn about ocean currents. However, one of the main forces driving ocean current patterns is the rotation of the Earth, which produces the Coriolis effect.

2. Guide students in a demonstration of the Coriolis effect through a mini-lab.

- Briefly show the *Prevailing Winds* layer of the map by finding the *Details* menu on the left side of the page, selecting *Content*, and checking the box next to *Prevailing Winds*.

- Zoom in on the Northern Hemisphere. Ask students to describe the direction of the prevailing winds. (Answer: clockwise)
- Then zoom in on the Southern Hemisphere and ask students to describe the direction of the prevailing winds. (Answer: *counterclockwise*)
- Explain that this phenomenon is known as the Coriolis effect, which students will explore through a mini-lab to see how it works.
- Distribute the *Coriolis Earth* and *Coriolis Mini-Lab* handouts.
  - First, have students cut out the Northern and Southern Hemispheres, tape them together, and stick a pencil through the poles so that the Earth can spin like a top. Before beginning the mini-lab, check students' tops to ensure that they are lined up correctly.
  - Once you have ensured that all tops are correctly assembled, tell students to complete the mini-lab according to the directions on the sheet, answering the questions as they work.
- When all groups have completed the mini-lab and worksheet, ask students to summarize the results of their investigations. Ask: *How could this information apply to the spilled rubber ducks?*
  - Possible responses: Water currents generally move clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. Therefore, spilled rubber ducks would likely follow a clockwise path since they were spilled in the Northern Hemisphere.
- Remind students that the Coriolis effect holds true for both wind and water currents.
- Add the terms *Coriolis effect* and *ocean gyre* to your word wall.

3. Prompt students to incorporate data from the *Coriolis Mini-Lab* handout into their *Ocean Plastics Movement Models.*

- Project the *Marine debris map from ArcGIS*. From the *Content* tab on the left side of the page, check the box next to *Prevailing Winds*. Ask students if this map agrees with their findings about the Coriolis effect.
- Next, check the box next to *Major Ocean Currents*.
  - First, ask students if they notice any similarities between the *Major Ocean Currents* and the *Prevailing Winds*.
    - Possible responses:

        - *Both tend to move clockwise in the Northern Hemisphere and counter-clockwise in the Southern Hemisphere.*
        - *However, there are exceptions to these general patterns, especially as water approaches the polar latitudes, both North and South.*

    - Remind students that these are only the major currents, and that the actual path of debris in the ocean can vary widely based on many other factors. Ask what other factors might affect debris as small as a rubber duck or a piece of plastic.

        - Possible responses: *waves, storms, wind, passing ships, migrating animals, tides, landforms creating physical barriers*

- Have students update their *Ocean Plastics Movement Models* with this new information.

    - Emphasize that they should depict information visually as well as verbally, including an explanation of what happens to surface water currents and why.
    - When groups have finished adding to their *Ocean Plastics Movement Models*, have them return the *Ocean Plastics Movement Models* and their *Coriolis Mini-Lab* sheets to their project folder.

- Ask students to make a final prediction using this new information about where the rubber ducks would end up.

4. Reveal the actual locations where Friendly Floatees were found.

- Show the TED-Ed video, How Do Ocean Currents Work? (4:33). After the video is finished, go back to 0:33 and pause to show the locations where Friendly Floatees have been identified.
- Ask students: *Do the actual locations of the Friendly Floatees agree with your predictions? If not, what could explain the difference between your hypothesis and the results of this natural experiment?*

    - Possible responses:

        - Other forces are not yet included in the model, including waves, storms, wind, passing ships, migrating animals, tides, and landforms creating physical barriers.
        - The forces included in this model are large and global in scale. Since rubber ducks are small, they are sensitive to much smaller, local variations in water direction.

- Add that the Friendly Floatees did not reach the east coast of the United States or the United Kingdom until the early 2000s, taking over 20 years to complete this journey.

Thousands of Friendly Floatees are assumed to be still lost at sea, with many of them presumably floating in the Great Pacific Garbage Patch—the subject of the next activity.

- Emphasize to students that while models are useful, they are also theoretical. When empirical results disagree with a model, the model is updated. Reality is generally much more complex and less predictable than the simple models that humans create. Models are meant to be simplified versions of reality; if a model were as complex as the real world, it would cease to be a model.
- As an exit ticket, ask students to summarize what they learned in this activity by answering the following questions:
  - *What is the Coriolis effect, and how does it work?*
  - *How did your Ocean Plastics Movement Model change after you learned about the Coriolis effect?*
  - *What other questions do you have about the movement of plastics in the ocean?*

Informal Assessment

Students' lab sheets, their participation in discussions, their developing *Ocean Plastics Movement Model*, and their responses to the exit ticket questions provide insights into their current understanding and ideas about oceanic circulation, and the relationships between models, data, and predictions.

Extending the Learning

Use these resources after students have developed their *Ocean Plastics Movement Model* to provide more information about the story of the Friendly Floatees and what they teach us about ocean currents.

- *'Moby-Duck': When 28,800 Bath Toys are Lost At Sea (NPR)*
- *How Lego Figures and Rubber Ducks Reveal Ocean Secrets (BBC)*

The Geography of Ocean Currents is an activity that uses these concepts to predict the impacts of major oil spills.

Ocean Currents and Climate is a video resource that relates the concepts in this activity to climate change. This will help ensure students address all components in the MS-ESS2-6 Performance expectation, as this unit does not address the connection between oceanic circulation and regional climates.

OBJECTIVES

Subjects & Disciplines

- Conservation
  Earth Science
  - Climatology
  - Oceanography
  Geography

Learning Objectives

Students will:

- Observe how the rotation of Earth affects surface ocean currents.
- Apply knowledge of current patterns to predict the destinations of floating rubber ducks.

Teaching Approach

- Project-based learning

Teaching Methods

- Hands-on learning
- Inquiry
- Lab procedures

Skills Summary

This activity targets the following skills:

- Critical Thinking Skills
  - Analyzing
  - Applying
  - Understanding

- Geographic Skills
  - Acquiring Geographic Information
  - Analyzing Geographic Information
  - Answering Geographic Questions
  - Asking Geographic Questions
  - Organizing Geographic Information
- Science and Engineering Practices
  - Analyzing and interpreting data
  - Constructing explanations (for science) and designing solutions (for engineering)
  - Developing and using models
  - Planning and carrying out investigations

National Standards, Principles, and Practices

NATIONAL GEOGRAPHY STANDARDS

• **Standard 1:**
How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information

NEXT GENERATION SCIENCE STANDARDS

• **Crosscutting Concept 2: Cause and Effect:**
Cause and effect relationships may be used to predict phenomena in natural or designed systems.
• **Crosscutting Concept 4:**
Systems and system models
• **HS. Earth's Systems:**
HS-ESS2-6. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.
• **Science and Engineering Practice 1:**
Asking questions and defining problems
• **Science and Engineering Practice 3:**
Planning and carrying out investigations

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- Paper towels
- Scissors
- Tape
- Water

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Projector, Speakers

PHYSICAL SPACE

- Classroom

SETUP

Coriolis Earth should be printed in advance on cardstock, with scissors and tape provided for students to assemble their miniature Earths. You also need a way to clean up any spilled water, such as towels and a basin or sink.

GROUPING

- Large-group instruction
- Large-group learning
- Small-group learning
- Small-group work

BACKGROUND & VOCABULARY

Background Information

In 1992, a cargo ship carrying approximately 29,000 bath toys (mostly rubber ducks) spilled in the northern Pacific Ocean. These so-called Friendly Floatees have been drifting ashore for over 20 years, sometimes in surprising parts of the world—not only Alaska, but also Hawaii, Australia, Indonesia, and Chile. By the early 2000s, a few had even been found as far away as Maine and the British Isles. It is presumed that many Friendly Floatees are still adrift at sea, including in the infamous North Pacific Gyre (the location of the so-called Great Pacific Garbage Patch). The destinations they have reached, and the time it took for them to wash ashore, have helped scientists better understand the complex dynamics of ocean surface currents.

Rubber (including both natural and synthetic rubber) and plastics are related in that both are carbon-based polymers that can be made from either plant-based materials or fossil fuels, although the vast majority currently come from fossil-based fuels. In fact, different kinds of plastics are often combined in various ratios to create materials that have hybrid properties. In general, additives in synthetic rubbers make them more flexible and stretchable at room temperature, while some other plastics tend to be harder and more brittle. Rubbers, whether natural or synthetic, are a special group of polymers known as elastomers, whose long-chain molecules have stronger chemical cross-linkages that plastics lack. Like plastics, synthetic rubber does not biodegrade, and though recycling rubber is possible, it is not always easy.

Prior Knowledge

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Recommended Prior Activities

- Autopsy of an Albatross
- Plastics Aplenty

Vocabulary

Term	Part of Speech	Definition
Coriolis effect	*noun*	the result of Earth's rotation on weather patterns and ocean currents. The Coriolis effect makes storms swirl clockwise in the Southern hemisphere and counterclockwise in the Northern Hemisphere.
decompose	*verb*	to decay or break down.
marine debris	*noun*	garbage, refuse, or other objects that enter the coastal or ocean environment.
microplastics	*noun*	piece of plastic between 0.3 and 5 millimeters in diameter.
ocean gyre	*noun*	an area of ocean that slowly rotates in an enormous circle.

For Further Exploration

Articles & Profiles

- NASA Ocean Motion: Curt Ebbesmeyer Profile
- National Geographic: Coriolis Effect

Interactives

- Plastics Adrift

Reference

- National Geographic: The Global Conveyor Belt
- National Geographic: Ocean Currents
- National Geographic: Ocean Gyre
- National Geographic: Great Pacific Garbage Patch

Websites

- Polymer Science Learning Center: All About Elastomers

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