UNIT
Adopt-A-Drifter Program

LESSON 3
Tracking a Drifter

Subject (Focus/Topic): Ocean and Atmospheric Science: Ocean Surface Currents and Climate, Ocean Observing Systems

Grade Level: 5^{th} – 9^{th} grade

Average Learning Time: 1 50-minute class for the initial investigation. Additional tracking of the buoy can be conducted on subsequent days on a daily, weekly, or monthly basis, and should take approximately 5 minutes each time.

Lesson Summary (Overview/Purpose): Students will utilize data from the *Adopt-a-Drifter* website in order to locate and track the course of a drifting buoy. Students will draw upon their knowledge of ocean surface currents to identify the current in which the buoy is traveling. Completion of this lesson and the tracking activity will help students understand ocean surface currents, ocean observing systems, and how to collect and utilize scientific data.

Overall Concept (Big Idea/Essential Question): Where will the drifting buoy go?

Specific Concepts (Key Concepts):

- Drifting buoys are part of the Global Ocean Observing System (GOOS).
- Drifting buoys collect data on sea surface temperature, sea level pressure, and ocean surface current patterns.
- Knowledge of the ocean surface currents can be used to predict the track of a buoy.
- Drifting buoys transmit data to satellites, which send them to data collection centers where they can be accessed online.

Focus Questions (Specific Questions):

- How are ocean surface currents formed?
- What are some of the ocean surface currents and where do they flow?
- What kinds of data can drifting buoys collect?
- How can we predict the track of a drifting buoy?
- How can the data from drifting buoys be used?

Objectives/Learning Goals:

- Students will use the *Adopt-a-Drifter* website to locate and track a drifting buoy.
- Students will utilize their map skills to plot data from a table onto a map.
- Students will identify the current in which the drifter is moving.

Background Information:

As parts of the Global Ocean Observing System (GOOS), drifting buoys (drifters) are small buoys that float in the water and move around the world with the ocean surface currents.

A drifting buoy consists of a floater about the size of a beach ball connected to a 15 feet long canvas drogue that hangs down in the water. There is a photograph of a drifter on the *Adopt-a-Drifter* website. The floater contains batteries and sensors that measure and record sea surface temperature and sea level pressure. The drifter data are sent to a satellite and then relayed to a land station where we can all access the data. Drifters typically last for about 400 days and they are continually being deployed around the world. The world map on the *Adopt-a-Drifter* web site shows the location of drifters around the world.

Drifting buoy data can be used to track major ocean currents and eddies (rings) globally, ground-truth data from satellites, build models of climate and weather patterns, and predict the movement of pollutants in the sea.

During the December 2004 scientific cruise of the NOAA ship, *Ronald H. Brown*, in the Pacific Ocean off the coast of Chile, teacher Mary Cook and her 8th grade students from Southside Middle School in Batesville, Arkansas, were the first to adopt a drifting buoy. They named their buoy, "Bob". The students tracked "Bob" and graphed the sea surface temperature as he drifted in the surface current of the Eastern Pacific Ocean called the Peru (Humboldt) Current.

On September 18, 2005, the global drifting buoy array became the first component of GOOS to reach its goal and to become fully implemented, as Global Drifter 1250 was deployed off the coast of Halifax, Nova Scotia, Canada. The buoy drifted for 521 days, across the Atlantic Ocean, collecting data on sea surface temperature and sea level pressure along the way. When it was retrieved on February 21, 2007, off the coast of Brest, France, all of its sensors were fully functioning.

Common Misconceptions/Preconceptions:

- A drifting buoy's sensors could not continue to collect data for a long period of time.
- We would not be able to access the data in real-time. Instead, there would be a time-lapse and the data would be need to be retrieved at a later date, thus "dated".

Materials:

- Small Scale Map of the Pacific Ocean sheet (provided)
- Large Scale Map of the Region (provided)
- Ocean Surface Currents Map sheet (provided)
- Large Scale Map Grid sheet (provided)
- Internet access: http://adp.noaa.gov/track_drifting_buoys.html

Technical Requirements:

- Access to a computer to show PowerPoint presentation.
- Student access to *Adopt-a-Drifter* website.

Teacher Preparation:

- Prepare PowerPoint presentation for viewing.
- Make copies of the Small Scale Map of the Pacific Ocean sheet, Ocean Surface Currents Map sheet, and Large Scale Map Grid sheet for each student.
- Provide students with Wrap-Up questions (can be written on board).

Keywords:

- Ocean surface currents
- Sea surface temperature
- Sea level pressure
- Global Ocean Observing System (GOOS)
- Global Positioning System (GPS)
- Latitude
- Longitude
- Drifting buoy
- Sensor
- Satellite

Pre-assessment Strategy/Anticipatory Set:

- Review the concept of ocean surface currents with students.
- Ask students why they think it is important to study ocean surface currents.
- Ask students to imagine that they are scientists. How could they collect data about ocean conditions and/or ocean surface currents? Give them time to turn-and-talk and brainstorm with a partner. Then, have them share ideas with the class. Ideas can be recorded on the board or on a flip chart.

Lesson Procedure:

1. Show the short PowerPoint presentation "What is a Drifting Buoy?"
2. Access the *Adopt-a-Drifter* website at the web address listed above. If possible, take the class to a computer lab or display the website on a projector. Model how to use the website and the following steps before having students work independently. You can decide whether you would like students to track the same drifter or different ones.
3. Have students click on a buoy number and then scroll down to click on either "map showing measurements" or "map showing drifter track dates". Under "View a Drifter Variable," have them click on "Sea Surface Temperature." Then, have them click "View Results."
4. After looking over these colorful displays and discussing the drifter's location and movement over time, have students click on the "back" button and then click on "table of measurements".
5. Instruct students to use the last line of numbers on the table of measurements to plot the drifting buoy location on the Ocean Surface Currents Map sheet. The table of measurements shows longitude, latitude, date, and temperature. The longitude and latitude numbers are written in decimal degrees. The longitude data should be subtracted from 360. A negative sign in front of the latitude number

means that it is south of the equator. For example: If lon=277.1200, then subtract 277.1200 from 360 and the longitude reading is 82.88 degrees west. If the lat= -18.2300, then the latitude reading is 18.2300 degrees south.

Procedure: Subsequent Days

1. Have students access the *Adopt-a-Drifter* website and pull up the table of measurements. They should use the data for the dates since the previous plotting.
2. On the map, have students plot the drifter's location on a daily, weekly or monthly basis. If using a small scale map, it would be best to plot the drifter once every two weeks or once a month.
3. Over the course of a few weeks, the drifter's track will develop on the map. Have students compare the drifter's track with the map of the Ocean Surface Currents and determine in which current the drifter is flowing.
4. *A fun and easy way to get a large-scale plotting of the drifter's track is to access the USGS map generator and input the data. It will construct a map of the drifter's path! Simply go to http://stellwagen.er.usgs.gov/
   Then, use the data from the *Adopt-a-Drifter* website and follow the map generator directions!

Wrap-up:

Once students plot the data, students should write the answers to the following questions independently, on a separate sheet of paper. After writing their answers, if time allows, they can discuss their ideas with the class.

1. Based on your comparison of the drifter's track and the map of Ocean Surface Currents, where do you think the drifter will be in one month? Two months? One year?
2. Can you identify in which current the drifter is located?
3. If an oil spill accident occurs near this drifter's location, where would you expect the oil to move? Are there any islands or continents nearby that would need a warning about the oil movement?

Answers will vary.

Math Extension Activity (optional):

1. Have students convert the latitude and longitude decimals to degrees, minutes and seconds. (DMS)
   - Example for converting the decimal 88.456 into degrees, minutes and seconds:
     1. Keep the 88 as the degrees.
     2. Multiply .456 by 60. This equals 27.360. Keep the 27 as the minutes.
     3. Multiply .360 by 60. This equals 21.600. Keep the 21.6 as the seconds.
     4. Final answer is 88º 27' 21.6" (88 degrees, 27 minutes, and 21.6 seconds.)
2. Using the Large Scale Map Grid sheet, have students plot a more accurate track of the drifting buoy.

Assessment and Evaluation:
Check each map to ensure that the latitude and longitude for each day has been plotted correctly. Collect the answers to the wrap-up questions and grade them based on their accuracy and correct use of scientific vocabulary and language.

Standards:

- **National Science Education Standards Addressed (Grades 5-8):**
  NSES D: Earth and Space Science
  Sub-category: Structure of the earth system
- **Ocean Literacy Principles Addressed (Grades K-12):**
  Principle 1: The Earth has one big ocean with many features.
  Fundamental Concept: c
  Principle 7: The ocean is largely unexplored.
  Fundamental Concepts: b, d, e, f
- **Atmospheric Science Literacy Principles Addressed:**
  Essential Principle 5: Earth's atmosphere continuously interacts with the other components of the Earth System.
  Fundamental Concept:
- **Climate Literacy Principles Addressed:**
  Essential Principle 2: Climate is regulated by complex interactions among components of the Earth System.
  Fundamental Concepts: A, B
  Essential Principle 5: Our understanding of the climate system is improved through observations, theoretical studies, and modeling.
  Fundamental Concept: B
- **State Science Standard(s) Addressed:**
  Will differ depending on your state

Additional Resources:

Websites:

Ocean Literacy Principles -
http://www.coexploration.org/oceanliteracy/scopeandsequence/publicreview/index.html#cfds

Climate Literacy Principles –
http://www.climate.noaa.gov/index.jsp?pg+/education/edu_index.jsp&edu=literacy

Atmospheric Science Literacy Principles – http://eo.ucar.edu/asl/

Adopt-a-Drifter Program – http://www.adp.noaa.gov
Tracking Page – http://www.adp.noaa.gov/track_drifting_buoys.html

University of Southern California (USC) Earth Sciences –
http://earth.usc.edu/~stott/Catalina/Oceans.html

Smithsonian Ocean Planet –
http://seawifs.gsfc.nasa.gov/OCEAN_PLANET/HTML/oceanography_currents_1.html

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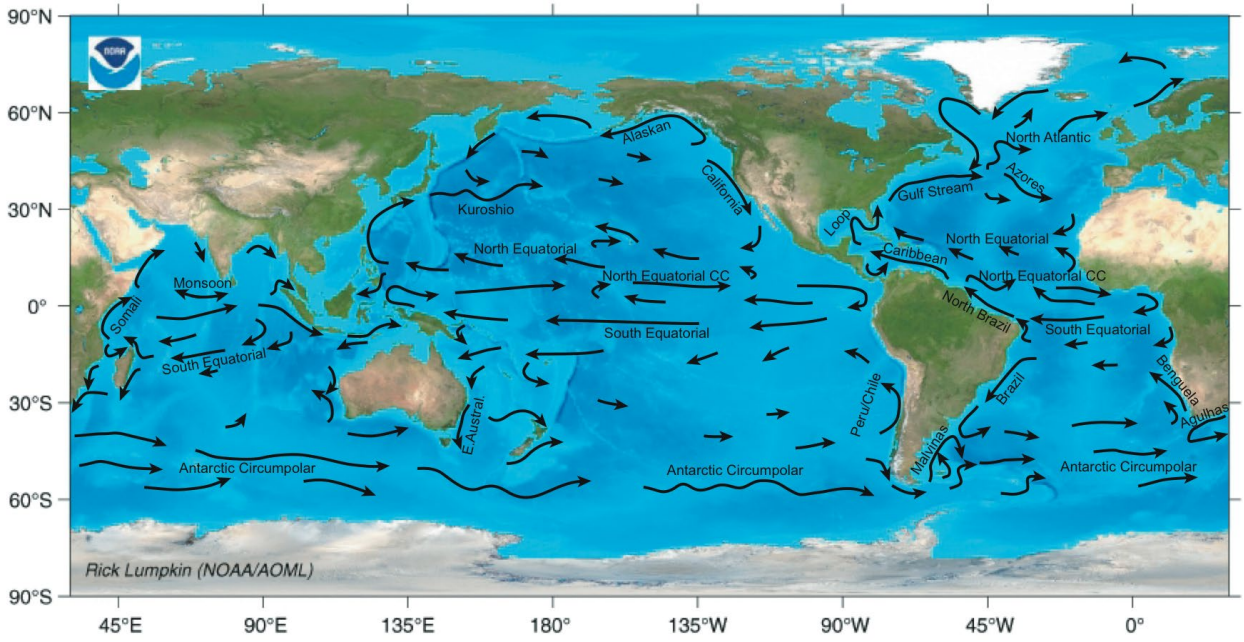
Name_____

Ocean Surface Currents Map



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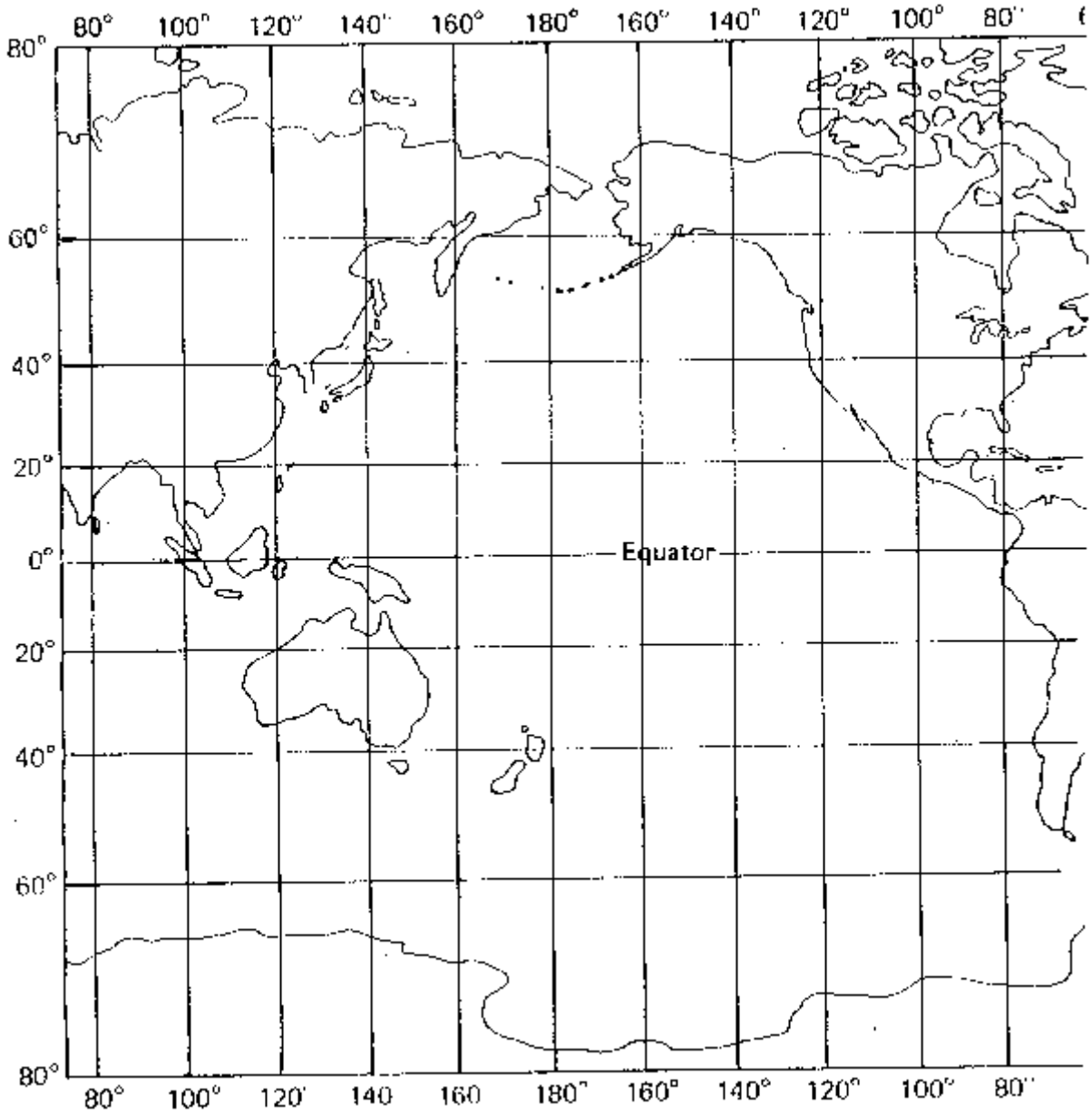
Gathering and Recording Data

Small Scale Pacific Ocean Map



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Gathering and Recording Data

Large Scale Map Grid

*This grid can be used to represent one-half degree with 30-minute divisions OR one-half minute with 30 second divisions.