Title: Drifting Forward

Subject: Earth Science, Technology

Grade Level: High School

Average Learning Time: 2 – 3 class periods

Summary: Students will use actual data from the NOAA Global Drifter Buoy program to learn how ocean currents work.

Overall summary: How do drifter buoys provide information for tracking data of weather and climate patterns worldwide?

Specific concepts:

- Latitude/longitude
- Ocean currents
- Data sets and output
- Map reading
- Average distance

Objectives: Students will be able to use the Global Drifter Buoy data to plot the latitude and longitude of a buoy's track and find the average distance the buoy travels in a specific amount of time. Students will use this information and information learned about ocean currents to estimate the buoy's future track.

Background information:

Introduce students to the Global Drifter program and what a global drifter buoy is used for - http://www.adp.noaa.gov/teacher_background.html. The Adopt a Drifter Buoy was established in 2004, it is a program that allows teachers the educational opportunity to participate in data collection from the buoys' ocean observations. The drifter buoy is equipped with GPS and meteorological and/or oceanographic sensing instruments that are linked to satellites. Drifter buoys are used worldwide to track ocean currents and eddies and are used to model climate and weather patterns, predict the movement of pollutants, and aid in the forecast of approaching hurricanes.

Materials:

Computer

Outline map of the East Coast of the US (Google earth)

Technical requirements: Internet access

Teacher preparation:
1. A variety of drifter buoys can be used from the site:
http://www.adp.noaa.gov/track_drifting_buoys.html
Teachers can choose one of these (instead of the one listed below), but need to get the WMO ID # for the buoy that is used (can be found by clicking on the serial number). This buoy needs to be tested on the drifter buoy website listed below (http://www.aoml.noaa.gov/phod/trinanes/xbt.html). It is important that you put in the date of start, and highlight the approximate location of where the buoy was launched on both the large and small map. Also make sure that the Data Set: GTS Buoys and Platform # (WMO ID#) is choosen.
2. Teachers may want to print out a map for students to use to plot the latitude/longitude of the drifter buoy. Google maps can be used for this.

Procedure:

1. Go to the drifter buoy website:
http://www.aoml.noaa.gov/phod/trinanes/xbt.html

2. Choose Data Set: GTS Buoys and Platform # 44932
Highlight the East Coast of the US on both the large and small map
Make sure you put the Initial date as: June 19, 2013
Click Go

3. To Zoom in highlight this area again and click Go.
Do this several more times to get a close up picture of the Buoy's track.

4. Make a table with the following information: Dates, Latitude/Longitude Point 1, Latitude/Longitude Point 2, Latitude/Longitude Point 3, Distance traveled. Under this table put Average Nautical Miles traveled.

Dates	Point 1 – Latitude/ Longitude	Point 2 – Latitude/ Longitude	Point 3 – Latitude/ Longitude	Distance Traveled

Average Nautical Miles Traveled = _____

5. On your map outline draw in the grid boxes you see near the buoy track. Horizontal lines are latitude and vertical are longitude. Make sure you include the Number and Direction (N or S and E or W).

6. Click on the dot that indicates where the buoy started. Record the latitude/longitude on your table and plot this point on your map. Pick a specific color for this time period and indicate this on your map's key. Find 2 more points for this time (one in the middle and then a point at the end of this day), record their latitude/longitude on your table and plot these in the same color. Use an arrow to indicate the direction that the buoy is moving. Arrow should go in the direction of day you are plotting to the next day's track.

7. Continue to do the same for at least 5 different time periods that the buoy has been deployed. Make sure that you use a different color for each one and put this in your key. Also you must include the last day that it moved. Continue to put in arrows to show its direction of movement.

8. Now you will find the number of Nautical Miles the buoy went for each time period. Go to: http://www.nhc.noaa.gov/gccalc.shtml

- You will input the Point 1 and Point 3 for each time in the Latitude/Longitude Calculator.
- Hit compute and record the distance in Nautical Miles (nm) on your table.

9. Now find the average number of Nautical Miles your buoy travels per time period and record this on your table (remember average is found by adding each distance traveled and dividing by how many dates you have).

10. Go to: http://www.oscar.noaa.gov/datadisplay/oscar_latlon.php
Put in the range of Longitude and Latitude for the buoy (add 10-20^{o} for both).
Put in the date range of the buoy.
Generate Plot

- Find the currents that are closest to our buoy and put these on your map
- Use arrows to indicate the directions of the currents near the buoy (choose a color you have not used and indicate this in your key).

10. Based on your graph, the average number of nautical miles that the buoy travels per time period, and the ocean currents hypothesize where you think the buoy will travel during the next amount of time on your map. Use a dotted line to show the route on your map.

11. Indicate below why you believe it will travel this route:

12. Go back next week and see if you were correct. Put the actual route on your map. How close was your prediction to the actual route the buoy went?

13. What surprised you about this route?

Assessments: Student's data table and map will be evaluated to make sure it corresponds to the correct latitude/longitude of buoy. Make sure that the hypothesized route corresponds to ocean currents and previous routes of this buoy.

Standards:

Next Generation Science Education Standards:
HS-ESS1 Earth's Place in the Universe
HS-ESS2 Earth's Systems
HS-ESS3 Earth and Human Activity
HS-PS2 Motion and Stability: Forces and Interactions
HS-PS3 Energy

Ocean Literacy Principles:

- **The Earth has one big ocean with many features.**

c. Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of the Earth's rotation (Coriolis effect), the Sun, and water density differences. The shape of ocean basins and adjacent land masses influence the path of circulation. This 'global ocean conveyor belt' moves water throughout all of the ocean's basins, transporting energy (heat), matter, and organisms around the ocean. Changes in ocean circulation have a large impact on the climate and cause changes in ecosystems.

- **The ocean is a major influence on weather and climate.**

A. The ocean controls weather and climate by dominating the Earth's energy, water and carbon systems.

- **The Ocean is largely unexplored.**

D. New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

E. Use of mathematical models is now an essential part of ocean sciences. Models help us understand the complexity of the ocean and of its interaction with Earth's climate. They process observations and help describe the interactions among systems.

Arizona Standards:
Strand 1: Inquiry Process
Concept 1: Observations, Questions, and Hypotheses
Concept 2: Scientific Testing (Investigating and Modeling)
Concept 3: Analysis, Conclusions and refinement
Strand 3: Science in Personal and Social Perspectives
Concept 2: Science and Technology in Society
Strand 6: Earth and Space Science
Concept 2: Energy in the Earth System (Both Internal and External)

Additional Resources:

http://www.adp.noaa.gov/
http://www.aoml.noaa.gov/phod/dac/index.php
http://www.oscar.noaa.gov/

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Drifter Buoy Map - #44932