# Ocean Currents Activity Key

*** For ease of use during class the Teacher Key pages are numbered the same as the Student Activity Book pages.

## I. Introduction

Ocean currents influence the weather in coastal areas. They also influence sailing vessels. Though they visibly affect many people's lives, they are invisible. To be able to map and predict currents, we have to release floating buoys and keep track of their positions.

This activity will introduce you to the information that these buoys collect for us.

### Get Info Objectives

1. Relate direction given in degrees to compass direction
2. Describe floats used in ocean current research.
3. Estimate current speed from scaled graphical representations.

### Gather Data Objectives

1. Interpret graphs of current speed and direction.
2. Determine the relationship between current speed and depth.
3. Explain how Global Positioning System-equipped drifters send more useful information than buoys without GPS.

### Application Objectives

1. Describe currents' effects on coastal weather.
2. Describe currents' effects on sailing vessels.
3. Describe currents' effects on sea life.

Before doing anything else, add the NOAA Research "Ocean Currents" page to Bookmarks or Favorites on your browser.

- From the Ocean Currents main page, click "Get Info."

# II. Get Info

## A. Current Meter Floats

- Click on the "Lagrangian Drifter Float" site.

1. What five sensors are attached to a Lagrangian Drifter?

Barometer, submergence sensor, irradiance meter, sea surface temperature recorder, conductivity sensor;

2. What do the sensors measure?

Barometers measure atmospheric pressure; submergence sensors indicate if the buoy is underwater; irradiance measures sunlight intensity; sea surface temperature recorders measure the water temperature; conductivity sensors measure the salinity of the water.

- Click "Back" to return to the Ocean Currents "Get Info" web page.

## B. Interpreting Graphical Current Marks

- Click on the "Average Atlantic Current Velocity" site.

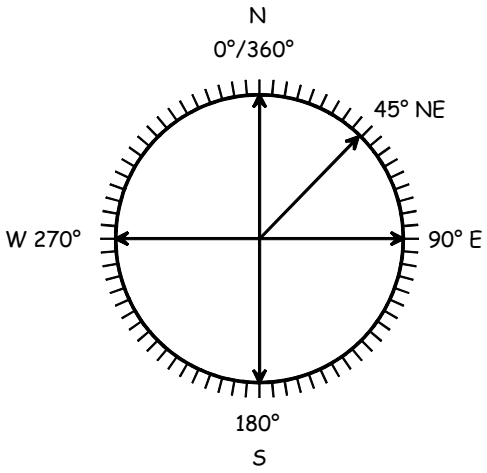
1. At what latitude range is the current strongest? 40 N to 50 N
2. Use the legend at the top of the graph and a metric ruler to measure the strongest current. About how fast is the current?

30 centimeters/second

- Click "Back" to return to the Ocean Currents "Get Info" web page.

## C. Numerical Compass Directions

Ocean current information is given as current speed and current direction. The direction is not shown as north, south, east or west. It is given as a number. A circle has 360 degrees. Refer to the picture below to understand how the numbers relate to compass directions. A compass direction of north is given as 0 degrees. A current from the east is given as 90 degrees. A current from the south is given as 180 degrees. A current from the west is shown as 270 degrees. Northeast would be 45 degrees.




- Click "Back" to return to the NOAA Research "Oceans Currents" main page, or click "Return" at the bottom of the page.

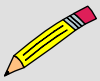
- Click "Gather Data."

# III. Gather Data

## A. Current Speed and Direction vs. Depth

The World Ocean Circulation Experiment (WOCE) made observations using current meter moorings as part of a large climate research study. In the following section you will be using data from WOCE site ACM7 off the coast of Brazil.

- Click to see the map of all the mooring sites.
- Click "Back" to return to the Ocean Currents "Gather Data.1" web page.
- Click the "WOCE CURRENT METER DATA" site.
- Click on "ACM7 - Equatorial Atlantic."
- Find mooring K327 at 100 meters depth and click "view metadata."



1. Fill in the missing information in Chart 1 below.

### Chart 1

| Mooring Name | K327 | K340 | K341 | K360 | K361 |
|---|---|---|---|---|---|
| Depth of Current Meter | 100 m | 50 m | 50 m | 100 m | 50 m |
| Seafloor Depth | 545 m | 3340 m | 4108 m | 3660 m | 4110 m |
| Mean (average) Current Speed | 103 cm/ sec | 92 | 38.5 | 86 | 47 |
| Mean Degrees of Current Direction | 312 | 306 | 235 | 330 | 290 |
| Mean Compass Current Direction (N, S, E, W) | NW | NW | SW | NNW | WNW |
| Latitude/ Longitude | .087 N 44.39 W | .420 N 44.25 W | 1.55 N 44.01 W | .617 N 44.17 W | 1.186 N 44.04 W |

- Click "Back" to return to the data tables.
- Scroll to the next table.
- Find mooring K340 at 50 meters depth and click "view metadata."

2. Fill in the missing information in Chart 1 in the activity book

- Click "Back" to return to the data tables.
- Scroll to the table with mooring K341 at 50 meters depth and click "view metadata."

3. Fill in the missing information in Chart 1 in the activity book

- Click "Back" to return to the data tables.
- Scroll to the table with mooring K360 at 100 meters depth and click "view metadata."

4. Fill in the missing information in Chart 1 in the activity book

- Click "Back" to return to the data tables.
- Scroll to the table with mooring K361 at 50 meters depth and click "view metadata."

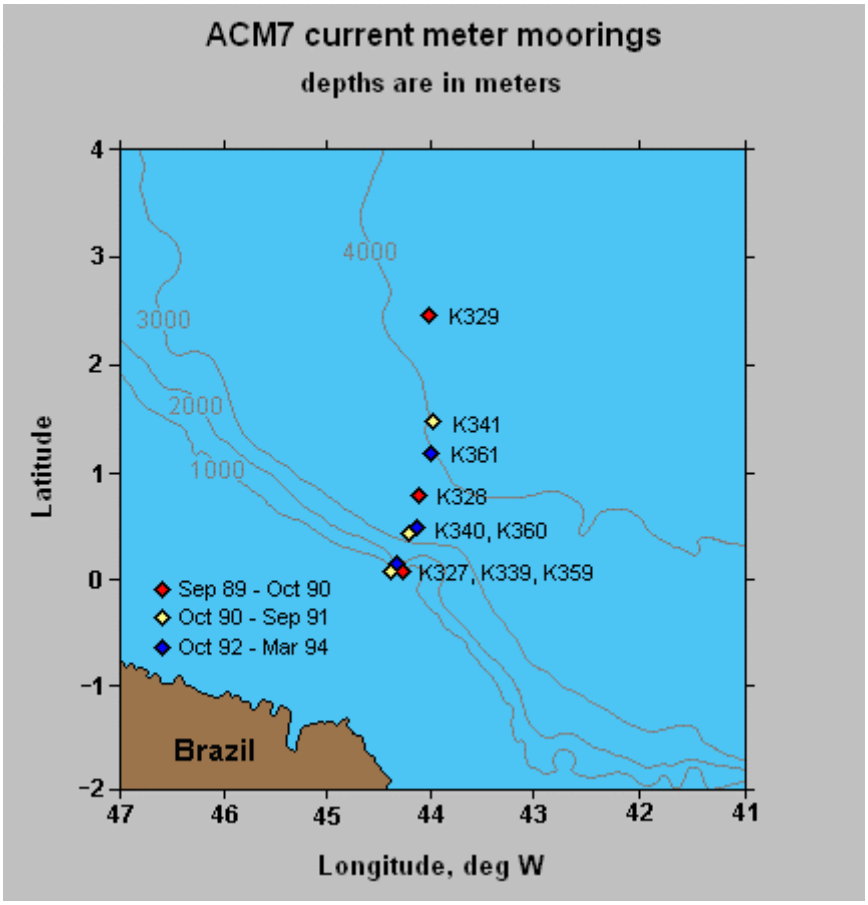
5. Fill in the missing information in Chart 1 in the activity book

- Click "Back" to return to the Ocean Currents "Gather Data.1" web page.

- Click "Forward" at the bottom of the page.

- Use Chart 1 and the map of the Brazilian coast to help you complete the following activities.

6. On the map, draw arrows showing the direction of the current. The arrowheads should point in the direction the current flows <u>from</u> the station.



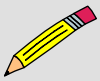

7. What is the relationship between seafloor depth and current speed?

The greater the depth, the slower the current.

8. Does the current seem to flow only along the shore, out to sea, or into the shore? along the shore

## B. Open Ocean Current Speed and Direction at 45 Meters

- Click on the "Tropical Atmosphere Ocean Array 45 Meter" site. (Current speed is shown as centimeters per second on the vertical scale.)
- Look at the top graph.



1. What month has the greatest current speed? __May_____
2. What season shows the greatest current speed? __Summer__

- Look at the bottom graph.

3. What season shows the least variation (change) in direction of current flow? __Summer___
4. What is the compass direction of flow during this season? _East_
5. Write the average current speed in June at 45 meters in Chart 2 below.

- Write the number that best fits the graph during June. The graph will not be a straight line, so use a best estimate of the average directions and speeds.

6. Write the average current direction in June at 45 meters in Chart 2 below.

- Click "Back" to return to the Ocean Currents "Gather Data.2" web page.
- Click "Forward" at the bottom of the page.

Chart 2

| Depth | Average June Current Speed | | Average June Current Direction | |
|---|---|---|---|---|
| | | | degrees | compass |
| 45 m | 75 | cm/sec | 100 | East |
| 160 m | 20 | cm/sec | 150 | SSE |
| 250 m | 25 | cm/sec | 200 | SSW |

## C. Open Ocean Current Speed and Direction at 160 Meters

- Click on the "Tropical Atmosphere Ocean Array 160 Meter" site.
- Look at the top graph.

1. Write the average current speed in June at 160 meters in Chart 2 above.

- Look at the bottom graph.

2. Write the direction of current flow in June at 160 meters in Chart 2 above.

- Click "Back" to return to the Ocean Currents "Gather Data.3" site.

## D. Open Ocean Current Speed and Direction at 250 Meters

- Click on the "Tropical Atmosphere Ocean Array 250 Meter" site.
- Look at the top graph.

1. Write the direction of current flow in June at 250 meters in Chart 2 above.

- Click "Back" to return to the Ocean Currents "Gather Data.3" web page.

## E. Interpreting Data in Chart 2

1. Is there a relationship between depth and current speed? If so, what is it?

Faster currents are towards the top of the water.

2. Is there a relationship between depth and current direction? If so, what is it?

As you go deeper, the current shifts more to the south and west

## F. GPS-Upgraded Drifters

- Click on the "Global Positioning Satellite Tracking" site.
- Scroll down to the second picture.
- Read the paragraph between the second and third pictures.

1. What advantage is there to running the drifter's transmitter more often?

The data showed many small-scale features that were missed by the one-day-on,/ two-day-off "1/3" duty cycle of traditional drifters.

- Click "Back" to return to the NOAA Research "Ocean Currents" main page, or choose "Ocean Currents" from your Bookmarks or Favorites.
- Click "Application."

# IV. Application

## A. Ocean Currents' Effects

1. How do you think the temperature of an ocean current could affect weather on the coast?

Answers may vary. A cold current would cool the air near the shore, and a hot current would warm the air near the shore.

2. How do currents affect sailing ships?

Sailing ships can use ocean currents to help them move. This is particularly useful when there is no wind.

## B. Ocean Currents and Marine Life

1. How could ocean currents affect microscopic marine life?

On one hand, cold currents cool organisms and make them slow down. On the other hand, cold currents from the floor of the ocean bring nutrients to the surface so phytoplankton (microscopic plants) can grow and become food for animals.

2. How could ocean currents affect large marine creatures such as whales?

If whales have to go against the current, they use more energy than they would going in the direction of the current. Whales are large so they have to use a great deal of energy to stay afloat.

- Click "Back" to return to the NOAA Research "Ocean Currents" main page, or choose "Ocean Currents" from your Bookmarks or Favorites.
- Click "Enrichment."

## V. Enrichment

### A. Research

1. Research "density currents." Relate density currents to "upwelling."

2. Find out how upwelling is related to El Nino.

3. Research the different types of sailing vessels used by traders in the 1500's through the 1900's. How did the materials used to build the vessels change? How did the navigation change?

4. Research "doldrums" and "horse latitudes." Why were these areas named this way?

## B. Related Web Sites

1. Tropical Atmosphere Ocean Project
   http://www.pmel.noaa.gov/tao/index.shtml

2. OSU Buoy Group
   http://kepler.oce.orst.edu/

3. World Ocean Circulation Experiment Global Data Resource
   http://woce.nodc.noaa.gov/wdiu/

4. TAO Mooring Information
   http://www.pmel.noaa.gov/tao/proj_over/mooring.shtml

5. Ocean Surface Current Analyses – Realtime (OSCAR)
   http://www.oscar.noaa.gov/