Ocean in Motion

The aim of this activity is to explore how currents affect a coral reef at a local level.

You will experiment in the field measuring current flows at different tides, along with water and wind conditions, to gain a better understanding of how currents behave and can influence marine life.

Time

One day (including low, mid and high tide)

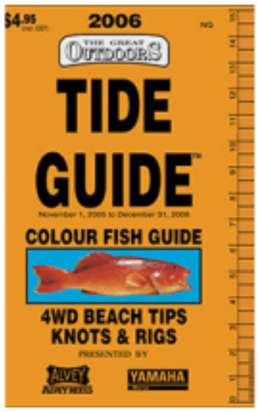
Tools

- GPS (optional)
- Compass
- Measuring tape
- Oranges
- Stop watch
- Sample jars
- The Beaufort Scale
- Water quality testing kit
- Silver chloride/potassium cromate dropper test for salinity
- Thermometer
- Tide charts
- Graph paper

Background

Tides, wind and coastal topography determine the direction and speed of local currents, which affect water temperature, salinity, nutrients and oxygen levels in an area. You can easily see and measure these changes in flows and determine how they affect you and other species. Predicting water flows is useful for determining whether conditions are good for a snorkel or perhaps better suited for a reef walk. For the plants and organisms that live within the intertidal zone of our shores, the changing nature of water flowing around them presents immense challenges and opportunities in the continuous struggle to survive. The fish move with the ebb and flow of the tide, while other organisms, restricted in their movement, employ a series of strategies to cope with an environment always in motion.

Large ocean currents are determined by the same factors as local currents, as well as the rotation of the planet, differences in salinity and sea surface temperatures and weather patterns around the globe.



You can look up local tides in the newspaper, on the web, in tide table booklets or software.

Field activity

1. During this activity, measurements will be taken at a low tide, mid tide and high tide at one location. Which order these are done in will depend on the tide times on the day of the investigation. All measurements need to be recorded in the 'Current and tide comparison table'.
2. Stand on the shore of a coastal zone, draw a line in the sand and fix your position using a GPS, if available.
3. Measure the speed of the current:
   a. throw three oranges into the water at the same time and start a stopwatch
   b. walk down the shore, parallel to the water, until you have reached a distance of 20m (or similar)
   c. record the time it takes for each orange to reach you and use these results to calculate the speed of the current
4. Use the compass to find the direction of the current.
5. Use the Beaufort Scale to find the strength of the wind.
6. Use the thermometer to measure the air temperature on shore.
7. Use the thermometer to measure the water temperature at the shoreline.
8. Collect a sample of seawater in a bucket, or something similar.
9. Using a Hach Test Kit (or similar brand) test for the following factors:
   a. pH
   b. dissolved oxygen
   c. phosphorous
   d. nitrogen
10. Test for salinity levels using the silver chloride/potassium cromate dropper test (or similar).
11. Draw a sketch of the area you are studying and draw the current direction during low and high tide.

Teacher Hint
Laminate the Beaufort Scale to take in the field

Direction of currents map

Current and tide comparison table

Observer(s):

Location: Date:

Weather conditions: windy / calm / cloudy / sunny

Abiotic factor	Low tide Time: Tide Height: Direction:	Mid tide Time: Tide Height: Direction:	High tide Time: Tide Height: Direction:
Current speed s=d/t	1. 2. 3. Average:	1. 2. 3. Average:	1. 2. 3. Average:
Air temperature			
Water temperature			
Wind speed (Beaufort Scale) and direction			
pH			
Dissolved oxygen (mg/L)			
Phosphorous (mg/L)			

Beaufort Scale

0	Calm	1 knot Sea like a mirror.
1	Light air	1-3 knots Ripples with the appearance of scales, no foam crest.
2	Light breeze	4-6 knots Small wavelets. Crests do not break.
3	Gentle breeze	7-10 knots Large wavelets. Crests begin to break. Scattered horses.
4	Moderate breeze	11-16 knots Small waves becoming longer. Fairly frequent white horses.
5	Fresh breeze	17-21 knots Moderate waves. Many white horses. Some spray.
6	Strong breeze	22-27 knots Large waves. Extensive white foam crests. Spray.
7	Near gale	28-33 knots Sea heaps up. White foam begins to be blown in streaks.
8	Gale	34-40 knots Moderate high waves. Crests begin to break.
9	Strong gale	41-47 knots High waves. Dense streaks of foam. Crests begin to roll over. Spray may affect visibility.
10	Storm	48-55 knots Very high seas. Tumbling sea. Surface mostly white. Visibility affected.
11	Violent storm	56-63 knots Exceptionally high waves. Small and medium vessels sometimes lost to view.
12	Hurricane	>64 knots Air filled with foam and spray. Sea completely white. Visibility very seriously affected.

Classroom activity

1. During this activity you will create graphs to show how the physical parameters you have measured change over time. Use different symbols or colours for each different parameter and ensure you label them accurately.
2. Use graph paper or a spreadsheet to plot:
   a. current speed versus time
   b. nutrients: dissolved oxygen, phosphorous and nitrogen levels, in milligrams per litre (mg/L) versus time
   c. temperature versus time
   d. pH versus time
3. Compare the graphs and look for trends or patterns in the data.

Questions

1. What relationship can be seen between the currents and water temperature?
2. Explain the variations that exist in the data between current speed and the nutrient concentrations.
3. What causes the fluctuations in the dissolved oxygen and pH over the duration of the tide?
4. What conclusions can be drawn about the ocean currents on a local level and the distribution of the nutrients on the reef?
5. Why do scientists use this set of analyses to assist them in determining the health of a coral reef?
6. What other data would be required to gain a better understanding of the health of a coral reef?
7. How can fishermen use these data to their advantage?
8. Predict which direction the tide will be flowing at the same site at 12:00pm in 1 day, 2 days and 10 days time.
9. Provide the time(s) and height(s) of high tide on March 1st and October 1st this year.

Research

1. Propose how you would undertake the same process on a regional basis and why this would be important.
2. What advantages are there in linking this information with satellite data of land use patterns?
3. How are currents tracked on a global scale?

References

Reid et al. (2009) Coral Reefs and Climate Change: The guide for education and awareness. CoralWatch, The University of Queensland, Brisbane. (See Rhythm and Flow page 44, Breath of Wind page 48 and Current Connections page 52)

Current Publishing (2006) Life on an Ocean Planet. Current Publishing Corp., California

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