name/date/period

Lab-Where'd the Reef Go?

(Modified from International Geosphere-Biosphere Programme)

Ocean Acidification – The Other CO_2 Problem

The world's oceans are at risk of becoming too acidic to support coral reefs and certain marine life, and a substantial reduction in CO_2 emissions is urgently needed to stem the dramatic rise of acidification, according to research presented at The Second International Symposium on the Ocean in a High CO_2 World. The meeting was co-sponsored by the International Geosphere-Biosphere Programme, UNESCO-IOC, the Scientific Committee on Oceanic Research, and the International Atomic Energy Agency. "The ocean is sick, and one of its problems in ocean acidification," said James Orr, chairman of the symposium's International Scientific Planning Committee. The ocean has provided an important buffer to higher concentrations of CO_2 in the atmosphere by soaking up 4 kg of the 11 kg of greenhouse gas produced by the average person every day. But once it mixes with seawater, CO_2 dissolves, converts to carbonic acid, and makes the oceans increasingly acidic. As CO_2 emissions rise, so does the acidity of the ocean. The ocean acidity level has already increased by 30% since the onset of the industrial revolution, with half of that increase occurring in the last 30 years. The increased acidity is adversely affecting the capability of marine corals and shell-forming organisms to build their skeletal material. It may also be affecting the developmental lifecycles of marine life, reducing growth, production and life spans. This is bad news for fish stocks, which are already stressed by overfishing and warmer sea temperatures. Research presented at the symposium underscores the notion that ocean acidification is happening now and is measureable. Evidence supporting this fact includes:

- Shell weights of pteropods (small plankton) are decreasing
- Calcification rates for coral reefs are decreasing
- Ecosystems located near hydrothermal vents (which emit high levels of CO_2 naturally) have experienced a total loss of some species and reduced biodiversity, providing a glimpse of what may happen on a much larger scale if the rate of ocean acidification continues at its current pace
- Controlled laboratory experiments on the effect of ocean acidification on certain calcifiers (organisms that form their own shell) showed that the organisms could not adapt to a more acidic environment even after 150 generations
- Ocean acidification impacts underwater sound by increasing noise levels, particularly at shallow depth. This impacts echolocation in marine mammals which migrate through those depths.

A key message from the symposium is that ocean acidity is expected to increase to the point where marine corals and other shell forming organisms will actually start to dissolve by the middle of the century. The only way to slow the trend of ocean acidification is substantial and urgent reductions in CO_2 emissions. Prince Albert II of Monaco, whose environmental foundation provided support for the symposium, attended a special session devoted to raising awareness of ocean acidification amongst policy makers and the general public. He re-affirmed his foundation's commitment to supporting the scientific community's research efforts. "Only by working together will we be able to move this important issue forward," he said.

Prelab questions:

1. Why is studying ocean acidification important?
2. How does ocean acidification affect marine organisms?
3. How could ocean acidification affect human populations?
4. How can ocean acidification be slowed or reversed?

The experiment:

a. Add 150 mL of water to a 250 mL beaker.
b. Test the pH of the water using pH paper. Trial 1 INITIAL pH = _____
c. Using a straw, blow bubbles into the water for 10 minutes.
(share this responsibility to ensure that no one passes out)
d. Test the pH of the water again using pH paper. Trial 1 FINAL pH = _____
e. Empty water into the sink.
f. Add a fresh 150 mL of water into the 250 mL beaker.
g. Add 25 mL of crushed coral to the beaker.
h. Test the pH of the water using pH paper. Trial 2 INITIAL pH = _____
i. Using a straw, blow bubbles into the water for 10 minutes.
(share this responsibility to ensure that no one passes out)
j. Test the pH of the water again using pH paper. Trial 2 FINAL pH = _____
h. Empty water into the sink and coral into the designated container.

Postlab questions:

5. What gas are you exhaling into the water?
6. What happened to the pH of the water during trial one? Why do you think this happened?
7. Describe the anticipated difference between trial one and two chemically.
8. What happened to the pH of the water during trial two? Why do you think this happened?
9. What happened to the crushed coral during trail two?
10. Explain differences between this experiment and what happens in the real world.
11. How does ocean acidification affect corals reefs?
12. How can ocean acidification be slowed?