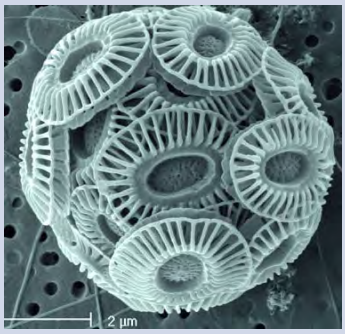
Marine Osteoporosis



Grade Level

- 5th - 8th

Timeframe

- 2- 45 minute lessons
- Observation time - 3 hours
- *Experiment 1*: Students will record observations every 30 minutes for 2-3 hours (but can complete other work in between recordings)

Materials

- Computer(s) and projector
- Internet connection
- Acid Test video and worksheet (video available online by clicking here or visiting http://www.nrdc.org/oceans/acidification/aboutthefilm.asp
- Sanctuary Encyclopedia DVD

Activity Summary

In this lesson students will explore the effects of acidic oceans on certain marine organisms, in the ocean food web, and to humans. Students will conduct a science experiment using the scientific method to see the effects of increased acidity on certain species. They will also investigate the causes for increased ocean acidity and discuss ways to minimize the impact as an individual and as a society.

Learning Objectives

Students will be able to:

- Use the scientific method to hypothesize, test, record, and make conclusion on the effects of acidity on certain marine organisms.

Background Information

The process of ocean acidification (the decreasing pH of the ocean water) affects the organisms living within those waters. Many organisms use various forms of calcium carbonate to form their shells and skeleton. The increasing acidity of the water affects these organisms. As CO_2 is absorbed into the water the resulting chemical process reduces the amount of available carbonate ions used to by organisms to create their shells and skeleton. In addition to reducing the available carbonate ions the decreased pH makes the ocean water more corrosive.

Some of the organisms most immediately affected by ocean acidification include: sea urchins, abalone, corals, and some species of plankton (such as pteropods and coccolithophores). If the ocean water continues to grow more acidic these organisms will be unable to form their shells and grow. The loss of these organisms will greatly impact the marine food web.

Plankton is at the base of the marine food web. Plankton are organisms that cannot swim against the current. Some plankton are algae and some are animals. Phytoplankton (algae-plankton) include coccolithophores and zooplankton (animal plankton) include pteropods. Planktonic feeders include bivalves (mussels, clams, scallops, and oysters), sand crabs, and anchovies. Baleen whales, such as blue whales, are also planktonic feeders. As the base of the marine food web plankton are incredibly important. If oceans become inhospitable to plankton the removal of that portion of the marine food web could result in disaster to many other marine species.

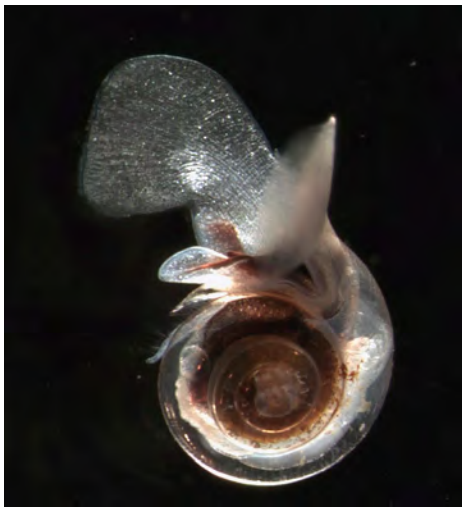
The increasing acidity of the ocean also has an effect on habitat. Coral reefs provide habitat for a large and diverse number of organisms. Many species of fish and invertebrates inhabit coral reef. If the coral can no longer successfully grow at optimum rates they will not be able to maintain the reef. Without the reefs the biodiversity of the ocean will decrease.

Ocean acidification may also affect important fisheries. Sea urchins, crabs, lobsters, and shrimp all use calcium carbonate to create their shells and skeletons. These are very important fisheries worldwide. A loss in species population would not only affect the marine food web, but would also affect the availability of food for humans as well as a means of livelihood for many people worldwide.

Teacher Preparation/ Materials

Experiment 1:

- Small dishes (petri dishes, Tupperware dishes)
- Tap water
- Vinegar
- pH meter or strips (pH strips are sold at pet stores and aquarium stores. You may also purchase online at Carolina Biological – www.carolina.com search for pH universal strip)
- Shells, piece of dead coral, urchin test (skeleton), chicken bones – chalk will work as well, but to make the connection more powerful it is better to use a shell/skeleton of an organism (If you have a personal collection of shells you can use those or your local marine science center may have a collection of shells that they can distribute for classroom use).



Experiment 2:

- 1-liter bottles or containers with lids
- Water (tap and carbonated)
- Chicken bones, clam shells, urchin tests, small abalone shells, other snail shells, piece of coral skeleton

Learning Procedure

1. Acidity Activity

Experiment 1: Classroom Experiment

*To vary the experiment teachers may instruct students to test different items in the liquids (i.e. one team tests clam shells, another tests urchin tests, student groups may be allowed to decide which item they would most like to test). Then students can present their findings to the rest of the class at the end.

1. Fill one dish with tap water and the other dish with vinegar
2. Hypothesize what the pH of each substance will be and justify your answer
3. Measure and record the pH of both substances
4. Hypothesize what will happen when the item is immersed in each liquid. Justify your answer
5. Record initial observation of the item(s) to be immersed in the fluids
6. Record observations at 30 minute intervals
7. Draw conclusions from your observations
8. Create a graphic representation of your results and present it to the class

Note: Graphic representation may be a picture (or series of pictures, a graph (y-axis = time elapsed, x-axis = dissolution of item i.e. strong, slightly strong, slightly weak, weak, very brittle, breakable)

KEY VOCABULARY

- Ocean acidification
- Corrosive
- Dissolve
- Argonite
- Calcite
- Foraminifera
- Colithophore
- Calcareous,
- Pteropod
- Mollusk
- Echinoderm

Experiment 2

1. Place small chicken bones or small pieces of shell into 2 1-liter bottles (1 containing tap water and the other containing carbonated water)
2. Hypothesize what will happen in the 2 containers
3. Record observations (in writing and by sketching) each day
4. After the items have started to react to the carbonated water have students review their hypothesis and determine whether it was correct

2. View the short video Acid Test

Discuss the video and answer questions about it.

ASSESSMENT

Students will use the scientific method to form a hypothesize of the causes of ocean acidification and how it affects marine organisms

1. Go to http://virtualurchin.stanford.edu/
2. Click on the Acid Ocean button and click through the 10 informational pages
3. On the How To page click on the "To proceed to Part 2" button on the top right of the page to enter the Acid Ocean interactive lab
4. Follow the additional instructions to complete the interactive lab
    a. Math Extensions: Have students graph data on paper as they gather it online. Have students determine not only the average but other stats such as: mean, median, and mode)
    b. Visual Art Extensions: Have students sketch the urchin larvae
5. Allow students to explore the other interactive tutorials
6. Journaling: Write down some ways that you personally contribute to the increase in CO_2 emissions. Write specific changes you can make in your life to reduce your contribution to the CO_2 emission problem.

EXTENSIONS/ RELATED CAREERS

Review Ocean Acidification PowerPoint #2

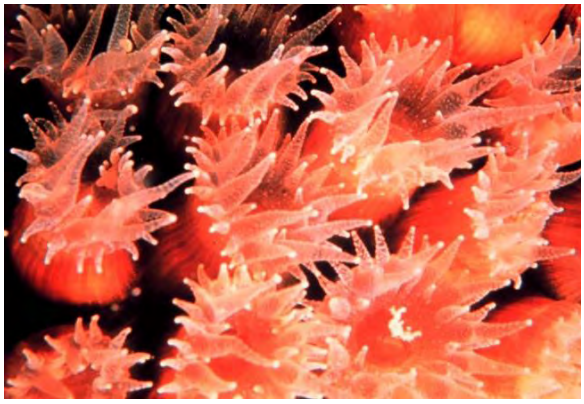
1. Write a letter to a legislator addressing ocean acidification, it's effects, and your opinion on what should be done in regards to the issue
    a. Look at the "In My Opinion" lesson for information on how to write a letter to a legislator or community leader
    b. Take Action Now on the National Resources Defense Council website: https://secure.nrdconline.org/site/Advocacy?cmd=display&page=UserAction&id=1569
2. View the Encyclopedia of Channel Islands National Marine Sanctuary (online: http://www8.nos.noaa.gov/onms/park/Parks/?pID=3 or CD) to learn about organisms that will be affected by increasing acidity at the Channel Islands National Marine Sanctuary. How do those organisms relate to each other (i.e. food web)
3. Write a report on an organism that will be affected by increasing acidity. Include its role in the food web and how ocean acidification will affect the organism.
4. In small groups write and act out a public service announcement on ocean acidification.
5. Research related careers- Chemical oceanographer, Marine biologist, Chemist, Biochemist

Education Standards

National Education Standards	Science: 5-8 • Content Standard A: Science as Inquiry • Content Standard B: Physical Science • Content Standard C: Life Science • Content Standard F: Science in Personal and Social Perspectives
Ocean Literacy Principles	3. The ocean is a major influence on weather and climate. 5. The ocean supports a great diversity of life and the ecosystem. (f) 6. The ocean and humans are inextricably interconnected (e)
Climate Literacy Principles	7. Climate change will have consequences for the earth system and human lives.

WEBSITES & RESOURCES

1. Click on Ocean Science Topics: Biology
   http://www.vims.edu/bridge/
2. NOAA Pacific Marine Environ. Laboratory
   http://www.pmel.noaa.gov/co2/OA/
3. Ocean Acidification Network
   http://ioc3.unesco.org/oanet/index.html
4. National Resources Defense Council
   http://www.nrdc.org/oceans/acidification/default.asp
5. Channel Islands National Marine Sanctuary
   http://channelislands.noaa.gov/sac/pdf/CWG_OAR_final.pdf
6. Gulf of the Farallones National Marine Sanctuary
   http://farallones.noaa.gov/pdfs/manage/OceanAcidification_021209.pdf
7. Climate Change Animations
   http://archipelago.co.uk/articles/climate-change-animations-launched



For More Information

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