

OCEAN ACIDIFICATION/CARBON CYCLE/CLIMATE CHANGE: INTRODUCTION

The pH of a liquid is a measure of how acidic or basic that liquid is, based on the number of hydrogen or hydroxide ions present. If the pH of the ocean decreases to become more acidic, many marine ecosystems may be affected, particularly those including organisms with shells made of calcium carbonate, which is more soluble at a lower pH.

The carbon cycle is the cycle by which carbon is exchanged throughout the earth and atmosphere. Increased levels of carbon dioxide in the atmosphere due to human and other activity lead to changes in global climate, which also has an effect on the earth's ecosystems.

KEY WORDS

Ocean Acidification

Carbon dioxide
Calcium carbonate
carbon sink
carbon source

Carbon Cycle

carbon
atmosphere
fossil fuels
emissions

biosphere
carbon cycle
carbon dioxide
decomposition
earth's crust
methane
zone
carbon sink
carbon source
climate change

FOCUS QUESTIONS

1. What does pH measure?
2. How does increasing or decreasing acidity affect the pH level?
3. What is carbon?
4. What is a carbon sink?
5. What is a carbon source?
6. What is the carbon cycle?
7. What is climate change?

LEARNING OBJECTIVES

Ocean Acidification

The students will:

define pH.

define carbon and its effect in our oceans and with marine life.

- define carbon sinks and sources.
- define climate change in our atmosphere and oceans.
- observe soda siphon experiment; measuring level of pH before and after O₂ gas is added.
- explain method of "carbonating" water.
- conduct oyster shell experiment.

MATERIALS

Soda Siphon Experiment

- soda siphon
- water
- CO₂ gas cartridge

Oyster Shell Experiment

- oyster shells for each group, 1 shell per solution (12 total for this session)
- pint jars for each group, 1 jar per solution (12 total for this session)
- Coca Cola
- carbonated water
- ocean water
- labels
- permanent markers/pens
- digital scale
- pH meter
- niskin sample bottle or other means of obtaining an ocean water sample
- student lab sheets

Carbon Cleanup Obstacle Course (for group of 24 students)

- large room such as a gymnasium or outdoor area
- five pylons or other markers
- six large hula hoops
- 48 bean bags
- 24 balls (volley balls, playground balls, etc.)

Climate Change Bingo

- Bingo sheets

LEARNING PROCEDURE

See "Lesson 3 Activity Instructions" for details.

- A. Soda Siphon Experiment (**30 minutes**)
- B. Oyster Shell Experiment (**30 minutes**)
- C. Carbon Clean Up Obstacle Course (**45 minutes**)

D. Climate Change Bingo (**10 minutes**)

E. Wrap-up discussion (**5 minutes**)

STANDARDS

Alaska State Standards:

- SA** The student will demonstrate an understanding of the processes and applications of scientific inquiry.
- (5) **SA1.1** asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.
 - (5) **SA1.2** using quantitative and qualitative observations to create their own inferences and predictions.
- SA1** The student will develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend arguments.
- SA2** The student will develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.
- (5) **SA2.1** supporting their statements with facts from a variety of resources and by identifying their sources.
- SA3** The student will develop an understanding that culture, local knowledge, history, and interactions with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.
- (5) **SA3.1** identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survives.

National Science Education Standards

Content Standard A: Scientific Inquiry

- All students will develop abilities necessary to do scientific inquiry.
- Identify questions that can be answered through scientific investigations.
 - Design and conduct a scientific investigation.
 - Use appropriate tools and techniques to gather, analyze and interpret data.
 - Develop descriptions, explanations, predictions and models using evidence.
 - Think critically and logically to make the relationships between evidence and explanations.
 - Communicate scientific procedures and explanations.
- All students will gain an understanding about scientific inquiry.
- Different kinds of questions suggest different kinds of scientific investigations.
 - Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.
 - Scientific explanations emphasize evidence, have logically consistent arguments and use scientific principles, models and theories.

Ocean Literacy Standards

1. The ocean is largely unexplored.
 - a. The ocean is the last and largest unexplored place on Earth – less than 5% of it has been explored. This is the great frontier for the next generation’s explorers and researchers, where they will find great opportunities for inquiry and investigation.
 - b. Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

RESOURCES

National Research Council (U.S.), (1996). *National Science Education Standards: observe, interact, change, learn*. Washington, D.C.: National Academy Press.

Project 2061 (American Association for the Advancement of Science), (2001). *Atlas of Science Literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

Carbon Clean-up Obstacle Course and Climate Change Bingo documents:
<http://wildbc.org/index.php/programs/climate-change-education/>

FEEDBACK

We value your feedback on this lesson.
Send us your comments to: khoffman@pwssc.org
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