

## Education

# Acidification: What does it mean for the oysters?



### Grade Level

- 5-8

### Timeframe

- 45 minutes

### Materials

- Oyster shells
- Vinegar Water
- Clear display jars (can be old spaghetti sauce or salsa jars)
- Paper towels/hand towels
- Can display image below

Photograph by **MARYLAND SEAFOOD** full information here:

<http://twistedstiffer.com/2014/10/two-tanks-filled-with-same-water-one-has-oysters/>



### Essential Question

How does ocean acidification affect marine animals that we depend on for healthy coastal waters, food and a sustainable coastal economy?

### Activity Summary

Human actions on land are connected to changes in the atmosphere, and thus, the ocean. The health and survival of ocean creatures is at risk because of the change in the ocean's chemical composition due to additional carbon dioxide that is dissolved into sea water from the burning of fossil fuels and land use changes. This change in the ocean's composition disrupts the ability of organisms with skeletons and shells to grow, due to a change in the availability of a building block crucial to shell and skeleton growth- calcium carbonate. This change can impact the ocean's food web and the food we eat. We can reduce our carbon footprint in many ways to help maintain the ocean's composition now and into the future.

### Learning Objectives

Students will be able to:

- Understand and value the importance of how human activities influence the chemistry and thus health of the ocean ecosystem and organisms.
- Understand and value the importance of how changes in the ocean ecosystem affect marine life (specifically calcium carbonate shell and building) and human life.

## Values

- Interconnected – Even though humans don't spend the majority of our time in the oceans, our actions on the land affect the atmosphere (air), the ocean and the marine life within it
- Stewardship – It is our responsibility to take care of the ocean by our actions on land so that we can clean coastal waters
- Simplifying models – the ocean is composed of building blocks for the organisms that live within it and on which humans depend for the food we eat
- Causal chain – burning fossil fuels emits CO<sub>2</sub> → the ocean absorbs CO<sub>2</sub> → the ocean becomes more acidic → calcium carbonate is not readily available → it is more challenging for calcifying animals to build their shells/skeletons → the food web is disrupted → the food we eat could change

## Solutions

To leave more building blocks in the sea for those animals with shells and skeletons we can

- Community Level Solutions – support increased public transportation infrastructure, support renewable energy, supporting local community with local purchases, participate in community garden initiatives
- Individual/Household Solutions – unplug vampire electronics (phone chargers, computer, laptops); reduces CO<sub>2</sub> and saves on the electric bill, reusable water bottles

## Key Messages

- The ocean is a vital part in the Earth's ecosystem and provides a home to marine life that contribute to the health of human life on our planet.
- Human actions are changing the ocean's chemistry which is altering life below the surface and could potentially change food webs and the food we eat
- We want to make sure that our ocean marine life remains healthy
- Together, we can work as stewards of our planet's ocean and make positive changes in the world we

## Activity Outline:

Preparation: 1 week prior

- a. Create 3 solutions in display jars
  - i. Vinegar
  - ii. ½ vinegar/ ½ water
  - iii. water
- b. Place ~3 oyster shells in each of

Preparation: day prior to event/lesson


- c. Remove shells from each and allow to dry on paper towels/ hand towels
  - i. Find a way to mark/etch into the oyster to track which solution they were in

## Activity Outline (cont'd)

1. Display oyster shells that were in water is in from a “pre-industrial revolution” ocean (with lower CO<sub>2</sub> levels, ½ vinegar ½ water) – can label oyster harvest from “healthy or pre-industrial revolution ocean” (water) and those that were in pure vinegar “more acidic” oceans - can label oyster harvested from a “more acidic ocean”
2. Inquire with student? Do you know what these are? Shells → oyster
  - a. Have you ever eaten an oyster?  
Not only do we enjoy eating them they are very important for keeping our water’s clean.
3. Have you ever visited the Chesapeake Bay (or important estuary in region)?
  - a. This photo (link in materials sections) shows bay water with and without oysters in it. Oysters help keep our waters clean, allowing them and other creatures in the water be healthy and grow  
(1) Oyster beds serve as a nursery habitat, a place where young, tiny fish and shellfish can grow and be protected from predators, or organisms that would eat them
  - b. Encourage student to take one oyster from each “ocean” in each hand.

## Follow up Discussion

1. Compare the oyster from the two simulated oceans
  - a. What are the differences between the oysters?
    - i. The one from the more acidic ocean is chalky; the shell is beginning to break down, dissolve
    - ii. It is harder for oysters to build and keep their shell in more acidic waters?
  - b. Which do you think would be a more healthy and better able to filter ocean water?
    - i. In more acidic water, an oyster can’t put as much time into growing because so much energy goes into maintaining its shell.
  - c. Which do you think will taste better?
    - i. Below is a story of the scientific publication noting shrimp taste worst from more acidic waters  
<http://phys.org/news/2014-12-ocean-acidification-shrimp-bad.html>
  - d. You have one shell from a more acidic ocean, do you know what causes the ocean to become more acidic?
    - i. If you haven’t introduced the concept in another activity or lesson:
    - ii. Carbon dioxide is an “acid gas” and causes the ocean to become more acidic (measured by a lowering of pH).
    - iii. Carbon dioxide emissions/pollution into our atmosphere from things like:
      - driving our cars, boats, planes, trains
      - using electricity in our home
      - removing trees (deforestation) that hold this carbon dioxide in their leave, preventing it from ending up in the ocean



## Follow up Discussion (cont'd)

2. What can we do to help keep these oysters' shells from breaking down and our Bay water healthy?
  - a. Discuss solutions (some community scale solutions are outlined above) which are appropriate when discussing with families and middle and high school students
  - b. For younger audience, individual solutions may be more appropriate:
    - i. turning of the lights when you leave the room
    - ii. unplugging any vampire electronics (computers, chargers, etc.)

## Education Standards

<p><b>Common Core ELA Standards</b></p>	<p><b>Informational Text Grades 4-8:</b>            1 – Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text            4 – Determine the meaning of general academic and domain-specific words or phrases in a text            7 – Interpret information presented visually, orally, or quantitatively and explain how the information contributes to an understanding of the text in which it appears.</p> <p><b>Writing Standards Grades 4-8:</b>            1 – Write opinion pieces on topics or texts, supporting a point of view with reasons and information            2 – Write informative/explanatory texts to examine a topic and convey ideas and information clearly</p> <ul style="list-style-type: none"> <li>• 4 – Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.</li> </ul>
<p><b>Common Core Math Standards</b></p>	<p><b>Mathematical Practices:</b>            Reason abstractly and quantitatively</p> <ul style="list-style-type: none"> <li>• Construct viable arguments</li> </ul>
<p><b>Next Generation Science Standards</b></p>	<p><b>4 Structure, Function, and Information Processing</b>            4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction</p> <p><b>Science and Engineering Practices:</b>            Engaging in Argument from Evidence</p> <p><b>Crosscutting Concepts:</b>            Cause and Effect            Systems and System Models</p> <p><b>3-5 Engineering Design</b>            3-5ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.</p> <p><b>Science and Engineering Practices</b>            Constructing Explanations and Designing Solutions</p> <p><b>Crosscutting Concepts:</b>            Influence of Science, Engineering, and Technology on Society and the Natural World</p> <p><b>MS Human Impacts</b>            MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment</p> <p><b>Science and Engineering Practices:</b>            Constructing Explanations and Designing Solutions</p> <p><b>Crosscutting Concepts:</b>            Cause and Effect            Influence of Science, Engineering, and Technology on Society and the Natural World</p>
<p><b>Ocean Literacy Principles</b></p>	<ul style="list-style-type: none"> <li>• 5 The ocean supports a great diversity of life and ecosystems</li> <li>• 6 The ocean and humans are inextricably interconnected</li> </ul>
<p><b>Climate Literacy Principles</b></p>	<p>3 Life on Earth depends on, is shaped by, and affects climate            A,C,E</p> <p>6 Human activities are impacting the climate system            C,D,E</p>





## Evaluation

Students will write a short essay on the effects of ocean acidification. They will need to address the following:

- What is ocean acidification
- What happens (chemically) when the oceans absorb CO<sub>2</sub>?
- What does the absorption of CO<sub>2</sub> by the ocean mean for certain organisms such as oysters?
- What is creating the atmospheric CO<sub>2</sub>? What can humans do to decrease the amount of atmospheric CO<sub>2</sub>?

Utilize the International Student Carbon Footprint Challenge website (<http://footprint.stanford.edu/calculate.html>). Students will investigate how to calculate their own carbon footprint and develop and present ideas on how they individually, as a family, and as a school community can lower their carbon footprint and help decrease the amount of CO<sub>2</sub> (produced by the burning of fossil fuels) being absorbed by the world's oceans. Have students present and compare their solutions to reduction of carbon footprint and have them use individual plans to come up with the best overall plan. For middle and high school students have students devise a way to evaluate the effectiveness of their solution(s).

## Extensions

Students will read Earth's Acid Test published in Nature March 10, 2011 and answer questions about the text.

Students will explore the <http://www.cisanctuary.org/ocean-acidification/>

Web site (with supervision of teacher) to learn more about ocean acidification.

Investigate what other types of organisms may be the first to be impacted by ocean acidification and why.

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Students will explore ways they can effect change in the use of fossil fuels beyond their home and school communities.

Share portions of archived SOARCE (Sharing Ocean Acidification Resources for Communicators and Educators) Ocean Acidification webinars with students.



<http://oceanacidification.noaa.gov/AreasofFocus/EducationOutreach/SOARCEWebinarSeries.aspx>

**Resources:**

<http://www.cisanctuary.org/ocean-acidification/>

<http://oceanacidification.noaa.gov/>

**Credits: NOAA Ocean Acidification Program, additions and correlation to Common Core and Next Generation Science Standards by Maria Petueli. Please email [noaa.oceanacidification@noaa.gov](mailto:noaa.oceanacidification@noaa.gov) with any questions about the lesson.**