

## Effect of Acidification on Coral Reefs

### *Document Overview:*

Article: Coral Reef Formation

Pre-Lab Activity: Ocean Acidification Article/ Pre-Lab Activity

Lab: Effect of Ocean Acidification on Coral Reef (with eggs or with coral)

Video on Acid Test: The Global Challenge of Ocean Acidification (22 min)

### *MN State Science Standards:*

9.4.1.1.1 Explain how cell processes are influenced by internal and external factors, such as pH and temperature, and how cells and organisms respond to changes in their environment to maintain homeostasis.

9.4.2.1.2 Explain how ecosystems can change as a result of the introduction of one or more new species.

9.4.4.1.2 Describe the social, economic and ecological risks and benefits of changing a natural ecosystem as a result of human activity.

### *Objective:*

- Outline what a coral reef is and how it is made.
- Explain ocean acidification occurs and its impact on coral reefs.
- Suggest ways we can create change to slow the process of CO<sub>2</sub> from harming ocean habitats.
- Examine the effect of pH on coral reefs using data.
- Discuss how ocean acidification leads to coral reef destruction using lab data.

### *Type of Activity:*

Literacy, Scientific Inquiry

### *Duration:*

2-50 min class hours

### *Connection to Nobel Speaker:*

Ove Hoegh-Guldberg, at the University of Queensland, is a leading coral biologist whose professional interests focus on the impact of global warming and climate change on coral reefs. He has written numerous papers and participated in many videos regarding ocean acidification and its impact on coral reefs.

### *Concepts:*

Coral Reef formation

Ocean Acidification

Effects of pH on Coral

CO<sub>2</sub> levels in the ocean

*Description of Activity:*

1. Article: Coral Reef Formation

Students will read the article on coral reef formation. “What is a Coral Reef?”

[http://coris.noaa.gov/about/what\\_are/](http://coris.noaa.gov/about/what_are/)

They will outline each section of the article to learn about the fundamentals of a coral reef and how it is formed.

2. Pre-Lab Activity: Ocean Acidification Article/ Pre-Lab Activity

Before entering the lab students will interact with ocean acidification by looking at an article (located below: Ocean Acidification: The Other CO<sub>2</sub> Problem

<http://www.nrdc.org/oceans/acidification/default.asp>

This is suggested to be used as a pre-lab activity as it reviews vocabulary before starting the lab. Some of the questions in this activity could also be done as they wait for results between day 1 and day 2.

3. Lab: Effect of Ocean Acidification on Coral Reef (with eggs or with coral)

Students will investigate how different pH levels affect the ability of coral to keep their exoskeleton. Students will use their scientific data they collect along with information from the articles to discuss the implementations of ocean acidification. Lab sheets included.

4. Video on Acid Test: The Global Challenge of Ocean Acidification (22 min)

After completing the lab students will watch video on research completed and how they can change what they do to reduce the amount of carbon they use.

Video: Acid Test; The Global Challenge of Ocean Acidification

<http://www.nrdc.org/oceans/acidification/aboutthefilm.asp>

Video Questions for students can be found on the Nobel teacher website in the lesson:

“CO<sub>2</sub> from the Atmosphere to the Oceans”

*Materials:*

Eggs, vinegar, salt water, baking soda concentrate, soda water (Sprite works fine as well).

The coral can be bought at a local pet store that sells salt water equipment (It is about \$14 for 20 lbs. of coral substrate). You will need a small handful of coral substrate for each class.

*Teacher Tips:*

- There are 2 versions of the lab on the “Effects of Ocean Acidification on Coral Reefs”. The first version is a qualitative lab that looks at the effect of acid on the shell of the egg. The egg is made of calcium carbonate as are coral reefs. Students collect observational data about how the shell changes.
- The second version of the lab is quantitative and allows students to take mass measurements of the change of small pieces of coral that are in different pH’s.
- Instead of using vinegar carbonated water can be used, but it takes 2 weeks to get results. Limestone or chalk can also be substituted for the coral.

*Acknowledgements:*

NOAA Coral Reef Information System, What are Coral Reefs?,  
[http://coris.noaa.gov/about/what\\_are/](http://coris.noaa.gov/about/what_are/), June 2012

Natural Resources Defense Council, Ocean Acidification: The Other CO<sub>2</sub> Problem,  
<http://www.nrdc.org/oceans/acidification/default.asp>, June 2012

Video: Acid Test; The Global Challenge of Ocean Acidification  
<http://www.nrdc.org/oceans/acidification/aboutthefilm.asp>

*Web Resources:*

Coral Reef Activities- mapping, classification, 3D images, AMAZING RESOURCE  
<http://www.usm.edu/marineeducation/old/coralreef/index.html>

Coral Reef Formation

<http://www.marinebio.net/marinescience/04benthon/crform.htm>

Ocean Acidification: The Other CO<sub>2</sub> Problem (article adapted below for easy printing)

<http://www.nrdc.org/oceans/acidification/default.asp>

Coral Reef Ecosystems Lab

<http://www.coralreefecosystems.org/>

Ecological Succession of a Coral Reef Power Point

<http://krupp.wcc.hawaii.edu/BIOL200/powerpnt/reefzone/sld033.htm>

Coral Reef Information

<http://www.coral-reef-info.com/where-are-coral-reefs-located.html>

NOAA Coral Reef Information System

[http://coris.noaa.gov/about/what\\_are/](http://coris.noaa.gov/about/what_are/)

What is a Coral Reef? (article adapted below for easy printing)

[http://coris.noaa.gov/about/what\\_are/](http://coris.noaa.gov/about/what_are/)

Name \_\_\_\_\_ Class Hour \_\_\_\_\_ Date \_\_\_\_\_

**What are Coral Reefs?**

**Directions:**

1. Read the article
2. Outline each section of the article with key ideas. (minimum of 6 ideas)
3. Write at 5 vocabulary words for each section. Define them by using context clues or the dictionary
4. Draw an idea/ picture from each section that you find interesting.

<b><i>Corals and their Kind</i></b> <b>Key Ideas</b>	<b><i>From Polyp to Reef</i></b> <b>Key Ideas</b>
<b>Vocabulary Words</b>	<b>Vocabulary Words</b>
<b>Drawing</b>	<b>Drawing</b>



Name \_\_\_\_\_ Class Hour \_\_\_\_\_ Date \_\_\_\_\_

Pre-Lab: Effect of Acidification on Coral Reefs

**Vocabulary:**

pH:

acid:

base:

neutral:

substrate:

solution:

Ocean Acidification:

**Questions:**

1. How much CO<sub>2</sub> are oceans absorbing now?
2. Where is the carbon coming from? List 8 sources.
3. How much of an increase is this as compared to the past?
4. Name 5 organisms with shells that live in the ocean.
5. What is carbonate?
6. Why is carbonate being reduced in the ocean?
7. How do organisms use carbonate?

8. If there is less carbonate in the ocean, what will happen to the skeletons of animals that use it?
  
9. Hypothesize how the loss of coral reefs will impact coastal community life.
  
10. Hypothesize how the loss of coral reefs will impact other organisms in the ocean.
  
11. Hypothesize how the change in CO<sub>2</sub> levels could change the whole ocean.
  
12. Hypothesize how the change in CO<sub>2</sub> levels could change the trophic levels of the ocean?
  
13. Hypothesize how the change in CO<sub>2</sub> levels could change the trophic levels on land?

Name \_\_\_\_\_ Class Hour \_\_\_\_\_ Date \_\_\_\_\_

**Title:** Effect of Acidification on Coral Reefs

**Purpose:** Examine the effect of pH from different solutions on substrates using data. Discuss how the lab data demonstrates effect of acidification has on a coral reef.

**Hypothesis:**

**Materials:**

Substrate- egg  
100 mL vinegar  
100 mL of salt H<sub>2</sub>O  
100 mL of saturated baking soda water  
100 mL of soda water  
3 beakers  
Graduated cylinder  
pH meter or pH strips

**Procedure:**

1. Place 100 mL of vinegar in a beaker and egg. Label the beaker. Check pH. Make observations. (Does it fizz/ bubble/ nothing/ move/ etc.)
2. Place 100 mL of salt H<sub>2</sub>O in a beaker and egg. Label the beaker. Check pH. Make observations.
3. Place 100 mL of saturated baking soda water in a beaker and egg. Label the beaker. Check pH. Make observations.
4. Place 100 mL of saturated soda water in a beaker and egg. Label the beaker. Check pH. Make observations.
5. Wait 24 hours. Recheck each egg. Make observations. Check pH.
6. Wait 24 hours. Recheck each egg. Make observations. Check pH
7. Open each egg. Has the inside of the egg changed? Make observations.



**Data:**

Solution	pH	Day 1 Observations	pH	Day 2 Observations	pH	Day 3 Observations	Observations of Open Egg
100 mL vinegar		1. 2. 3.		1. 2. 3.		1. 2. 3.	1. 2. 3.
100 mL salt H <sub>2</sub> O		1. 2. 3.		1. 2. 3.		1. 2. 3.	1. 2. 3.
100 mL saturated baking soda		1. 2. 3.		1. 2. 3.		1. 2. 3.	1. 2. 3.
100 mL soda water		1. 2. 3.		1. 2. 3.		1. 2. 3.	1. 2. 3.

**Conclusion:** Examine the effect of pH from different solutions on substrates using data. Discuss how the lab data demonstrates the effect acidification has on a coral reef. (Use information from the reading and evidence from your lab in the answer.)

Name \_\_\_\_\_ Class Hour \_\_\_\_\_ Date \_\_\_\_\_

**Title:** Effect of Acidification on Coral Reefs

**Purpose:** Examine the effect of pH from different solutions on substrates using data. Discuss how the lab data demonstrates effect of acidification has on a coral reef.

**Hypothesis:**

**Materials:**

Substrate- coral  
20 mL vinegar  
20 mL of salt H<sub>2</sub>O  
20 mL of saturated baking soda water  
20 mL of soda  
3 beakers  
Graduated cylinder  
pH meter or pH strips

**Procedure:**

1. Weigh the coral piece.
2. Place 20 mL of vinegar in a beaker and coral. Label the beaker. Check pH and weigh coral. Make observations. (Does it fizz/ bubble/ nothing/ move/ etc.)
3. Place 20 mL of H<sub>2</sub>O in a beaker and coral. Label the beaker. Check pH and weigh coral. Make observations.
4. Place 20 mL of saturated baking soda water in a beaker and coral. Label the beaker. Check pH and weigh coral. Make observations.
5. Wait 24 hours. Recheck each coral. Make observations. Check pH.
6. Place 20 mL of saturated soda water in a beaker and coral. Label the beaker. Check pH. Weigh coral. Make observations.
7. Wait 24 hours. Recheck each coral. Make observations. Check pH.
8. Let coral from each liquid dry on a paper towel overnight. Label the paper towel with the solution so they do not get mixed up. Weigh the dry coral the next day.
9. Calculate the % change for each coral.
10. Extension: Place the corals back into the solutions after drying. Wait for 4 days and recheck the pH and the weight of the coral.

**Data:**

Solution	pH	Weight of Coral (g)	Day 1 Observations	pH	Weight of Coral (g) (Day 3- dry the coral first)	Day 2 Observations	% Change in weight
20 mL vinegar			1. 2. 3.			1. 2. 3.	
20 mL salt water			1. 2. 3.			1. 2. 3.	
20 mL saturated baking soda			1. 2. 3.			1. 2. 3.	
20 mL soda water			1. 2. 3.			1. 2. 3.	

**Soda water**

Day 7 observations: \_\_\_\_\_

\_\_\_\_\_

pH after day 7: \_\_\_\_\_

Weight of Coral after 7: \_\_\_\_\_

% Change in Weight \_\_\_\_\_

**Conclusion:** Examine the effect of pH from different solutions on substrates using data. Discuss how the lab data demonstrates the effect acidification has on a coral reef. (Use information from the reading and evidence from your lab in the answer.)

*Gustavus/Howard Hughes Medical Institute Outreach Program  
2012-13 Curriculum Materials*

Possible data from the “Effect of Acidification on Coral Reefs” using coral.

Substance	Initial pH	Final pH	Initial observations	Final Observations	Initial Mass (g)	Final Mass (g)	% change in mass	
Sprite	<6.0		bubbles	looked same	0.3	0.2	33.3	
Water	7.6		no change	looked same	0.2	0.2	0	
Vinegar	4.3		bubbles	empty beaker	0.3	0	100	