

# Yo-Yos, Tow-Yos and pH, Oh My!

[http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal\\_gr7\\_8\\_12.pdf](http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal_gr7_8_12.pdf)

### Focus on Inquiry

The students will focus on inquiry by collecting and analyzing data to determine which sample of water was taken from a location near a hydrothermal vent in the ocean. Students form a hypothesis, conduct an experiment to test the hypothesis, and then explain and communicate their results.

### Lesson Overview

This activity is designed to teach pH. Once students learn about pH, they are introduced to CTD's as a way to collect information. They learn what a CTD is and how it is used. Then they gain knowledge of what hydrothermal vents are and where they are found. Students conduct an experiment to determine which water samples were collected near a hydrothermal vent.

<b>Duration</b> 2 - 45 minute class periods	<b>Setting</b> Classroom	<b>Grouping</b> Groups of 4	<b>PTI Inquiry Subskills</b> 1.3, 2.1, 3.1, 3.3, 4.3, 5.2, 5.8, 7.2
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
<i>Engage</i>	10 min.	1.3, 5.8	None	2	Class discussion on the characteristics of hydrothermal vents. Teacher models how a CTD works with a yo-yo. Students form a hypothesis as to which sample was collected near a hydrothermal vent.
<i>Explore</i>	30 min.	2.1, 3.1, 3.7	None	3	Students conduct an experiment to determine which water sample was collected near a hydrothermal vent.
<i>Explain</i>	15 min.	5.2, 5.8, 7.2	None	3	Students explain their hypothesis and conclusions to the class. Model white smoke on vent with Alka Seltzer.
<i>Expand</i>	30 min.	3.1, 3.3, 4.3	TV/VCR; Computer with Internet access	3	Students view a video called "Dive to the Edge of Creation". Then they compare and contrast hydrothermal vents to land geysers.
<i>Evaluate</i>					Student handout and research results can be used for evaluation.

#### Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

<p><b>National Science Education Standards – Inquiry</b></p> <p>Think critically and logically to make the relationships between evidence and explanations. Communicate scientific procedures and explanations.</p>	
<p><b>National Science Education Standards – Earth Science</b></p> <p>Living organisms have played many roles in the earth system, including affecting the composition of the atmosphere, producing some types of rocks, and contributing to the weathering of rocks.</p>	
<p><b>Louisiana Grade Level Expectations – Inquiry</b></p> <p>Gr. 8, Inquiry GLE#4. Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2) Gr. 8, Inquiry GLE#6. Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3) Gr. 8, Inquiry GLE#12. Use data and information gathered to develop an explanation of experimental results (SI-M-A4)</p>	

Gr. 8, Inquiry GLE#13. Identify patterns in data to explain natural events (SI-M-A4)  
 Gr. 8, Inquiry GLE#14. Develop models to illustrate or explain conclusions reached through investigation (SI-M-A5)  
 Gr. 8, Inquiry GLE#22. Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)

**Louisiana Grade Level Expectations Earth Science**

Gr. 8, GLE#22. Compare ocean floor topography to continental topography by using topographic maps (ESS-M-A9)  
 Gr. 8, GLE#51. Analyze the consequences of human activities on global Earth systems (SE-M-A4)

**Materials List (per class)**

- One yo-yo
- One chart showing where spreading ridges are located in the ocean floor
- National Geographic Video entitled “Dive to the Edge of Creation,” if available
- Pictures of hydrothermal vents from website: <http://www.divediscover.whoi.edu>
- Pictures of animals that live near hydrothermal vents from website: <http://www.divediscover.whoi.edu>
- Picture of CTD frame and sampling bottles from website: <http://www.divediscover.whoi.edu>
- One gallon of water, chilled in a refrigerator
- Vinegar (one bottle)
- A heat source (microwave oven or hot plate)
- One eyedropper
- One tablespoon
- TV/VCR to view the National Geographic Video “Dive to the Edge of Creation” if available

**Materials List (per group)**

- Five beakers labeled A, B, C, D and E
- One Alka-seltzer tablet (optional)
- Four thermometers
- 20 strips of pH paper and one color indicator scale
- One data record sheet per student

**Advance Preparation**

1. Read background knowledge section on activity website.
2. Chill one gallon of water overnight in a refrigerator.
3. For each group of students, fill five 100ml beakers with chilled water and label each with an A, B, C, D or E.
4. Heat the water in all beakers labeled D for 60 seconds in the microwave oven shortly before the start of class.
5. Add 3 drops of vinegar to all beakers labeled C and E and stir.
6. Add one tablespoon of vinegar to all beakers labeled D and stir.
7. Practice your yo-yo skills!
8. Copy and print student handout located on activity website.

**Other Information**

**Learning Objectives**

The learner will...

- learn how hydrothermal vents are formed and where they are located on the ocean floor.
- learn how scientists use CTDs to locate hydrothermal vents.
- learn how to determine the pH of a water sample and how this variable can be used to detect hydrothermal vent activity.

**Prior Knowledge Needed by the Students**

It would be better if students understood concept of pH prior to beginning this lesson. Although it is not necessary, it would be better to explain the concept of pH and provide examples of common acids and



bases for students prior to the lesson. If teacher chooses to wait to introduce this concept during the lesson, it is introduced to students during procedure # 6 of activity.

### **Procedure**

#### **Engage**

1. Complete steps 1-13 on page 4 of online activity worksheet. Teacher models how a CDT works and pH is used to test water samples. Students use **Blackline Master 1** to record data.

#### **Explore**

1. Complete step 14 of activity. Students conduct an experiment to determine which sample was taken from a location near a hydrothermal vent. Students use **Blackline Master 1** to record data.

#### **Explain**

1. Complete step 15 of the activity. Students report their hypothesis and conclusion to the class. Require that they be able to support their hypothesis using the data they have collected.
2. Complete step 16 of the activity. For any group that correctly identifies the correct sample, provide the group with an Alka-Seltzer to place in their sample. This can be used to explain that the fizzing looks similar to a white smoker on a hydrothermal vent.

#### **Expand**

1. Students view National Geographic Video “Dive to the Edge of Creation” if available.
2. Have students do research (individually or in groups) to determine three similarities and three differences between the land-based geyser called “Old Faithful” at Yellowstone National Park and a deep sea hydrothermal vent.

#### **Evaluate**

1. Student worksheet (Blackline Master 1) and research results can be used for evaluation.

### **Blackline Master**

1. Yo-Yos, Tow-Yos and pH, Oh My!  
Or print student handout from activity website:  
([http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal\\_gr7\\_8\\_l2.pdf](http://oceanexplorer.noaa.gov/explorations/02galapagos/background/education/media/gal_gr7_8_l2.pdf))

### **Supplementary Resources**

NOAA Ocean Explorer and Dive and Discover

<http://oceanexplorer@noaa.gov> and [www.divediscover.whoi.edu](http://www.divediscover.whoi.edu) - Follow the Galapagos Rift Expedition daily as documentaries and discoveries are posted each day for your classroom use. A wealth of resource information can also be found at both of these sites.

<http://www.pmel.noaa.gov/vents/nemo/>

<http://www.divediscover.whoi.edu>

<http://www.nationalgeographic.com>

<http://www.marine.whoi.edu/ships/alvin/alvin.htm>

<http://www.ocean.udel.edu/deepsea>

## Yo-Yos, Tow-Yos and pH, Oh My!

Name: \_\_\_\_\_

### Sample Data

Sample	Temperature	pH
A		
B		
C		
D		
E		

Which sample do you think was taken near a hydrothermal vent? \_\_\_\_\_

How does your data support this hypothesis? \_\_\_\_\_

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