

Level 4: Interactivity

Citizen Scientists Mission - In Search of Evidence

Summary

Grade Level: 6-8

Teaching Time: Two 45-minute periods

In this teacher/student-led level, students will use the knowledge and satellite data skills gained in the first three levels to identify data needed to support a simple hypothesis about a coral bleaching event.

Objective

- Students will present data in support of a research question.

Focus Questions

- Can you find evidence for coral bleaching events based on satellite data?
- Why is coral research important?

Climate Literacy

Scientific observations indicate that global climate has changed in the past, is changing now, and will change in the future. The magnitude and direction of this change is not the same at all locations on Earth (CL 4d)⁷.

Background (Teacher)

The main research question for students' work on coral bleaching in this module asks: What are the consequences of rising sea surface temperature on coral reefs, and why should we care? Oceanographers, marine biologists, Citizen Scientist Researchers, and all those who have enjoyed the experience of tropical coral reefs have become increasingly concerned with the health of these biologically rich, but delicately balanced, regions in the ocean. Your students have become aware that coral bleaching is one of the many threats to coral reefs and their associated fragile ecosystems. What if they do not recover? Why should

⁷ *Climate Literacy: The Essential Principles of Climate Science*, Second Version: March 2009. <http://www.globalchange.gov/browse/educators>

we care? Students need to understand that a study of coral reef health, comparing the past to the present, can help them think about future climate change and how to prepare for it.

So far, students have learned to generate, read, and interpret different kinds of data related to coral bleaching. At this level, students will apply what they have learned to answering a prepared research question. Students will compare collected satellite data against their in situ field surveys from Level 2 to see if there is a significant predictive relationship between accumulated heat stress (measured using NOAA Coral Reef Watch's degree heating weeks product) and bleaching intensity. After their study, students can join climate researchers in considering if severe, widespread coral bleaching and mortality will have long-term consequences for reef ecosystems, which may suggest a troubled future for tropical marine ecosystems under a warming climate.

Vocabulary

Students are encouraged to use vocabulary words presented in previous levels of this coral reef module as they write and discuss their coral bleaching research findings.

Activity 4: Answering and Supporting a Research Question

Materials

- **Teacher Master 4.1: In Situ Data Log Sheet with Locations (same as Teacher Master 2.3.1 from Level 2, Activity 2.3)**
(1 per team)
- **Student Master 4.1: Citizen Scientists Coral Reef Bleaching Mission - In Search of Evidence**
(1 per student)
- **Student Master 4.2: Data Log Sheet** (1 per student)

This activity challenges students to think like Citizen Scientist Researchers by designing a scientific investigation in which data collection and analysis are integral to identifying coral bleaching events. Students are asked to use real data to solve a problem, as they look for degree heating weeks for a specific coral region.

Preparation

1. It is recommended that you not show students any of the SST DHW maps or graphs before beginning this activity. A goal of this investigation is to encourage students to apply data gathering skills and techniques learned earlier in the module to examine unknown data. Specifically, students will read and interpret data and apply their knowledge to their observations from the in situ study in Level 2.

2. Reassign students as Citizen Scientist Researchers to their teams from Level 2 for the three coral reef monitoring sites: A. Stetson Bank, Pin 26; B. Stetson Bank, Pin 37; or C. Panama, Pin 208 (see **Teacher Master 4.1 In Situ Data Log Sheet with Locations**). Have each team divide data search responsibilities according to the following table.

Note: You may want to assign tasks for different monitoring years to different students if there are more than four students on a team.

Monitoring Year	Student #1	Student #2	Student #3	Student#4
Monitoring Year 1	SST Map	Coral Bleaching DHW Map	Time Series Graph Coral Bleaching DHW	Manager of Data Entry on Data Log Sheet
Monitoring Year 2	SST Map	Coral Bleaching DHW Map	Time Series Graph Coral Bleaching DHW	Manager of Data Entry on Data Log Sheet
Monitoring Year 3	SST Map	Coral Bleaching DHW Map	Time Series Graph Coral Bleaching DHW	Manager of Data Entry on Data Log Sheet

Procedure

1. Pass out the following materials to each team:

- Completed student team in situ reports and data sheets from **Level 2: Monitoring Coral Reefs—Establishing a Baseline**
- **Teacher Master 4.1: In Situ Data Log Sheet with Locations** – to remind students of the latitude and longitude of their assigned in situ locations and the dates of their three site monitoring visits
- **Student Master 4.1: Citizen Scientists Coral Reef Bleaching Mission - In Search of Evidence** (provide a copy for each student)
- **Student Master 4.2: Data Log Sheet** – to help students identify and organize the data they will need to collect to study the research question (provide a copy for each student)

2. Review with students the steps on **Student Master 4.1: Citizen Scientists Coral Reef Bleaching Mission - In Search of Evidence**.

Answer any questions students may have.

Ask teams to follow the prompts on the worksheet to:

- Identify the kinds of data they want to look at, in what region, and over what time period.
- Go online and generate their own time series graphs of degree heating weeks for the region they examined in Level 2 to complete their virtual in situ monitoring.
- Analyze the resulting data graphs and maps to identify periods of thermal stress.
- Based on this new information, have teams refine their presentations about coral reef conditions at their in situ site. Their revised presentations should include the data products they generated in this activity and incorporate information about DHW.

3. Have teams present their revised coral health findings to their

classmates.

4. Ask teams to use their collected in situ data together with newly collected satellite data and their knowledge of corals to answer the questions under Discuss Conclusions below:

Discuss Conclusions

- Do you think the susceptibility of corals to temperature changes may result in coral bleaching or a decrease in coral health?
- Why is it important to examine coral reefs for bleaching events both locally in situ and globally using satellite SST data?
- Why is it important to study coral reef health by comparing past reef with present reef conditions?
- As a Citizen Scientist Researcher, why is it important for you to care about rising sea surface temperature, and the health of coral reefs related to a changing climate?

Teacher Master 4.1

In Situ Data Log Sheet with Locations

Coral Reef Site A	Year/Month	Coral Reef Description (circle one)		
Stetson Bank, Pin 26 28.0°N, 93.5°W	June 2005 (Baseline)	Healthy Reef	Declining Reef	Dead Reef
	June 2006	Healthy Reef	Declining Reef	Dead Reef
	March 2009	Healthy Reef	Declining Reef	Dead Reef

Coral Reef Site B	Year/Month	Coral Reef Description (circle one)		
Stetson Bank, Pin 37 28.0°N, 93.5°W	Sept 2003 (Baseline)	Healthy Reef	Declining Reef	Dead Reef
	July 2007	Healthy Reef	Declining Reef	Dead Reef
	March 2009	Healthy Reef	Declining Reef	Dead Reef

Coral Reef Site C	Year/Month	Coral Reef Description (circle one)		
Panama, Tag 218 9.3°N, 82.2°W	2005 (Baseline)	Healthy Reef	Declining Reef	Dead Reef
	2006	Healthy Reef	Declining Reef	Dead Reef
	2008	Healthy Reef	Declining Reef	Dead Reef

Student Master 4.1

Citizen Scientists Coral Bleaching Mission - In Search of Evidence

Corals are facing bleaching events related to changing sea surface temperature (SST). Rejoin your Citizen Scientist Researcher team and recheck your in situ field data. Now you will use satellite degree heating weeks (DHW) maps and graphs to find more evidence regarding a possible large-scale coral bleaching event at your monitoring site. Your mission is to determine if coral bleaching is part of your site's past, present, and/or future. Let's get started!

Plan Your Investigation

Your Assignment: Collect and use satellite data to investigate whether high SSTs occurred at your site to cause coral bleaching or stress. Take out your previous Data Log Sheet (**Student Master 2.3.1**).

Where was your in situ site located? Latitude: _____ Longitude: _____

What was the day, month, and year of each data collection?

Year 1: _____ Year 2: _____ Year 3: _____

Your Research Question: Did the duration and intensity of changing water temperature affect coral health at your site?

Your Hypothesis: When there is accumulated thermal stress, with water temperature rising above the maximum of the monthly mean sea surface temperature (MMM SST), it will cause coral reef stress at the monitoring location.

Conduct Your Investigation

1. Design a plan to test your hypothesis and answer the research question.

What do you need to get started?

- a. More information: Do you need more information about changes in temperature over time and how long the temperature stayed at a high level?
- b. Specific data: When you go online to collect data, how many of the following maps and graphs will you generate?
 - SST map
 - Coral bleaching DHW maps
 - Coral bleaching DHW time series graphs

Hint: You should download three time series maps, one for each date you observed at your in situ site.

2. Go online and get the data using the following steps:

- a. Visit www.dataintheclassroom.noaa.gov, and find the Coral Bleaching module.
 - b. Follow the link to "Get Data."
 - c. Using the controls on the left side of the map, pan and zoom out until the map displays the area immediately around the site you are studying.
 - d. Select the dataset you wish to access under "Which dataset?"
 - e. Select either "Map" or "Time series graph" on the menu labeled "Which view?"
 - f. Using the form, specify a date or date range.
 - g. Click the "Get Data" button.
 - h. Save the graph to your computer. On a PC, right click with the mouse and select "Save as...." On a Mac, hold down the Ctrl key and click with the mouse.
3. Record the data you select and/or save it on **Student Master 4.2: Data Log Sheet**, and save images to your computer so you can refer to them later for data analysis and to show your classmates when you present your findings.
4. Analyze the data by answering the following questions:

What are the local conditions at your reef site for each year observed?

Hint: Look at time series graphs of SST to get a sense of the temperature range at this site.

Were corals at risk for thermal stress?

Look at false-color maps of DHW. Look for areas with DHW values above zero.

Hint: Check the DHW number at the top right of the map for a data point.

How high did the DHWs get?

Hint: Look at a time series graph of DHW for the area. If the DHW value gets above 4°C, you should expect to see significant coral bleaching. Values above 8°C indicate that you can expect coral mortality.

5. From your observations of each year's data, can you tell if your reef was at risk for bleaching? Give evidence.

6. Draw conclusions about your data.

Comparing all three years of data sets, would you conclude your reef was under stress?

Hint: Look at your maximum DHW figures/maps. DHWs measure the accumulated thermal stress on the reef. The maps/figures show the maximum DHW values experienced during each year of your in situ

monitoring.

How did thermal stress compare at each year's monitoring?

How did the severity of coral stress or bleaching compare at each year's monitoring?

Write down what you learned from your investigation of coral health. Use your data to help you decide if your hypothesis is supported. If your hypothesis is not supported, think about other data you might need to collect.

Report Your Coral Health Findings

All researchers need to publish and present their findings to their peers.

1. Your first step is to combine the data you collected to see if it tells the story of your coral reef's health.

2. The next step is to share it with your classmates. Use your collected data, vocabulary words, and reef images as part of your report.

3. Include the maps and graphs that you generated as part of your report, and highlight key information for each year so you can easily compare one year to another.

Coral Reef Site	Year/Month	Coral Reef Description (circle one)		
Lat: , Lon:	(Baseline)	Healthy Reef	Declining Reef	Dead Reef
		Healthy Reef	Declining Reef	Dead Reef
		Healthy Reef	Declining Reef	Dead Reef

Discuss Conclusions

- Do you think the susceptibility of corals to temperature changes may result in coral bleaching or a decrease in coral health? Give examples for why or why not.
- Why is it important to examine coral reefs for bleaching events both locally in situ and globally using satellite SST data?
- Why is it important to study coral reef health by comparing past reef with present reef conditions?
- As a Citizen Scientist Researcher, why is it important for you to care about rising sea surface temperature, and the health of coral reefs related to a changing climate?

