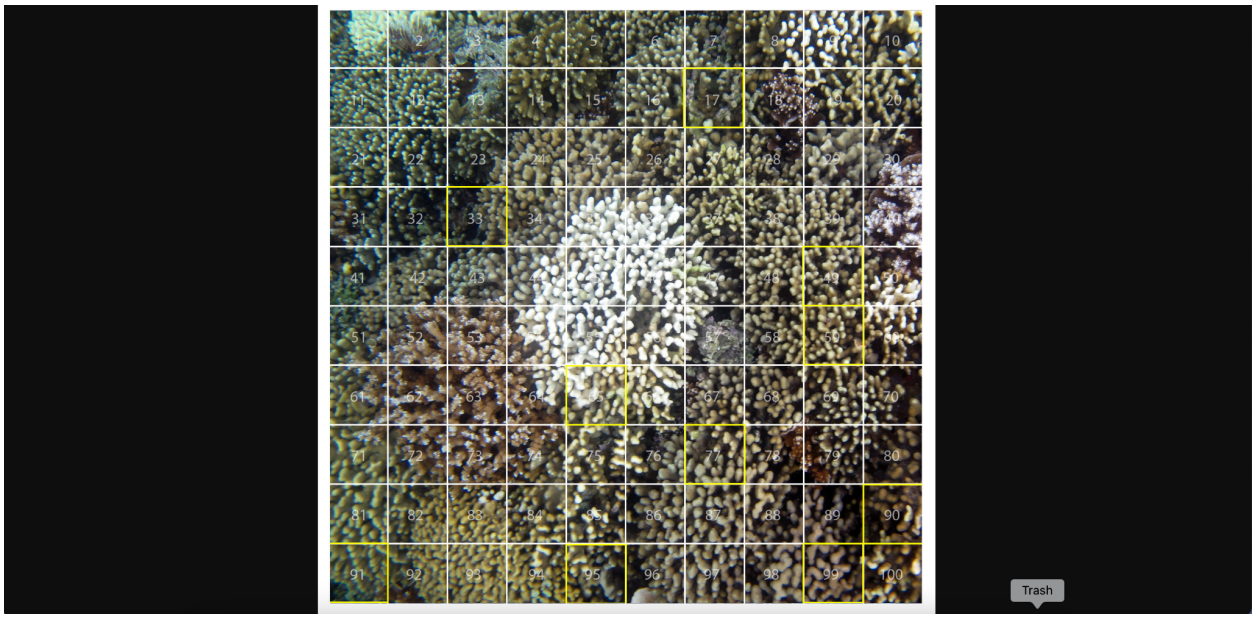
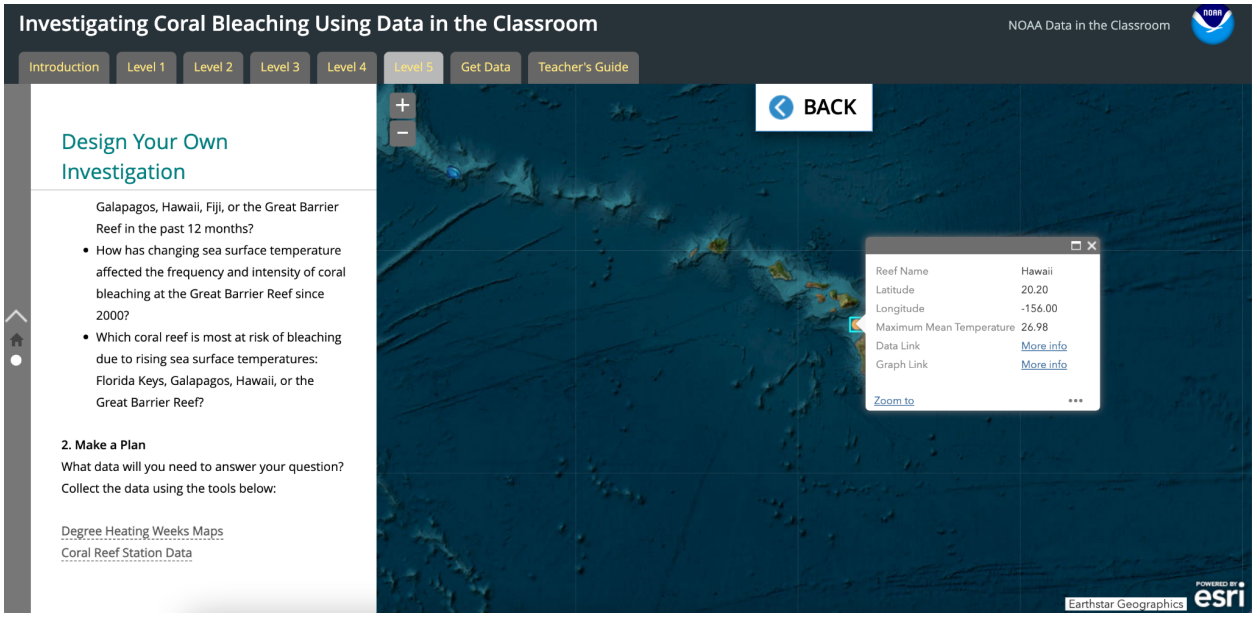
The mini lab that I chose to do was one of NOAA's Data in the Classroom modules on coral bleaching. Coral bleaching is a topic that has become more and more significant in our world because it is a direct consequence of rising sea surface temperatures (mostly caused by human activity). What I thought this module did well was the incorporation of videos and interactive maps. The videos that were throughout the module were engaging and sometimes silly. In self-paced, online labs like this, I feel like it is important to give students engaging items to stay focused on the content. This lab did a great job teaching the "student" how to monitor coral bleaching events and using data like DHW to determine if a coral bleaching event is likely to happen.

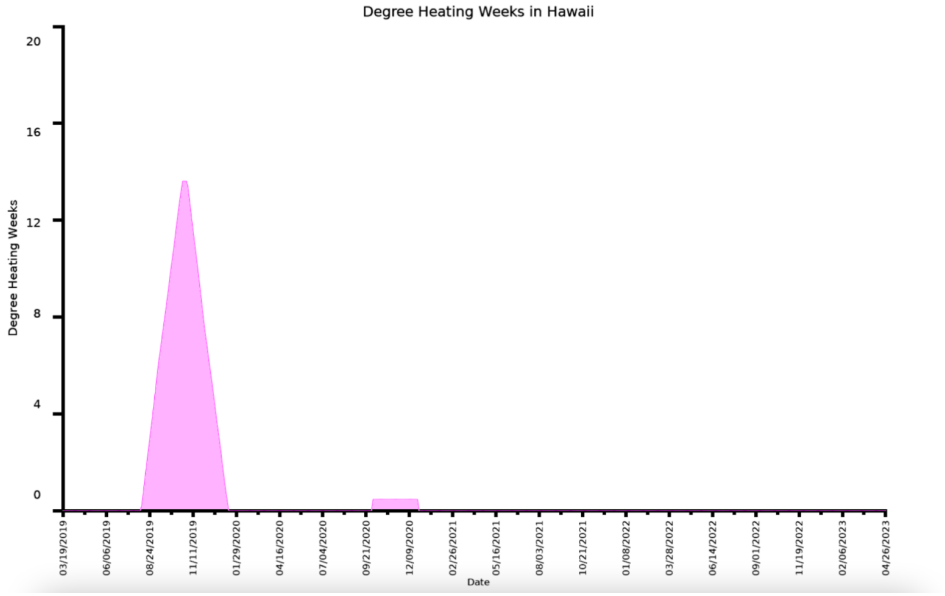
Since coral reefs are located in a very specific location around the world, I think the lab did a great job having students identify locations of coral reefs around the world and making connections between geography, potential climates, and why coral reefs are limited to those certain locations on Earth.

Level 3 of the lab was fascinating to use a quadrat to measure the amount of coral bleaching on a coral reef. This is a tool that divers actually use, so I thought students would really enjoy being a diver for the day. Although monitoring coral health using the quadrat sampling method was a new concept to learn, I thought it was a great way to really try a hand at ecological sampling. Another fantastic part of Level 3 was the ability to see coral reefs underwater using 360° cameras. I had no idea that these tours were available via Google and even had coral reefs from around the world. Since this lab may be a little advanced for my 2nd-5th grade students to do independently, I would still love to use the underwater coral reef tours when teaching about coral reefs.

Overall, I would say this is another fantastic lab option provided by NOAA. I believe that the way information is presented, the natural inquiry, and the ability to get up close and personal with coral reefs would make for an engaging lesson.






Degree Heating Weeks in Hawaii
Degree Heating Weeks
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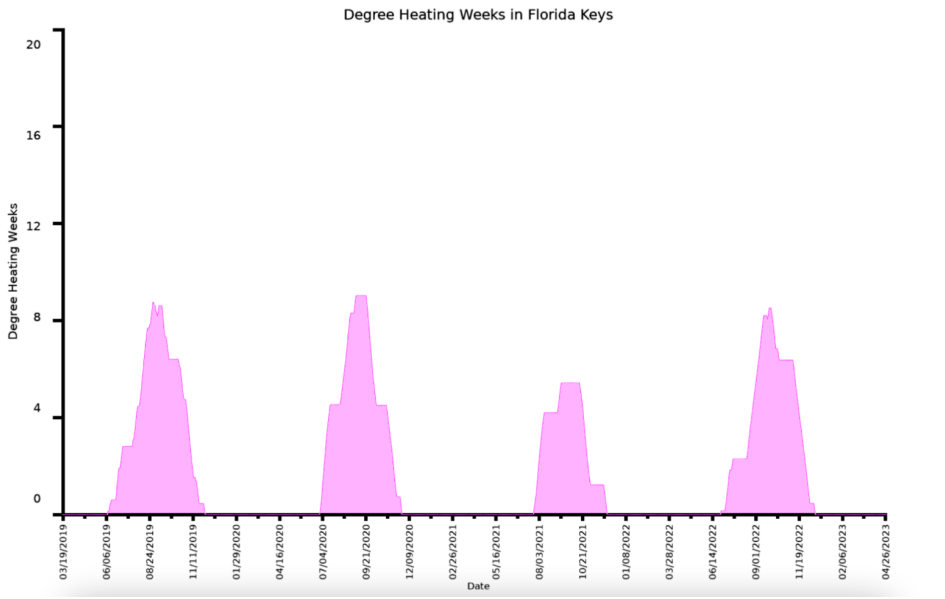
Degree Heating Weeks in Florida Keys
Degree Heating Weeks
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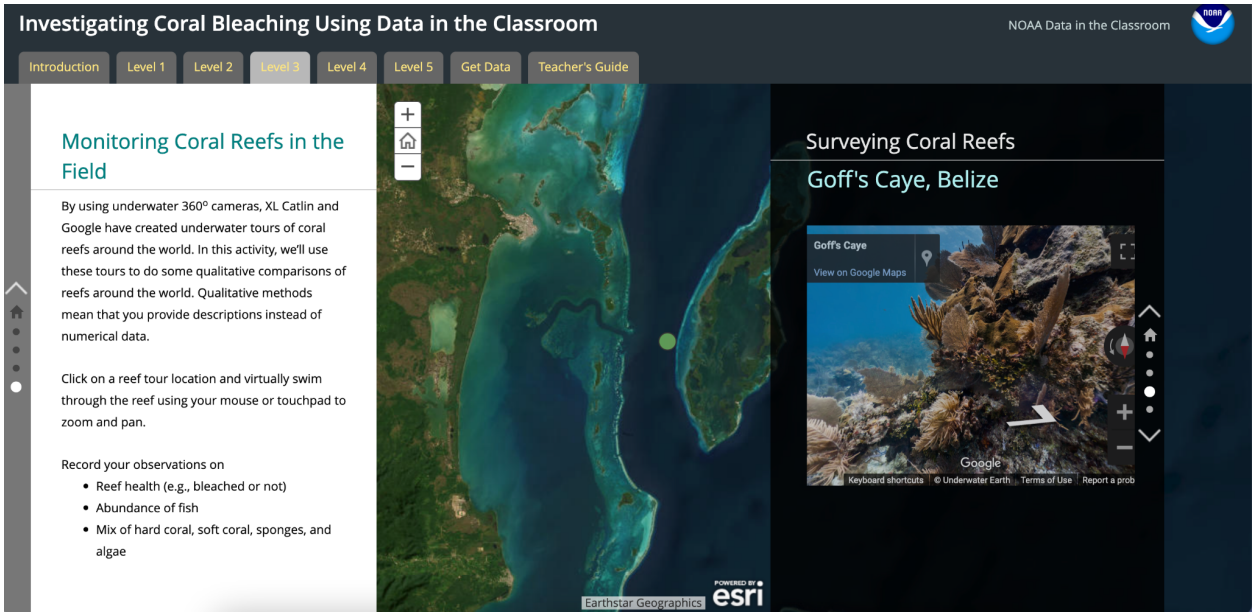
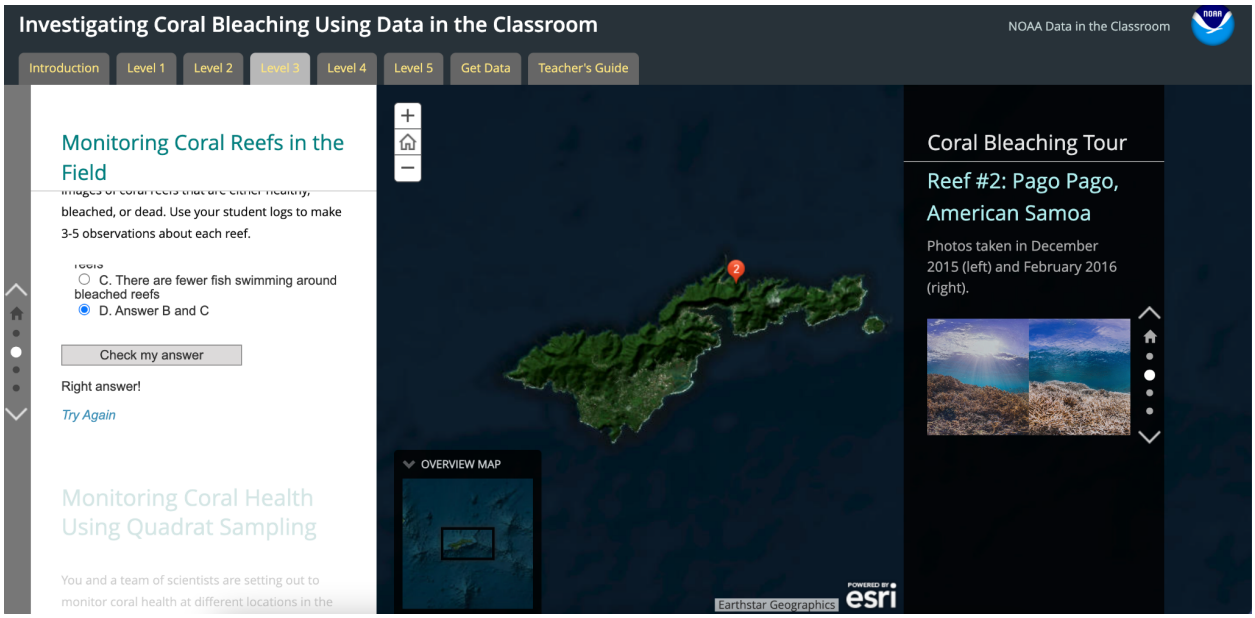

Investigating Coral Bleaching Using Data in the Classroom
NOAA Data in the Classroom
Introduction
Level 1
Level 2
Level 3
Level 4
Level 5
Get Data
Teacher's Guide
Monitoring Coral Reefs in the Field
By using underwater 360° cameras, XL Catlin and Google have created underwater tours of coral reefs around the world. In this activity, we'll use these tours to do some qualitative comparisons of reefs around the world. Qualitative methods mean that you provide descriptions instead of numerical data.
Click on a reef tour location and virtually swim through the reef using your mouse or touchpad to zoom and pan.
Record your observations on
Reef health (e.g., bleached or not)
Abundance of fish
Mix of hard coral, soft coral, sponges, and algae
Earthstar Geographics
esri
Surveying Coral Reefs
Goff's Caye, Belize
Goff's Caye
View on Google Maps
Google
Keyboard shortcuts
© Underwater Earth
Terms of Use
Report a prob


Investigating Coral Bleaching Using Data in the Classroom
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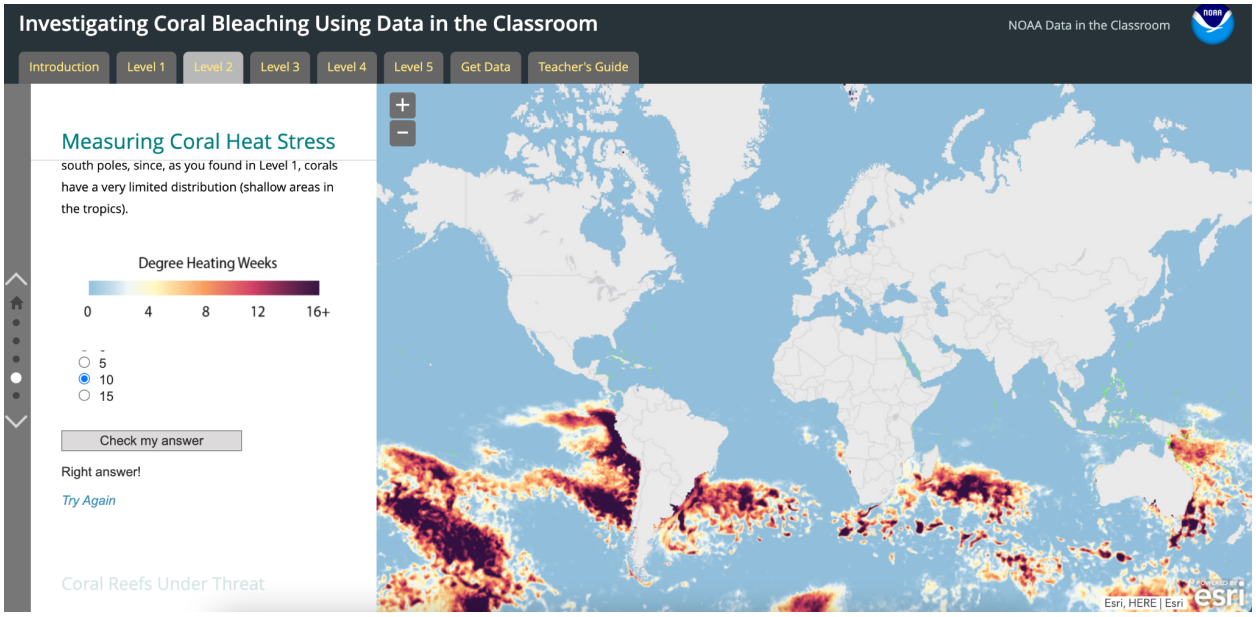
Monitoring Coral Reefs in the Field
bleached, or dead. Use your student logs to make 3-5 observations about each reef.
C. There are fewer fish swimming around bleached reefs
D. Answer B and C
Check my answer
Right answer!
Try Again
Monitoring Coral Health Using Quadrat Sampling
You and a team of scientists are setting out to monitor coral health at different locations in the
OVERVIEW MAP
Earthstar Geographics
esri
Coral Bleaching Tour
Reef #2: Pago Pago, American Samoa
Photos taken in December 2015 (left) and February 2016 (right).


Investigating Coral Bleaching Using Data in the Classroom
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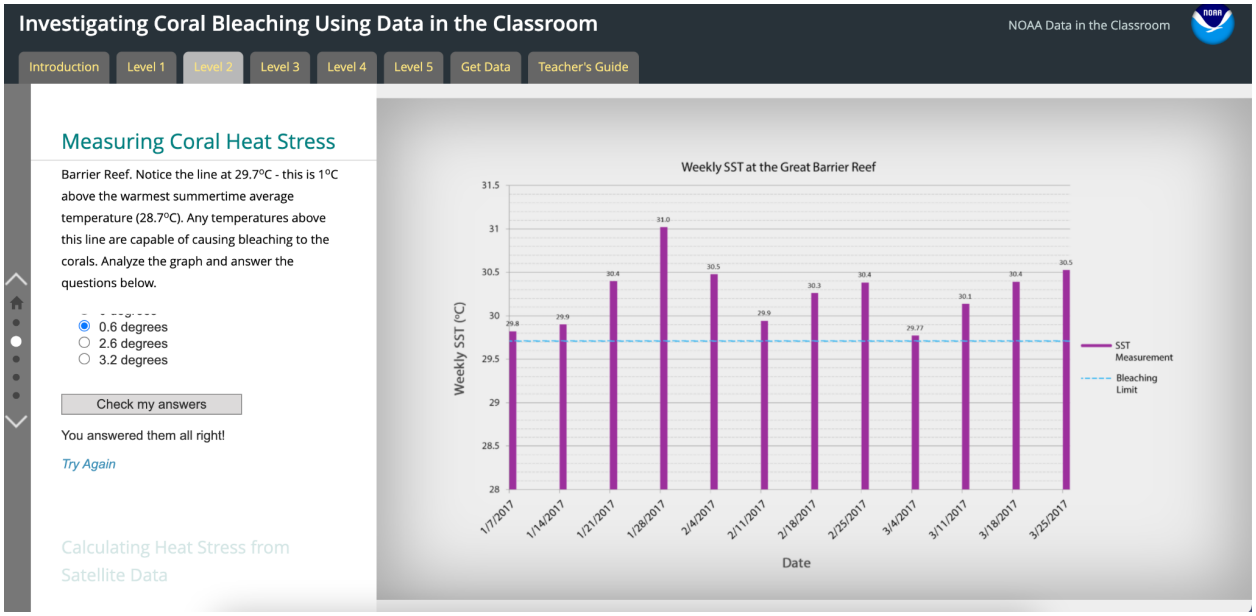
Level 4
Level 5
Get Data
Teacher's Guide
Measuring Coral Heat Stress
south poles, since, as you found in Level 1, corals have a very limited distribution (shallow areas in the tropics).
Degree Heating Weeks
0
4
8
12
16+
5
10
15
Check my answer
Right answer!
Try Again
Coral Reefs Under Threat
Esri, HERE | Esri


Investigating Coral Bleaching Using Data in the Classroom
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Level 5
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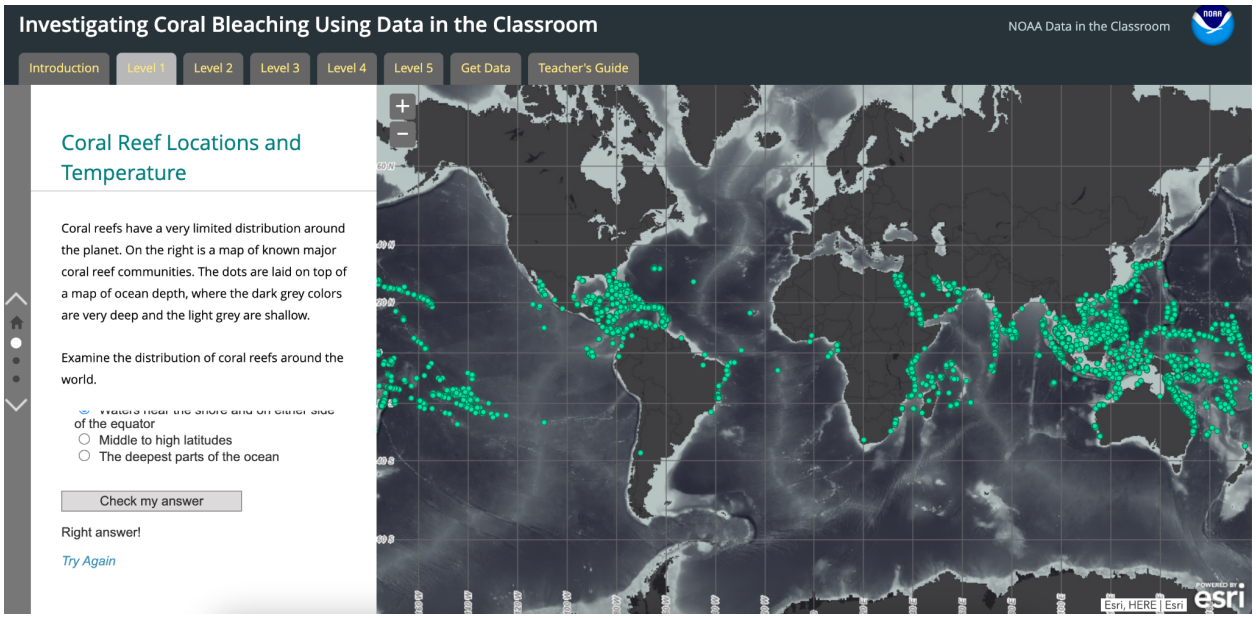
Teacher's Guide
Measuring Coral Heat Stress
Barrier Reef. Notice the line at 29.7°C - this is 1°C above the warmest summertime average temperature (28.7°C). Any temperatures above this line are capable of causing bleaching to the corals. Analyze the graph and answer the questions below.
0.6 degrees
2.6 degrees
3.2 degrees
Check my answers
You answered them all right!
Try Again
Calculating Heat Stress from Satellite Data
Weekly SST at the Great Barrier Reef
Weekly SST (°C)
Date
SST Measurement
Bleaching Limit


Investigating Coral Bleaching Using Data in the Classroom
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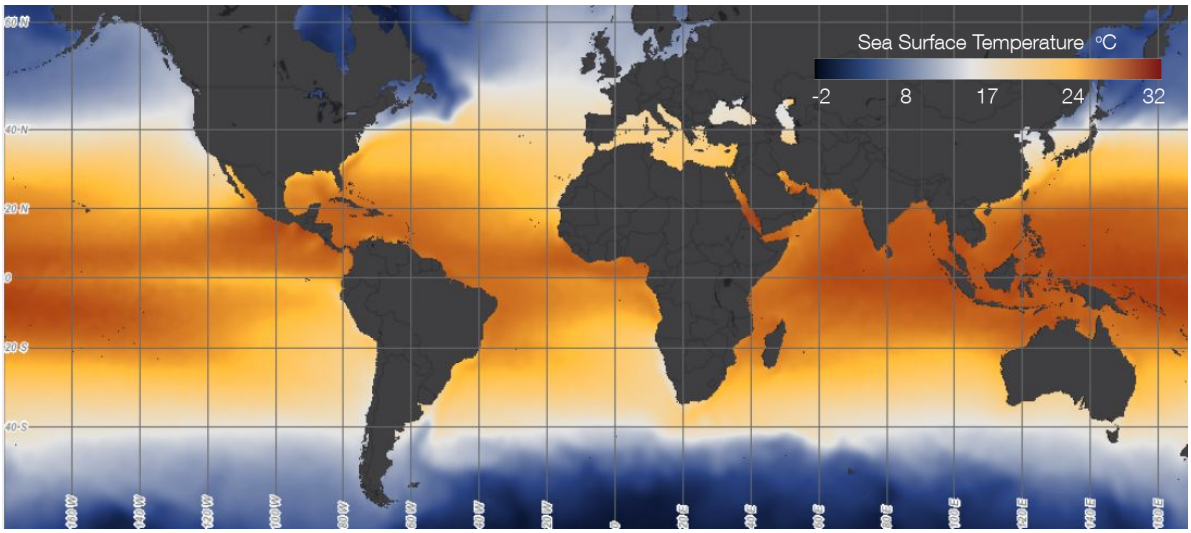
Teacher's Guide
Coral Reef Locations and Temperature
Coral reefs have a very limited distribution around the planet. On the right is a map of known major coral reef communities. The dots are laid on top of a map of ocean depth, where the dark grey colors are very deep and the light grey are shallow.
Examine the distribution of coral reefs around the world.
of the equator
Middle to high latitudes
The deepest parts of the ocean
Check my answer
Right answer!
Try Again
Esri, HERE | Esri

DATA IN THE CLASSROOM: LEVEL 1

Coral Reef Locations

1. Reading Sea Surface Temperature Maps: Coral reefs face numerous hazards and threats both globally and locally. To carefully monitor the ocean temperatures that coral reefs are exposed to, scientists use highly detailed maps of sea surface temperature (SST). To monitor SST across the planet, scientists frequently use data from satellites. By plotting the data values as colors on a map, called a false-colored map, it is easy to spot patterns of temperature and how they change across the map and at different times. Explore the interactive maps in Level 1 and fill in the blanks below.

What is the average temperature at 160 °East and 10°North?	The average temperature is aruond 28C
Between which latitudes do most of the warmest temperatures (orange-red) occur?	The warmest temperatures are between 30S and 30N



2. Coral Reef Habitat and Range Coral reefs have a very limited distribution around the planet. Explore the interactive maps in Level 1 and fill in the blanks below.

Latitude:	Corals reefs are generally located between 30 °North and 30 °South
Temperature:	Most corals survive in temperatures ranging from 18 to 29 °Celsius.

DATA IN THE CLASSROOM: LEVEL 2

Measuring Coral Heat Stress

1. Measuring Water that is Warmer than Normal: In 2017, an oceanic heat wave caused severe coral bleaching at reefs across the globe. It was the worst bleaching event in history. To what extent were corals on the Great Barrier Reef at risk? Explore the graph showing real temperature data (collected by satellites) along the Great Barrier Reef during Summer 2017, and answer the questions below.

Question	Answer
On the Great Barrier Reef, how warm does the water need to be for corals to bleach?	The water needs to be above 29.7C
How many weeks did the temperatures exceed the 'bleaching limit' during the 3 months summer season?	12 Weeks
How many degrees above the bleaching limit did the sea surface temperature rise during the week of February 18th, 2017?	.6C

2. Calculating Heat Stress from Satellite Data: Prolonged and severe heat stress, like the kind that corals from the Great Barrier Reef experienced in 2017, can add up. This accumulation of stress makes significant bleaching more likely and recovery more difficult. Use the graph showing sea surface temperature values above the bleaching limit line to answer the questions below.

Question	Answer
Calculate Degree Heating Weeks (DHW) by adding up the number of degrees above the bleaching limit over the 12 week time period.	DHW = 6.6
Why is this calculation useful?	This calculation is useful because it helps to predict is bleaching will occur.

3. Understanding Degree Heating Weeks: How do DHW values correlate with coral bleaching intensity? In general, when DHW values are 0, there is no stress. When DHW is equal to 4, significant bleaching is expected. When DHW is equal to 8, widespread bleaching and mortality is expected. Zoom into the map of the Great Barrier Reef, and answer the question below.

Were the corals on the Great Barrier Reef at high risk, moderate risk or low risk of bleaching due to heat stress? *Support your answer using evidence & data from the map.*	The corals on the Great Barrier Reef were are high risk of bleaching due to heat stress. You can see this because of the dark orange/red color on the map. These colors show that the thermal stress exceeds 8 DHW.

DATA IN THE CLASSROOM: LEVEL 3

Monitoring Coral Reefs

1. Identifying the Effect of Bleaching on Coral Reefs: Use the map tool to visit each of the four coral reefs in the western Pacific. Examine the photos and complete the table below. As an example, Reef #1 is partly completed for you.

Coral Reef #	Reef Name and Location	Time period	Observations
1	Phoenix islands, Republic of Kirabati	2004	**healthy** bleached dead *Other observations: Coral is bright green and yellow. Lots of colorful fish are present.*
1	Phoenix islands, Republic of Kirabati	**2016**	○healthy ○bleached ○dead *Other observations:*
2	Pago Pago, American Samoa	**December 2015**	○healthy ◉bleached ○dead *Other observations:*
2	Pago Pago, American Samoa	**February 2016**	○healthy ○bleached ○dead *Other observations:*
3	Lizard Island, Great Barrier Reef, Australia	**March 2016**	○healthy ○bleached ○dead *Other observations:*
3	Lizard Island, Great Barrier Reef, Australia	**May 2016**	○healthy ○bleached ○dead *Other observations:*
4	Kahului Point, Maui, Hawaii	**August 2015**	○healthy ○bleached ○dead *Other observations:*
4	Kahului Point, Maui, Hawaii	**November 2015**	○healthy ○bleached ○dead *Other observations:*

2. Making Sense of Your Observations: Use the observations above to answer the following questions.

Question	Answer
How many of the reefs you visited showed signs of bleaching?	All 4 reefs showed signs of bleaching/death
Has the health of these coral reefs changed over time? If yes, describe the changes you observed.	Yes, health of these reefs have changed over time. All of the images show that coral health has declined.

DATA IN THE CLASSROOM: LEVEL 3

Monitoring Coral Reefs

3. Monitoring Coral Health Using Quadrat Sampling:

Procedure: Select (click) a reef to monitor. Follow the online instructions, and record your data in the table. When you are done collecting data, calculate the percent dead and bleached.

Example: An example using the photo from Reef #1 is shown below.

Square #	Is Coral Dead? 0 = coral is alive 1 = coral is dead	Is Coral Bleached? 0 = unbleached 10 = completely bleached
4	1	
16	0	3

Leave blank since coral inside this square is dead

Data table:

Reef #: 4		
Square #	**Is Coral Dead?** 0 = coral is alive 1 = coral is dead	**Is Coral Bleached?** 0 = unbleached 10 = completely bleached
4	0	1
16	0	1
20	0	1
22	0	1
32	0	4
44	0	1
45	0	2
74	0	0
93	0	1
94	0	0
	Sum the squares above to calculate the total squares dead 0	**Average the values above to calculate the extent of bleaching** 1.3
	Calculate percent dead (total x 10) 0%	**Calculate percent bleached (average x 10)** 13%

4. Analyzing Your Data:

Describe the health of of the area you monitored using observations and data from the table above.	The overall health of this reef is moderate. While there is no evidence of dead coral, there is still evidence of bleaching
In order to monitor the health of this reef over time, you need to collect more data. How often do you think you should return to collect data (weekly, monthly, yearly)? And during which seasons? Why?	I would recommend sampling more data twice a year during the warmer months (Summer, Fall) so see significant trends.

DATA IN THE CLASSROOM: LEVEL 4

Identifying a Bleaching Event

1. Analyzing Data From the Florida Keys: To what extent is heat stress affecting the health of Florida's coral reefs? Collect & analyze evidence from the *Degree Heating Weeks* data on the interactive map & from Mote Marine Lab's website. Record your observations in the table below.

Graph: Were the corals in the Florida Keys at high risk, moderate risk or low risk of bleaching due to heat stress during the last 4 years? *Describe data and trends shown on the graph.*	The corals in the Florida keys are at a moderate risk during the last 4 years. The graph shows that 3 out of the 4 years experienced over 8 degree heating weeks. During these summer months, it is safe to assume that coral bleaching occurred.
Observations from Condition Report: Where did bleaching occur in the Florida Keys during the past year(s). How severe was it? *Describe specific data & observations from the report.*	Based on reports from Mote Marine, there were signs of coral bleaching in the Florida Keys. In the July 2022 report, the threat of mass coral bleaching within the Florida Keys was moderate. The reports indicated that no significant signs of coral bleaching were observed. At the sites where partial bleaching was noted, the overall percentage of corals exhibiting signs of thermal stress was 1-10%

2. Construct an Explanation: Is heat stress affecting the health of Florida's coral reefs? Use the claim, evidence, reasoning format to construction an explanation below.

To what extent is heat stress affecting the health of Florida's coral reefs?	My Claim: In the Florida coral reefs, there was moderate heat stress between 2018 and 2021.
Include specific data from your table above.	My Evidence: Graphs and data show that DHW values exceeded the value of 4 during each summer for 4 years. We have also learned from reportst that partial bleaching occurred during the July 2022 survey.
Connect the evidence to your claim	My Reasoning: Since the DHW value was higher than 4, we can safely assume that there was heat stress to coral reefs.

DATA IN THE CLASSROOM: LEVEL 5

Design an Investigation

1. Develop Your Question: Ask a question that can be answered using the data available in Level 5 of the module. Some sample questions are below.
   - How has sea surface temperature affected the health of coral reefs near the Galapagos, Hawaii, Fiji, or the Great Barrier Reef in the past 12 months?
   - How has changing sea surface temperature affected the frequency and intensity of coral bleaching at the Great Barrier Reef since 2000?
   - Which coral reef is most at risk of bleaching due to rising sea surface temperatures: Florida Keys, Galapagos, Hawaii, or the Great Barrier Reef?

Identify a question of interest about coral bleaching.	How has sea surface temperature affected the health of coral reefs near Hawaii in the past 12 months?

2. Collect Data: Collect the data that you need to answer your question using the data tools from Level 5. If possible, paste or attach any relevant graphs or data tables below (or in a separate document) .

Graph attached

3. Construct an Explanation: Use the claim, evidence, reasoning format to construction an explanation below.

Claim: Record a simple statement that answers your question and is based upon evidence.	There has been no sign of heat stress within the past 12 months in Hawaii.
Evidence: Include specific data from the the data maps or graphs you have analyzed.	According to the graph, DHW values have not exceeded 0 during the 12 month span. survey.
Reasoning: Connect the evidence to your claim.	Since the DHW value was 0 or below, we can safely assume that there was no evidence of severe heat that could cause coral bleaching.

Mote Marine Laboratory / Florida Keys National Marine Sanctuary

Coral Bleaching Early Warning Network

Current Conditions Report #20220728

Updated July 28, 2022

Summary: Based on climate predictions, current conditions, and field observations, the threat for mass coral bleaching within the FKNMS remains **MODERATE**.

NOAA Coral Reef Watch Current and 60% Probability Coral Bleaching Alert Outlook July 27, 2022 (experimental)

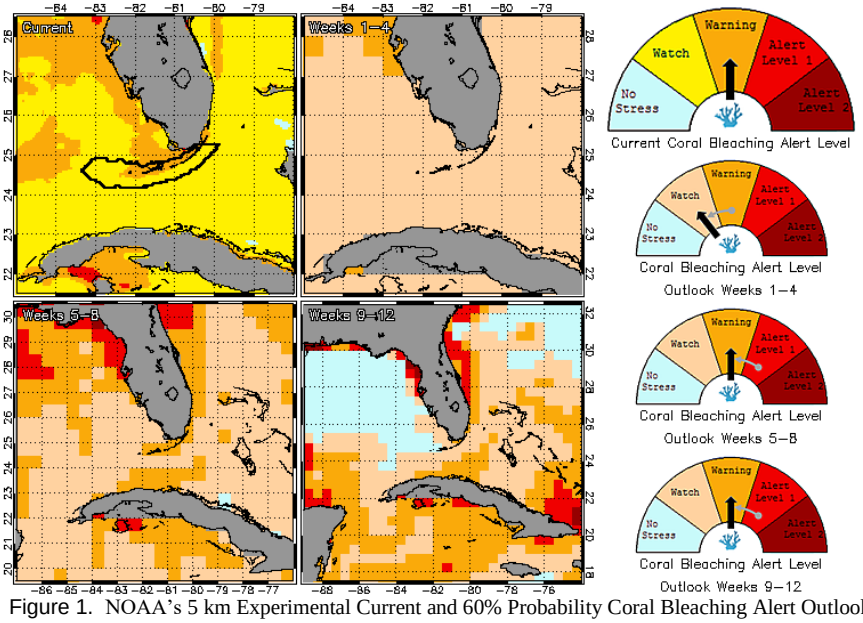


Figure 1. NOAA's 5 km Experimental Current and 60% Probability Coral Bleaching Alert Outlook Areas through October 2022. Updated July 27, 2022.
http://coralreefwatch.noaa.gov/vs/gauges/florida_keys.php

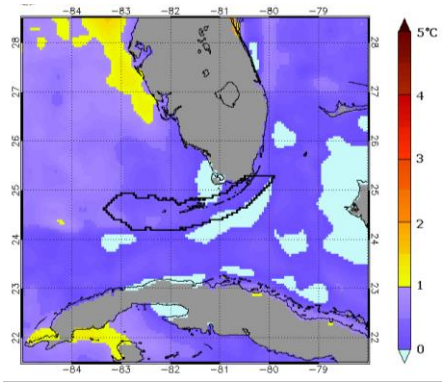


Figure 2. NOAA's Experimental 5km Coral Bleaching HotSpot Map for Florida July 27, 2022.
https://coralreefwatch.noaa.gov/vs/gauges/florida_keys.php

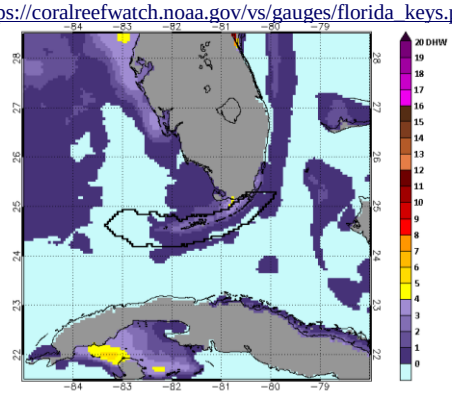


Figure 3. NOAA's Experimental 5km Degree Heating Weeks Map for Florida July 27, 2022.
https://coralreefwatch.noaa.gov/vs/gauges/florida_keys.php

Weather and Sea Temperatures

According to the newly released NOAA Coral Reef Watch (CRW) experimental 5-kilometer (km) Satellite Current and 60% Probability Coral Bleaching Alert Area, most areas of the Florida Keys National Marine Sanctuary are under a bleaching Warning, which means heat stress is accumulating and the potential exists for more bleaching warnings and alerts if sea temperatures continue to increase in the next few weeks (Fig. 1).

Recent remote sensing analysis by NOAA's CRW program indicates that the Florida Keys region is currently experiencing elevated thermal stress. NOAA's experimental 5 km Coral Bleaching HotSpot Map (Fig. 2), which illustrates current sea surface temperatures compared to the average temperature for the warmest month, shows sea surface temperatures are currently elevated above normal in the Florida Keys. Similarly, NOAA's experimental 5 km Degree Heating Weeks (DHW) map, which illustrates how much heat stress has built up over the past 12 weeks (Fig. 3), indicates accumulated temperature stress currently evident in the Florida Keys region. NOAA's Integrated Coral Observing Network (ICON) and Pacific Marine Environmental Laboratory (PMEL) monitoring stations, which provide near real time *in-situ* sea temperature and wind data along the outer reef tract throughout the Florida Keys as well as Mote Marine Laboratory's (MML) *in-situ* temperature collected at Looe Key SPA and Newfound Harbor SPA confirm that temperatures have been hovering around 30°C over the past two weeks (Fig.4), likely due in part to moderate to high winds during this period (Fig. 5). Mote Marine Laboratory will continue to monitor the NOAA HotSpot maps, DHW maps, and ICON sea temperature data from NOAA monitoring stations on a weekly basis for the remainder of the bleaching season.

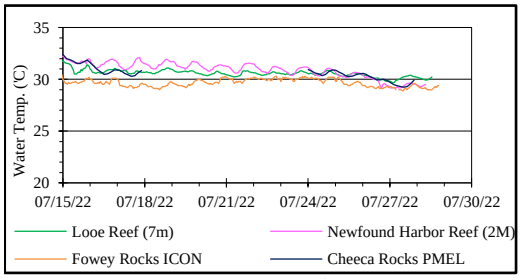


Figure 4. *in-situ* sea temperature from NOAA/ICON monitoring stations (July 15-28, 2022).

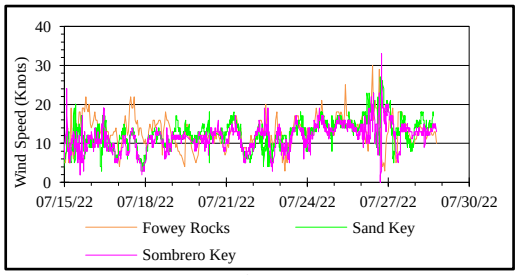


Figure 5. Wind speed data from NOAA/ICON monitoring stations (July 15-28, 2022).

Mote Marine Laboratory / Florida Keys National Marine Sanctuary

Coral Bleaching Early Warning Network

Current Conditions Report #20220728

Current Coral Conditions

Figure 7. Paling/partial bleaching *C. natans* at an inshore patch reef off Big Pine 7/20/2022.

A total of 16 BleachWatch Observer reports were received the past two weeks (Fig.6), with 7 reports indicating isolated colonies exhibiting signs of paling or partial bleaching (Fig. 7 & 8). The remaining 9 reports indicated that no significant signs of coral bleaching were observed. At those sites where paling/partial bleaching was noted, the overall percentage of corals exhibiting signs of thermal stress was 1-10% and the majority of paling/partial bleaching observations consisted of isolated colonies of Encrusting/Mound/Boulder corals (*Siderastrea spp*., and *Porites astreoides*) and Brain Corals (*Colpophyllia natans*). Other observations included paling of *Palythoa spp.* and Fire Coral as well as several reports of coral disease, mainly the Stony Coral Tissue Loss Disease (SCTLD).

Figure 8. Paling *Siderastrea siderea* at a patch reef near Looe Key SPA on 7/28/2022.

Continued field observations are needed as widespread coral bleaching could potentially develop if environmental conditions continue to be favorable. Please remember to **report even if there is no bleaching** at your site. Report at www.mote.org/bleachwatch

BleachWatch Reports for July 15-28, 2022

Figure 6. Overview of BleachWatch observer reports submitted from July 15-28, 2022

For more information about the BleachWatch program, or to submit a bleaching observation, contact:

Cory Walter
Mote Marine Laboratory
24244 Overseas Highway
Summerland Key, FL 33042
(305) 395-8730
http://www.mote.org/bleachwatch

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