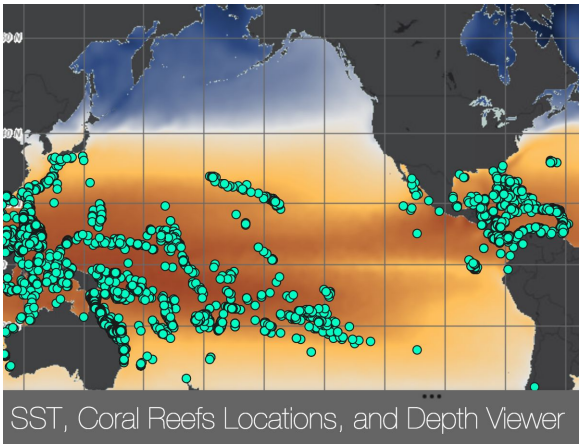
STUDENT WORKSHEET – LEVEL 1

CORAL REEFS: WHERE IN THE WORLD?

Dear Student, Are you fascinated by coral reefs where every surface, nook, and cranny is bursting with life? These oases of life are found around the tropics, where sunlight and sea surface temperature are fairly even throughout the year. But there's a problem - rising ocean temperatures are seriously affecting the health of coral reefs. Your job will be to investigate the consequences of rising temperature on reefs around the planet. Let's begin by investigating the locations of coral reefs around the world and the temperature range in which they can survive.



A map of coral reef locations around the world.

<u>Instructions:</u>

Go to the Coral Bleaching activity on the website. Click on Level 1, complete the activities and answer the questions below.

1. Generally, coral reefs are found in shallow waters between _____ degrees N latitude and _____ degrees S latitude.

2. In the United States, coral reefs are located off the coasts of which state(s)?

   _____ , _____ , and _____ .

3. Corals have a limited temperature range within which they can live. Most corals survive in temperatures ranging from _____ to _____ degrees Celsius.

STUDENT WORKSHEET – LEVEL 2

MEASURING WATER THAT IS WARMER THAN NORMAL

Your mission: An oceanic heat wave is causing severe coral bleaching at reefs across the globe. It's the worst bleaching event in history. To what extent are the corals on the Great Barrier Reef at risk? You have been selected to join a team of scientists who will analyze temperature data to find out.

Can you locate the Great Barrier Reef from space?

Instructions:

1. Go to the Coral Bleaching activity on the website. Click on Level 2 and scroll down to the activity titled *'Measuring Water That Is Warmer Than Normal.'*

2. The graph shows real temperature data (collected by satellites) along the Great Barrier Reef during Summer 2017. Use the graph to answer the questions below:

    a. On the Great Barrier Reef, how warm does the water need to be for corals to bleach? _____

    b. How many weeks did the temperatures exceed the 'bleaching limit'? _____

    c. How many degrees above the bleaching limit did the sea surface temperature rise during the week of Feb 18th, 2017? _____

3. Are the corals on the Great Barrier Reef at high risk, moderate risk or low risk of bleaching due to heat stress? Use the temperature data to explain your answer.

_____

_____

_____

_____

4. As you work through Level 2, keep a list of questions that you have about coral bleaching in the table below.

What GENERAL questions do you have about coral bleaching?	What questions could you ask (and answer) using the types of data you explored in Level 2?

STUDENT WORKSHEET #1 – LEVEL 3

IDENTIFYING THE EFFECTS OF BLEACHING ON CORAL REEFS AROUND THE WORLD

Your mission: Congratulations! You have been selected to join a team of scientists who will be investigating the health of coral reefs around the world. Your current mission is to look for evidence of coral bleaching and mortality at four reefs in the Pacific Ocean. Put on your goggles and get ready to take the plunge.

Visit the reefs (above) using the map in Level 3.

Making Observations: Go to the Coral Bleaching activity on the website, click on Level 3, and scroll down to the activity titled *'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	Date	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:*

Coral Reef #	Reef Name and Location	Date	Observations:
2			healthy bleached dead *Other observations:*
2			healthy bleached dead *Other observations:*

Coral Reef #	Reef Name and Location	Date	Observations:
3			healthy bleached dead *Other observations:*
3			healthy bleached dead *Other observations:*

Coral Reef #	Reef Name and Location	Date	Observations:
4			healthy bleached dead *Other observations:*
4			healthy bleached dead *Other observations:*

Making Sense of Your Observations: Answer the questions below.

1. How many of the reefs you visited showed signs of bleaching? _____

2. Has the health of these coral reefs changed over time? If yes, describe the changes you observed.

   _____

   _____

3. If you were a scientist, what more would you want to know to better understand coral bleaching?

   _____

   _____

   _____

   _____

4. What is one way that you could more accurately measure the amount of coral bleaching taking place at these locations?

   _____

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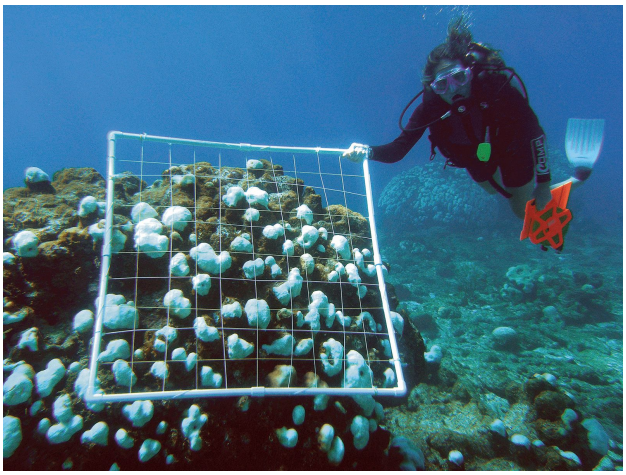
STUDENT WORKSHEET #2 - LEVEL 3

MONITORING CORAL REEFS IN THE FIELD



Your mission: You and a team of scientists are setting out to monitor coral health at different locations in the Pacific Ocean. The data that you collect will be used by managers and government officials who protect these coral reefs. Put on your scuba gear and dive in with a clipboard, data sheet and a tool called a quadrat in order to collect data that will help to begin to track the health of corals at these locations.

Question: How much coral is dead? How much is bleached?

Monitoring Methods - follow these instructions: To answer the question above, go to the Coral Bleaching module on the website. Click on Level 3 and scroll down to the activity titled *'Monitoring Coral Health Using Quadrat Sampling.'*

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

Example: Using the photo from Reef #1

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*

Reef #: _____

Square #	Is Coral Dead? 0=coral is alive, 1=coral is dead	Is Coral Bleached? 0=unbleached, 10=completely bleached
	Total # squares dead =	Average =
	% dead (total x 10) =	% bleached (total x 10) =

<u>Results:</u> answer the questions below.

1. In the area you monitored, approximately how much coral is **dead?** Approximately how much of the living coral is ***bleached***?

2. 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?

STUDENT WORKSHEET #2 – LEVEL 3

ANSWER KEY

REEF #1

Square #	Dead	Bleached
4	1	n/a
16	0	3
20	1	2
22	0	1
32	0	2
44	0	3
45	0	3
74	0	1
93	0	1
94	0	3
	Total Sum = 2	Average = 2.1
	% dead = 20%	% bleached = 21%

REEF #2

Square #	Dead	Bleached
1	1	n/a
3	1	n/a
20	1	n/a
27	1	n/a
44	0	4
48	0	0
49	0	2
61	0	5
62	0	4
89	0	3
	Total Sum = 4	Average = 3
	% dead = 40%	% bleached = 30%

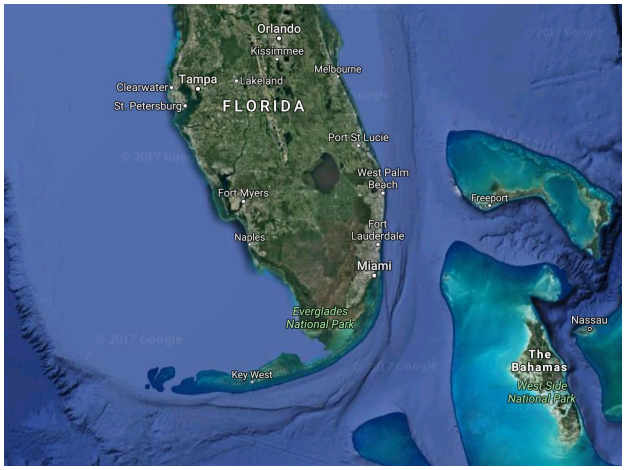
REEF #3

Square #	Dead	Bleached
4	1	n/a
5	1	n/a
8	n/a	n/a
12	1	n/a
37	0	1
42	1	n/a
49	1	n/a
55	0	3
78	1	n/a
95	0	8
	Total Sum = 6	Average = 4
	% dead = 60%	% bleached = 40%

REEF #4

Square #	Dead	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	2
94	0	0
	Total Sum = 0	Average = 1.3
	% dead = 0%	% bleached = 13%

RESEARCH PROJECT: CORAL BLEACHING IN THE FLORIDA KEYS



Your mission: Florida's coral reefs make up the third largest barrier reef ecosystem in the world. These reefs protect the shore and bring in billions of tourist dollars every year. How is sea surface temperature affecting the health of Florida's coral reefs? You are joining a team of scientists who are using data to find out.

Part 1 – Has the water been warm enough to put Florida's corals at risk?

1. Go to the Coral Bleaching activity on the website. Click on Level 4 and scroll down to the activity titled *'Analyzing Bleaching in the Florida Keys.'*

2. On the map, select the light green circle that marks the location of the Florida Keys. Click *'Graph Link.'* The graph shows the latest *Degree Heating Week* (DHW) data for this region. Analyze the graph and answer the questions below:

    a. What does the y-axis on the left represent? _____
    b. What time period is represented on this graph? _____

3. Record the date(s), if any, when coral bleaching was expected (above 4 DHW):

    _____

4. Make a prediction: How severe was the risk of bleaching during the time period described above? *Support your prediction by including information about 'how long' and 'how much' DHW values were over 4.*

_____

_____

_____

Part 2 – How much bleaching was actually observed?

5. Was your prediction accurate? Did corals bleach? Did they survive and recover? To find out, you'll need real data and observations from people who monitor coral reef conditions in the Florida Keys. Use the two options below, to begin your search:
   - Florida's *Mote Marine Lab* publishes coral Condition Reports on their website. These reports will show you when and where bleaching occurred in the Florida Keys during a given time period. ***See page 2 of the reports.**
   - Search for news articles about bleaching in the Florida Keys by using search terms such as: coral bleaching, Florida Keys, 2015.

6. Record information and specific evidence about bleaching from at least 2 sources.

Source	Date	Bleaching data and observations
Example: Mote Marine Lab, Current Conditions Report #20160601	June 1, 2016	No bleaching was observed during this time period.

Part 3 – Draw a Conclusion: How is sea surface temperature affecting the health of Florida's coral reefs? Use evidence and data from Parts 1 and 2 to support your conclusion.

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STUDENT WORKSHEET – LEVEL 5

DESIGN YOUR OWN INVESTIGATION

Develop Your Question:

_____

_____

_____

_____

Make a Plan: Make a list below of the specific data you will need to answer the question.

Data Set	Date	Map or Graph?
Example: Degree Heating Weeks, Florida Keys	August 2015	map

Other than the data listed above, what other information (if any) will you need to answer your question?

_____

_____

Get the data: Use the website to get the data you will need.

Interpret the data: What does your data show? Be specific and descriptive.

_____

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Draw a Conclusion: What is the answer to your question? Use evidence and data to support your conclusion.

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