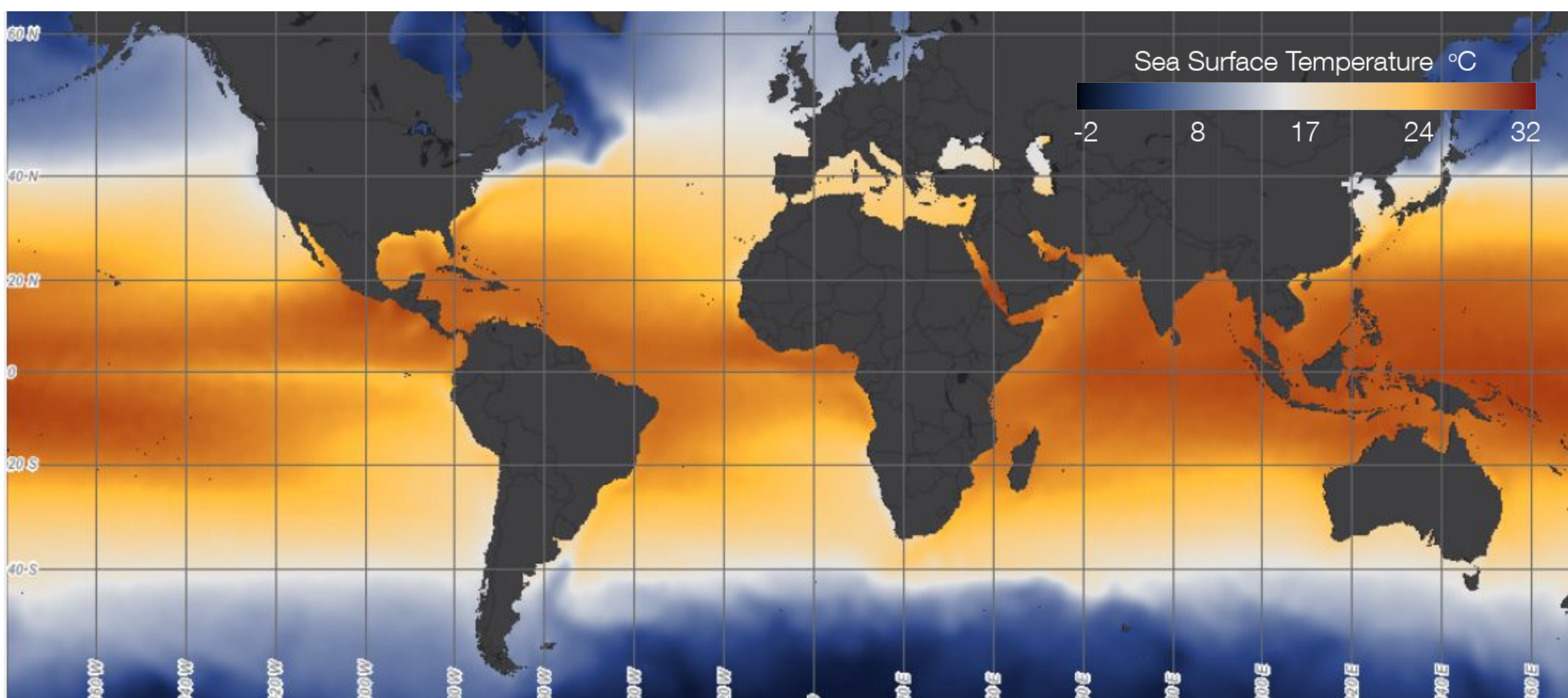


## DATA IN THE CLASSROOM: LEVEL 1

# Coral Reef Locations

- 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?	Approximately 28°C
Between which latitudes do most of the warmest temperatures (orange-red) occur?	Between 30°South and 30°North



- 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?	Above 29.7 °C (the bleaching limit)
How many weeks did the temperatures exceed the 'bleaching limit' during the 3 months summer season?	12
How many degrees above the bleaching limit did the sea surface temperature rise during the week of February 18th, 2017?	0.6 °C

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?	It is used by scientists to understand and predict bleaching events.

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? <i>Support your answer using evidence &amp; data from the map.</i>	Most of the reef is dark orange or red in color. These colors indicate that thermal stress has reached or exceeded 8 DHW. The reef is at high risk of bleaching due to heat stress.
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## 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	<b>healthy</b> bleached    dead  <i>Other observations: Coral is bright green and yellow. Lots of colorful fish are present.</i>
1	Phoenix islands, Republic of Kirabati	2016	healthy    bleached <b>dead</b>  <i>Other observations:</i>
2	Pago Pago, American Samoa	Dec 2015	<b>healthy</b> bleached    dead  <i>Other observations:</i>
2	Pago Pago, American Samoa	Feb 2016	healthy <b>bleached</b> dead  <i>Other observations:</i>
3	Lizard Island, Great Barrier Reef, Australia	Mar 2016	healthy <b>bleached</b> dead  <i>Other observations:</i>
3	Lizard Island, Great Barrier Reef, Australia	May 2016	healthy    bleached <b>dead</b>  <i>Other observations: dead coral is covered in algae</i>
4	Kahului Point, Maui, Hawaii	Aug 2015	<b>healthy</b> bleached    dead  <i>Other observations:</i>
4	Kahului Point, Maui, Hawaii	Nov 2015	healthy <b>bleached</b> dead  <i>Other observations:</i>

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 showed signs of bleaching or coral death.
Has the health of these coral reefs changed over time? If yes, describe the changes you observed.	All images showed declines in coral health over relatively short periods of time.

## 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.

#### 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
<b>Total Sum = 2</b>	<b>Average = 2.1</b>	
<b>% dead = 20%</b>	<b>% bleached = 21%</b>	

#### 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
<b>Total Sum = 4</b>	<b>Average = 3</b>	
<b>% dead = 40%</b>	<b>% bleached = 30%</b>	

#### 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
<b>Total Sum = 6</b>	<b>Average = 4</b>	
<b>% dead = 60%</b>	<b>% bleached = 40%</b>	

#### 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
<b>Total Sum = 0</b>	<b>Average = 1.3</b>	
<b>% dead = 0%</b>	<b>% bleached = 13%</b>	

## 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.

<p><b>Graph:</b> 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?</p> <p><i>Describe data and trends shown on the graph.</i></p>	<p>Answers will vary.</p> <p><i>Example: A Degree Heating Week value of 4 was exceeded during mid summer to fall in 2018 and 2021. A Degree Heating Week value of 8 was briefly exceeded during 2019 and 2020. Coral's likely experienced significant bleaching each summer and fall during this 4 year time period, though more so in 2019 and 2020.</i></p>
<p><b>Observations from <a href="#">Condition Report</a>:</b> Where did bleaching occur in the Florida Keys during the past year(s). How severe was it?</p> <p><i>Describe specific data &amp; observations from the report.</i></p>	<p>Answers will vary.</p> <p><i>Example: According to the reports, in 2020 and 2021 only minor signs of coral bleaching were observed in the Florida Keys. Most observations noted partial bleaching with only 1-10% of corals affected at most of those sites during summer and fall.</i></p>

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?	<p>My Claim:</p> <p>Moderate to severe heat stress regularly caused some coral bleaching in the Florida Keys between 2018-2021.</p>
Include specific data from your table above.	<p>My Evidence:</p> <p>DHW values have exceeded a value of 4 each summer and fall between 2018-2021. DHW values briefly exceeded a value of 8 in 2019 and 2020. In-the-field observations from Mote Marine Lab noted that partial bleaching occurred in 1-10% of corals at each location that was surveyed in 2020 &amp; 2021.</p>
Connect the evidence to your claim	<p>My Reasoning:</p> <p>When DHW values exceeded 4 each summer &amp; fall between 2018=2021, I expected moderate to severe coral bleaching in the Florida Keys. In-the-field observations reported that partial bleaching occurred in a small percentage of corals throughout the Florida Keys during these same time periods. So even though heat stress is causing some partial bleaching, it is not as severe as the DHW values predicted.</p>

## DATA IN THE CLASSROOM: LEVEL 5

# Design an Investigation

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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.	
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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) .

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.	
Evidence: Include specific data from the the data maps or graphs you have analyzed.	
Reasoning: Connect the evidence to your claim.	