

### Impact of a Changing Climate on Coral Reefs

**Region:** Caribbean

**Grade Level(s):** 5-8

**Time Required:** One 45-minute class period

**Focus Question:**

- Where are coral reefs located and what conditions are required to maintain healthy coral?

**Learning Objectives:**

- Students will be able to access data on selected coral reefs and manipulate these data to characterize these reefs.
- Students will be able to apply their understanding of reef composition to identify the location and conditions necessary to sustain the coral reef ecosystem.

**Materials:**

- Student handout (see below)
- Class set of computers

**Prerequisite Knowledge:**

- Students should have a working understanding of using a webpage application.
- Students should have a basic understanding of ecosystems.
- Students should understand the role of polyps and zooxanthellae in the formation and existence of coral reefs.
- Students should be able to convert between Celsius and Fahrenheit.

**Procedures/Instructional Strategies:**

1. You may want to group students into pairs or small groups for this activity.
2. Review with students the composition of coral reefs and role of polyps and zooxanthellae in the coral reef ecosystem.
3. Direct students to the student handout and let them begin.
4. Once students have finished with the worksheet, discuss students' results. Topics should include the variability of habitats in marine protected areas of the Caribbean. Students should recognize that there is often considerable variability among habitats, even though the habitats are in the same geographic area.

### **National Science Education Standards:**

#### **Science as Inquiry**

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

#### **Life Science**

- Populations and ecosystems
- Interdependence of organisms

#### **Science and Technology**

- Understandings about science and technology

#### **Science in Personal and Social Perspectives**

- Populations, resources, and environments
- Natural hazards
- Risks and benefits

#### **Life & Climate are Linked**

- Life on Earth has been shaped by, depends on, and affects climate.
- The evolution of organisms can be driven by specific climatological conditions, including but not limited to temperature, humidity, precipitation, and sunlight.
- Changes in one or more of these climate conditions can produce damaging changes in ecosystems.
- Changes in environmental conditions can affect the survival of individual organisms as well as entire species.

#### **The Nature of Science**

- We increase our understanding of the climate system through observation and modeling.
- We gain understanding of climate and how it has changed over time from observational data from weather stations, buoys, satellites, radars, ice and ocean sediment cores, tree rings, cave deposits, native knowledge, and other sources.

#### **Natural Variability & Change**

- Earth's weather and climate vary over time and space.
- Climate is understood as the atmospheric conditions (i.e., weather variables) averaged over a long period of time (season, year, or longer) and over a large area (region, continent, or larger).
- The temperature of a specific place on Earth's surface tends to rise and fall in a somewhat predictable pattern every day and over the course of a year.

- Differences in the intensity of sunlight warm Earth's surface and produce daily, seasonal and long-term variations in temperature.

### **Additional Resources:**

- NOAA's National Ocean Service Corals Roadmap to Resources  
[http://oceanservice.noaa.gov/education/kits/corals/supp\\_coral\\_roadmap.html](http://oceanservice.noaa.gov/education/kits/corals/supp_coral_roadmap.html)
- Biscayne National Park – Distance Learning Opportunities  
<http://www.nps.gov/bisc/forteachers/distancelearningopportunities.htm>
- "Altered Oceans", the Los Angeles Times  
<http://www.latimes.com/news/local/oceans/la-oceans-series,0,7842752.special>
- NOAA CoastWatch Data Products  
[http://coastwatch.noaa.gov/cw\\_dataproduct.html](http://coastwatch.noaa.gov/cw_dataproduct.html)
- NOAA CoastWatch: Product Search  
<http://coastwatch.noaa.gov/interface/interface.html>

### **References:**

A complete curriculum for middle school students about remote sensing and coral reefs can be found at [http://coralreefwatch.noaa.gov/satellite/education/reef\\_remote\\_sensing.html](http://coralreefwatch.noaa.gov/satellite/education/reef_remote_sensing.html)

### Student Handout

#### Section One: Identify the regions and conditions of ocean that support coral reefs

1. Point your web browser to <http://reefgis.reefbase.org/default.aspx>
2. Click on "Location of Coral Reefs"
3. Click off all the radio buttons and then click "Refresh Map", this will result in a map without any reefs marked.
4. Click the "Coral Reefs" radio button and then click "Refresh Map"; this will result in an image that shows the location of the coral reefs.
5. Because the color is grey you may want to alternate between showing and not showing the reefs to make sure you are identifying the reef locations accurately.
6. On the tool bar, try out the magnifying tools, the hand and the arrow buttons. Do not use the "Save Map" or "Print Map" buttons.
7. Find the latitude and longitude numbers on the bottom left corner of the image. In what state is Longitude -82 and Latitude 28? (You may have to zoom in to find it!)  
\_\_\_\_\_
8. Between what range of latitudes do you find most coral reefs?  
\_\_\_\_\_
9. Click on the "Maps" tab on the left and select "Coral Bleaching and SST" on the left hand menu. Click the button "SST" under "Coral Reef Watch" and then click "Refresh Map". You will see a multicolored map that shows Sea Surface Temperatures.
10. Click on the "Legend" tab on the left and you will find the temperatures and matching color.
11. Zoom onto the NOAA symbol at the bottom of Florida and find an area in the Caribbean.
12. What area have you selected?  
\_\_\_\_\_
13. What is the sea surface temperature of this area?  
\_\_\_\_\_
14. What is the range of sea surface temperatures (°C and °F) for the range of latitudes in which most of the coral reefs are found?  
\_\_\_\_\_

#### Section Two: Introduction to coral bleaching.

Coral bleaching events often occur in areas where the sea surface temperature is 1°C or more above the normal maximum temperature.

1. Go to: [http://www.nmfs.noaa.gov/pr/pdfs/species/acropora\\_factsheet.pdf](http://www.nmfs.noaa.gov/pr/pdfs/species/acropora_factsheet.pdf), to answer the following questions:
  - a. What is the most abundant species of corals in the world?  
\_\_\_\_\_
  - b. Is the temperature range required for *Acroporids* to survive consistent with what you found above?  
\_\_\_\_\_
  - c. What human induced factors can negatively impact *Acroporids*?  
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d. What is coral bleaching?

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e. What factor has caused widespread coral bleaching throughout the world?

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f. What impact would human induced climate change have on coral reefs?

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### Student Handout – Answer Sheet

#### Section One: Identify the regions and conditions of ocean that support Coral Reefs.

1. Point your web browser to <http://reefgis.reefbase.org/default.aspx>
2. Click on “Location of Coral Reefs”
3. Click off all the radio buttons and then click “Refresh Map”, this will result in a map without any reefs marked.
4. Click the “Coral Reefs” radio button and then click “Refresh Map”; this will result in an image that shows the location of the coral reefs.
5. Because the color is grey you may want to alternate between showing and not showing the reefs to make sure you are identifying the reef locations accurately.
6. On the tool bar, try out the magnifying tools, the hand and the arrow buttons. Do not use the “Save Map” or “Print Map” buttons.
7. Find the latitude and longitude numbers on the bottom left corner of the image. In what state is Longitude -82 and Latitude 28? (You may have to zoom in to find it!)  
Florida
8. Between what range of **latitudes** do you find most coral reefs?  
+30 and -30
9. Click on the “Maps” tab on the left and select “Coral Bleaching and SST” on the left hand menu. Click the button “SST” under “Coral Reef Watch” and then click “Refresh Map”. You will see a multicolored map that shows Sea Surface Temperatures.
10. Click on the “Legend” tab on the left and you will find the temperatures and matching color.
11. Zoom onto the NOAA symbol at the bottom of Florida and find an area in the Caribbean.
12. What area have you selected?  
Answers will vary
13. What is the sea surface temperature of this area?  
Answers will vary – should be in the range below
14. What is the range of sea surface temperatures (°C and °F) for the range of latitudes in which most of the coral reefs are found?  
25 °C to 29 °C, 77°F to 86°F (over +30 to -30)

#### Section Two: Introduction to Coral Bleaching.

Coral bleaching events often occur in areas where the sea surface temperature is 1°C or more above the normal maximum temperature.

2. Go to: [http://www.nmfs.noaa.gov/pr/pdfs/species/acropora\\_factsheet.pdf](http://www.nmfs.noaa.gov/pr/pdfs/species/acropora_factsheet.pdf), to answer the following questions:
  - a. What is the most abundant species of corals in the world?  
Acropora
  - b. Is the temperature range required for *Acroporids* to survive consistent with what you found in above?



- Yes, although according to the Fact Sheet the lower limit is near 16°C
- c. What human induced factors can negatively impact *Acroporids*?  
Pollution, sewage discharge, coastal development, and over fishing.
- d. What is coral bleaching?  
The temporary or permanent loss of zooxanthellae (symbiotic algae) from the coral.
- e. What factor has caused widespread coral bleaching throughout the world?  
Warm water temperatures.
- f. What impact would human induced climate change have on coral reefs?  
Increased water temperatures over 30°C would have devastating effects on the coral reef ecosystem, causing widespread coral bleaching that could be fatal to the reefs.