

Instructional Recipe
What is Coral Reef Bleaching?
Grade 9-12
Environmental Systems
Education Service Center Region 20



Online research and information resources available through a partnership between the Texas State Library and Archives Commission, the Texas Education Agency and Education Service Center, Region 20 <http://web.esc20.net/k12databases>

Step 1 – Ask

Objectives: Student will learn to evaluate the impact of human activity and technology on aquatic systems.

Introduction: Scientists use ocean temperatures and ocean "color" as indicators of what is happening with coral. Coral is very temperature sensitive. Ocean "color," or the concentration of chlorophyll in ocean plants, is important because it informs scientists about changes in the ocean's biological productivity. Though coral reefs exist around the world, researchers actually consider this network of reefs to be the center of the world's marine biodiversity, playing a critical role in human welfare, climate, and economics.



Photo from Goddard Space Center/ NASA:

http://www.nasa.gov/centers/goddard/news/topstory/2006/coral_bleach.html

Image above shows a healthy coral at the Great Barrier Reef. NASA satellites capture both temperature and color data from their space-based view of the coral reefs.

Ask:

- ★ What is plaguing the Great Barrier Reef and other reefs throughout the world?
- ★ Why is coral a good tool to measure changes that occur in oceans?
- ★ What creates ocean color?

Vocabulary:

- ★ Bioluminescence
- ★ Sea surface temperatures
- ★ Coral bleaching
- ★ Imaging spectroradiometer
- ★ Environmental stress

TEKS:

112.44.5 (F) Environmental Systems

The student knows the interrelationships among the resources within the local environmental system. The student is expected to (F) evaluate the impact of human activity and technology on land fertility and aquatic viability.

Technology Application

TEKS: 126.22.7(B)

(7) **Solving problems.** The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to: (B) use visual organizers to design solutions such as flowcharts or schematic drawings.

Step 2 – Investigate

[Click here for internet links/URLs](#)

K-12 Online Subscription Resources: Use search strategies (coral bleaching and reefs), (environmental stress and oceans), (sea surface temperatures)

From Britannica:

[Global warming](#)." *Encyclopædia Britannica*. 2008. *Encyclopædia Britannica Online School Edition*.

From EBSCO:

[Coral Bleaching Effect](#). *Preview Geographical*, Apr2006, Vol. 78 Issue 4, p9-9, 0p, 1 color; Reading Level (Lexile): (AN 20906893)

Additional Websites: [Online Encyclopedia of Life](#); [Reef Check University of California](#); [Coral Reef Management Program](#); [Learn About Reefs](#); [Underwater Reef Guide](#); [Ocean Science Animations](#).

Books:

Atlas of Coral Reefs. Mark D. Spalding, Corinna Ravilious, and Edmund P. GreenWorld. ([Book review](#).)

A Guide to the Coral Reefs of the Caribbean, by Mark D. Spalding ([Book Review](#))

Step 3 – Create

[Click here for internet links/URLs](#)

- ★ **Read** the articles listed in [Step 2](#). Use the [fishbone graphic organizer](#) to identify cause/effect relationships. Find additional articles in the [K-12 Subscription Databases](#).
- ★ **Use** the [key concepts rubric](#) to identify major concepts while reading.
- ★ **Watch & Listen:** [Coral Reefs Video -- National Geographic](#). Coral reefs are the foundation of many marine ecosystems. Watch the video clip and answer the [pre-quiz questions](#).

 **Technology Link -**

- ★ [All you Wanted to Know About Coral Reefs](#)

Step 4 – Discuss

[Click here for internet links/URLs](#)

- ★ **Conduct** a CSI (Crime Scene Investigation) of reef destruction and determine possible causes. Use Google Earth to assist with the investigation.
- ★ **Read & Discuss:** [Is Bleaching Coral's Way of Making the Best of a Bad Situation?](#) from National Geographic, [Investigating Coral Bleaching](#) from NOAA and [NASA Helps Researchers Diagnose Recent Coral Bleaching at Great Barrier Reef](#).
- ★ Study the images of the [sea surface temperature](#) and the [coast](#) near the Great Barrier Reef from the NASA satellite. (Use Google Earth to make a real-time peek at the Great Barrier Reef coastal line.)
- ★ Use the ocean science animations listed below from NASA to see how the global oceans are changing.
 - ✚ [How to Read a Sea Surface Map](#)
 - ✚ [Sea Surface Temperatures](#)
 - ✚ [Global Phytoplankton Cycle](#)
 - ✚ [Hurricanes and Sea Surface Temperatures \(Image only.\)](#)
 - ✚ [Warmer & Cooler Surface Warming Trends](#)
- ★ **Write** a paper detailing your findings. Use the [CSI Results Paper rubric](#) and the [Project Description](#) sheet to complete the writing portion of the assignment.
- ★ **Create** a digital poster with PowerPoint to present your findings.

Technology Link

View other [coral reef video clips](#) for additional information.


Use Google Earth to see where the coral reefs are located. To learn how to use Google Earth, download the [Google Earth tutorial](#) from TeacherTube.

- ★ Students will watch and use the [Google Earth tutorial](#) which will introduce them to the Google Earth Tour and also give instructions for downloading the .kmz file that will be used for the Google Earth tour.

Step 5 – Reflect

[Click here for internet links/URLs](#)

- ★ Allow students to present their papers and their digital posters to the rest of the class. Use the following suggested rubric to assess the students' work. Make sure that the students are familiar with the [CSI Results Paper rubric](#) before they begin creating their project. They should refer to the rubric repeatedly to monitor their progress in creating their project.

 **Technology Link:** You can also create your own rubric with your students at <http://rubistar.4teachers.org/index.php>.

Internet Links/URLs

Articles may be located by either the accession number (AN) or the persistent URL.

Step 2 – Investigate

- **Global warming**
<http://school.eb.com/eb/article-274853>
- **Coral Bleaching Effect**
<http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=20906893&site=ehost-live>
- **Online Encyclopedia of Life**
<http://www.eol.org/>
- **Reef Check University of California**
<http://www.reefcheck.org/>
- **Coral Reef Management Program**
http://www.reefcheck.org/conservation/coral_reef_management_program.php
- **Learn About Reefs**
<http://datamanagement.reefcheck.org/Issues.asp>
- **Underwater Reef Guide**
http://www.reefcheck.org/ecoaction/underwater_reef_guide.php
- **Ocean Science Animations**
http://www.nasa.gov/centers/goddard/earthandsun/climate_change.html
- **Atlas of Coral Reefs (Book review)**
<http://www.ucpress.edu/books/pages/9635.php>
- **A Guide to the Coral Reefs of the Caribbean (Book Review)**
<http://www.ucpress.edu/books/pages/10220.php>

Step 3 – Create

- **fishbone graphic organizer**
http://lexiconsys.com/graphic_organizers/fishboneIdx.html
- **K-12 Subscription Databases**
<http://web.esc20.net/k12databases/accessk12.html>
- **Coral Reefs Video -- National Geographic**
<http://video.nationalgeographic.com/video/player/environment/threats-to-animals-environment/coral-reefs.html>
- **All you Wanted to Know About Coral Reefs**
http://www.science-house.org/nesdis/coral/HTML_Presentation/index.html

Step 4 – Discuss

- **Is Bleaching Coral's Way of Making the Best of a Bad Situation?**
http://news.nationalgeographic.com/news/2001/07/0725_coralbleaching.html
- **Investigating Coral Bleaching**
<http://www.science-house.org/nesdis/coral/background.html>
- **NASA Helps Researchers Diagnose Recent Coral Bleaching at Great Barrier Reef**
http://www.nasa.gov/centers/goddard/news/topstory/2006/coral_bleach.html
- **sea surface temperature**
http://www.nasa.gov/centers/goddard/images/content/143901main_coral_seatemps_lg.jpg
- **coast**
http://www.nasa.gov/centers/goddard/images/content/143896main_heron_island_lg.jpg
- **How to Read a Sea Surface Map**
<http://www.science-house.org/nesdis/coral/map.html>
- **Global Phytoplankton**
<http://svs.gsfc.nasa.gov/documents/index.html>
- **Hurricanes and Sea Surface Temperatures (Image only)**
<http://svs.gsfc.nasa.gov/vis/a000000/a003200/a003279/index.html>
- **Warmer & Cooler Surface Warming Trends**
<http://svs.gsfc.nasa.gov/vis/a000000/a002800/a002831/index.html>
- **Google Earth tutorial**
<http://teachertube.com/videoList.php?pg=featuredvideolist>

Step 5 – Reflect

- <http://rubistar.4teachers.org/index.php>

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How to Investigate the question: What is Bleaching the World's Coral Reefs?

Student _____

Description of CSI Project Investigation

- **Resource Requirements:** There must be a minimum of two books and three internet sites used as sources - Please expect to use more.
 - There are a great number of [CORAL REEF WEBSITE RESOURCES](#) under the specific Internet resources on the resource page.
 - General research may require you to use more general keywords in your research. For instance if you were looking for the Exuma Cays Land and Sea Park, you might want to search for Bahamas or Caribbean or Caribbean coral reef, or Caribbean mangrove, or Caribbean sea grass if you have difficulty getting the information about your specific location.
- **Written notes** will need to be turned in with the paper. You will lose points if you have not written your paper from your notes.

Paper will include:

- Where located (include map)
- A physical description of the reef – types of habitat found there, depth range (keywords depth, bathymetry), sea surface temperature and salinity ranges (both found on links on the marine websites page), dissolved nutrient levels (keywords nitrogen, phosphorus, silicon), amount of light (refer to marine website page as well).
- If it is a sanctuary, some history, what resource it is trying to protect and when it was designated. If it isn't a sanctuary, talk about how long people have been studying the area and possibly geologically how it was formed.
- Common organisms in the reef (at least three) – bonus points for scientific names (Genus species)
 - At least one of these needs to be a key organism in the reef. These are organisms that define and determine the reef and without which the reef would be completely different.
- Any limiting factors that affect what organisms can live in the reef.
- How humans impact the habitat – BE SPECIFIC (you can't just say pollution)
- Current or recent research in the reef.

ALL research should be put together in an ESSAY with an introduction and well constructed paragraphs. The paper should be DOUBLE-SPACED. Font size must be between 12 and 13. You must also include a formal bibliography.

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CSI Results Paper Rubric

Student _____

Date _____ Period _____

Paper:	Possible	Earned
History of the reef: what it is protecting and when designated as a protected area?	5 points	
Map or diagram of where found.	5 points	
Physical description of reef.	10 points	
Common organisms found in reef (including key organism)	5 points	
Possible cause for reef deterioration	10 points	
Limiting factors that affect the populations of the reef.	10 points	
Human impacts on the reef.	5 points	
Recent or current research being done on the reef.	5 points	
Bibliography (at least 2 books and 3 internet sites)	10 points	
Notes	5 points	
Bonus points for scientific names and food web (1 each)	5 max each	
Digital Poster:		
Map	2 points	
Food chain with labeled organisms	5 points	
Key organism living in the reef	4 points	
Physical reef features – temp, salinity, depth, etc.	5 points	
Human impact and recent research	4 points	
Presentation:		
Covering the key points in the paper, using the poster	10 points	
Points will be removed for reading your report while presenting.	-5 maximum	
Total Grade:	100	

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Coral Reef Video Clips

Raw Human Waste Killing Off Coral Reefs?

Raw Human Waste Killing Off **Coral Reefs**? ... White pox has nearly wiped out hornlike elkhorn **coral** in some **reefs** in the Caribbean and elsewhere. ...

news.nationalgeographic.com/news/2002/06/0627_020627_coral.html - 27k

Global Warming Has Devastating Effect on Coral Reefs, Study Shows

... Global Warming Has Devastating Effect on **Coral Reefs**, Study Shows. Sean Markey for National Geographic News. May 16, 2006. Eight years ...

news.nationalgeographic.com/news/2006/05/warming-coral.html - 28k

Electricity Revives Bali Coral Reefs

Electricity Revives Bali **Coral Reefs**. Joseph Coleman in Pemuteran Bay, Indonesia Associated Press. December 4, 2007. Just a few years ...

news.nationalgeographic.com/news/2007/12/071204-AP-bali-electrified.html - 27k

Coral Reefs Vanishing Faster Than Rain Forests

Coral reefs in the Indian and Pacific Oceans have been disappearing much faster and for a longer time than previously thought, a new study shows. ...

news.nationalgeographic.com/news/2007/08/070807-coral-loss.html - 28k

The National Geographic Online Store - Jump Into Science: Coral ...

Jump Into Science: **Coral Reefs** - Kids will marvel at this introductory glimpse of the colorful world beneath the seas. ... underwater realm of **coral reefs**. ...

shop.nationalgeographic.com/product/2391.html - 43k

Why Is Seaweed Killing Florida's Coral Reefs?

In the last 15 years, a species of brown seaweed has been growing out of control and choking the **coral reefs** of Florida, the Bahamas and the Caribbean. ...

news.nationalgeographic.com/news/2001/08/0823_TVseaweed.html - 27k

Coral, Coral Profile, Facts, Information, Photos, Pictures, Sounds ...

... jellyfish. At their base is a hard, protective limestone skeleton called a calicle, which forms the structure of **coral reefs**. **Reefs** ...

animals.nationalgeographic.com/animals/invertebrates/coral.html?nav=A-Z - 46k

Coral Reefs: Canaries of the Sea

Issues > July/August 2003 (#97) > **Coral Reefs**: Canaries of the Sea.

Coral Reefs: Canaries of the Sea. by Mindy Pennybacker. ...

www.thegreenguide.com/doc/97/coral - 23k

Predator Fish Help Coral Reefs Rebound, Study Shows

Predator Fish Help **Coral Reefs** Rebound, Study Shows. John Roach for National Geographic News. January 5, 2006. The return of a top ...

news.nationalgeographic.com/news/2006/01/0105_060105_reef_fish.html - 27k

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Coral Bleaching Pre-Quiz

1. Coral reefs are the foundation of many marine ecosystems. Watch the video clip, [Coral Reefs Video -- National Geographic](#) and answer the questions below.
2. Where do you think most coral reefs are located?
Why do you think they are located there?
What do you think causes coral reef bleaching? Why?
Are there any other factors that could contribute to this problem? If so, what are they?
3. The Coral Reef Bleaching information page on the NOAA/NESDIS web page. <http://www.coris.noaa.gov/>
4. Are there any regions of the US where you think you might find coral reef bleaching? Why or why not? The links below are to Sea Surface Temperature Maps.
Visit the link "[How to Read A Sea Surface Temperature Map](#)" before trying to answer the questions.
5. Do you think that the time of year has anything to do with coral reef bleaching events?
If so, what months do you think would have the greater likelihood of coral reef bleaching? Why?
This link is a list of Monthly Sea Surface Temperature Anomaly Charts. Use different months of data to compare the seasons.
<http://www.osdps.noaa.gov/PSB/EPS/SST/climo.html>
6. Do you think El Niño/La Niña have an effect on coral reef bleaching?
If you are unsure about what El Niño/La Niña are use this link to help you find out more.
El Niño Theme Page. <http://www.pmel.noaa.gov/toga-tao/el-nino/nino-home.html>

***Questions come from NOAA (<http://www.science-house.org/nedis/coral/student.html>)