# CORAL REEFS (4 days, total 6 hours, with lab)

**School: Animo Leadership Charter High School** **Teacher: Steffan Panos**
**Subject**: Life Science **Grades**: 9-10 **Unit Topic**: Protecting our World

**Focus Question:** Why are coral reefs important? What are explanations for "coral bleaching?" How do weather changes and human activities affect coral reefs?

**Learning Objectives**

- Students will be able to identify and explain five ways that coral reefs benefit human beings and the myriad of organisms that live upon them.

- Students will be able to identify and explain three major threats to coral reefs.

- Students will be able to identify / discuss actions that can reduce or eliminate threats to coral reefs.

- Students will be able to discuss at least one hypothesis why corals under stress expel their zooxanthellae

**State standards:**

California standards for life sciences, grades 9-12, High school, ecology and biology *

**6. Stability in an ecosystem is a balance between competing effects.**
As a basis for understanding this concept, students know:
a. biodiversity is the sum total of different kinds of organisms, and is affected by alterations of habitats.
b. how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of non-native species, or changes in population size.
c. how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.

**Resources**:

**Class textbook** Marine Science by T. Greene, classroom library books, Internet, teacher prepared packet. *"Coral Reef Subject* Review Crossword Puzzle," laboratory packet, etc.
Corals http://www.nos.noaa.gov/education/corals/supp_coral_roadmap.html
http://www.nos.noaa.gov/education/education/welcome.html.
http://www.reffcheck.org

**Technology**: Video, PowerPoint, Internet, CD-ROM, overhead projector

**Key Vocabulary Word List**

*Algae biodiversity calcium carbonate coral habitat Photosynthesis symbionts zooplankton zooxanthellae*

**Extension:**
Students or student groups can prepare a report on a specific aspect of coral biology, ecology, or management. Some possible topics include:

- oil spills on coral reefs
- coral reef restoration
- species diversity on coral reefs
- benthic habitats associated with coral reefs

**Focus student**:

**Day 1-**As students enter the class they will see a PowerPoint of a coral reef with multiple organisms in a time slide show presentation. Captivating will be captivating photographs, showing the beauty of this ecosystem and its relationship to the marine environment in general.

**Day 2-** Beginning with a few healthy coral reef photos the timed PowerPoint presentation will immediately switched to unhealthy coral reefs that are diseased, bleached out, and virtually free of invertebrates and vertebrates common to this marine ecosystem

**Day 3-** Students will work in their "PODS" which are their cooperative learning groups on comparison worksheets (see attached), vocabulary definitions, and beginning their homework.

**Day 4-** This day is devoted to labs. The first part will be a demonstration by the teacher on the physiology and function of the cnidoblast. It will include a worksheet which students will have to diagram and label the functioning parts of the cnidoblasts.

**Day 5**- Field trip to Long Beach Marine Aquarium (date and funding to be arranged) students will be given a worksheet to complete as they tour the aquarium. Special attention will be given to the soft and hard coral exhibits.

**The first day of this lesson is intended to:**

- Introduce students to coral reefs and improve their understanding of why these systems are important, how they are threatened, and what can be done to protect and restore these unique and valuable ecosystems.
- Introduce students to hypotheses that explain why corals under stress may expel their zooxanthellae.

**In the second day of this lesson students:**

- Design and prepare educational programs to improve public awareness of the importance of coral reefs and what needs to be done to reduce or eliminate harmful impacts from human activities.

**During the third and fourth day of this lesson students:**

- Develop a more complete understanding and familiarity of the terminology, complexity and will view coral reefs as an entire ecosystem. They will gain an appreciation for reef ecology and the environmental concerns associated with their rapid demise.

**Day five will be a Field trip that will:**

- Give students a hands-on and up close perspective of coral reefs in their ecosystem. They will carry out a scavenger hunt to complete a worksheet at the aquarium.

**Organization of the Classroom**

I have organized my class in a **constructivist / cooperative model** using heterogeneous groups of four that are called **P. O. D. S.** Each group, or P. O. D. of students, has named their group. The students have bonded over the past several weeks and see themselves as a cohesive unit (I change the P. O. D. members every two months). At the beginning of each class the P. O. D. coordinator for the week checks on attendance, tardiness, homework, preparedness of each student in the group. They perform dissections and group projects as a team as well as research, textbook reading, and worksheet completion. They **work as a team** and compete against other teams in the classroom for certificates, educational rewards, the privilege of attending special field trips, and extra credit points. The competition is friendly but intense. This takes care of the major classroom management issues as I the teacher have the right to deduct points from each P. O. D. for negative behavior or to award special points for exceptional behavior, assistance to other P. O. D. S., etc.

I generally try to the incorporate four different activities and give them a few minutes break in the middle of the 90 minute period. I maintain a very visually stimulating class and one in which students actively participate in class discussion, P. O. D. collaboration, and question and answers.

**Prior knowledge**:

At the beginning of this unit we do a **K. W. W. L. chart** with the students. One student is asked to come to the overhead and write down all of the organisms that might possibly encounter on a tropical coral reef. We compile a list of about 20 items which students copy into their duplicated K. W. W. L. chart in their notebooks. Then we solicit questions that students want to ask and have answered about coral reefs over the course of the unit. We take about eight to ten questions that are incorporated into my lesson and materials that students will read and view.

**DAY 1-Background for students**

Coral reefs are one of the most biologically productive ecosystems on Earth. Most people have seen images of brightly colored fishes and other reef-dwelling organisms, yet many do not understand why these systems are personally important. Programs and articles about coral reefs typically point out benefits that include protecting shorelines from erosion and storm damage, supplying foods that are important to many coastal communities, and providing recreational and economic opportunities. These benefits are obviously important to people who live near reefs, but there is another aspect of coral reefs that can benefit everyone: the highly diverse biological communities are new sources of powerful antibiotic, anti-cancer and anti-inflammatory drugs.

The idea of coral reefs as a source of important new drugs is new to many people; but in fact, most drugs in use today come from nature. Aspirin, for example, was first isolated from the willow tree. Morphine is extracted from the opium poppy. Penicillin was discovered from common bread mold. Although almost all of the drugs derived from natural sources come from terrestrial organisms, recent systematic searches for new drugs have shown that marine invertebrates produce more antibiotic, anti-cancer, and anti-inflammatory substances than any group of terrestrial organisms. Particularly promising invertebrate groups include sponges, tunicates, bryozoans, corals, and some molluscs, annelids, and echinoderms.

**DAY 2-Background for students**

Despite their numerous benefits to humans, many coral reefs are threatened by human activities. Sewage and chemical pollution can cause overgrowth of algae, oxygen depletion, and poisoning. Fishing with heavy trawls and explosives damages the physical structure of reefs as well as the coral animals that build them. Careless tourists and boat anchors also cause mechanical damage. Thermal pollution from power plants
and global warming cause physiological stress that kills coral animals and leaves the reef structure vulnerable to erosion. Many of these impacts are the result of ignorance; people simply aren't aware of the importance of coral reefs or the consequences of their actions, but the damage and threats to reefs continues to increase on a global scale.

Some of the most severe damage appears to be caused by thermal stress. Shallow-water reef-building corals live primarily in tropical latitudes (less than 30° north or south of the equator). These corals live near the upper limit of their thermal tolerance. Abnormally high temperatures result in thermal stress, and many corals respond by expelling the symbiotic algae (zooxanthellae) that live in the corals' tissues. Since the
zooxanthellae are responsible for most of the corals' color; corals that have expelled their algal symbionts appear to be bleached. Because zooxanthellae provide a significant portion of the corals' food and are involved with growth processes, expelling these symbionts can have significant impacts on the corals' health. In some cases, corals are able to survive a "bleaching" event and eventually recover. When the level of environmental stress is high and sustained, however, the corals may die.

Prior to the 1980s, coral bleaching events were isolated and appeared to be the result of short-term events such as major storms, severe tidal exposures, sedimentation, pollution, or thermal shock. Over the past twenty years, though, these events have become more widespread, and many laboratory studies have shown a direct relationship between bleaching and water temperature stress. In general, coral bleaching occurs where water temperature increases by 1° C.

**Day 3--P. O. D. Activity**
In a subsequent day of this unit, students design and prepare educational programs to improve public awareness of the importance of coral reefs and what needs to be done to reduce or eliminate harmful impacts from human activities. This activity offers many opportunities for cross-curricular activities, and may be extended over several weeks.

Direct students to the coral reef tutorials at
http://www.nos.noaa.gov/education/education/welcome.html.

Student groups can be assigned different tutorial sections. Each group can complete one version of the Coral Reef Subject Review, and lead a discussion to review the answers. It is important for the students to understand the relationship between coral animals and their symbiotic algae (zooxanthellae), and that many corals under various types of stress will expel their zooxanthellae. Briefly explain the purpose and activities of the U.S. Coral Reef Task Force (CRTF), and highlight the monitoring functions that are intended to identify reef area threatened by thermal stress or algal blooms.

**Students will collectively write an educational brochure or flyer or put together a PowerPoint on marine ecosystems they will produce and share with the class. They will make their collective presentations in front of the whole class and the best one will be chosen to present at a school-wide assembly. (See rubric at end)**

**This culminating activity will be based on further prior independent practice (homework) and collective collaboration in the P. O. D. during classroom. The teacher will move around the class assisting groups in mastering their materials and putting them in presentation format.**
**Differentiated instruction**:

Due to the fact that all my students are **English language learners** and the class incorporates special education students, I have integrated my cooperative learning strategies with **SDAIE** techniques. There are a lot of **visuals, hands-on activities, realia, worksheets, distributions of specimens and dissections** as part of each major unit. I group students so that they can receive assistance from others in their group. During the lesson itself, I utilize **Spanish vocabulary** as much as I can (also accessing prior knowledge at this time), instruct English language learners to use Spanish language web sites, and copy related material into special packets for those English language learners needing more help in their language transition. At times I have organized Spanish language study groups. I spend substantial time on vocabulary; **incorporate vocabulary words into PowerPoint slides** with pictures of the particular feature. Vocabulary and concept definitions are a focus of the homework. I have developed an of ecology crossword puzzle that aids students in vocabulary learning and retention. My assessments are also coordinated with the special education teacher at Animo so that **special education students receive accommodations** in their assessments as well is in their placement in the front of the classroom and in a strong P. O. D.

**Learning styles**:

The use of many visuals, including PowerPoint, overhead, specimen distribution, hands-on worksheets, short video clips and continuous movement around the room touches on **various learning styles** and will assist each and every student in learning the material. We **read** homework assignments and the answers, we read sections from the textbook, and we work through our **worksheets together** so students hear the questions and answers as well is see them **written** on the board or overhead.

**Model**:

Throughout each lesson I model several examples. First is the setup of the homework in the **Cornell** note- taking method. Second, is note taking during PowerPoint's and class discussion in this same format. I ask a student how they would set up the information in the Cornell method as we proceed, so

students can model themselves from other students work as well. Third, the **completion of worksheets, Venn diagrams and concept maps** through transparencies on the overheads Fourth, during **dissections**, I will model each incision and step-by-step procedure prior to students carrying out this activity.

**Guided practice**:

Students will demonstrate their understanding of the material covered (i.e. the lesson objective) through the successful **completion of their worksheet** with the rest of their P. O. D. during class time, the successful completion of their **homework**, reviewed by the P. O. D. coordinator the next day and checked by the teacher two times a week. The teacher will also summarize the material, or ask a student to summarize what they learned over the course of the day. Often I will ask students to **write a short summary** in their notebook about what they learned and to use newly acquired vocabulary and information from the PowerPoint or video.

**Checking for understanding**:

The ability of the students to **collectively complete the worksheets** and to begin work on the **vocabulary crossword puzzle** that includes materials from the days lesson and prior homework, will give me an understanding of their level of comprehension and ability to do work on their own. I will randomly call on **students to answer questions** from the worksheet or from the prior day's **homework**.

**Ongoing feedback:**

During guided practice I constantly **move around the classroom**, giving assistance where needed, especially to **special education** students and **English language learners**. If I have a TA, I ask him/her to do the same, assisting individuals or P. O. D. S. I give for support and **answer questions continuously** during the class.

**Formal and informal assessment**:

Informal assessments will take place during the course of the class viewing the PowerPoint, working on the **worksheet**, vocabulary definitions, **diagramming and labeling dissected organisms**, and seeing how the P. O. D. S. function. A formal assessment will be a **quiz** after this unit. This will be preceded by a **coral reef bingo** game which reviews vocabulary and concepts and provides a fun activity while learning the material.

**Daily Closure**:

Students will be asked to **write a summary** in their class notes prior to the end of each class. Although only be a few sentences long they will review what they learned that day about the types of various phylum of marine organisms seen on a healthy coral reef and by contrast to the lack of them on a diseased reef.

**Independent practice**:

A homework assignment, working on the **crossword puzzle and vocabulary definitions** and a **reading assignment** with questions to answer from the course textbook will enable students to apply

what they have learned, what they need to learn from their notes, as well as to provide advanced learners with initiatives to continue on their own.

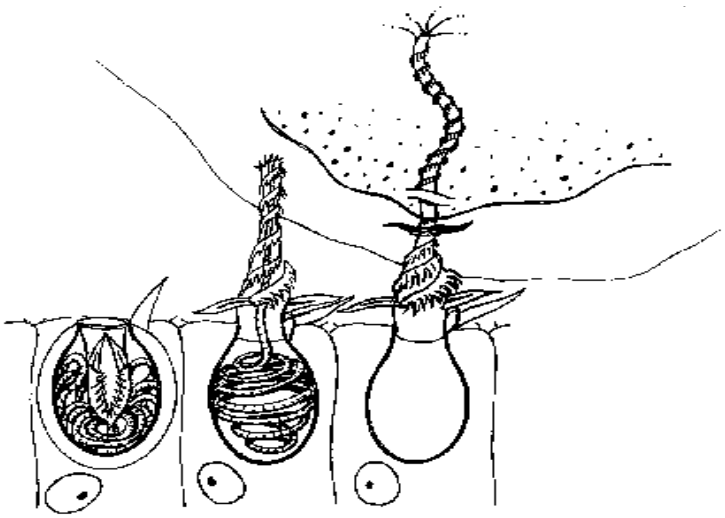
**Day 4-Laboratory**

I do not have living specimens of soft or hard corals; therefore, I shall use the calcium carbonate skeletons and fossilized polyps that I do have during the instructional periods. Jelly specimens, a sea fan skeleton, and an anemone model will aid in visual understanding (and enhance SDAIE teaching techniques) of the morphology of the coral reef.

At some point however, we shall have a field trip to the Long Beach Aquarium of the Pacific where there is a living coral exhibit.

The following lab will be conducted in class to simulate the physiology and behavior of coral polyps.

**Name** _____**Date** _____**Period** ___



# Cnidarians and Nematocysts

Cnidarians have specialized cells in their tentacles called cnidoblasts. Within the cnidoblasts are tiny stinging capsules called nematocysts. Inside the nematocyst capsule is a coiled thread. This thread injects venom into anything that brushes against the capsule's trigger. The capsule's trigger is called a cnidocil. The diagram below will help you understand how this occurs.

Nematocyst cnidocil cnidoblast

*Answer the following questions on the bottom of this sheet of paper.*

**1. Using information in the text and diagram above list and describe the steps**
That occur in A, B, and C when a cnidarian captures food. You will need to
Include a step D as well. (Hint: What does the cnidarian do with its food after it stings it?)

**2. People may be stung if they step on a dead jellyfish washed up on the beach.**
Why do you think this is so?

**3. What functions do the stinging cells of a cnidarian serve?**

# LAB DEMO: HOW DOES A CNIDARIAN CATCH its PREY?

***M A T E R I A L S***

Thin latex lubber gloves

***PROCEDURE:***

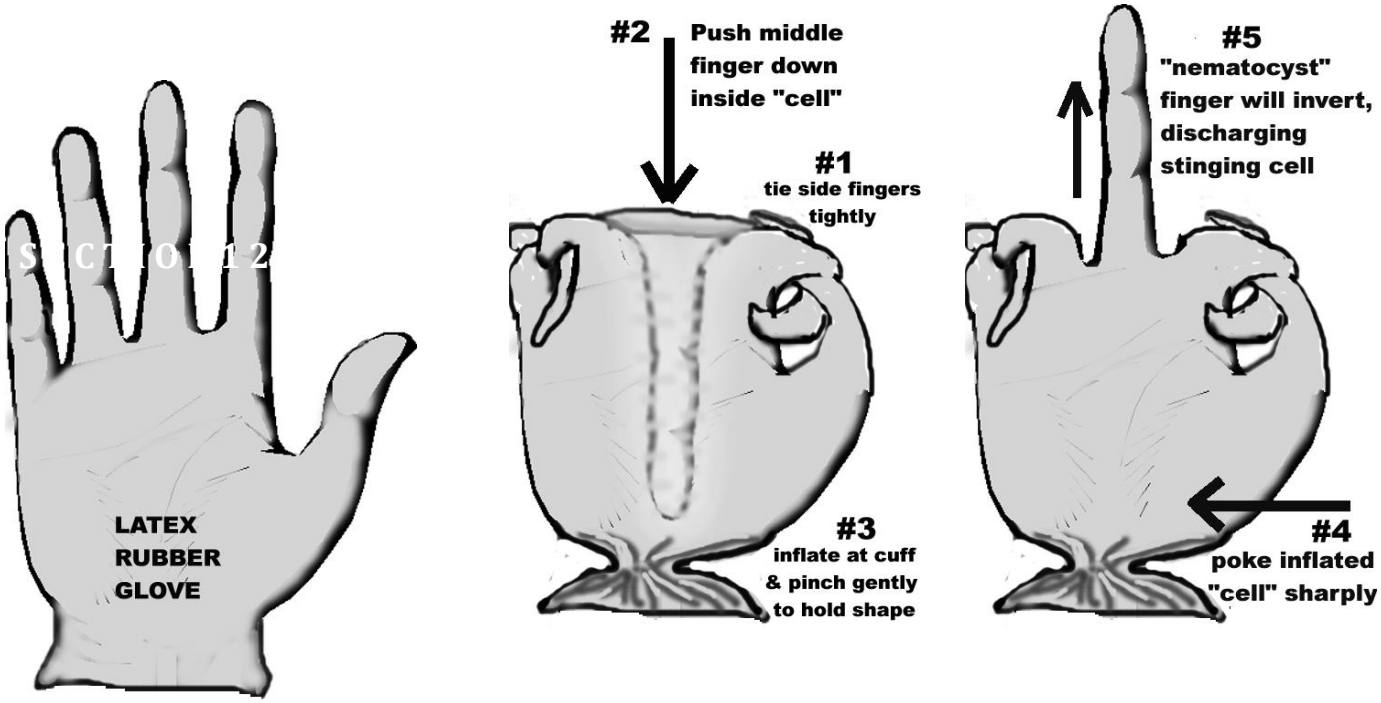
A. Take a thin latex surgical glove and tie the side fingers together tightly, leaving the middle finger free. *This represents a single sting cell and the middle finger represents the nematocyst, a cnidarians venomous harpoon.*

B. Push the middle finger inward into the glove so that it is inverted inside the hand area.

C. Cup the glove's opening and ***GENTLY*** blow air into the "cell," filling the glove like a small balloon WITHOUT disturbing the harpoon inside. Keep the air inside by gripping the cups of the glove. *This represents an un-discharged stinging cell, filled with toxins, with the nematocyst curled up inside.*

D. Ask another student to be a prey item that unknowingly bumps into the stinging cell on a tentacle. Have them sharply poke the air-filled bag on the side. Watch what happens to the "nematocyst" finger inside the "cell." *This represents the mechanical discharging of a stinging cell.*

Once discharged, a cnidarian cannot reuse the cell. It has to grow another. Because the discharge is caused by the prey itself, a freshly dead jellyfish can sting a person as badly as a living jellyfish, until the cells start to decompose. *Be careful how you dispose of dead jellyfish along the beach!*



# Laboratory #2 - Building Skeletons into Reefs

## Objectives:

Students experiment with sodium bicarbonate and calcium carbonate to simulate how algae in coral polyps react with seawater to assist the polyps in forming skeleton as reef rock.

## Materials:

··chalk
·baking soda
·1 clear cup (8 oz)
·2 clear cups (16 oz)
·stirring sticks
·vinegar
·water

## Procedures:

1. Pose the question, "Where does hard coral reef material come from. (Write down possible answers.)
2. Have students break a piece of chalk (calcium carbonate) inside a paper bag with a hammer.
3. Dissolve the chalk in 250 ml of vinegar (a weak acetic acid). Label the container. Let the mixture stand overnight.
4. Next day have the students observe their glass of vinegar and chalk and write down what they see.
5. Label 2 of the clear cups as follows: 1 16-oz. cup, "dissolved limestone," and the 8 oz. cup, "dissolved baking soda."
6. Pour off the clear liquid from the chalk mixture into the "dissolved limestone" (calcium carbonate) cup.
7. Place 8 oz. of water in the second 16 oz. cup. Add 6 teaspoons of baking soda (sodium bicarbonate) to the water. Stir and let stand about 15 minutes.
8. Pour off the clear liquid in the baking soda cup into the 8 oz. cup labeled "dissolved baking soda."
9. Pour the baking soda solution from the 8 oz. cup into the "limestone" cup. Have students carefully observe what happens. Explain that this is similar to what happens when seawater comes in contact with the algae in the coral polyps. The polyps than secrete the calcium carbonate downward as skeleton.

Skeleton is laid down in specific crystal structures by each type of coral.

## Evaluation:

Write a paragraph about how a coral builds its skeleton by using what was learned in the experiment.

What would happen if coral polyps settled in very deep water? (They could not make a reef because sunlight would not be able to penetrate to react with the algae in the symbiotic relationship with the coral polyp.)

**Addendum**: CNIDARIANS-WORKSHEET- Group work in class, complete for homework.

## COMPARE & CONTRAST CNIDARIANS & HUMANS

**Directions**: Using the information from our textbook to compare the human body and cnidarians. Use the following key terms: cnidarian, radial symmetry, oral surface, tentacles, gut, nematocyst, polyp, medusa, gastrodermis, mesoglea, epidermis, larvae, planula, nerve net, broadcast spawning & hydrostatic. Underline the key terms.

| Cnidarian | Function | Human |
|---|---|---|
| | 1. Body structure (Picture) | |
| | 2. Symmetry | |
| | 3. Skeleton | |
| | 4. Feeding & Feeding Structures | |
| | 5. Lifecycle stages | |
| | 6. Reproduction | |

| | | |
|---|---|---|
| | | |

# *ANSWER SHEET:* COMPARE & CONTRAST CNIDARIANS & HUMANS

**Directions**: Using the information from our textbook to compare the human body and cnidarians. Use the following key terms: cnidarian, radial symmetry, oral surface, tentacles, gut, nematocyst, polyp, medusa, gastrodermis, mesoglea, epidermis, larvae, planula, nerve net, broadcast spawning & hydrostatic. Underline the key terms.

| Cnidarian | Function | Human |
|---|---|---|
| | 1. Body structure (Picture) | |
| Radial | 2. Symmetry | Bilateral |
| Have a hydrostatic skeleton made of water. 98% water | 3. Skeleton | Made of bones. Bones are made of calcium. Bones have marrow on the inside that makes red blood cells. |
| Cnidaria have nematocysts, like poison darts, that they use to kill their prey. Then they use their tentacles to bring the food toward their oral surface and gut. Food enters the gut and exits through their mouth. | 4. Feeding & Feeding Structures | Eat using a mouth. Teeth & saliva break down the food then goes into the stomach and intestine where the food is then digested. After the food is digested it leaves through the anus. |
| Individuals start off as mobile planula larva. Then they metamorphosis into the medusa or polyp stage depending on their species. | 5. Lifecycle stages | Then the embryo is born and it is called a baby. The baby grows up to a toddler, child, adolescent, and then, adult. |
| Most reproduce sexually but they can reproduce a sexually by producing gametes and broadcast | 6. Reproduction | Humans reproduce sexually. Sperm & egg fertilize one another in the female. They develop into an embryo. |

| | | |
|---|---|---|
| spawning. To reproduce asexually corals and sea anemones can develop buds which grow into the adult form. | | |

# Coral Reef Bingo

- Select of the terms provided. Write one word in each of the 25 boxes in whatever sequence you desire. Do not repeat words, and do not leave any spaces blank.
- When the word you have in a box is called, cross it out. When you have the pattern, call out BINGO!

| | | | | |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Algae
Animal
Bleached
Conservation
Coral
Carbon dioxide
Ecosystem
Disease
El Nino
Limestone
Marine park
Photosynthesis
Pigmentation
Plant
Pollution
Polyp
Protection
Salinity
sea surface temp
Sediment
Storm
Sugar
Symbiosis
Reef
Zooxanthellae
1998

# El Nino Fact/Study Sheet for group work

The bleaching events reported prior to the 1980s were generally attributed to localized phenomena such as major storm events, severe tidal exposures, sedimentation, rapid salinity changes, pollution, or thermal shock. The events since 1980 have not been so easily explained. Numerous laboratory studies have shown a direct relationship between bleaching and water temperature stress. Elevated water temperatures have been implicated in the majority of the major bleaching events of the 1980s and 1990s.

El Niño **is a disruption of the ocean-atmosphere system in the Tropical Pacific having important consequences for weather and climate around the globe.**

## What is El Niño?

**The term El Niño refers to the large-scale ocean-atmosphere climate phenomenon linked to a periodic warming in sea-surface temperatures across the central and east-central equatorial Pacific (between approximately the date line and 120°W). El Niño represents the warm phase of the El Niño/Southern Oscillation (ENSO) cycle, and is sometimes referred to as a Pacific warm episode. El Niño originally referred to an annual warming of sea-surface temperatures along the west coast of tropical South America.**

**NOAA's Climate Prediction Center, which is part of the National Weather Service, declares the onset of an El Niño episode when the 3-month average sea-surface temperature departure exceeds 0.5°C in the east-central equatorial Pacific [between 5°N-5°S and 170°W-120°W].**

## What Happens During El Niño or La Niña?

**During an El Niño or La Niña, the changes in Pacific Ocean temperatures affect the patterns of tropical rainfall from Indonesia to the west coast of South America, a distance covering approximately one-half way around the world. These changes in tropical rainfall affect weather patterns throughout the world.**

## Why do El Niño and La Niña occur?

**El Niño and La Niña are naturally occurring phenomena that result from interactions between the ocean surface and the atmosphere over the tropical Pacific. Changes in the ocean surface temperatures affect tropical rainfall patterns and atmospheric winds over the Pacific Ocean, which in turn impact the ocean temperatures and currents. The El Nino and La Niña related patterns of tropical rainfall cause changes in the weather patterns around the globe.**

## How are sea surface temperatures monitored?

**Sea surface temperatures in the tropical Pacific Ocean are monitored with oceanic buoys, ships, and satellites. NOAA operates a network of 70 moored buoys in the equatorial Pacific that provide important data about upper-ocean and sea surface conditions. This array of moored buoys is called the TOGA/ TAO Array.**

**These data are used to calibrate sea surface temperature analyses derived from the NOAA series of polar orbiting satellites**

Name_____ Period_____ Date_____

# Coral Reef /Cnidarian Quiz (Multiple choice, 5 pts each)

**1) Draw a diagram of a coral polyp and label five parts.**

**2) Name three types of body forms (plans or shapes) of invertebrates?**
**_____ _____ _____**

**3) What are the two main life stage cycles of the jellies? _____ _____**

**4) What are the zooxanthellae in corals?**

**What <u>two</u> things do they produce that aids the animal? _____ _____**

**5) What was the Cambrian explosion? Write one sentence.**

**6) The stinging cells in cnidarian tentacles are called _____?**

**7) A coral skeleton is made of what chemical compound? _____ _____**

**8) True or false? Sponges and sea fans are plants? _____**

**9) A close relationship between two species is called_____?**

**10) True or false? A sea anemone is attached to a surface? _____**

**11) True or false? Weather patterns, + El Nino/ La Nina have no affect on corals? ___**

**12) Name three causes of coral bleaching? _____, _____.**

**Short essay: (Use complete sentences; write on the back of this sheet) (35 pts)**

## List and describe several ways in which humans can help stop coral bleaching. How can such activities be changed?

*** Addendum to the content standards**

Connections to the National Science Education Standards:

Content Standard A: Science as Inquiry
- Abilities necessary to do scientific inquiry.
- Understandings about scientific inquiry.

Content Standard C: Life Science
- Interdependence of organisms
- Matter, energy, and organization in living systems.
- Behavior of organisms

Content Standard D: Earth and Space Science
- Energy in the earth system
- Geochemical cycles

Content Standard E: Science and Technology
- Understandings about science and technology

Content Standard F: Science in Personal and Social Perspectives
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Connections to the National Geography Standards:

Standard 4: "The physical and human characteristics of places"

Standard 14: "How human actions modify the physical environment"

# POD and Class Participation Rubric

***The following is a guideline for class participation points in the marine biology class. Remember, this is a DISCUSSION-BASED class, which means that every day you are required to participate. In order to contribute to class/POD discussions, you must do the following: 1) have a positive attitude, 2) do your homework well and 3) pay attention in class.***

***Your class participation is worth 20% of your grade. You will receive an individual grade and a POD grade.***

| **I. INPUT** | **II. BEHAVIOR/ ATTENTION** |
|---|---|
| **5= Student gives relevant and meaningful input to the class discussion, presenting well-thought ideas.** | **5= Student contributes to the success of the learning environment through active participation and having a positive attitude. In addition, his/ her posture and body language are appropriate, and help to improve the classroom dynamic.** |
| **3= Student gives a fair amount of input to the class discussion.** | **3= Student contributes little to the success of the learning environment. Student may display a negative attitude or his/ her posture and body language may not always be appropriate or respectful to the classroom environment.** |
| **0= Student gives NO input to the class discussion and may distances himself/ herself from the class environment.** | **0= Student contributes NOTHING to the success of the learning environment. Student displays a negative attitude or his/ her posture and body language may not always be appropriate or respectful to the classroom environment.** |

## POD Reflection: Team Work

Name_____Period_____Date ____

1. What is the most interesting thing you learned about your coral reef project?

2. How do you feel about the final product/brochure your group produced?

3. Evaluate how much time & effort **YOU** put into this project.

4. List your teammates and evaluate their effort.
   Consider what each one contributed and how it helped the final outcome.

   _____

   _____

   _____

   _____

5. What did you learn about your own personality? (Are you a leader? Are you better at following directions? Is it difficult for you to work with others? )

6. If you were to give yourself a grade for this project in your work during this unit thus far what should you receive?

TEACHER RUBRIC FOR POD PRESENTATIONS/**Coral reef Ecology**

| | **Content** | **Comprehension** | **Time-Limit** | **Visual Support** | **Stays on Topic** | **Prepared** | **Enthusiasm** | **V** |
|---|---|---|---|---|---|---|---|---|
| 4 | Shows a full understanding of the topic. | Student is able to accurately answer almost all essential questions | Presentation is 7-10 minutes long. | Student uses several visuals that show considerable work/creativity and which make the presentation better. | Stays on topic all (100%) of the time. | Student is completely prepared and has obviously rehearsed. | Facial expressions and body language generate a strong interest and enthusiasm about the topic in others. | Volu loud to b by a aud mer thro the pres |
| 3 | Shows a good understanding of the topic. | Student is able to accurately answer most essential questions | Presentation is 7 minutes long. | Student uses 1 visual that shows considerable work/creativity and which make the presentation better | Stays on topic most (99-90%) of the time. . | Student seems pretty prepared but might have needed a couple more rehearsals. | Facial expressions and body language sometimes generate a strong interest and enthusiasm about the topic in others. | Volu loud to b by a aud mer leas the |
| 2 | Shows a good understanding of parts of the topic. | Student is able to accurately answer a few essential questions. | Presentation is 5 minutes long. | Student uses 1 visual which makes the presentation better. | Stays on topic some (89%-75%) of the time | The student is somewhat prepared, but it is clear that rehearsal was lacking. | Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat faked. | Volu loud to b by a aud mer leas the |
| 1 | Does not seem | Student is | Presentation | The student | It was | Student | Very little | Volu |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | to understand the topic very well. | unable to accurately answer essential questions | is less than 5 minutes OR more than 12 minutes. | uses no visual OR the visual chosen detract from the presentation | hard to tell what the topic was. | does not seem at all prepared to present. | use of facial expressions or body language. Did not generate interest | ofte to b by a aud mer |

# Coral Crossword Challenge

**Across**
3. When frightened, the octopus can change its _____.
6. _____ fishes have long snouts and can reach into places other fishes can't.
8. _____ coral is big and flat, like a giant dinner plate.
9. Each coral animal, or _____, is about the size of a pencil eraser.
13. Corals prey on small drifting plants and animals called _____.
14. Corals have tiny plants, called _____, growing inside of them.
16. A coral's mouth is surrounded by _____.
17. Sea turtles can hold their breath for up to _____ hours.
18. The _____ is over 1,200 miles long.
19. _____ coral looks like the surface of a human brain.
20. Tiny plants that grow inside corals use the sun to make food through a process called _____.

**Down**
1. _____ coral looks like deer antlers.
2. Sea fans, sea whips, and other soft corals have skeletons that are _____.
4. Probably the greatest threat to corals is coastline _____.
5. To defend itself, the snapping shrimp uses its large _____ to make a loud snapping sound that startles nearby hungry predators.
7. Coral reefs grow in ____oceans all over the world.
10. The reef is home to millions of plants and animals because it offers good feeding and _____ from the many predators of the reef.
11. Corals use minerals from seawater to build a skeleton made of _____.
12. Animals and plants are everywhere on the reef. Some snapping shrimp live inside _____.
15. The mounds, boulders, and branches called coral reef are actually made by tiny _____.
16. Divers from the New England Aquarium explored parts of the Pear Tree and Rio Bueno reefs that are more than five ____years old.

# The reefs are suffocating!!! Help!!

Wildfires in tropical forests can be dangerous to life on the bottom of the ocean.

---

In 1997, wildfires raged for months over much of Southeast Asia. Even after the fires went out, the destruction continued offshore. Coral reefs near Indonesia started to die off, and so did the organisms that live on them. Companies that rely on the reefs for tourism lost business, and people who depend on the reefs for food lost their source of fish. A group of scientists in Australia and Indonesia say the environmental losses at sea are directly connected to smoke from the fires.

Nerilie Abram is working studied skeletal remains of the Indonesian coral to recreate what happened when the reefs died.

Abram says the coral suffocated. She says smoke from the wildfires contained huge amounts of iron, and it fell out on the surface of the sea and settled onto the reefs. The iron fed blooms of algae, and when the algae died, the process of decomposition robbed the water of oxygen.

Abram says coral reefs will be hard hit if tropical wildfires become more common.

"There isn't really any reason why this thing wouldn't happen again, particularly because the predictions are that wildfires are going to continue to become larger and more common in the future."

Abram says global warming might contribute to more tropical wildfires and more problems for marine ecosystems.

"Our study adds a new threat to coral reefs and shows that ecosystems are quite intricately linked. What happens in one ecosystem can have an important impact on other ecosystems, so we need to be looking at more integrated management solutions."

***<u>Write and answer the following questions in the "class notes" section of your notebook</u>***

What did the fires do to the Coral reefs in Asia?

What was contained in the fallout that affected the reefs?

1. **Corals are animals**

The ancient Greeks mistakenly believed that corals were plants. Corals are actually animals, related to anemones and jellyfish. Corals consist of a limestone structure filled with thousands of small animals called polyps. Each polyp has a skeleton cup, tentacles with stinging cells, a mouth and a stomach. The tiny tentacles snatch at passing plankton for food, but for their main course, reef-building corals have devised a much more ingenious method to get fed.

Algae called zooxanthellae live within each coral. In return for a safe sunny home, the zooxanthellae eat the nitrogen waste that the coral produces (nitrogen is very good for algal growth) and, like all plants, algae turn sunlight into sugars by the process of photosynthesis. The sugars produced by the zooxanthellae make up 98 per cent of the coral's food. So, without having to do any work at all, the coral is kept clean and well fed, and the zooxanthellae with their brilliant reds, oranges and browns give corals their color.

Every coral species, as well as numerous other reef inhabitants, maintains a special symbiotic relationship with a microscopic organism (algae) called zooxanthellae. These organisms provide their hosts with oxygen and a portion of the organic compounds they produce through photosynthesis. When stressed, many reef inhabitants have been observed to expel their zooxanthellae en masse. The polyps of the coral are left bereft of pigmentation and appear nearly transparent on the animal's white skeleton. This phenomenon is normally referred to as coral bleaching.

The zooxanthellae work like an internal symbiotic vegetable garden; carrying out photosynthesis and providing nutrients that help reef-building corals create reef structures.

2. **Importance of coral reefs**

Coral reefs are important for many different reasons. Apart from protecting the shoreline from the damaging effects of the ocean, they provide habitats and shelter for many organisms and are the source of nitrogen and other nutrients essential for the food chain. This is why hundreds of thousands of marine species live in reefs. Many fisheries depend on the fish that spend the first part of their life in coral reefs, before making their way out to the open ocean. The Great Barrier Reef is especially important to the Australian economy and generates 1.5 billion dollars every year from fishing and tourism. In addition, the study of coral reefs can provide a history of past climates.

A reef is a sculpture of living organisms, varied in color, texture, shape, and size. The creation of these works of art takes many, many years (some reefs are thousands of years old), and they don't exist solely for show. Reefs are building blocks for rich communities, providing habitat and shelter for a myriad of organisms, and they are some of the most diverse ecosystems on the planet. In addition, they support fishing grounds, attract tourists, and protect shorelines from waves and storms.

Coral reefs are considered to be the key to tropical ocean ecosystems, and marine scientists warn that their decline could be a prelude to widespread ecological damage.

And coral are very important in controlling how much carbon dioxide is in the ocean water. The coral polyp turns carbon dioxide in the water into a limestone shell. Without coral, the amount of carbon dioxide in the water would rise dramatically and that would affect all living things on Earth.

3. **Rising sea temperatures and coral bleaching**

Coral reefs can live only within a certain temperature and salinity range. Global warming caused by the green house effect has raised the temperature of the oceans so high that the coral get sick and die. Even a rise of one degree in the average water temperature can hurt the coral. Due to global warming, 1998 was the hottest year in the last six centuries and 1998 was the worst year for coral.

Coral bleaching, induced by high water temperatures, has raised concerns about these fragile ecosystems. Coral bleaching occurs as coral tissue expels zooxanthellae, a type of algae that resides in the structure of the coral, and is essential to the coral's survival.

The term bleaching is used because the dazzling colors of living corals are due to the colors of zooxanthellae in coral tissue, and when zooxanthellae are lost, corals appear white, or “bleached.”

Coral bleaching is not well understood by scientists. Many different hypotheses exist as to the cause behind coral bleaching, but the strongest evidence points to unusually warm sea surface temperatures as being the main factor (Glynn 1993). Coral bleaching events worldwide have been attributed to sea surface temperatures (SSTs) rising and staying as little as 1°C higher than the usual average monthly maximum SST during the hottest months of the year (Goreau and Hayes 1994). In Jamaica, significant coral bleaching and death occur when SSTs remain at 29.3°C or higher for one month (Hoegh-Guldberg 1999). Therefore, in the Caribbean and Florida Keys, when SSTs rise and stay above this thermal threshold, coral bleaching is likely to occur.
Mass coral bleaching was first recognized on the Pacific coast of Panama following the 1982-83 El Nino events (Glynn 1984). The warm SSTs associated with the El Nino event were identified as the cause of death of over 99% of corals and the complete loss of reef structures in the Galapagos Islands and the death of over 50% of corals in Panama (Glynn and D’Croz 1990; Glynn 1993). The sensitivity of corals to small temperature changes then became a major concern of researchers as predictions of global warming and stronger, farther-reaching El Nino events came to light. The 1997-98 El Nino event is the strongest on record to date, resulting in unprecedented coral bleaching and death across the globe (Wilkinson et al. 1999). SSTs are expected to continue to increase worldwide (Hoegh-Guldberg 1999) and El Nino events are expected to increase in frequency, strength and duration, endangering the future survival of coral reefs.

4. **Other causes of coral bleaching**

Apart from heat stress, other causes of coral bleaching may include:

- increased exposure to ultraviolet (UV) radiation;
- large amounts of storm water from heavy rains flooding the reef;

- the exposure of coral to certain chemicals or diseases;
- sediments such as sand or dirt covering the coral;
- excess nutrients such as ammonia and nitrate from fertilizers and household products entering the reef ecosystem. Often coral reefs are exposed to a combination of these factors.

Coral reefs are suffering the hardships of environmental Average global sea temperature has been rising gradually over several decades, which is generally believed among the scientific community to be due to global warming. Coral bleaching is being widely documented. Coral bleaching occurs when the microscopic plants, or zooxanthellae, which live in coral tissue, stop functioning. The zooxanthellae provide corals with color, food and most of their ability to rapidly grow skeletons. Without them, corals can die.

Look at the threats to each reef. How many of those are human threats? How many are natural threats? Many potential threats exist, including destructive fishing, anchor damage, pollution, sedimentation, bleaching, diseases, storms, and biological outbreaks. Although bleaching may be argued to be a result of human threats to the reef, these events are classified under natural threats since, more often than not, the incidents reported in the literature attribute bleaching to a natural cause.

The most obvious sign that coral is sick is coral bleaching. That is when either the algae inside die or the algae leave the coral. The algae are what give coral its color, so without the algae the coral has no color and the white of the limestone shell shines through the transparent coral bodies. People have been noticing coral bleaching since the turn of the century, but only since the 1980s has it gotten really bad.

It has been shown that stress caused by pollution, solar radiation, changing salinity, and bacteria can also result in coral bleaching.

5. **Rate of coral bleaching**

Coral bleaching is a natural process. For thousands of years, fishermen have noticed mysterious whitening of the reefs. What is not natural is the rate at which coral bleaching is occurring. In 1998, the worst coral bleaching in 700 years struck the Great Barrier Reef, followed by an even worse bleaching only 4 years later. Massive areas of corals were affected all over the world. In Australia alone, the 2002 bleaching saw nearly 60 per cent of the reef suffer bleaching and, in the worst areas, 90 per cent of the coral was bleached.

Corals which had thrived for hundreds of years suddenly died in 1998. It was the worst year ever recorded globally for coral bleaching, and it brought the hottest sea surface temperatures since 1982.

In 1998 coral reefs around the world experienced the most extensive and severe bleaching in recorded history. Coral bleaching was reported in 60 countries and island nations at sites in the Pacific Ocean, Indian Ocean, Red Sea, Persian Gulf, Mediterranean and Caribbean. Indian Ocean corals were particularly severely impacted, with greater than 70 percent mortality reported in the Maldives, Andamans, Lakshadweep Islands, and in Seychelles Marine Park System. The 1998 mass bleaching was coincident with anomalously high sea surface temperatures. That year was the warmest of this century (NOAA, 1999), and tropical sea surface temperatures were the highest in the modern record (Strong et al., 1998). For many parts of the Pacific, the 1997-98 mass bleaching has been linked to the strong El Niño-induced seawater warming.

**Can corals survive bleaching?**

In the past, rapid changes of climate have sometimes led to extinctions. The dinosaurs were wiped out 65 million years ago, and there have been several mass extinctions before and since. Does the coral have any hope? If a channel of cold water constantly runs through the warm water, thus keeping the zooxanthellae cool, then those corals can survive. Another way in which corals can survive is just by being tougher than others, in the same way that some people are always healthy while other people are always sick.

**6. Protecting coral reefs**

Perhaps the best thing we can do is to protect the corals that do survive bleaching better than others. One way we can do this is by creating marine parks: areas protected in some way from souvenir hunters and activities such as fishing and boating.

At the moment less than 5 per cent of the Great Barrier Reef is protected from fishing. The Great Barrier Reef Marine Park Authority (GBRMPA) wants to increase this area to 25 per cent. An important consideration is to locate marine parks in areas where the coral is resistant to bleaching. If the coral dies, eventually the fish and other marine species will die too.

The other thing we can do for the reef is to keep an eye on it. The reef has 2.4 million visitors every year, and these people go to places scientists can't always get to. GBRMPA can use information from visitors about where they saw bleaching. And, just as importantly, where they didn't see bleaching. This helps scientists to form an overall picture of which areas are vulnerable to bleaching.

Though the reefs may not be doomed, there is definitely cause for concern. Some scientists have predicted that by 2030 massive and devastating coral bleaching events will occur every year. Other scientists believe that there is a future for the reefs and that though the reefs may change; they will be there in some form or another. We can only hope that they are right.

**Oceanworld**

Oceanworld is a web site for middle-school, high-school, undergraduate, and graduate students and teachers interested in the ocean. It has tutorials for middle-school and high-school students, materials for middle-school teachers, an on-line textbook in physical oceanography, all course material for five college courses, and on-line resources which include links to hundreds of site with on-line data.

The tutorials cover fisheries, weather, Forams, coral reefs, currents and more. The material is tied to Texas standards for teaching science, which are very similar to the national standards. Teacher material includes classroom activities in oceanography. The college courses for undergraduates are problems-based, and could be modified for high-school use.

For more information, check out http://oceanworld.tamu.edu/ .