

Kids as Airborne Mission Scientists

Lesson overview: What is a coral reef?

FRAME

Students see a short movie of corals and begin to think about what a coral reefs is.

INFORM

Students participate in activities to develop their understanding about symbiosis and the types of coral reefs.

EXPLORE

Students explore the conditions in which coral reefs can grow well and participate in activities to build a coral reef model ~~miniature~~ with Plaster of Paris.

TRY

Students use their knowledge while evaluating factors (i.e. the ocean temperature) limiting the occurrence of coral reef in Hawaii.

SUPPORT

Support materials for the teacher including ideas to promote student reflection, sample answers to activities, and extension ideas.

Click on FRAME, INFORM, EXPLORE, TRY, or SUPPORT above to view the detailed lesson plan.

Lesson context:

The main topic of investigation for the KaAMS mission is protection of coral reefs. To address the overall problem, students will need to have a basic understanding of coral reefs. During this lesson, students participate in the following hands-on activities about coral reefs:

- drawing a picture of coral reefs,
- discussing symbiosis and relating it to coral reefs,
- constructing paper models of different types of island coral reefs, and
- building different types of coral reefs with Plaster of Paris.

Based on the understanding of what coral reefs are, how they work, what features they have, and where they grow, students can determine what data they will need to collect to evaluate whether restrictions should be applied to tourism, recreation, or commercial enterprises around the coral reefs in Kailua Bay.

Key science concepts:

- Definition of symbiosis.
- Types of coral reefs.
- Major factors limiting the occurrence of coral reefs globally.

Links to teacher resources:

- [What is a coral reef \(US coral reef task force\) \(http://coralreef.gov/what.cfm \)](http://coralreef.gov/what.cfm)
- [Coral Reef Symbiosis \(http://oceanworld.tamu.edu/students/coral/coral3.htm \)](http://oceanworld.tamu.edu/students/coral/coral3.htm)

- [How to Construct Four Paper Models that Describe Island Coral Reefs](http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html) (<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html>)
- [For information on the Plaster of Paris hands-on activity](http://www.ohiodnr.com/geosurvey/edu/hands16.htm) (<http://www.ohiodnr.com/geosurvey/edu/hands16.htm>)
- [Information on the structure of a coral reef](http://www.sprl.umich.edu/GCL/paper_to_html/coral.html) (http://www.sprl.umich.edu/GCL/paper_to_html/coral.html)

Problems addressed in this lesson:

- What is the structure and symbiotic relationship of a coral reef ecosystem?
- What are the major factors limiting the occurrence of coral reefs?
- Where does a coral reef grow?

Activity bursts:

- [Constructing a paper model that describes a fringing reef](http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html) (<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html>)
- [Constructing a paper model that describes a barrier reef](http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs5.html) (<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs5.html>)
- [Constructing a paper model that describes an atoll](http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs6.html) (<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs6.html>)
- For information on the plaster Paris hands activity (<http://www.ohiodnr.com/geosurvey/edu/hands16.htm>)

Links to other resources:

Lesson	<u>Teacher</u>	<u>Student</u>
FRAME	Coral reefs http://www.fisheyeview.com/Movies.html Note: This movies is large files (1-5 MB) and may take a few minutes to download	Coral reefs http://www.fisheyeview.com/Movies.html Note: This movies is large files(1-5 MB) and may take a few minutes to download
	What is a coral reef (US coral reef task force) http://coralreef.gov/what.cfm	What is a coral reef (US coral reef task force) http://coralreef.gov/what.cfm
	Examples of different healthy corals http://www.reefrelief.org/Image_archive/healthy/healthy_left.html	Examples of different healthy corals http://www.reefrelief.org/Image_archive/healthy/healthy_left.html
	Corals are alive http://makaha.mic.hawaii.edu:80/aquarium/coral/index.html	Corals are alive http://makaha.mic.hawaii.edu:80/aquarium/coral/index.html
INFORM	Coral Reef Symbiosis http://oceanworld.tamu.edu/students/coral/coral13.htm	Coral Reef Symbiosis http://oceanworld.tamu.edu/students/coral/coral13.htm

	Symbiotic relationship(zooxanthellae) http://www.uvi.edu/coral.reefer/zooxanth.htm	Symbiotic relationship(zooxanthellae) http://www.uvi.edu/coral.reefer/zooxanth.htm
	Coral Reef Animal Printouts http://www.enchantedlearning.com/biomes/coralreef/coralreef.shtml	Coral Reef Animal Printouts http://www.enchantedlearning.com/biomes/coralreef/coralreef.shtml
	Making a fringing reef http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html	Making a fringing reef http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html
	Making a barrier reef http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs5.html	Making a barrier reef http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs5.html
	Making an atoll http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs6.html	Making an atoll http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs6.html
	Animation showing development of reefs http://walrus.wr.usgs.gov/coralreefs/facts4.html	Animation showing development of reefs http://walrus.wr.usgs.gov/coralreefs/facts4.html
	How to Construct Four Paper Models that Describe Island Coral Reefs http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs1.html	
EXPLORE	Physical requirements for coral reefs http://www.fknms.nos.noaa.gov/sanctuary_resources/welcome.html#reefs	Physical requirements for coral reefs http://www.fknms.nos.noaa.gov/sanctuary_resources/welcome.html#reefs
	Wave and Reef development http://www.seaworld.org/infobooks/coral/habdiscr.html	Wave and Reef development http://www.seaworld.org/infobooks/coral/habdiscr.html
	The maximum depth and coral http://www.fknms.nos.noaa.gov/sanctuary_resources/morecoral.html	The maximum depth and coral http://www.fknms.nos.noaa.gov/sanctuary_resources/morecoral.html
	Coral Reef Habitat (ideal conditions) and Distribution http://www.seaworld.org/infobooks/coral/habdiscr.html	Coral Reef Habitat (ideal conditions) and Distribution http://www.seaworld.org/infobooks/coral/habdiscr.html

	For information on the plaster Paris hands activity http://www.ohiodnr.com/geosurvey/edu/hands16.htm	
	The information on structure of a coral reef http://www.sprl.umich.edu/GCL/paper_to_html/coral.html#MAKING	The information on structure of a coral reef http://www.sprl.umich.edu/GCL/paper_to_html/coral.html#MAKING
TRY	Lobe coral http://library.thinkquest.org/J002237/corals/lobecoral.htm?tqskip=1	Lobe coral http://library.thinkquest.org/J002237/corals/lobecoral.htm?tqskip=1
	Cauliflower coral http://library.thinkquest.org/J002237/corals/cauliflower.htm?tqskip=1	Cauliflower coral http://library.thinkquest.org/J002237/corals/cauliflower.htm?tqskip=1
	Finger coral http://library.thinkquest.org/J002237/corals/finger.htm?tqskip=1	Finger coral http://library.thinkquest.org/J002237/corals/finger.htm?tqskip=1
	Rice coral http://library.thinkquest.org/J002237/corals/finger.htm?tqskip=1	Rice coral http://library.thinkquest.org/J002237/corals/finger.htm?tqskip=1
	The map of remotes sensing of coral reefs http://seawifs.gsfc.nasa.gov/cgibrs/reefs.pl	The map of remotes sensing of coral reefs http://seawifs.gsfc.nasa.gov/cgibrs/reefs.pl
	The National Data Buoy Center. http://www.ndbc.noaa.gov/Maps/rmd.shtml	The National Data Buoy Center. http://www.ndbc.noaa.gov/Maps/rmd.shtml

Kids as Airborne Mission Scientists

What is a Coral Reef?

Related subject area: Science, Geography.

Overall problem: Which restrictions (if any) should be applied to activities around the coral reefs of Kailua Bay to insure their lasting protection?

Relationship of problem in this lesson to overall problem: To encourage student's participation in KaAMS, they need to know the basic characteristics of coral reefs. The goal of this lesson is for students to develop background knowledge about coral reefs while they are participating in building different coral reef models. To attain this objective, students participate in four different activities about coral reefs:

- drawing a picture of coral reefs,
- discussing symbiosis and relating it to coral reefs,
- constructing paper models of different types of island coral reefs, and
- building different types of coral reefs with Plaster of Paris.

Based on the understanding of what coral reefs are, how they work, what features they have, and where they grow, students can determine what data they will need to collect to evaluate whether restrictions should be applied to tourism, recreation, or commercial enterprises around the coral reefs in Kailua Bay.

Estimated time required: 2 to 3 class periods

Student outcomes/objectives:

- Students will be able to represent the structure and symbiotic relationship of a coral reef ecosystem.
- Students will be able to identify the major conditions in which coral reefs can grow (light, temperature, sediments, salinity, depth of sea).
- Students will be able to describe where coral reefs grow.

Prerequisite skills or knowledge:

- Basic internet skills
- Ability to work in teams
- Basic understanding of problem solving
- Basic reading skills



Kids as Airborne Mission Scientists

What is a Coral Reef?

(Continued)

Teacher preparation:

- Print Student Journal /Activity sheets for these activities
- Bookmark appropriate websites for students

Student reflection and assessment: [Student reflection activity](#) | [Assessment](#)

Education standards supported by this lesson:

[National Science Education Standards](#) | [Project 2061 Benchmarks](#)

[National Standards for School Mathematics](#) | [National Technology Standards](#) | [National Geography Standards](#)

Cross-curricular connections to National Education Standards for this lesson:

Math | Technology | Geography

Teacher activities	Student activities
<p>FRAME ideas: Involve students in the demonstration and initial discussion of a coral reef’s structure and location.</p> <p>Show students a short movie that includes the motion of coral and other marine invertebrates and ask them what questions come to mind with the focus on the structure and locations of coral reefs.</p> <p>Coral reefs (Teacher Note: These movies are large files and may take a few minutes to download. To open these movies, you need a QuickTime software.)</p>	<p>Student activity:</p> <ul style="list-style-type: none"> • Students observe a short movie on various types of coral and participate in an initial discussion of coral reefs

<p>download (http://www.apple.com/quicktime/download/): Select the fish eye view time-lapse movies on the various types of coral.</p> <p>Ask students</p> <ul style="list-style-type: none"> • What is a coral reef? • How do they live? • Where do they live? <p>Prompt students to draw a picture of coral reefs on Activity Sheet 1: What Does a Coral Reef Look Like? (WCR-1) (See Activity Sheet 1: What Does a Coral Reef Look Like? Below this document)</p> <p>Teacher Resources</p> <ul style="list-style-type: none"> • What is a coral reef (US coral reef task force) (http://coralreef.gov/what.cfm) • Examples of different healthy corals (http://www.reefrelief.org/Image_archive/healthy/healthy_left.html) • Corals are alive (http://makaha.mic.hawaii.edu:80/aquarium/coral/index.html) 	<p>Student activity:</p> <p>Students draw a picture of a coral reef on the Activity Sheet 1: What Does a Coral Reef Look Like? (WCR-1)(See Activity Sheet 1: What Does a Coral Reef Look Like? Below this document)</p>
Teacher activities	Student activities
<p>Inform students that they will be participating in different activities in order to develop their understanding of coral reefs.</p> <p>Activity 1: Coral Reef Symbiosis</p> <p>Introduce the concept of symbiosis by having students think about a time when they helped each other and it turned out they were helping themselves too.</p> <p>Then, ask students to research the word in Coral Reef Symbiosis (http://oceanworld.tamu.edu/students/coral/coral3.htm) and Symbiotic relationship(zooxanthellae)</p>	<p>Student activity:</p> <ul style="list-style-type: none"> • Write their investigation on Activity Sheet 2: Coral Reef Symbiosis (WCR-2) (See Activity Sheet 2: Coral Reef Symbiosis. This document below)

(<http://www.uvi.edu/coral.reefer/zooxanth.htm>) websites.

- **Prompt students to write a brief explanation of what they investigated. See [Activity Sheet 2: Coral Reef Symbiosis. \(WCR-2\)](#)**
(See Activity Sheet 2: Coral Reef Symbiosis. This document below)

Activity 2: Constructing three paper models that describe island coral reefs.

Ask students to research the types of coral reefs in Coral Reef Animal Printouts <http://www.enchantedlearning.com/biomes/coralreef/coralreef.shtml> (scroll down to Types of Reefs section) and [Types of coral reefs](http://www.uvi.edu/coral.reefer/structre.htm) (<http://www.uvi.edu/coral.reefer/structre.htm>) web sites.

Use the patterns provided in the web sites for the group to construct the three types of coral. For this activity, You may want to print them out, cut them into individual coral reef types, and distribute to the groups.

Divide your students into three groups and assign each group to create one of the following types of coral reefs. Show students animation of how a reef progression from a fringing reef to a barrier reef and then finally to an atoll. <http://walrus.wr.usgs.gov/coralreefs/facts4.html>

- [Making a fringing reef](#)
(<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs4.html>)
- [Making a barrier reef](#)
(<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs5.html>)
- [Making an atoll](#)
(<http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs6.html>)

Prompt students to write a brief explanation of what they investigated.

Student activity:

- Break into groups and assign to one of types of coral reefs.
- Read the brief description of coral reefs. Use the web site:
Coral Reef Animal Printouts
<http://www.enchantedlearning.com/biomes/coralreef/coralreef.shtml> (scroll down to Types of Reefs section)
- Students complete the activity sheet during this part of the activity.

- Write the results of their investigation on the [Activity Sheet 3: Researching the Types of Coral Reefs \(WCR-3\)](#)
(See Activity Sheet 3: Researching the Types of Coral Reefs. This document below)

<p>See <u>Activity Sheet 3: Researching the Types of Coral Reefs (WCR-3)</u>. (See Activity Sheet 3: Researching the Types of Coral Reefs. This document below)</p> <p>After students build different types of coral reefs, have them share with each other the important characteristics of each.</p> <p>Teacher Background:</p> <ul style="list-style-type: none"> • How to Construct Four Paper Models that Describe Island Coral Reefs (http://wrgis.wr.usgs.gov/docs/parks/sea/4reefs1.html) 	
Teacher activities	Student activities
<p>Explore the conditions under which coral reefs can grow and have students build different models of coral reefs.</p> <p>Introduce the lesson by reminding the students the story of <i>Goldilocks and Three Bears</i>.</p> <p>Ask students</p> <ul style="list-style-type: none"> ○ What kinds of chairs did Goldilocks find in the bear’s house? ○ Why did Goldilocks think that <i>Little bear</i>’s chair was made just for her? ○ Why did Goldilocks think that Papa bear’s pie and Mama bear’s pie were not tasty? ○ Like a Goldilocks story, can we find favorable conditions that coral reefs can grow well—not too extreme in temperature, salinity, wave action, depth of sea? <p>Prompt students to explore the growing conditions that coral reefs can grow well by investigating the following websites.</p>	<p>Sample student responses:</p> <ul style="list-style-type: none"> ○ Great/Big, Middle, little chair ○ Papa bear’s chair was too hard and Mama bear’s chair was too soft. ○ Too sour, too sweet ○ Yes, it is similar <p>Student activity:</p> <p>Explore information on the growing conditions that coral reefs can grow well and</p>

- [Physical requirements for coral reefs](http://www.fknms.nos.noaa.gov/sanctuary_resources/welcome.html) (http://www.fknms.nos.noaa.gov/sanctuary_resources/welcome.html)
- Wave and Reefs Development <http://www.seaworld.org/infobooks/coral/habdiscr.html>
- [The maximum depth and coral](http://www.fknms.nos.noaa.gov/sanctuary_resources/morecoral.html) (http://www.fknms.nos.noaa.gov/sanctuary_resources/morecoral.html)

[Coral Reef Habitat \(ideal conditions\) and Distribution](http://www.seaworld.org/infobooks/coral/habdiscr.html)
<http://www.seaworld.org/infobooks/coral/habdiscr.html>

Prompt students to write a brief explanation of what they investigated. See [Activity Sheet 4: Goldilocks and Coral Reefs \(WCR-4\)](#) (See [Activity Sheet 4: Goldilocks and Coral Reefs This document below](#))

Activity: Building coral reef miniatures with Plaster of Paris.

Break students into several groups and provide the following instructions.

In your teams,

- review the reference [tutorial](http://www.pbs.org/edens/palau/p_classroom_2.htm)(http://www.pbs.org/edens/palau/p_classroom_2.htm) on the web site,
- select one type of coral you want to build based on your understanding of coral reefs, and
- create different miniature coral reefs with plaster-Paris, and finally
- present your coral reef to the rest of the group and describe why you made it like you did.

Teacher Background:

- For information on [the Plaster of Paris hands-on activity](http://www.ohiodnr.com/geosurvey/edu/hands16.htm) <http://www.ohiodnr.com/geosurvey/edu/hands16.htm> (You can find the explanation about how to make a rock

write their investigation on [Activity Sheet 4: Goldilocks and Coral Reefs \(WCR-4\)](#)

Student activity:

In their teams: students

- review the [tutorial](http://www.pbs.org/edens/palau/p_classroom_2.htm) (http://www.pbs.org/edens/palau/p_classroom_2.htm) on the website,
- select one types of coral reefs to build,
- create their coral reefs with Plaster of Paris, and finally
- present their coral reefs miniature and their rationale as to why they made it like they did.

<p>sculture with a Plaster of Paris. You can use this information to build a coral reefs instead of a rock sculture).</p> <ul style="list-style-type: none"> ○ The information on structure of a coral reef (http://www.sprl.umich.edu/GCL/paper_to_html/coral.html) <p>Prompt each team, one at a time, to present their coral reefs miniature and their rationale as to why they chose that model and how it worked.</p> <p>Discuss each teams' presentation</p>	
Teacher activities	Student activities
<p>Try using the new knowledge about coral reefs to find an ideal environment for them.</p> <p>Provide students with the various images of Hawaiian coral reefs.</p> <ul style="list-style-type: none"> ○ Lobe coral (http://library.thinkquest.org/J002237/corals/lobecoral.htm?tqskip=1) ○ Cauliflower coral (http://library.thinkquest.org/J002237/corals/cauliflower.htm?tqskip=1) ○ Finger coral (http://library.thinkquest.org/J002237/corals/finger.htm?tqskip=1) ○ <p>Ask students</p> <ul style="list-style-type: none"> ○ What type of coral reefs did you observe? ○ What are the characteristics of Hawaiian coral reefs? <p>Ask students to find where the islands of Hawaii are located and whether there are coral reefs around the islands of Hawaii in the map of remote sensing of coral reefs</p>	<p>Student activity:</p> <ul style="list-style-type: none"> ● Students look at the various images of coral reefs in the island of Hawaii. ● Lobe, cauliflower, and finger coral ● Students look at the map of remote sensing of coral reefs (http://seawifs.gsfc.nasa.gov/cgibrs/refs.pl) and locate Hawaii. ● Students look at the National Data Buoy Center

(<http://seawifs.gsfc.nasa.gov/cgihrs/reefs.pl>)

Have students to use the zoom feature and the Reefsbase option to identify where the reefs are located around the islands of Hawaii. After zooming Hawaii, ask students to look at additional remote sensing images of Hawaii at the bottom of the screen.

Prompt students to evaluate whether the islands of Hawaii are ideal for coral reefs by having them explore the ocean temperature of Hawaiian islands from [the National Data Buoy Center](#).

(<http://www.ndbc.noaa.gov/Maps/rmd.shtml>)

Activity Instruction:

- Ask students to identify where Hawaiian islands are located at the larger map from [the National Data Buoy Center](#) (<http://www.ndbc.noaa.gov/Maps/rmd.shtml>)
- Ask students to find the buoy closest to the reefs on Oahu
- Ask students to identify temperature at buoy closest to the reefs on Oahu It is highly recommended that you print student activity sheets in advance

Prompt students to write a brief explanation of what they investigated. See [Activity Sheet 5: Analyzing Their Living Conditions \(WCR-5\)](#). (See Activity Sheet 5: Analyzing Their Living Conditions. In this document below)

Teacher Notes:

1. Studies have shown that most reefs tend to grow well between temperatures of 23-25°C (Stable temperature between 18-30°C is necessary for the survival of coral reefs).
2. You may want to see whether coral reefs grow in a your area instead of Hawaii. For this activity, you can

(<http://www.ndbc.noaa.gov/Maps/rmd.shtml>) and evaluate whether islands of Hawaii areas are ideal for a coral reefs.

- Students write the results of their investigation on [Activity Sheet 5: Analyzing Their Living Conditions \(WCR-5\)](#) (See Activity Sheet 5: Analyzing Their Living Conditions. In this document below)

Student Activity

- [The location of Hawaiian Islands](#) (<http://www.ndbc.noaa.gov/Maps/Hawaii.shtml>)
- Buoy 51003 (http://www.ndbc.noaa.gov/station_page.phtml?station=51003)

<p>click on your respective locations on the map of remote sensing of coral reefs (http://seawifs.gsfc.nasa.gov/cgibrs/reefs.pl) and also test water temperature in your locale from the National Data Buoy Center (http://www.ndbc.noaa.gov/Maps/rmd.shtml) or from local samples to simulate whether you live in an ideal environment for a coral reef to thrive.</p>	
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Student reflection activity:

- Prompt students to think about how the characteristics of coral reefs can be investigated using aircraft and remote sensing instruments.
 - Prompt students to record the questions they have, the information they know, the information they think they know about coral reefs, and the ideas for further investigating the problem in their reflective journal.
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Assessment:

- Students have identified the key characteristics of coral reefs, including:
 - coral reef symbiosis
 - Definition of a fringing reef, barrier reef, and atoll ~~coral reef~~.
 - major factors limiting the occurrence of coral reefs in globally.
 - major factors limiting the occurrence of coral reefs locally.
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Ideas for math lesson connections

- Students read a chart that shows the latitude ~~altitude~~ and longitude ~~(to scale)~~ of the islands of Hawaii.

Related National Education Math Standards

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Ideas for geography lesson connections

- Students identify the geographic location of the Hawaiian Islands. For example, the students might create a report describing the location and geography of the island.

Related National Education Geography Standards

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Ideas for technology lesson connections

- Students create their own electronic journal for keeping notes on KaAMS project.
- Students create a database of vocabulary words and terms they will learn throughout KaAMS.

- Students learn to use presentation software while preparing a presentation on their investigation results.
- Students begin to develop a web site to report their progress and what they learn during the KaAMS project.

Related National Education Science Technology Standards

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Activity Sheet 1: What Does a Coral Reef Look Like? (WCR-1)

Name:

1. Draw a picture of a coral reef and label its features.

Parts of a Coral Polyp



<Reference> <http://library.thinkquest.org/J002237/corals/partscoralpolyp.gif>

Teacher Note: In reality, each polyp in the picture is extremely small, about 1mm across.

2. What does your picture show about real coral reefs?

A coral reef is made up of the shells of single, small marine animals called coral polyps. When coral polyps grow into a group they are called a coral colony. As polyps die, new ones grow on top of the old empty shells. Over time, the collection of shells left behind by dead coral polyps and dead coral colonies build large groups of rock-like structure called a coral reef. Although the entire coral reef looks like a lot of large rocks, the top surfaces are actually covered with new coral colonies that are very much alive.

Activity Sheet 2: Coral Reef Symbiosis (WCR-2)

Name:

1. Did you have a time when you helped someone and it ended up benefiting both of you? Please write about this situation in 1-2 paragraphs.

Examples:

- Boosting another person up to reach something of importance to both –like a cookie they would share.
 - Running a relay race
 - A grandparent living in the same house as their children. They are provided with room and board for free, while they baby-sit for the parents, or do the laundry.
2. What you described in item 1 is symbiosis. Combine what you learned from this experience and what you found out about its definition to define symbiosis in your own words.

Symbiosis means sustaining the life of each other by living together in harmony. What students should have described in answer one was an action whose purpose was to benefit the other.

3. Define zooxanthellae.

Zooxanthellae are one-celled yellow-brown (dinoflagellate) algae that live symbiotically in the reef-building corals.

4. Why do we say that coral reefs live symbiotically?

Inside the sac of each coral polyp lives a one-celled algae called zooxanthellae (zoo-zan-thel-y). The algae gives off oxygen and other nutrients that the coral polyps need to live and in return the polyp gives the algae carbon dioxide and other substances the algae needs. In addition to the symbiotic relationship between zooxanthellae and the coral polyps, many other fish live symbiotically with the coral reefs.

5. Why do coral reefs grow so near the surface of the water?

Because the algae (zooxanthellae) need sunlight to create food through photosynthesis, they live in ocean waters less than 100 meters deep.

6. Why do you think that symbiosis is important to coral reefs?

Without the algae, the coral could not live. Without the coral, giving off carbon dioxide and other substances, the algae could not live.

Activity Sheet 3: Researching the Types of Coral Reefs (WCR-3)

Name:

1. What is the difference between *fringing*, *barrier*, and *atoll* coral reefs?

The main difference between each type of reef is the distance it lies from the beach shoreline.

2. Define *fringing* coral reefs.

Fringing reefs attach themselves to the beach where they can find much food and clean, rather than muddy, freshwater. These are the simplest and most common kind of reef.

3. Define *barrier* coral reefs.

Barrier reefs grow out from the beach as far as 100 km from shore, often rimming and protecting a relatively deep lagoon on the ocean side. Some are 2000 km in length. The lagoon is a common place for boats to dock, and therefore can threaten the coral.

4. Define *atolls*.

Atolls are circular, surrounding a lagoon. Its upper surface is nearly flat with steep outer slopes. They are found far from land, and are mainly in the west Pacific. Charles Darwin, solving the puzzle of how they are formed, determined that they formed around islands that are sinking. As the island sinks, the reefs continue to grow upward at the same pace, and therefore remain visible.

Activity Sheet 4: Goldilocks and Coral Reefs (WCR-4)

Name:

1. Where do coral reefs grow?

Coral reefs can be seen throughout the tropical and subtropical Western Atlantic and Indo-Pacific oceans, generally within 30 degrees N and 30 degrees S latitudes.

2. Why do you think that coral reefs only occur between certain latitudes, and then only within certain areas?

Studies have shown that most reefs grow well between the temperatures of 23-25 degrees C. The temperature is ideal year round in these locations, not too hot, and not too cold.

3. What major factors limit where coral reefs can be found? List 5 major factors limiting the occurrence of coral reefs and find the

	Factor	Requirements	Why is it important?
	Temperature	18-30 C (64-86 F)	Stable temperature between 18-30 C is necessary for the survival of coral reefs.
	Salinity	33 - 36 parts per thousand	
	Light	The maximum depth for actively growing coral is 70m	The need for light for coral reefs' symbiotic plant is thought to limit reefs building corals to shallow water.
	Wave action	Reef development is generally more abundant in area that is subject to strong wave action.	Waves carry food, nutrients, and oxygen to the reef. Waves distribute coral larvae. Waves prevent sediment from settling on the coral reefs.

Activity Sheet 5: Analyzing their Living Conditions (WCR-5)

Name:

1. Search for locations where coral reefs can be found.
 - Where are the islands of Hawaii?

1. Do you think that the islands of Hawaii are ideal environment for a coral reef? Why?

They have a stable temperature. Salinity is perfect, and there is enough wave action.

2. Do you think that coral reefs could live in your area? Why or why not?

This answer depends on the location of your school. Test the salinity, temperature, wave action and sediment in water near you to determine this.