Coral Reefs: Integrative Teaching Tool (and Guide to NOAA Resources)

National Science Teachers Association
April 6, 2006
Anaheim, California
NOAA Coral Reef Conservation Program: Created by NOAA in 2000

• Cross-NOAA, multidisciplinary program:
  • NOAA Oceans and Coasts
  • NOAA Fisheries
  • NOAA Research
  • NOAA Satellites and Information

• Mission: Support effective management and sound science to preserve, sustain and restore valuable coral reef ecosystems
Why Care? Reefs are Valuable

• **Reefs provide food, income, jobs:**
  - $6-10 billion in U.S. tourism annually
  - 50% of species in federal fisheries depend on reef ecosystems
  - ½ billion people depend on coral reefs globally
  - 60 nations depend on reefs for food, income, protection

• **Reefs provide valuable products and services:**
  - **Medicines:** Increasing focus on coral reef species
  - **Storm protection:** 1,000 U.S. communities depend on healthy reefs for protection from storms and erosion.
  - Decline of coral reefs in SE Asia has been identified as a key factor resulting in catastrophic tsunami damage.
Why Care? Loss of Coral Reefs

• Increasing reef decline: 25% lost; 35% are threatened; only 30% at low risk of destruction

• Major causes of reef loss:
  – Over-fishing
  – Land-based pollution
  – Climate change
  – Vessel groundings
  – Coastal development
  – U.S. imports

• Degradation of many U.S. Reefs
  – South Atlantic
  – Carribean
  – Western Pacific
Better Education is Key to Reef Survival

- Major actions needed to halt and reverse coral reef decline
- Better education will be critical to conserving reefs for future generations
- Importance of coral reef education:
  - Promotes lifelong environmental literacy
  - Precursor to diverse reef workforce
  - Promotes stewardship and sustainable behaviors
  - Excites children about science: reefs as “imagination-friendly” teaching tool
Exploring Reefs in the Classroom

• Resources help you address national education standards for oceans, biology, geology:
  – National Science Education Standards
  – American Association for the Advancement of Science Project 2061 standards

• Today: Help locating existing educational materials and tools to help you create content for your classroom
What are Corals? What are Reefs?

**Corals = Marine Invertebrates**

- Phylum: Cnidara, Class: Anthozoaans (over 6000 known species)
- Most corals live in **colonies** of hundreds to thousands of individuals. Each individual is called a “polyp.”
- Two features all polyps possess:
  - A “**mouth**” to intake food and expel waste
  - A **circle of tentacles** surrounding the mouth – aids in eating and defense
- **Symbiotic relationship with algae** that live inside tissues and help polyp feed through photosynthesis
What are Corals? What are Reefs?

Some corals build reefs:
- Stony (hermatypic) corals build reef structures that range from tens to thousands of meters across.
- Reef-building corals are confined to shallow, warm, clear waters.
- Coral reefs are the largest structures on earth of biological origin.

Other corals live in cold, deep waters:
- Stony, soft, gorgonian, black, horny corals.
- Range from 50 to 1000+ meters.
- Lack symbiotic algae (don’t feed through photosynthesis).
- Can live in groups (like reef-building corals) called patches, mounds, banks, etc.
Teaching Coral Reefs

- Geography
- Geology
- Oceanography
- Biology
- Ecology
- Policy and Conservation
Geography & Oceanography: Where are Coral Reefs?

Concepts: Water Temperature, Salinity, Turbidity
Geography: Where are Coral Reefs?

**U.S. States and Territories:**

**Pacific:**
- Hawaii
- Guam
- Commonwealth of the Northern Marianas
- American Samoa

**Atlantic:**
- Florida
- U.S. Virgin Islands
- Puerto Rico
Geography: Where are Coral Reefs?

**International:**

- **Usual suspects:**
  - Australia
  - Fiji
  - Indonesia
  - Galapagos

- **Unusual suspects:**
  - Palau
  - Papua New Guinea
  - Tuvalu
  - Vietnam
  - East Africa
  - Red Sea
Geology: Coral Reef Formation and Life Cycle

Concepts: Subsidence, Fringing reef, Barrier reef, Atoll, Charles Darwin
Biology: Coral Reefs are Living Organisms

Concepts: Invertebrate Zoology, Symbiosis, Life History
Ecology: Coral Reef Ecosystems

Concepts: Habitat, Niche, Population, Community
Policy: The Short History of Reef Management

• Marine Conservation Management Milestones:
  – 1872: First National Park
  – 1960: World’s first underwater park (John Pennekamp State Park)
  – 1975: First National Marine Sanctuary

• Coral Reef Management Milestones:
  – 1994: ICRI
  – 1997: Int’l year of reef
  – 2000: Coral Reef Conservation Act
Conservation: Research, Restoration, and Preservation

Concepts: History and Status of Ocean Management, Benefits of Reefs for Human Society, Human Impacts
Conservation: Research, Restoration, and Preservation

- Reefs are valuable
- Reefs are severely threatened
- Critical role of education in conserving coral reefs for future generations

⇒ Imagination-friendly teaching tool
Coral Reef Teaching Resources

1. NOAA/NSTA resources
   1. NSTA symposium (Friday, April 7 1-5:30pm)
   2. Web-seminars (May 10 and June 7)
   3. SciGuides and SciPaks

2. NOAA online educational resources:
   www.coralreef.noaa.gov
   www.coris.noaa.gov

3. Coral Reef Resource Roundup CD


5. Multi-topic environmental education websites
NOAA/NSTA Resources: SciGuide

Free SciGuide: Severe Weather (9-12)

In light of the continuing tragedies of the 2005 hurricane season, NSTA is offering the NSTA SciGuide on Severe Weather as a free resource to assist teachers with students' inquiries about severe weather in general and specifically, hurricanes. This SciGuide features a theme on Thunderstorms, Tornadoes, and Hurricanes. Each theme stresses the basics of how these severe weather events form and how to prepare for each event.

NSTA encourages you to visit the Federal Emergency Management Agency, which provides phone numbers and Internet links to key charities and organizations:

Featured SciGuide: Energy Resources (9-12)

Energy fuels our planet. Find out where we get our energy and how we have developed technologies to fulfill our energy needs. Learn how our increasing demand for energy affects the environment and how we are addressing the...
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NOAA Online Education Resources

- NOAA Coral Reef Conservation Program website: www.coralreef.noaa.gov
  - Roadmap to educational websites and online resources
  - Lesson Plans
  - Things You Can Do to Protect Reefs
  - Why Reefs are Valuable: Facts and Posters
  - News Archive and Newsletter
Coral Reef Outreach and Education

The links below include resources for students interested in learning more about reefs as well as lesson plans and other useful information for educators.

Outreach Materials
Educational Resources

Outreach Materials

Learn About Coral Reefs

Protect Coral Reefs: Learn More. Coral reefs are some of the oldest and most diverse ecosystems on the planet. They have survived millions of years of natural disturbances, but today they are also threatened by many human activities. Learn how healthy coral reefs are valuable to the people, fish, plants, and animals that depend on them. Help protect our coral reefs by learning more about them.

Things You Can do to Protect Coral Reefs. Even if you don’t live near a coral reef you can help protect reefs in the U.S. and around the world.

Links to More Information about Coral Reefs. Links to other useful sources of information about coral reefs.
Educational Resources

The sites below provide access to lesson plans and other useful information to help incorporate coral reefs into the classroom.

**Online Coral Reef Discovery Kits.** This discovery kit contains three sections devoted to learning about coral reefs: an online tutorial, an educational roadmap to resources, and formal lesson plans (developed for grades 9-12).

**Coral Literature, Education and Outreach (CLEO).** The CLEO Program Web site includes access to coral reef educational modules, live coral reef Web cameras, and a literature search. The CLEO Program leverages techniques developed at NOAA/Atlantic Oceanic and Meteorological Laboratory under the Explorer of the Seas, Coral Health and Monitoring Program, and Coral Reef Early Warning System programs.

**NOAA Ocean Explorer Education Site.** This site includes downloadable educational materials and lesson plans for all ages, including a wide variety of lesson plans that relate to coral reefs and deep-sea corals.

**NOAA Educational Resources Site.** This Web site provides links to a number of educational resources available from NOAA. The site includes resources for teachers, students and the public.
Healthy Coral Reefs Provide:

Medicines: Treatments for Heart Disease, Cancer and HIV

Coral reefs are often considered the medicine cabinets of the 21st century. Coral reef plants and animals are important sources of new medicines being developed to treat cancer, arthritis, human bacterial infections, heart disease, viruses, and other diseases. The pharmaceutical value of coral reefs in Jamaica’s Montego Bay, for example, has been estimated at approximately $50 million.

Some coral reef organisms produce powerful chemicals to fend off attackers, and scientists continue to research the medicinal potential of these substances. In the future, coral reef ecosystems could represent an increasingly important source of medical treatments, nutritional supplements, pesticides, cosmetics, and other commercial products.

Below are a few examples of treatments developed from reef plants, corals and other animals:

- Reef sponges have been used in antiviral drugs to treat HIV and herpes;

Why Are Reefs Valuable? :
The “Healthy Coral Reefs Provide…” Series
NOAA Online Education Resources

- Coral Reef Information System CoRIS website: [www.coris.noaa.gov](http://www.coris.noaa.gov)
  - Essays
  - Professional exchanges (online debates)
  - Online library of reports and products
  - Illustrated Glossary
  - Search for maps, aerial photography, real-time data
NOAA Coral Reef Information System (CoRIS): www.coris.noaa.gov

NOAA's Coral Reef Information System (CoRIS) is designed to be a single point of access to NOAA coral reef information and data products, especially those derived from NOAA's Coral Reef Conservation Program.

Special Note

- Visit ReefBase for information on Corals around the world.
- Recently added data: Bathymetric Atlas of the Northwestern Hawaiian Islands.
- Learn about the activities of the U.S. Coral Reef Task Force.
- View the National Coral Reef Action Strategy.
- Read the report on the State of U.S. Coral Reefs.
- Go to Professional exchanges for expert discussion on DNA sequencing in corals.
- Read the report on the Status of Coral Reefs of the World.
- Take the User Survey.

DISCOVER NOAA's DATA
ABOUT CORAL REEFS
PROFESSIONAL EXCHANGES
THE LIBRARY
NOAA's CORAL REEF ACTIVITIES
GLOSSARY
Coral Reef Biology

Thousands of corals species exist worldwide. Stony (hermatypic) corals are the best recognized because of their elaborate and colorful formations. One trait of stony corals is their capacity to build reef structures that range from tens, to thousands of meters across. As they grow, reefs provide structural habitats for hundreds to thousands of different vertebrate and invertebrate species.

Although corals are found throughout the world, reef-building corals are confined to waters that exhibit a narrow band of characteristics. The water must be warm, clear, and saline. These waters are almost always nutrient-poor as well. Physiologically and behaviorally, corals have evolved to take advantage of this unique environment and thrive.

A wide variety of corals in this small view is evidence of a healthy coral reef.
Coral Reefs – Rainforests of the Sea?

Are coral reef communities analogous to tropical rainforests? Coral reef specialists discuss the implications of the comparison, and debate whether the analogy is accurate or if it is just a catchy “sound bite” meant to garner attention from a public more aware of rainforest degradation than threatened coral reefs.

The discussion centered on the value of the analogy as an educational tool as well as its degree of scientific accuracy. The analogy also sparked an examination by some participants of the true similarities and differences of the two systems.

Click here for a listing of...
Coral Reef Teaching Resources

1. NOAA/NSTA resources
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   2. Web-seminars (May 10 and June 7)
   3. SciGuides and SciPaks

2. NOAA online educational resources:
   www.coralreef.noaa.gov
   www.coris.noaa.gov

3. Coral Reef Resource Roundup CD


5. Multi-topic environmental education websites
Coral Reef Resource Roundup CD

• Compiled by U.S. Coral Reef Task Force Education and Outreach Working Group
• Materials created by 20+ government agencies, non-profits, and education organizations
• CD Contains:
  – Lesson Plans (elementary through high school)
  – Activities for Kids
  – Science and Conservation Guides
  – Factsheets, Issue Briefs, and Reports
  – Newsletters and Brochures
  – Short Videos
  – Posters and Postcards
CD: NOAA Coral Lesson Plans

- Grades 5-6: 12 lesson plans
- Grades 7-8: 4 lesson plans
- Grades 9-12: 12 lesson plans
- Features of Lesson Plans:
  - All tied to National Science Education Standards
  - Hands-on, inquiry based activities
  - Focus questions
  - Background information for teachers
  - Links to interesting internet sites
  - Extensions
CD: NOAA Coral Lesson Plans

- Topics:
  - Coral Biology
    - Coral spawning
    - Morphology of corals
    - Feeding adaptations
  - Coral Reef and Deep Sea Coral Ecology
    - How corals colonize deep sea environment
    - Biodiversity of deep corals
  - Associated Biotic Communities
    - Common fauna groups found in deep coral communities
    - Monk seals and corals
CD: NOAA Coral Lesson Plans

• Topics:
  • Physical and Geological Science
    • Water currents and corals
    • Corals and satellites
    • Coral bleaching and sea surface temperature
  • Research, Management and Conservation
    • Medicinal compounds
    • Management of coral reefs
    • Deep corals as indicators of long-term climate change
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Our Goal:
Raising awareness of coral reefs and related ecosystems is crucial to their survival. The aim of this global collection of coral reef awareness tools is to help local and regional programs maximize available resources and knowledge. As a result time and money can be devoted to outreach purposes rather than on researching and re-creating publications.

The Library:
Descriptions of brochures, books, videos and other items suitable for coral reef awareness and education efforts can be found in the library. Each entry contains contact information on how to obtain the publication, a brief description, and some publications are available for download directly from this site.

How you can help:
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<td><strong>Description:</strong> Covers the ecology of coral reefs, who lives on the reefs, how cora reefs are threatened and what kids can do to save them. Activities, puzzles, and games. Black and white. Soft Cover. Received Teachers Choice Award from Learning Magazine and Parent's Choice from Parent's Choice Foundation. Written by Toni Albert. Ages 9-12</td>
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5. Multi-topic environmental education websites
Multi-Topic Environmental Education Websites

Additional “Portal” sites

- The BRIDGE – National Oceanographic Partnership Program
  www.vims.edu/bridge/
- Digital Library for Earth System Education (DLESE) – National Science Foundation
  www.dlese.org/
www.vims.edu/bridge

BRIDGE
Sea Grant Ocean Sciences Education Center

Site Navigation
- Ocean Science Topics
- Lesson Plans
- Research & Data Connection
- Professional Development
- Guiding Students
- Resource Center
- About the Bridge
- Communicate

Follow the red and green channel markers to the best marine education materials available on the Web. Enjoy your visit to the BRIDGE, and come back soon. New materials are added often.

The Bridge is a COSEE partner, and is supported by SEA GRANT and the NATIONAL MARINE EDUCATORS ASSOCIATION.

Teachers’ Top Web Picks
⭐ Gulf of Maine Ocean Observing System (GoMOOS)
"Real time data that is easy to find and navigate for students. You could use the site as a lab and role play real life situations in harvesting from the sea, collecting data about the weather, pollution, and fisheries management."
- Marilyn, TROLL (Teacher Reviewer of On-Line Learning)
Find out more about becoming a TROLL.

NMEA 2006: Call for Presentations
Presentation options include 1 hour lecture/demonstration, 30 min poster presentation, and a researchers' track. Be sure to correlate your proposal with one of the seven essential principles of Ocean Literacy. Application deadline is April 1, 2006.

More...

Online Expeditions, Resources, Activities and Workshops...
www.dlese.org

Digital Library for Earth System Education

Funded by the National Science Foundation

What’s new at DLESE

- Call for papers. Special Issue on Digital Libraries and eScience for the International Journal on Digital Libraries
- Making a Broader Impact: Geoscience Education, Public Outreach, and Criterion 2 - report available
- New resources & reviews

Resource of interest

Students and families are invited to participate in a worldwide campaign March 22-31 to observe and record the magnitude of visible stars as a means of measuring light pollution in a given location. GLOBE at Night is an easy observation and reporting activity with a goal of collecting 5,000 observations.

Information for parents, students and teachers details the data collection activity, and participants can subscribe to the GLOBE at Night mailing list to receive updates and results. The site includes background information and interactive simulations that show the effects of light pollution on the night sky, and finding the constellation Orion.

(See announcement in DLESE News and Opportunities)
Hands-On Opportunities for Students

- **Place-based opportunities** – Explore reefs and the coastal connection:
  - NOAA Regional Offices
    - NOAA in your area
    - [www.accessnoaa.noaa.gov/apr0601/neighborhood.html](http://www.accessnoaa.noaa.gov/apr0601/neighborhood.html)
  - National Marine Sanctuaries (13 total, 3 coral reef sanctuaries, 1 coral research reserve)
    - [www.sanctuaries.noaa.gov](http://www.sanctuaries.noaa.gov)
  - National Estuarine Research Reserves (26 total, 1 coral reef reserve)
    - [www.estuaries.noaa.gov](http://www.estuaries.noaa.gov)
  - National Parks (2 coral reef national parks)
    - [www.nps.gov](http://www.nps.gov)
Hands-On Opportunities for Students

• **Place-based opportunities** – Explore the land use and watershed connection:
  – Coastal Marine Learning Centers (aquaria)
  – Wildlife refuges
    • [www.usfws.gov](http://www.usfws.gov)
  – Adopt-a-storm-drain
    • [www.adoptastormdrain.com/](http://www.adoptastormdrain.com/)
  – Adopt-a-park or highway
    • [www.adoptahighway.com](http://www.adoptahighway.com)
  – Watershed organizations
    • [www.rivernetwork.org](http://www.rivernetwork.org)
    • [www.theoceanproject.org](http://www.theoceanproject.org)
Hands-On Opportunities for Students

- Event-centered opportunities:
  - Dive into Earth Day
    - www.coral.org
  - International Coastal Cleanup
    - www.icc.org
  - Great Annual Fish Count
    - www.reef.org
Future of Coral Reefs: We Need Your Help

- Teaching about:
  - Interconnectedness of reef creatures
  - Interconnectedness of humans and waterways/coasts
  - Threats to reefs
  - The benefits of reefs and reef-dwelling creatures for human society

...helps build public support for their protection for future generations.

We still have far to go!
Thank You

Contact Information:

Alissa Barron ~~ Liza Johnson
NOAA Coral Reef Conservation Program

Email:
Alissa.Barron@noaa.gov
Liza.Johnson@noaa.gov