Unit 1 Lesson 4: Coral Reefs as Indicators of Paleoclimate

esson Objectives: Students will gain knowledge of how the marine environment can tell a story about years past through naturally recorded geographic and environmental phenomenon.

Vocabulary: Paleoclimate, greenhouse effect, proxy data

information gathered from www.noaa.gov

Paleoclimatology is the study of the weather and climate from ages past. The word is derived from the Greek root word "*paleo*-," which means "long ago" with combined with "*climate*," meaning weather. Scientists and meteorologists have been using instruments to measure climate and weather for only the past 140 years! How do they determine what the Earth's climate was like before then? They use historical evidence called **proxy data**. Examples of proxy data include tree rings, old farmer's diaries, ice cores, frozen pollen and ocean sediments.

Scientists know the Earth's average temperature has increased approximately 1°F since 1860. Is this warming due to something people are releasing into the atmosphere or natural causes? Many people today are quick to blame the **greenhouse effect** for global warming, but the temperature increases may have a natural cause, for example, from elevated volcanic activity.

Gases in the earth's atmosphere which trap heat, and cause an increase in temperature cause the greenhouse effect. **Carbon dioxide** (CO_2), water vapor, and other gases in the atmosphere absorb the infrared rays forming a kind of blanket around the earth. Scientists fear that if humans continue to place too much carbon dioxide in the atmosphere, too much heat will be trapped, causing the global temperature to rise and resulting in devastating effects.

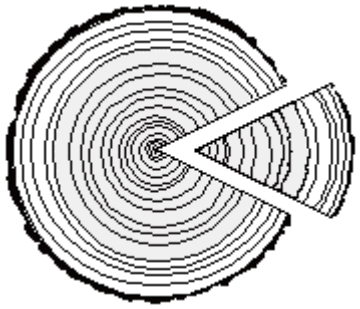
Some scientists speculate that natural events like volcanic eruptions or an increase in the sun's output, may be influencing the climate. Perhaps the temperature rise is a natural trend that is part of a

long-term cycle. Obviously, using only the weather data scientists have collected in the past 140 years will not be sufficient to answer these questions, so scientists use paleoclimactic studies to determine if today's warming climate has occurred anytime in the past. Through past climate studies, scientists can predict what future climates and trends may occur.

Coral tells how the Earth's climate has changed

Coral reefs provide paleoclimatologists with important proxy data. Coral reefs have been a part of the Earth's oceans for millions of years and are very sensitive to changes in climate. Scientists can use indicators from corals to study weather conditions from the past hundreds or even thousands of years to determine trends in climate.

Corals form skeletons by extracting **calcium carbonate** from the ocean waters. When the water temperature changes, calcium carbonate densities in the skeletons also change. Coral formed in the summer has a different density than coral formed in the winter. This creates seasonal growth rings on the coral (like rings on a tree). Scientists can study these rings to determine the temperature of the water, and the season in which the coral grew. By using these growth bands, scientists can date the



coral samples to an exact year and season.

How is Information Gathered from the Corals?

View a diamond-tipped drill used to gather a core from corals for scientific research. This website also contains a short video of the coral coring procedure: www.ogp.noaa.gov/misc/coral/coral_paleo/movies/kenyacoral.mov Quick Time player is necessary to see this.

Predicting future climate

By determining past climate trends, scientists can predict what future trends will be. Tropical coral reefs once again play a role in this prediction because of their location and characteristics. The heat of the tropical oceans influences the world's climate. Information about the tropical Pacific is very important in predicting **El Nino**. El Nino, which is spawned in the Pacific, greatly affects weather in both North and South America. By sampling corals in the Pacific, scientists can determine El Nino patterns from the past few hundred years, and make predictions for the future. These studies have led to an improved ability to provide seasonal climate forecasts.

The government agency responsible for climate forecasts is the National Oceanographic and Atmospheric Administration (NOAA). NOAA predicts that global climate change will lead to the following changes over the next century:

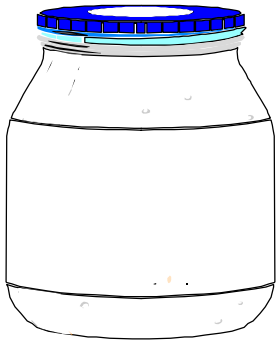
- increased air and sea surface temperatures
- rises in sea level
- changes in weather patterns
- more frequent storms, droughts, floods and other extreme weather in some places
- possible alteration of ocean circulation patterns
- changes in seawater chemistry due to increased carbon dioxide concentrations

Activity 4-1: Ecosystem in a Jar

Objective: Students will understand the amount of life an environment can support, and the interrelationships of temperature, light, and population on a system.

Methods and Materials: One class period for set-up

- pickle jar (or other of approximate size)
- marker
- gravel and rocks
- pond water
- aquatic plants
- pond snails
- microscope slides
- microscope
- duct tape



Procedure:

1. Use a clean jar with a tight fitting lid. Remove the label by soaking it in hot water.
2. Label the jar with your name and the date.
3. Add 3-4 cm of gravel or rocks to the bottom of the jar.
4. Fill the jar halfway with water that has set at room temperature for 24 hours.
5. Add 200mL of pond water to the jar.
6. Add some aquatic plants. You may have to anchor these to the bottom
7. Add 1-2 pond snails.
8. Add more water if necessary to bring level to within 2.5 cm of top
9. Tightly seal the jar. Tape the lid closed using duct tape.
10. Make a microscope slide of the pond water to view what is living in the pond water.
11. Keep the ecosystem in bright, but not direct, light.
12. Observe the ecosystem growing, and allow the system to grow as long as possible.

Discussion:

1. Describe your system, and the parameters that act upon it.
2. Identify all components, living and non-living, of your ecosystem.
3. Discuss what sort of climate is in the mini-ecosystem.
4. Discuss how scientists would study this mini-ecosystem if found completely preserved in 50,000 years.
5. How might they date the ecosystem, and how would they determine what the climate was?

Student Information Sheet 4: Coral Reefs as Indicators of Paleoclimate

A study of the weather in the past is called paleoclimatology. The word "paleo-" is a Greek word for "long ago", and "climate" means weather. Scientists have been using instruments to measure weather for only the past 140 years. So, how do you suppose they gather information about the ice-age that caused all of the dinosaurs to die, or ancient volcanic eruptions? They study "**proxy data**". This is data that is collected from corals, old farmer's diaries, ice cores, ocean sediments and frozen pollen.

Coral reefs have been around for the last 5,000 to 8,000 years. Through these ancient structures, scientists can learn a lot about past climate trends.

Corals record climate changes in their growth rings. These are similar to tree rings. Corals grow by extracting calcium carbonate from the ocean waters and using it to build their skeletons. The density of the coral skeleton, or how many minerals are present in a piece of a certain size, changes with temperature. Coral skeletons formed in the summer have a different density than that formed in the winter. This creates seasonal growth rings on the coral (just like the rings on a tree). Scientists can study these rings to determine the temperature of the water, and the season in which the coral grew. By using these rings, the exact year and season can be determined.

By learning about the climate trends in the past, scientists hope to be able to predict future climate trends and weather patterns.

To learn more about how a coral is drilled to take core samples visit: http://www.ogp.noaa.gov/misc/coral/coral_paleo/coralcores.html