

Climate Change & Coral Activities

Theme

The Ocean stabilizes our respective climates. Global warming threatens to alter this delicate balance. We still have time to change our energy consumption patterns to help reduce this threat

Objectives

- Understand Climate Change and its impacts on the world's oceans
- Realize that fossil fuel emissions are responsible for this warming trend
- Become familiar with alternative forms of energy, specifically renewable energy
- Take the challenge to reduce your energy consumption and encourage others to do the same

Did You Know?

- **The ten hottest years on record have occurred in the last two decades**
- **Current atmospheric concentrations of CO₂ are higher than they've been in the past 420,000 years and likely, for the past 20 million years**
- **The primary human-related causes of CO₂ release are fossil fuel combustion (mainly oil, coal and gas) and deforestation**
- **Sea level is projected to rise another meter or more by the end of this century**

Background Information Climate Change

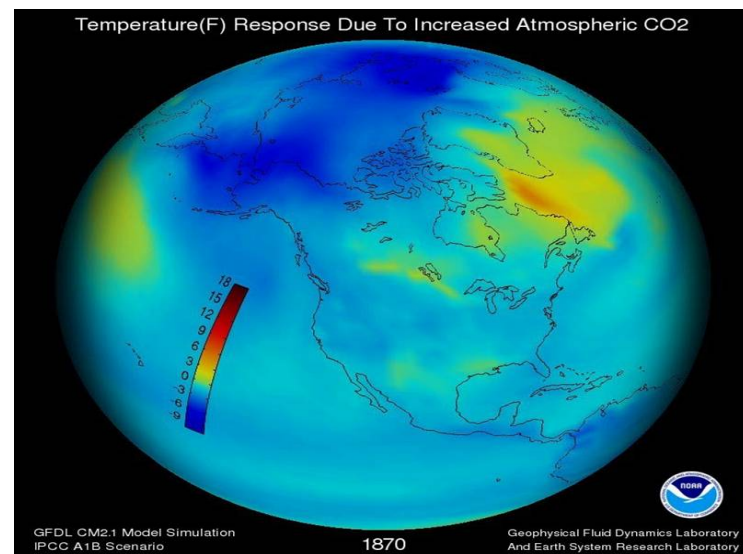
Incoming energy from the sun is absorbed by the Earth and then redistributed by atmospheric and oceanic circulation before being radiated back to space. Naturally occurring 'greenhouse gases' in the Earth's atmosphere—water vapor (H₂O), carbon dioxide (CO₂), ozone (O₃), methane (CH₄) and nitrous oxide (N₂O)—absorb some of this outgoing thermal radiation, which is ultimately reflected back to warm the Earth's surface. This phenomenon is typically known as the 'greenhouse effect'. An enhanced greenhouse effect is now considered to be occurring, due to substantially higher concentrations of greenhouse gases in the atmosphere. This is causing global warming and climate change.

The oceans are not exempt. Sea level is rising, the oceans are becoming more acidic, species are changing habitats and migrating, corals are bleaching, and storms are becoming stronger and more frequent.

Did You Know?

- **When water temperatures get too high, corals expel the symbiotic algae that give coral their food and color, causing them to “bleach” and die**
- **Recent years have seen widespread and severe coral bleaching episodes around the world**
- **As the oceans warm, the location of the ideal water temperature may shift for many species and some have already begun migrating**
- **Species will face extinction if they are not able to move due to natural or man-made barriers**
- **Two (uninhabited) islands have already been submerged and a number of island nations exist at only a few meters above sea level**

The current increase in global temperature of 0.7°C since pre-industrial times is already disrupting life in the oceans, from the tropics to the poles. The species affected include everything from plankton to corals, fish, polar bears, seals, penguins, and seabirds. Nearly half the CO₂ produced by human activities in the last 200 years has been absorbed by the ocean. The ocean is now becoming more acidic as a result. When CO₂ dissolves into water, it forms carbonic acid. As pH decreases (becomes more acidic), it decreases the ability of shellfish to make their shells and corals to build their skeletons.



For a short video of showing past and predicted temperature changes from 1870 to 2100, go to Videos & More folder on this CD, or go to:

http://sos.noaa.gov/videos/gfdl_temp800_labeled.mov

We possess all of the knowledge and technology needed to reduce our emissions. Some governments have begun to do their part and as a result, their economies have actually grown. There are lots of things you can do as an individual to reduce your own daily emissions and save money in the process.

Lesson 1: Ocean Effects

Purpose

Through simple experiments students discover the effects of climate change on the ocean and discuss their impacts on marine life and people.



Inquiry Questions

Will climate change affect the ocean? What kind of changes will take place? Will climate change cause problems for marine life? Will it impact people who live on the coasts or even inland?

Duration: 1.5 hours

Level: Grades 5-12

Materials

- 2 Beakers
(measured containers)
- Water
- Salt
- Bromphenol blue
(acid/base indicator)
- Dry ice
- Antacid tablet
- Straw
- Ice
- Stove/Water heater
- Internet*



Experiment 1: Increasing the Acidity of the Ocean

What happens to the pH of the ocean when you add carbon dioxide (CO₂)? Procedure:

1. Make an “ocean” by filling a flask with water and adding a pinch of salt.
2. Add Bromphenol blue (or another pH indicator), it will turn **yellow if it is acidic**, blue if it is not. It should start out blue.



3. Add a chunk of dry ice (cooled and compressed CO₂) to the “ocean” and watch as the color turns from blue to yellow. *Wear protective gloves – dry ice to be handled*

by teacher only.

4. Explain that as the dry ice **sublimates** (goes from a solid to a gas), CO₂ bubbles enter the ocean, which makes it more acidic.
5. Try the same experiment again, except instead of placing dry ice in the “ocean” use a straw to blow CO₂ into the water. You should see the same color change (from blue to yellow).
6. Explain that the ocean can hold a great deal of CO₂, but that today the levels are starting to change the chemistry of the ocean. The oceans are becoming more acidic (like the yellow “ocean”).

EXTENSION

The ocean helps to stabilize the world climates. Changes to major ocean currents like the Thermohaline Conveyorbelt, or the North Atlantic current, would cause significant climate changes in places like Eastern North America and Western Europe.

Research the causes and effects of disrupting these currents.

How does this chemical change affect marine life?

7. Explain that the marine life that are most vulnerable to an acidic ocean are those that use Calcium carbonate (CaCO_3), things like mollusks who have shells and coral which use Calcium carbonate to make reefs.
8. Place an antacid tablet into the acidic "ocean." What happens to the tablet? (It should dissolve)
9. Discuss the implications of an acidic ocean on marine life that depends on calcium carbonate.

Experiment 2: Melting Glaciers and Polar Icecaps

Why will global warming increase sea level?

Procedure

1. Make an "ocean" by filling a beaker (container) with water and adding a pinch of salt.
2. Place a few ice cubes ("icebergs/polar ice cap") in the beaker and take note of the water level (use tape or a marker if it is not a measured container) this watermark will be your "sea level".
3. Ask students if they think that the water level (sea level) will change when the ice melts. (Will sea level rise when the polar ice cap melts?)
4. Set "ocean" with ice aside, (you can place it under a heat lamp "sun" to increase the rate of melting)
5. Take another beaker and place the same amount of water and salt in to this container so that the "sea level" is the same.
6. Place a few of ice cubes in a bowl and explain to the students that the bowl represents Greenland (ice/glaciers that are not floating in the ocean).
7. What will happen to the "sea level" when the ice in the bowl (Greenland) melts and runs into the "ocean"?
8. Either wait for the ice to melt in the bowl, or simply add the ice and note the "sea level."

9. Discuss the difference between the impacts of the polar icecaps melting verses the glaciers on Greenland. Which will cause sea level to rise more? (Greenland) Why doesn't the melting of ice burls/icecap change the sea level? (Ice in water is already displacing that amount of water)

Experiment 3: Thermal Expansion

What is *thermal expansion* and how why does it lead to sea level rise?

Procedure

1. Make an "ocean" by filling a beaker (container) with water and adding a pinch of salt.
2. Take note of the water level ("sea level").
3. Ask students if they think that the "sea level" will decrease or increase when it is heated? Explain how climate change is increasing the temperature of the ocean, what will happen to the ocean as sea level changes?
4. Heat the water and take another measurement. Has the sea level risen?

Note: As water is heated, it will create steam which leads to the reduction of water level. Avoid heating water to boiling point.

5. How will sea level rise affect people living on the coasts? What kinds of threats do people face because of increasing sea level?
6. Warmer oceans lead to stronger and more frequent storms. What can we do to protect our coasts and ourselves?