

EARTH'S ENERGY FLOWS AND CLIMATE

PCEP Web Interactive Series #2 | Teacher Supporting Document

Discussion Questions

Explore the interactive and then consider the following:

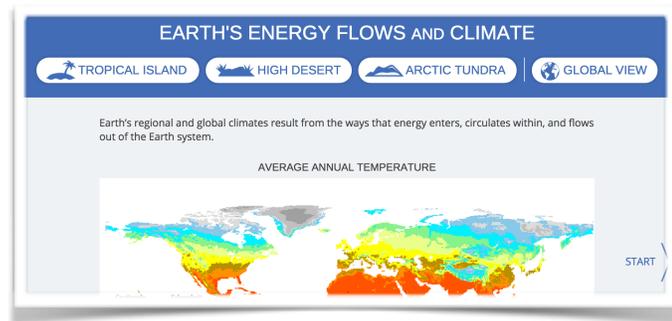
How does energy enter, flow within, and leave different kinds of locations on planet Earth and on the planet as a system?

Which movements of energy into, within, and out of the Earth system are examples of radiation?

How does the greenhouse effect increase the temperature of the planet, and what is its role in global warming?

What kinds of changes in the flows of energy would increase global warming, and what kinds of changes would decrease global warming?

What is the difference between global warming and climate change?



Learn how Earth's climate results from the ways that energy enters, circulates within, and flows out of the Earth system. Explore the flows of energy in regional locations and then at the global level to understand how the increased greenhouse effect causes global warming.

An introductory interactive (*Carbon Dioxide and the Carbon Cycle*) from the Pacific Islands Climate Education Partnership and WGBH explains the factors leading to an increased greenhouse effect. The concluding interactive in this series (*Impacts of Climate Change in the Pacific Region*) illustrates impacts of climate change and adaptation strategies for ecosystems and human systems.

All interactives are available online at <http://pcep.prel.org/resources/?collection=interactives>

Background Essay

As described in the interactive *Carbon Dioxide and the Carbon Cycle*, human activities have changed Earth's carbon cycle, and the most significant result is that global temperatures are increasing. During Earth's very long history, the climate of the planet has changed many times. At times, the climate has been very cold, and large amounts of ice have covered most of the land masses and even large parts of the ocean. For other periods, the climate has been very warm, and there has been little or no ice, even in polar regions. These changes in global temperature

Teaching Tip

Ask students in groups to analyze the Global View screen from the interactive. To guide their discussion, students should hypothesize what the results are likely to be if the following flows increase or decrease:

- * inflow of sunlight;
- * reflection of sunlight;
- * outflow of heat; and
- * greenhouse effect.

Each student group should make a chart of their predictions including the change, the prediction, and the rationale for each prediction. For example, students could create a table with three columns: the change in the flow (e.g., increased reflection of sunlight), the predicted effect on global climate (e.g., global cooling), and the rationale for that prediction (e.g., less energy would be entering the Earth system).

Students can then individually do a gallery walk, examining each group's chart and noting where they had agreements, significant disagreements, or questions. A subsequent whole class discussion can result in a consensus about the answers and explanations for the answers.

correlate very closely with the amount of carbon dioxide in the atmosphere at the time.

For the past 10,000 years, Earth's climate has generally been very comfortable for ecosystems and human communities. However, human activities, especially burning of fossil fuels (oil, coal, and natural gas), are adding carbon dioxide to the atmosphere, causing the climate to become warmer—a change often called global warming.

This interactive explains how the increase in atmospheric carbon dioxide causes global temperatures to rise. Earth's global temperature is determined by the amount of sunlight energy that enters, is absorbed by, moves through, and eventually exits from the Earth system. Carbon dioxide and other greenhouse gases prevent some of this thermal energy (heat) from leaving the Earth system. When the amount of incoming energy is larger than the amount of energy exiting the Earth system, then Earth's average global temperature increases. Because human-caused emissions of carbon dioxide into the atmosphere reduce the rate at which heat leaves the Earth system, the resulting energy imbalance leads to global warming.

The trapping of thermal energy by specific gases in the atmosphere is called the greenhouse effect. Earth's natural greenhouse effect, caused mostly by water vapor and carbon dioxide, enables life as we know it on our planet. Without the natural greenhouse effect, Earth's average temperature would be about 60°F colder, well below the freezing point of water. While the natural greenhouse effect is helpful to ecosystems and human communities, the rapidly increasing greenhouse effect is already harming many of them.

Scientific projections indicate that if current rates of emissions continue, there is a high likelihood of major, probably catastrophic, effects on the web of life and on many human communities during this century. The interactive *Impacts of Climate Change in the Pacific Region* explains some of the major impacts of climate change and also some of the adaptation strategies that can help ecosystems and human communities to suffer less damage from climate change. While this interactive has a Pacific island focus, much of the information applies in other regions of the planet.