Human Impacts on the Earth Environment

Climate Change in Earth History

Trends

- In general, the Earth has been hotter and more humid than it is today. However, there are times like the ice ages, where the Earth's climate has been much colder.

Changing Temperatures

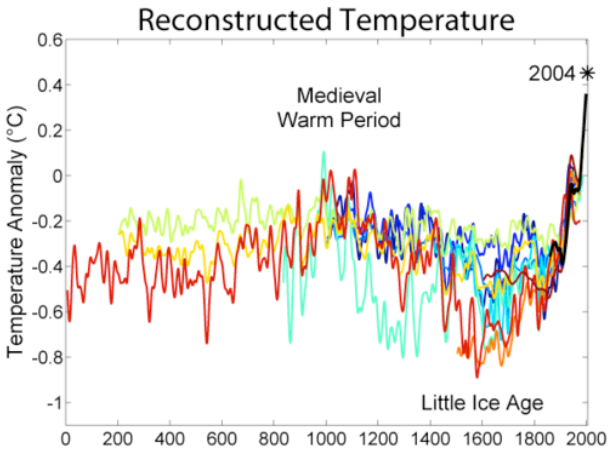
- A small temperature change translates to a great change in the global climate.
- For instance, during the ice ages, the average temperature of the Earth was only 5.5 degrees Celsius (10 degrees Fahrenheit) lower than it is today.
- Over the past 2000 years, human civilization was able to thrive because the climate was stable. We are currently in an interglacial period that has lasted 10,000 years.
- The stability of the climate allowed humans to develop agriculture, which would be the foundation for new societies.

Study Tip

Think about how the Earth's climate has been changing in the past. Do you think it will continue to change? Will it get hotter or colder? Do you think humans contribute to climate change?

Effects of Temperature Shifts

- When the temperature is lower sea levels are lower because much of the continent is covered in ice
- When temperatures are higher sea levels are higher because much of the continental ice melts.



Over the past 2000 years there were periods of fluctuating warmth. Different methods were used to record temperatures. These methods are indicated by the different colored lines.

Concept Check

- How would you describe the climate change over the history of the Earth?
- Why were humans able to develop societies over the past 2000 years?

Human Impacts on the Earth's Environment

Global Warming

Global Warming

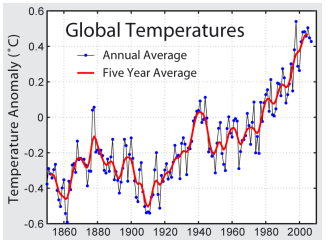
- **Global warming** is the gradual warming of the Earth due to the trapping of greenhouse gasses primarily released by human activity.
- The rate that temperature has been increasing has been greatest within the past century.
  - The 2000s have been the warmest decade recorded.
- Gases such as carbon dioxide enhance the greenhouse effect and causes global temperature to increase

Changes

- The timing for the events of species is changing.
  - For instance, mating and migrations take place earlier in the spring months due to the changing temperatures.
- Sea levels are rising due to the ice caps melting.

Study Tip

Think about greenhouse gasses as a large blanket. It traps warmth and keeps it from escaping.



The global temperatures continue to rise as global warming occurs.

Concept Check

- How does the Earth's temperature change due to global warming?
- What other effects does global warming have on the Earth?

Earth Science

Atmospheric Processes

Greenhouse Effect

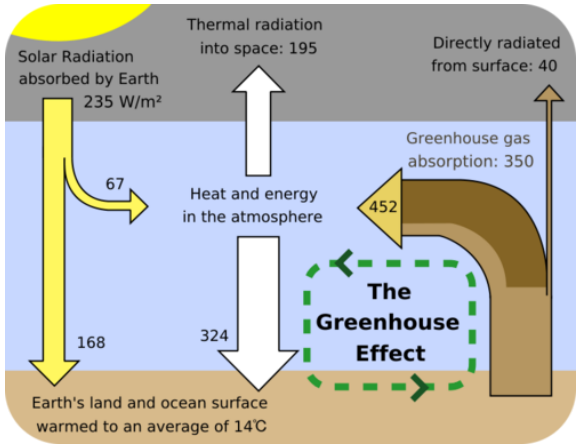
The Greenhouse Effect

Greenhouse gases warm the atmosphere by trapping heat.

- Some of the heat that radiates out from the ground is trapped by greenhouse gases in the troposphere
- Acts as insulation for the planet
- Warming of atmosphere because of **insulation** by greenhouse gases is called **greenhouse effect**
- Component of atmosphere that moderate Earth's temperatures
- Greenhouse gases have different abilities to trap heat. They include:
  - Carbon dioxide (CO_2)
  - Water (H_2O)
  - Methane (CH_4)
  - Ozone (O_3)
  - Nitrous oxides (NO and NO_2)
  - Chlorofluorocarbons (CFCs)
- Human activity has significantly raised the levels of many greenhouse gases in the atmosphere
  - Methane levels are about 2.5 times higher as a result of human activity
  - Carbon dioxide has increased more than 35%
- When atmospheric greenhouse gas levels increase, more gases trap more heat and warm the atmosphere
  - Increase or decrease of these gases affects climate and weather

Study Tip

"Greenhouses" are glass buildings which heat up and provide suitable living conditions for plants by retaining solar radiation in the roofs and walls. Think about the Earth's greenhouse effect in a similar way.



The Earth's heat budget shows the amount of energy coming into and going out of the Earth's system and the importance of the greenhouse effect. The numbers are the amount of energy that is found in one square meter of that location.

Concept Check

- If you were trying to keep down global temperature and you had a choice between adding 100 methane molecules or 1 CFC-12 molecule to the atmosphere, which would you choose?
- What is the greenhouse effect?
- How does Earth's atmosphere resemble a greenhouse?

Earth Science Study Guide

Human Impacts on the Earth Environment

Impact of Continued Global Warming

Human Impact

In the future, it is unclear how much global temperatures will rise exactly. Changes in the sun's irradiance, El Niño and La Niña cycles, natural changes in greenhouse gas, and other atmospheric gases all cannot account for rising temperatures the past few decades, proving that human impact is a large contributor to effects of global warming.

Connection

Global warming has been linked to 2011 weather extremes such as the unusually hot and dry weather in Texas for the spring to summer growing season.

The Impact in the Future

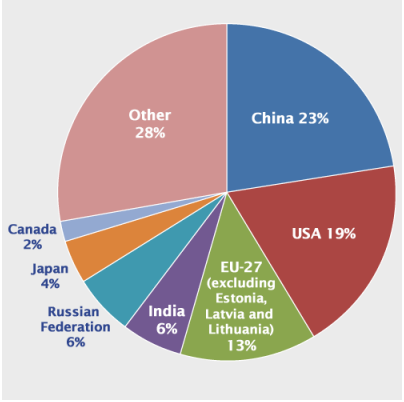
The impact that developed nations have on global warming depend on technological advances in those societies that will produce fewer carbon dioxide emissions. The impact on global warming for developing nations depends on lifestyle changes that may or may not reduce carbon dioxide emissions.

Predictions

Scientists have made models of how the world will be affected by global warming in the near future. Temperatures and sea levels can rise in varied amounts from 1.1°C to 4.5°C and 18 to 97 cm by the year 2100 depending on how quickly humans respond to the situation. They have predicted that carbon dioxide levels become 63% greater than they were in 2002 by 2030 if nothing is done to counteract carbon dioxide emissions. This contributes to an overall warmer earth, as earth's temperature is expected to rise a few degrees due to these effects. Temperature effects will vary globally, heating the poles more than the equator.

Effects on the Environment

The increase of greenhouse gases will bring about extreme changes in global climate. The oceans will become more acidic and sea levels will rise. Ice will melt across the globe and weather will become extreme. These changes will lead to the extinction of many species of plants and animals. Due to the increasing temperatures and more extreme weather conditions, agricultural practices would be difficult to sustain.



This chart shows that the US is responsible for 19% of the world's CO2 emissions in 2008.

Concept Check

- Explain the effects of increasing levels and other greenhouse gases on the environment.
- What evidence points towards the fact that humans have impacted global warming?

Human Impacts on the Earth's Environment

Long-Term Climate Change

Study Guide

Study Tip

Remember **S**ally **P**icks **M**any **G**rapes, to remember the four main causes of long-term climate change.

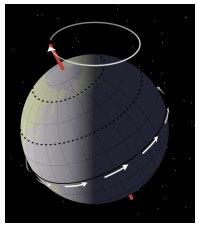
Solar Variation

- The amount of energy the sun radiates changes over time. **Sunspots**—magnetic storms that appear on the sun's surface—can increase the amount of solar radiation that the earth receives.

Plate Tectonics

- As plates move, ocean currents can change and distribute heat differently on continents.
- Continents drifting toward the poles can cause more ice to accumulate, thus lowering the global temperature.
- Plate motions can also cause volcanic eruptions, releasing dust and carbon dioxide that can change climates for years.

Milankovitch Cycles



- The elliptical shape of the orbit, the wobbling on the axis of rotation, and the tilt of the axis can all cause variations in the amount solar radiation Earth receives.
- This creates a **Milankovitch cycle**, a climate pattern estimated to be 100,000 years long.
    - Ice ages are often timed with the Milankovitch cycle.

Greenhouse Gas Levels

- Greenhouse gases trap the heat that radiates off Earth's surface; therefore, changes in levels of carbon dioxide can change global temperature.
- The amount of carbon dioxide and other greenhouse gases can be increased by volcanic eruptions and the decaying of organic matter, and can be decreased from the absorption by plants and animal tissue.

Concept Check

- How do plate tectonics, solar variation, Milankovitch cycles, and differing levels of greenhouse gases affect long term climate change?

Earth Science Study Guide

Human Impacts on the Earth's Environment

Reducing Greenhouse Gas Pollution

Study Guide

Study Tip

Carbon taxes work just like other taxes: they discourage activity by implementing fines.

Kyoto Protocol

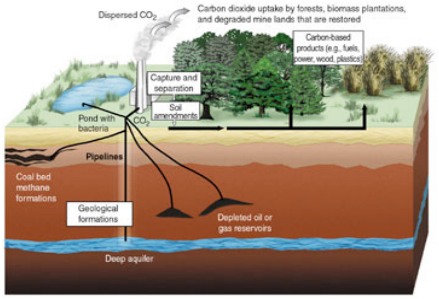
- International agreements have been a method of trying to encourage the countries of the world to reduce their greenhouse gas emissions.
- The Kyoto Protocol was an agreement that set up a **cap-and-trade system**, a system that provides a monetary incentive for the countries that reduced their carbon levels. This agreement was not very successful because it did not encourage countries to follow it.

Carbon Taxes

- Some governments have placed **carbon taxes** on their citizens and businesses.
- A carbon tax fines the emissions of carbon dioxide, encouraging energy conservation.
- As an alternative to fossil fuels, people have begun to use **biofuels** to reduce costs.

Carbon Capture and Sequestration

- **Carbon sequestration** is the method of taking carbon dioxide out of the air. This occurs naturally in forests, but can also occur artificially.
    - This carbon dioxide can be stored underground in salt layers or coal seams.
- Scientists are trying to find new ways to counteract global warming.
    - One idea would be sending mirrors into orbit around the Earth, partially blocking sunlight coming to Earth.



Concept Check

- What was the Kyoto Protocol, and why didn't it work?
- What are carbon taxes, and what do they try to combat?
- What does carbon sequestration accomplish?