Introduction to Climate Change

A Changing Climate

Since its formation, Earth's climate has been constantly changing. Many factors have altered the climate, including the Earth's orbit and changing proximity to the sun, as well as the amount of heat-trapping **gases** in the **atmosphere**.

Human societies have evolved during an extended period of favorable climatic conditions. In fact, some researchers believe that a period of favorable climate was the primary factor that allowed the rise of civilization.

Over the past several decades, scientists have collected an increasing amount of data indicating that, for the first time in Earth's history, the activities of one species—*homo sapiens*—are altering the climate. Research shows a significant increase in the **concentration** of heat-trapping gases, especially **carbon dioxide** (CO_2), in the Earth's atmosphere since the beginning of the Industrial Revolution. A rise in global temperatures relates to the rise in carbon dioxide.

There are many complex forces, both natural and man-made, that influence our climate. Should we be concerned if human activities are changing the climate? What effects might a change in climate have on us?

Weather and Climate

Climate and weather are not the same thing; the difference is simply a matter of time. **Weather** describes the conditions in the atmosphere over a short period of time, and is usually described in terms of its effects on human activities. Weather forecasts are focused on temperature, humidity, precipitation, atmospheric pressure, and wind conditions that occur over a time span of days.

Scientists use long-term averages and trends to describe **climate**. Russian Wladimir Köppen developed the most famous climate classification chart in 1884. Using annual and monthly temperatures, precipitation patterns, and native vegetation, Köppen categorized the Earth into five different climate groups. He refined it over his lifetime with the help of German scientist Rudolf Geiger. Their work is often called the Köppen-Geiger Classification System.

Climate Groups

A. **Tropical Moist Climates:** all months have average temperatures above 18° Celsius or 64.4° Fahrenheit.

B. **Dry Climates:** with deficient precipitation during most of the year.

C. **Moist Mid-Latitude Climates with Mild Winters**

D. **Moist Mid-Latitude Climates with Cold Winters**

E. **Polar Climates:** with extremely cold winters and summers.

Climatologists have analyzed multiple sources to put together a history of Earth's climate. By looking at **ice cores**, boreholes, tree rings, glacier lengths, pollen remains, ocean sediments, and by studying Earth's orbit, they have determined that the climate naturally changes over time. There are multiple variables that affect Earth's natural climate patterns.

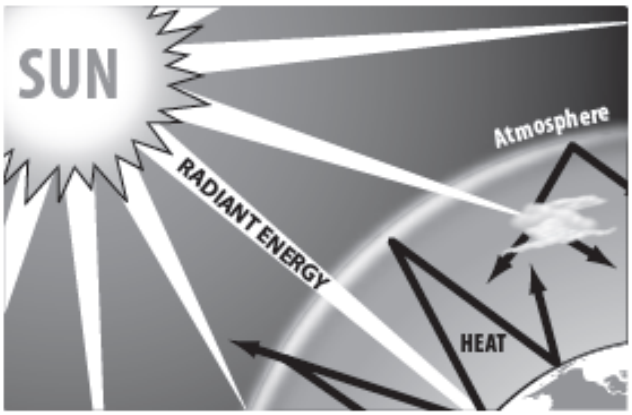
▪ Earth's Reflectivity

The reflectivity of the Earth's surface plays an important role in climate patterns. If you want to stay cooler on a hot, sunny day, you should wear light colors—especially white. We are kept cooler because more of the radiant energy from the sun that strikes us reflects off of lighter clothing. In darker clothing, more energy is transformed to thermal energy. Earth works the same way. Four percent of the sun's radiant energy that strikes Earth is reflected back into space. The amount of reflection that takes place at any given point of the Earth's surface varies widely. A dark surface like a parking lot or a body of water will reflect less than 10 percent of the light, while snow and ice can reflect 90 percent. Earth's atmosphere reflects 26 percent of the incoming radiation. The ability of a surface to reflect light is called its **albedo**.

During the ice ages, there were decreases in solar **radiation**. This allowed more snow to accumulate, and this high albedo surface reflected more solar radiation, keeping the ground and the air cooler. Scientists call this a 'positive feedback loop'. As this loop continued, it allowed snow and ice to accumulate for thousands of years until the **Milankovitch Cycles** increased solar radiation enough to promote warming of the climate.

The Greenhouse Effect

A natural heat-trapping process



Radiant energy (light rays) shines on the Earth. Some radiant energy reaches the atmosphere and is reflected back into space. Some radiant energy is absorbed by the atmosphere and is transformed into heat (dark arrows).

Half of the radiant energy that is directed at Earth passes through the atmosphere and reaches the Earth, where it is transformed into heat.

The Earth absorbs some of this heat.

Most of the heat flows back into the air. The atmosphere traps the heat.

Very little of the heat escapes back into space.

The trapped heat flows back to the Earth.

QUESTIONS FROM ARTICLE

A Changing Climate

1. List two ways that Earth's climate is constantly changing. _____
2. Who do scientist believe is the major cause in altering our climate? _____
3. Identify a heat-trapping gas in our atmosphere. _____
4. What is the relationship between the amount of carbon dioxide in Earth's atmosphere and Earth's temperature?

   _____

Weather and Climate

5. Explain how weather and climate are different.

   _____

6. Köppen categorized the Earth into how many different climate groups? _____
7. How do climatologist create a history of Earth's climate? _____

Earth's Reflectivity

8. From the article, which type of Earth surface would reflect the most sunlight? _____
9. How much sunlight on average is reflected from Earth's atmosphere? _____
10. Define albedo. _____

The Greenhouse effect

11. Summarize the greenhouse effect