

# Climate

## Recent Climate Change

### Key Concepts

- How can human activities affect climate?
- How are predictions for future climate change made?

### Study Coach

**Organize Your Notes**  
Make a table with two columns. As you read, write the main idea about each heading in the left column. List the details that support the main idea in the right column.

### Visual Check

**1. Identify** What 20-year period shows the most change?

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### ..... Before You Read .....

**What do you think?** Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you've read this lesson, reread the statements and see if you have changed your mind.

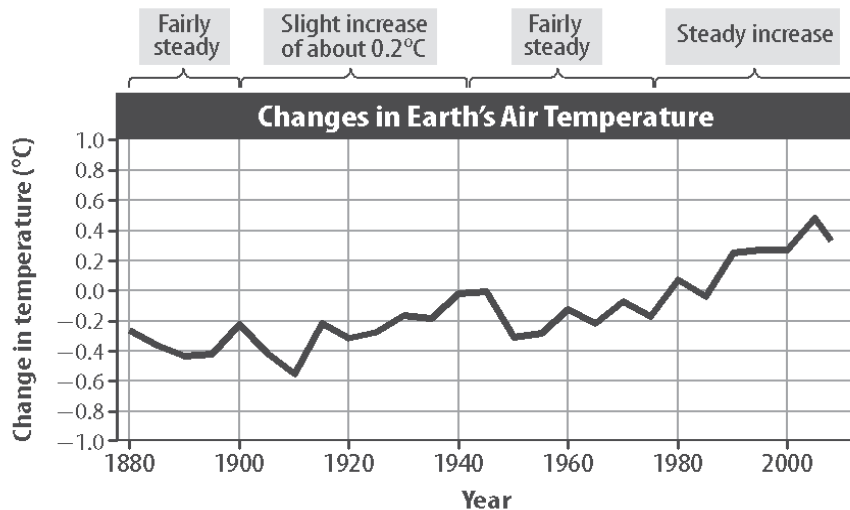
Before	Statement	After
	5. Human activities can impact climate.	
	6. You can help reduce the amount of greenhouse gases released into the atmosphere.	

### ..... Read to Learn .....

## Regional and Global Climate Change

Average temperatures on Earth have been increasing for the past 100 years. The graph below shows that the warming has not been steady.

Since about 1975, global average temperatures have steadily increased. The greatest warming has been in the northern hemisphere. However, temperatures have been steady in some areas of the southern hemisphere. Parts of Antarctica have cooled.



# Human Impact on Climate Change

The rise in Earth's average surface temperature during the past 100 years is often referred to as **global warming**. Scientists have studied the possible causes of global warming. The Intergovernmental Panel on Climate Change (IPCC) is an international organization created to study global warming. In 2007, the IPCC concluded that most of this temperature increase is a result of human activities. These activities include the release of increasing amounts of greenhouse gases into the atmosphere through the burning of fossil fuels and the cutting and burning of forests. Although many scientists agree with the IPCC, some scientists propose that global warming is a result of natural climate cycles.

## Greenhouse Gases

Gases in the atmosphere that absorb Earth's outgoing infrared radiation are **greenhouse gases**. Greenhouse gases help keep temperatures on Earth warm enough for living things to survive. This phenomenon is called the greenhouse effect. Without greenhouse gases, the average temperature on Earth would be much colder, about  $-18^{\circ}\text{C}$ . Carbon dioxide ( $\text{CO}_2$ ), methane, and water vapor are all greenhouse gases. ✓

Levels of  $\text{CO}_2$  in the atmosphere have been increasing for the past 120 years. Higher levels of greenhouse gases create a greater greenhouse effect. Most scientists suggest that global warming is a result of the greater greenhouse effect. What are the sources of excess  $\text{CO}_2$ ?

**Human-Caused Sources** Coal, oil, and natural gases are fossil fuels. Carbon dioxide enters the atmosphere when fossil fuels burn. Burning fossil fuels releases energy that provides electricity, heats homes and buildings, and powers automobiles. ✓

**Deforestation** is the large-scale cutting and/or burning of forests. Forests often are cleared for agricultural and development purposes. Deforestation affects the global climate by increasing carbon dioxide in the atmosphere in two ways. Living trees remove carbon dioxide from the air during photosynthesis. Trees that have been cut down do not. Sometimes, cut trees are burned. As the trees burn, carbon dioxide enters the atmosphere.

**Natural Sources** Carbon dioxide occurs naturally in the atmosphere. Volcanic eruptions and forest fires release carbon dioxide. Cellular respiration in organisms contributes additional  $\text{CO}_2$ .



## Think it Over

**2. Discuss** two possible causes of global warming.

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## ✓ Reading Check

**3. Relate** How do greenhouse gases affect temperatures on Earth?

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## ✓ Reading Check

**4. Name** three fossil fuels.

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**✓ Reading Check**  
**5. Define** aerosols.

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**🔑 Key Concept Check**  
**6. Evaluate** How can human activities affect climate?

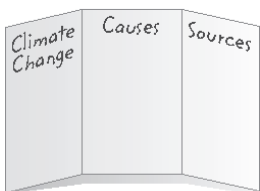
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**FOLDABLES<sup>®</sup>**

Make a tri-fold book and use it to organize your notes about climate change and its possible causes.



## Aerosols

The burning of fossil fuels also releases aerosols into the atmosphere. Aerosols are tiny liquid or solid particles. They reflect sunlight back into space. This prevents some of the Sun's energy from reaching Earth. Aerosols can cool the climate over time. ✓

Clouds that form in areas with large amounts of aerosols have smaller cloud droplets. Clouds with small droplets reflect more sunlight than clouds with larger droplets. Clouds with small droplets prevent sunlight from reaching Earth's surface, helping to cool the climate. ✓

## Climate and Society

A changing climate can present serious problems for society. Heat waves and droughts can cause food and water shortages. Too much rainfall can cause flooding and mudslides.

Climate change can also benefit society. Warmer temperatures can mean longer growing seasons. Food crops can grow in areas that were previously too cold. Governments around the world are responding to the problems and opportunities created by climate change.

## Environmental Impacts of Climate Change

Recall that ENSO cycles can change the amount of precipitation in some areas. Warmer ocean surface temperatures can cause more water to evaporate from the ocean surface. The increased water vapor in the atmosphere can result in heavy rainfall and frequent storms in North and South America. Increased precipitation in these areas can lead to decreased precipitation in other areas, such as parts of southern Africa, the Mediterranean, and southern Asia.

Increasing temperatures can also affect the environment in other ways. As glaciers and polar ice sheets melt, the sea level rises.

Ecosystems can be disturbed as coastal areas flood. Coastal flooding is a serious concern for the people living in low-lying areas on Earth.

Extreme weather events are becoming more common. What effects will heat waves, droughts, and heavy rainfall have on infectious disease, existing plants and animals, and other systems of nature? Will increased CO<sub>2</sub> levels have the same effects?

Permanently higher temperatures can have worldwide effects. Previously frozen soils are beginning to thaw and then refreeze. Other ecosystem changes can affect the migration patterns of insects, birds, fish, and mammals.

## Predicting Climate Change

Weather forecasts help people make daily choices about their clothing and activities. In a similar way, climate forecasts help governments plan how to respond to future climate changes.

A **global climate model**, or *GCM*, is a set of complex equations used to predict future climates. While weather forecasts are short-term and regional, GCMs are long-term and global. GCMs use mathematics and physics to predict temperatures, amounts of precipitation, wind speeds, and other characteristics of climates. Supercomputers solve the mathematical equations and display the results as maps. ✓

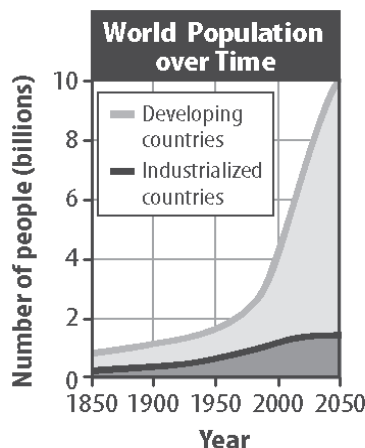
**GCMs Predictions** The forecasts and predictions given by GCMs cannot be immediately compared to real data. This is a drawback of GCMs. Weather forecasters can compare their model's predictions with the actual weather results. Then they can adjust their models to be more accurate. GCMs predict climate conditions for several decades into the future. For this reason, the accuracy of climate models is not yet known.

**GCMs and Global Warming** Most GCMs predict further global warming as a result of greenhouse gas emissions. By the year 2100, temperatures are expected to rise between 1°C and 4°C. Polar regions are expected to warm more than the tropics. Summer arctic sea ice is predicted to disappear by the end of the twenty-first century. Global warming and the rise in sea level are expected to continue for several centuries. ✓

### Human Population

In 2000, more than 6 billion people lived on Earth. The graph shows that Earth's population is expected to increase to 9 billion by the year 2050.

By the year 2030, it is likely that two of every three people on Earth will live in urban areas. Many of these areas will be in developing countries in Africa and Asia. Large areas of forests are already being cleared for expanding cities. More greenhouse gases and other air pollutants will be added to the atmosphere.



### Reading Check

7. Explain what a GCM is.

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### Key Concept Check

8. Describe How are predictions for future climate change made?

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### Visual Check

9. Analyze Where is the greatest increase in population expected?

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## Math Skills

If Earth's population increases from 6 billion to 9 billion, what percent is the increase?

**a.** Subtract the initial value from the final value:

$$9 \text{ billion} - 6 \text{ billion} = 3 \text{ billion}$$

**b.** Divide the difference by the starting value:

$$\frac{3}{6} = 0.50$$

**c.** Multiply by 100 and add a percent sign:

$$0.50 \times 100 = 50\%$$

**10. Use Percents** If a climate's mean temperature changes from 18.2°C to 18.6°C, what is the percentage of increase?

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## Think it Over

**11. Explain** what changes you could make to reduce greenhouse gases.

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## Visual Check

**12. Estimate**, using the chart, the average number of watts per hour you use when you study.

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## Ways to Reduce Greenhouse Gases

There are many ways to reduce levels of pollution and greenhouse gases. People are developing alternative sources of energy that do not release carbon dioxide into the atmosphere. Solar energy and wind energy are two alternatives. Hybrid vehicles reduce greenhouse gas emissions because they use electric motors part of the time. This reduces the amount of fuel that is used.

**Green Building** Emissions of greenhouse gases can be reduced by green building. Green building is the practice of creating energy-efficient buildings. Planting trees in deforested areas is another example of a green activity that helps remove carbon dioxide from the atmosphere.

**Conservation and Recycling** You can help control greenhouse gases and pollution by conserving fuel and recycling. The table below shows the average number of watts of electricity used by common household appliances. Turning off lights and electronic equipment that you are not using reduces the amount of electricity you use. Recycling metal, paper, plastic, and glass reduces the amount of fuel required to manufacture these materials.

Average Amount of Electricity Used by Common Household Appliances			
Appliance	Average Electricity Used per Hour	Appliance	Average Electricity Used per Hour
Standard lightbulb	100	Oven	1,300
Stereo	100	Air conditioner	1,500
Television	230	Hair dryer	1,500
Washing machine	250	Microwave	1,500
Vacuum cleaner	750	Clothes dryer	4,000
Dishwasher	1,000	Freezer	5,100
Toaster	1,200	Refrigerator/freezer	6,000

..... **After You Read** .....

**Mini Glossary**

**deforestation:** the large-scale cutting and/or burning of forests

**global climate model (GCM):** a set of complex equations used to predict future climates

**global warming:** the rise in Earth's average surface temperature during the past 100 years

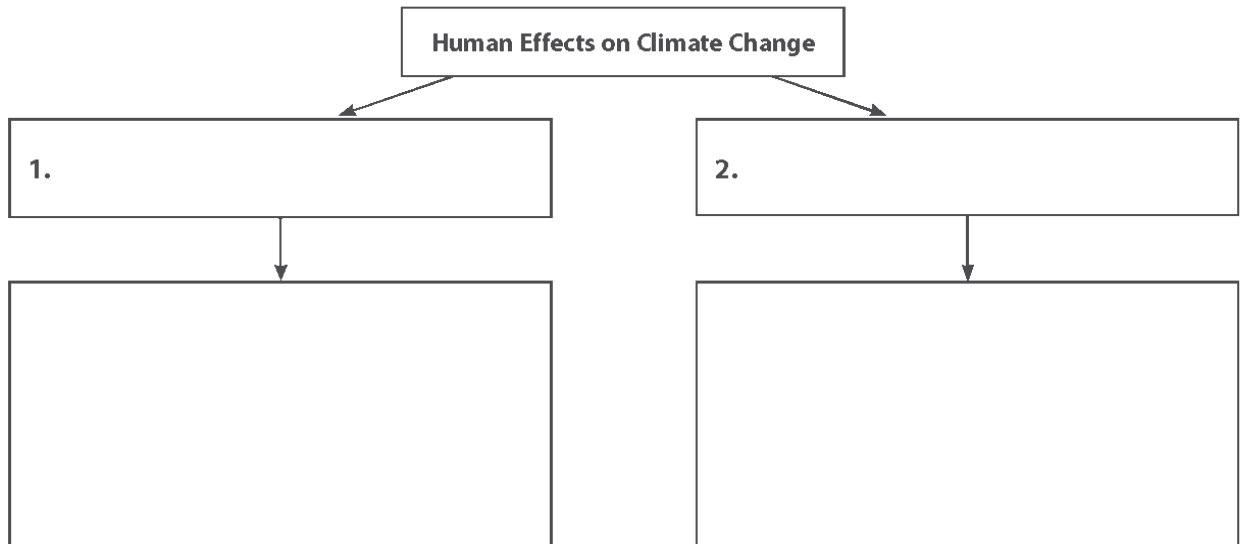
**greenhouse gas:** a gas in Earth's atmosphere that absorbs Earth's outgoing infrared radiation

1. Review the terms and their definitions in the Mini Glossary. Describe the connection between greenhouse gases and global warming.

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2. Fill in the chart below to identify two ways that humans bring about changes in climate. Then describe actions that humans can take to limit the changes.



3. How did organizing your notes into two columns help you understand recent changes in climate?

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**What do you think NOW?**

Reread the statements at the beginning of the lesson. Fill in the After column with an A if you agree with the statement or a D if you disagree. Did you change your mind?



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**END OF LESSON**