Greenhouse Effect

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CHAPTER 1

Greenhouse Effect

- Describe the greenhouse effect.
- Explain how human actions contribute to the greenhouse effect.

How does the atmosphere resemble a greenhouse?

To extend the growing season, many farmers use greenhouses. A greenhouse traps heat so that days that might be too cool for a growing plant can be made to be just right. Similar to a greenhouse, greenhouse gases in the atmosphere keep Earth warm.

The Greenhouse Effect

The exception to Earth’s temperature being in balance is caused by greenhouse gases. But first the role of greenhouse gases in the atmosphere must be explained.

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. Like a blanket on a sleeping person, greenhouse gases act as insulation for the planet. The warming of the atmosphere because of insulation by greenhouse gases is called the greenhouse effect (Figure 1.1). Greenhouse gases are the component of the atmosphere that moderate Earth’s temperatures.

Greenhouse Gases

Greenhouse gases include CO₂, H₂O, methane, O₃, nitrous oxides (NO and NO₂), and chlorofluorocarbons (CFCs). All are a normal part of the atmosphere except CFCs. Table 1.1 shows how each greenhouse gas naturally enters the atmosphere.

<table>
<thead>
<tr>
<th>Greenhouse Gas</th>
<th>Where It Comes From</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>Respiration, volcanic eruptions, decomposition of plant material; burning of fossil fuels</td>
</tr>
<tr>
<td>Methane</td>
<td>Decomposition of plant material under some conditions, biochemical reactions in stomachs</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Produced by bacteria</td>
</tr>
<tr>
<td>Ozone</td>
<td>Atmospheric processes</td>
</tr>
<tr>
<td>Chlorofluorocarbons</td>
<td>Not naturally occurring; made by humans</td>
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</tbody>
</table>
Different greenhouse gases have different abilities to trap heat. For example, one methane molecule traps 23 times as much heat as one CO$_2$ molecule. One CFC-12 molecule (a type of CFC) traps 10,600 times as much heat as one CO$_2$. Still, CO$_2$ is a very important greenhouse gas because it is much more abundant in the atmosphere.

**Human Activity and Greenhouse Gas Levels**

Human activity has significantly raised the levels of many of greenhouse gases in the atmosphere. Methane levels are about 2 1/2 times higher as a result of human activity. Carbon dioxide has increased more than 35%. CFCs have only recently existed.

What do you think happens as atmospheric greenhouse gas levels increase? More greenhouse gases trap more heat and warm the atmosphere. The increase or decrease of greenhouse gases in the atmosphere affect climate and weather the world over.

**Summary**

- Greenhouse gases include CO$_2$, H$_2$O, methane, O$_3$, nitrous oxides (NO and NO$_2$), and chlorofluorocarbons (CFCs).
- Tropospheric greenhouse gases trap heat in the atmosphere; greenhouse gases vary in their heat-trapping abilities.
Levels of greenhouse gases in the atmosphere are increasing due to human activities.

**Review**

1. 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 and why?
2. What is the greenhouse effect?
3. How does Earth’s atmosphere resemble a greenhouse?

**Explore More**

Use this resource to answer the questions that follow.

![Video](https://www.ck12.org/flx/render/embeddedobject/160869)

1. What would the temperature of the surface be if the Earth did not have an atmosphere?
2. What does it mean to say that Earth is in radiative equilibrium?
3. What happens to the radiation emitted by Earth into space?
4. What are the most common greenhouse gases?
5. How do greenhouse gases react to incoming solar radiation and outgoing heat?
6. What do greenhouse gases do with the radiation they absorb? What happens to that?
7. What is greenhouse effect?
8. What happens to the surface of the Earth when there is an increase in greenhouse gases?

**Resources**

![Image](https://www.ck12.org/flx/render/embeddedobject/178121)

**References**

1. Jodi So. *Diagram of Earth’s heat budget*. CC BY-NC 3.0