



Let's Make Molecules

Create your own greenhouse gas models!

Activity Guide

Description: Visitors will use gumdrops and toothpicks to model three greenhouse gases: carbon dioxide (CO₂), water vapor (H₂O) and methane (CH₄)

Audience: Hands-on activity for families and kids ages 5 and up

Length: 10-15 minutes

Learning Objective

Visitors will learn the composition and molecular structure of three greenhouse gas molecules. They will explore of how greenhouse gases are released into the atmosphere and the resulting contribution to global climate change.

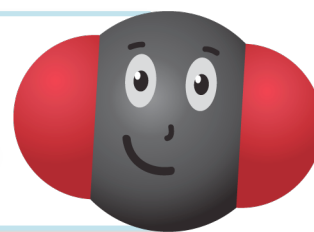
Climate Connection

Carbon dioxide (CO₂) is the byproduct of burning carbon-based fossil fuels such as coal and oil. Once we use the heat from these energy sources, large amounts of carbon are released into the atmosphere; this carbon combines (bonds) with oxygen atoms to create carbon dioxide. As a result of our dependence on carbon based fossil fuels we have seen a significant increase in the amount of atmospheric carbon dioxide in the past hundred years. This increase in CO₂ is the primary cause of global warming and climate change.

Our atmosphere is composed of primarily nitrogen and oxygen with small amounts of greenhouse gases. Although carbon dioxide is the most common contributor to climate change, water vapor (H₂O) and methane (CH₄) are also important greenhouse gases. Greenhouse gases absorb and reflect back infrared energy, thus trapping heat within the Earth's atmosphere.

Did you know?

Greenhouse gases help regulate the temperature of the Earth; without them it would be too cold for humans!

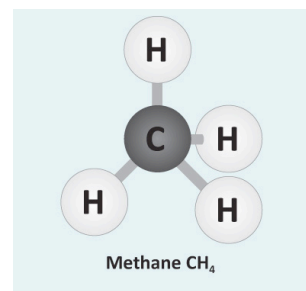
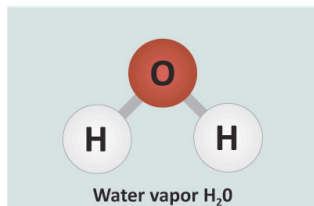
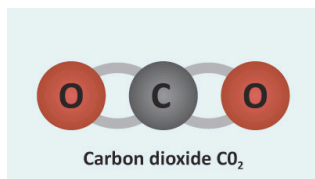


Materials

- Gumdrops (per group or person)
 - 3 red gumdrops (oxygen)
 - 6 green gumdrops (hydrogen)
 - 2 black or purple gumdrops (carbon)
- 5 toothpicks broken in half (per group or person; the models are more accurate if the toothpicks are broken in half to represent the bonds between atoms)
- 5 small bowls

Set up

- Pre-sort the gumdrops according to color and place each color in an individual bowl.
- Pre-cut toothpicks in half and place them in a separate bowl (the extra bowl is used to discard used gumdrops and toothpicks).
- Prepare models of each molecule as an example for visitors.



Program Delivery

What are greenhouse gases?

Most greenhouse gas molecules are comprised of three or more atoms and have the ability to absorb and reflect infrared (heat) energy. By contrast, molecules that are comprised of the same two atoms each, such as molecular oxygen (O_2) or molecular hydrogen (H_2), do not absorb infrared energy and are not greenhouse gases. Carbon dioxide is the most common greenhouse gas; water vapor (H_2O) and methane (CH_4) are also important contributors to the global Earth's temperature.

How is CO_2 formed?

When we burn carbon-based fossil fuels such as coal and oil, large amounts of carbon are released into the atmosphere. This carbon combines (bonds) with oxygen atoms to create carbon dioxide (CO_2). In the past hundred years we have seen a significant increase in the amount of atmospheric carbon dioxide, and scientists believe the increase in CO_2 is the primary cause of global warming and climate change.

[Have visitors start building the carbon dioxide molecule, and then proceed with the rest of the molecules. To correctly build the molecules, visitors may use the example model or the pictures on the background sheet.]

What does the structure of greenhouse gases look like?

In carbon dioxide, the oxygen atoms are double bonded to the carbon atom in the center. [Visitors will use two toothpicks on each side to connect the atoms. They should form a straight line.]

In water vapor, the two hydrogen atoms are bonded to the red oxygen atom. [Visitors will use one toothpick on each side of the oxygen atom to connect the atoms. They are not in a straight line but come out in an angle.]

In methane, the four hydrogen atoms are bonded to the carbon atom. [Visitors will use one toothpick each to connect the atoms. The atoms should be as far apart from each other as possible.]

Extension: Human methane model!

[If visitors are having a hard time visualizing the arrangement of atoms in methane, ask them to imagine that their body is the carbon atom, and their hands and feet represent the hydrogen atoms. Tell visitors that the hydrogen atoms want to be as far apart as possible. How do you stand so your hands and feet are as far apart as possible? The answer is one hand over your head in front of you and one hand over your head back of you and your feet spread apart to the left and right. This forms the corners of a tetrahedron.]



BJ is illustrating how to be a human methane model

Discussion Questions:

- How do greenhouse gases make the Earth warmer?
- What things in your home produce or contribute to producing greenhouse gases?
- What are ways of reducing greenhouse gases in our atmosphere?

Credits

This project is made possible by a grant from the U.S. Institute of Museum and Library Services
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