Greenhouse effect

Activity

The Science

Unlike many other planets in the universe, Earth has an atmosphere surrounding it, shielding us from space. It is made up of gases such as nitrogen, oxygen, and carbon dioxide which contribute to lots of different reactions. One very significant process is called the Greenhouse Effect. This is how our atmosphere traps heat, which increases the surface temperature and allows the Earth to develop and sustain life. It is often compared to a thick blanket covering the surface and keeping us warm. In this analogy, different gases can be thought of as different fabrics, with some gases being more effective at trapping in the heat. We call the most effective ones Greenhouse Gases. With not enough or too much of one, our whole planet could look very different.

Two particularly important greenhouse gases are water vapour and carbon dioxide. The first occurs as a part of the water cycle, when water evaporates from rivers, lakes and the sea. The second comes from a variety of processes such as photosynthesis or the burning of fossil fuels, which is impacted by human activity.

In this experiment, we will explore three different scenarios: no atmosphere, a thin atmosphere with water vapour, and a thin atmosphere with water vapour and carbon dioxide.

Time

Around an hour

Materials

- Lots of ice cubes
- 3 plastic 2 litre bottles (big glass jars would also work well)
- Scissors
- A big lamp if it’s a cloudy day
- Cling film
- Vinegar
- Teaspoon
- Baking soda/ bicarbonate of soda
- 3 smaller plastic cups that fit inside the bottles/jars
- Marker pen
- Stopwatch

Instructions

1. Cut each 2 litre bottle in half and discard the top section. Label each one of your bottles A, B, and C.

Bottle A represents the Earth with no atmosphere, so we'll leave it uncovered
Bottle B represents the Earth with a thin atmosphere with a bit of water vapour
Bottle C represents the Earth with an atmosphere, water vapour, and carbon dioxide

2. Add a big scoop of ice into each bottle. The more ice, the more noticeable the effect will be.
3. Add 3 teaspoons of baking soda into one plastic cup and place this inside Bottle C. Place the other two empty cups in Bottle A and B.
4. Cover the top of Bottle B in cling film. Make sure it's tightly stuck down to the sides and don't be afraid to go back in there and adjust.
5. This step will require you to be quick! Ask someone to help if you need it. Pour the vinegar into the plastic cup in Bottle C, and it react with the baking soda. The combination will foam and quickly rise up to the top of the cup, producing carbon dioxide. Stop pouring when this happens and make sure it doesn't overflow out of the plastic cup. Quickly cover the bottle with cling film as in Step 4.
6. If it's a sunny day place all three bottles in the sunlight, otherwise you can use a big lamp to represent the heat from the sun. You want them all to be evenly exposed.
7. Monitor how much of the ice has melted in each case by marking the rising water level every 15 minutes for up to an hour.

Things to think about

While you observe your experiment, try to consider what factors affect the temperature inside the bottle. Try to answer the following questions:

- Which set of ice cubes do you think will melt the fastest?
- What is the effect of the cling film?
- What is the effect of the carbon dioxide?
- How could you stop sunlight getting in, and what could that be in our daily weather?
- What extra processes inside the bottle could make it hotter or colder?
- What improvements or additional experiments could you do? What is the point of the plastic cup in Bottle A and B?
- How could you represent clouds?
- Does Bottle A really have no atmosphere?

Tips

If you have a thermometer this can be a more accurate way to test the Greenhouse Effect seen in each bottle. Just measure the temperature inside each bottle.

Caution

The reaction between vinegar and baking soda is very fast! Be careful not to put too much into your cup too quickly as it may overflow and impact your experiment.

Make sure to get an adult to help you cut the 2 litre bottles in half!