Greenhouse Thermo-meter

Science Film Festival Knowledge Through Entertainment

KEY OBJECTIVES

Gain insights into the greenhouse effect

INTRODUCTION

Global warming – primarily driven by an enhanced greenhouse effect – is causing greater extreme weather events and other climate based disasters, and disruptions to ecosystems. The greenhouse effect – driven primarily by emissions of carbon dioxide and methane - from burning fossil fuels, natural gas extraction and intensive livestock production – is the major driver of global warming. This activity allows students to gain some insights into the greenhouse effect, and see that it operates at the human scale as well as globally.

KEYWORDS

Greenhouse effect | carbon dioxide | methane | fossil fuels | extreme weather | emissions | ecosystems | global warming

LEVEL

Primary & Secondary School

TIME FOR ACTIVITY

15–25 min

GUIDING QUESTIONS

How do you make your own thermometer? ?

What effect does placing a black bag over the thermometer have? ?

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MATERIALS & PREPARATION

- **Several plastic bottles – preferably ones used for carbonated (fizzy) soft-drinks – of the same size and with good fitting lids**
- **Plastic straws**
- **Water and food coloring**
- **Glue, wax or modeling clay**
- **Scissors, drill or awl to safely put a hole in the lid of the bottles**
- **A black plastic bin liner bag**

TASKS & PROCEDURE

Stage 1

1. Carefully put a small hole in the center of the bottle lids. The hole should be just big enough for the straw to be pushed through.
2. Move the lid to the middle of the straw. And seal the straw in place either with some glue, or by pressing some modeling clay around it. Don't crush the straw, and don't get any material on the threads of the lid.
3. Fill the bottles with water (add food dye if available to help see the water levels) so that the bottom of the straw - when the lid is replaced - is under about 2 cm of water. Try to have all the bottles, straw lengths and water levels as similar as possible.
4. Once the bottles are filled, carefully replace the lids and screw firmly shut - but try not to squeeze the sides of the bottles. Let them stand for a minute or two.
5. Then try gently resting your hands on the bottles near the top where there is an air space. Watch what happens to the level of water in the bottle and the straw. Take your hands off, what happens next.

We have made an effective and sensitive thermometer. As the air in the bottle warms it expands, as the bottle is sealed, the air pushes down on the water, pushing the water up the straw. The warmer the air, the higher the water goes.

Stage 2

1. Assemble two thermometers and let them stand in the same space to equalize their temperatures.
2. Take the large thin black plastic bin liner, and put a small hole in the bottom of the bag. When you see that both thermometers are not changing the level in their straws, carefully carry them out into some full sunlight (or if not available place them near a bright incandescent light, but make sure the thermometers are equally well illuminated).
3. Quickly place the black bag over one of the thermometers, and poke the top of the straw out through the bag. Stand back and observe.

You will most likely see the water level of the thermometer with the bag rise much faster than the other, coming up and out of the bottle, the water may even reach the top of the straw.

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POSSIBLE EXTENSIONS

The thin black plastic used in many bin liner bags may seem dark and opaque. Yet it is very transparent to infrared light. This means it creates a very strong greenhouse effect around the bottle - just as greenhouse gasses do around our planet. You can proof that the bag is transparent to infrared light by using a TV remote to turn on a TV through the black plastic bag.

The black plastic absorbs much of the visible light, heating up, and warming the air within it. But it also allows the infrared light to enter the bottle and also be absorbed. By trapping the air around the bottle the heat is held in, leading to that thermometer rising in temperature much faster than the one exposed directly to the sunlight.

SOURCES

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