**ACTIVITY: Greenhouse simulation**

**Activity idea**

In this activity, students use a plastic soda bottle to make and test the temperature of a bottle ‘greenhouse’ and demonstrate how light energy is transformed into heat energy.

By the end of this activity, students should be able to:

* demonstrate how light energy is transformed into heat energy
* discuss how this activity is an example of the law of energy conservation.

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**Introduction/background**

If you have ever been inside a greenhouse, you will know that the temperature inside is warmer than the temperature outside. The law of energy conservation states that energy cannot be created, so how is this heat made?

In this experiment, students make their own small greenhouse using a soda bottle and record the temperature inside and outside the bottle. The temperature should be hotter inside the bottle than outside. The plastic bottle is similar to a greenhouse. The transparent plastic lets light (infrared and visible light) pass through the bottle, and the light energy is transformed into heat energy. You will be familiar with this effect from experiencing the heat in the direct sunshine in contrast to standing in the shade. The sealed bottle won’t let the heat escape.

Gases in our atmosphere act in a similar way to the plastic of the bottle or the glass of a greenhouse. They let the light in, but once the light energy is converted into heat energy, it is trapped by those gases because they are poor conductors of heat. This is why they are called the greenhouse gases. These gases include methane, carbon dioxide and water vapour.

**What you need**

* Clear plastic soda bottle with a lid
* Blu-Tack
* Two thermometers

**What to do**

1. Have students set up the experiment:

* Use the Blu-Tack to attach the top end of one thermometer to the inside of the lid.
* Insert the thermometer into the bottle.
* Carefully screw the lid with the thermometer onto the bottle.
* Place the bottle and the other thermometer in a sunny location.

1. Ask students to record the initial temperatures on each thermometer and continue recording the temperatures every minute for 10 minutes or until a constant temperature is reached (no change in temperature for 3 minutes).

**Discussion questions**

1. Which thermometer had the greatest change in temperature and why?
2. Which thermometer showed the fastest increase in temperature and why?

**Extension idea**

Discuss in what way the atmospheres of Mars and Venus are different to Earth’s atmosphere in trapping and transforming the Sun’s light energy.

* **The Earth’s atmosphere** – The atmospheric gases shield the Earth’s surface from harmful ultraviolet radiation and insulate the Earth. The average surface temperature is 15°C (maximum 51°C in Libya and minimum -89°C in Antarctica).
* **The Martian atmosphere** – The atmosphere is 95% carbon dioxide but is too thin to protect or insulate the surface of Mars significantly. The atmospheric pressure is too low, so water on the surface quickly boils away. The average surface temperature is -63°C.
* **The Venetian atmosphere** – Venus has a thick carbon dioxide atmosphere that traps heat efficiently. The average surface temperature is 464°C. Venus’s atmosphere consists of 97% carbon dioxide, and the atmospheric pressure is 92 times that of the Earth’s.

For more information about the greenhouse effect on Earth in comparison to that on Venus and Mars, see [www.ucar.edu/learn/1\_3\_1.htm](http://www.ucar.edu/learn/1_3_1.htm).