THE GREENHOUSE EFFECT – BUILD A GREENHOUSE

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Key Learning Objectives:

1. Conduct investigations safely, competently, and methodically for the collection of valid and reliable data (ACSES003).
2. Represent data in meaningful and useful ways; organise and analyse data to identify trends, patterns and relationships; qualitatively describe sources of measurement error, and uncertainty and limitations in data; and select, synthesise and use evidence to make and justify conclusions (ACSES033).
3. Understand that most of the thermal radiation emitted from Earth's surface passes back out into space but some is reflected or scattered by greenhouse gases back toward Earth; this additional surface warming produces a phenomenon known as the greenhouse effect (ACSES049).

*SEQ Figure * ARABIC 1: Greenhouse Gases*

https://bit.ly/meriSTEMgreenhousegases

Energy from the sun is radiated down to earth as shortwave visible radiation (light). When it is reflected back off the surface of the Earth, however, it is re-emitted as longwave infrared radiation (heat). Greenhouse gases (such as carbon dioxide, water vapour, nitrous oxide, and methane) in the atmosphere will trap some of this outgoing infrared radiation. This heat energy is then re-emitted down to the surface of the Earth. As more of these greenhouse gases enter our atmosphere, the amount of heat being re-emitted onto the Earth's surface increases.

Since the industrial revolution, carbon dioxide levels have increased by roughly 100 parts per million; alongside this, the average global temperature has increased by over 1°C. In this experiment, we will be testing the greenhouse effect, and comparing how CO_2 and water vapour impact air temperatures.

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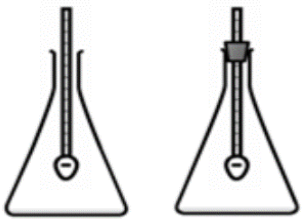
PART 1 – Open and Closed Systems

Materials:

1x rubber bung with hole
2x 250ml conical flasks
2x thermometers
Heat lamp or sunny environment

Method:

1. Stopper a conical flask with a bung and thermometer. You should label this flask "greenhouse".
2. In a second conical flask, suspend a thermometer without a bung – this can be done using a rubber band and a boiling stick, a thermometer clamp, or a piece of string attached to an elevated piece of equipment. You should label this flask "open".



Open

Greenhouse

3. Place each of the flasks on a dark surface and position in front of a heat lamp, or in direct sunlight.
4. Record the initial temperature of each flask, start a timer, and record again every minute for 20 minutes.

Aim:

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Hypothesis:

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Risks and Precautions:

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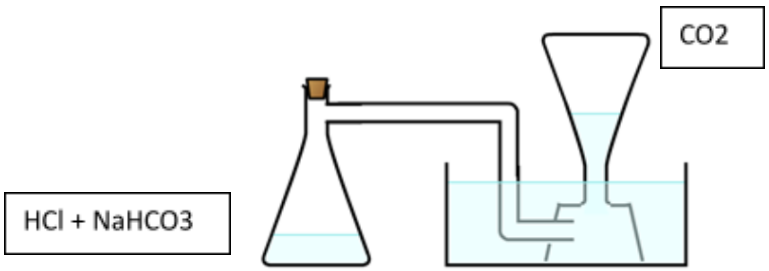
PART 2 – Water Vapour vs. CO2

Materials:

0.1M Hydrochloric acid (vinegar can also be used) 2x rubber bungs with holes
Sodium bicarbonate 2x thermometers
3x 250mL conical flasks Heat lamp or sunny environment

Method:

1. Set up CO2 collection apparatus as seen below:



2. In the conical flask sitting upright, add 20g of sodium bicarbonate followed by 45mL of 0.1M HCl or vinegar. Quickly stopper the conical flask with the bung connected to the delivery tube and wait until the water in the receiving conical flask has been displaced by CO2 generated from the reaction.
3. Once the CO2 has been generated, remove, and cap the conical flask containing the CO2 with a bung and thermometer. You should label this flask "CO2".
4. In a second conical flask, add 100ml of room temperature water. Stopper this flask with a thermometer and bung and label "water vapour"



Water Vapour CO2

5. Place each of the flasks on a dark surface and position in front of a heat lamp, or in direct sunlight. Each of the conical flasks should receive the same amount of heat/light.

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6. Record the initial temperature of each flask, start a timer, and record again every minute for 20 minutes.

Aim:

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Hypothesis:

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Risks and Precautions:

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Results:

Select an appropriate method to represent your data. In the box below record your results for part 1 and 2.

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Compare the “open” and “greenhouse” flasks. What does this tell us about the effect of having a “thick” atmosphere?

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Compare the “greenhouse” flask in part 1 to your results in part 2. What do your results tell you about the effect of different greenhouse gases on warming?

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Are there any anomalies in your data? Can you identify any potential sources of error?

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