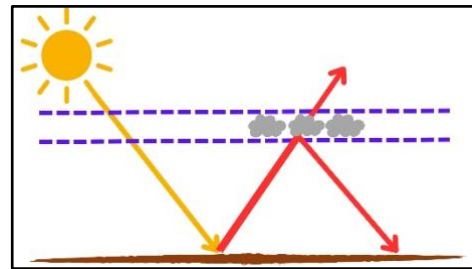




Read the text box.

### Text box: The natural greenhouse effect

The greenhouse effect is a **natural process**. This means that it happens on its own. The greenhouse effect helps to keep the Earth warm. It works like this:



- (1) The **sun** shines on the Earth. The **sun's rays** penetrate something we call **the atmosphere**. The atmosphere is the Earth's gas envelope.
- (2) The sun's rays hit the matter on our Earth. Matter is everything you can see, touch or measure. Examples of matter are the **ground**, plants, houses, but also **gases**.
- (3) The matter absorbs the sun's rays. Some of the sun's rays are reflected back as heat radiation. This heat radiation is called **infrared radiation**.
- (4) The infrared radiation hits the atmosphere again. Some gases in the atmosphere reflect these heat rays back to Earth. These **greenhouse gases** include water vapour (water in the air), carbon dioxide (CO<sub>2</sub>) and methane.
- (5) This keeps the heat on Earth, similar to how a greenhouse keeps heat for plants. Without the natural greenhouse effect, the average temperature on Earth would be -18 °C. That would be very cold.

### The man-made (anthropogenic) greenhouse effect

The greenhouse effect is exacerbated by humans. For example, humans burn coal, oil and gas to obtain energy. This produces the **gas CO<sub>2</sub>**. More CO<sub>2</sub> in the atmosphere means that more heat is "reflected" back to Earth. This is why climate change exists.

## EXPERIMENT



### The greenhouse gas carbon dioxide (CO<sub>2</sub>)

#### Research question:

What influence does the greenhouse gas carbon dioxide have on air temperature?

#### Your assumption (hypothesis):

---

---

---

---

#### Materials:

- ☐ 2 kitchen thermometers
- ☐ 1 small plastic bottle: still water
- ☐ 1 small plastic bottle: sparkling water
- ☐ 1 teaspoon
- ☐ salt
- ☐ funnel
- ☐ lamp
- ☐ ruler
- ☐ clock (mobile phone or iPad)

#### Experiment procedure:

1. Insert a kitchen thermometer into the hole in the lid of the small plastic bottle containing *still water*.  
Switch on the thermometer.
2. Insert a kitchen thermometer into the hole in the lid of the small plastic bottle containing *sparkling water*.  
Switch on the thermometer.

3. Open the small plastic bottles (leave the thermometer in the lid).  
Use the funnel to pour a teaspoon of salt into both water bottles.  
Quickly screw the lids back on.
  
4. Place both plastic bottles side by side at a distance of 15 cm in front of the heat lamp.  
Wait until both thermometers show approximately the same temperature – differences of up to one degree are acceptable. Record the air temperature in the bottle with *still water* and the bottle with *sparkling water* in the table (**measurement 1**).
  
5. Switch on the lamp. Now take three measurements in a total of 10 minutes:  
Record the temperatures after 1 minute in the table (**measurement 2**).  
Record the temperatures after 5 minutes (**measurement 3**).  
Record the temperatures after 10 minutes (**measurement 4**).  
Use the QR codes on the table while you wait – but don't forget the time!

Table: Measurements

|                 | Temperature in °C<br>(measurement 1) | Temperature in °C<br>after 1 minute<br>(measurement 2) | Temperature in °C<br>after 5 minutes<br>(measurement 3) | Temperature in °C<br>after 10 minutes<br>(measurement 4) |
|-----------------|--------------------------------------|--------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|
| Still water     |                                      |                                                        |                                                         |                                                          |
| Sparkling water |                                      |                                                        |                                                         |                                                          |

Describe the test results. Summarise your results from the table.

---



---



---



---



---

### Experiment evaluation:

1. Explain the results. You can use the text box: The natural greenhouse effect. Our question was: What influence does the greenhouse gas carbon dioxide have on air temperature?
2. Why did we measure the temperature in two different bottles (one bottle with still water and one bottle with sparkling water)? Explain.

---

---

---

---

---

---

---

### Conclusion:

Compare the results with your assumption (hypothesis).

Tick the box:

- ☐ The hypothesis is correct
- ☐ The hypothesis is incorrect
- ☐ The hypothesis is partly correct