



Co-funded by
the European Union

Steam4Climate Student Activity Worksheet

*Project Activity Booklet “Zero”:
CO₂ Chamber to illustrate the greenhouse effect*

Creator(s): Thomas Joerg (Kepler-Gymnasium Pforzheim)



Table of Contents

Inhalt

Table of Contents.....	2
About This Booklet	3
 Experiment CO ₂ and the Greenhouse Effect	5
 Materials List	6
 Setup Instructions.....	7
 Procedure.....	8
 Expected Observations.....	9
 Conclusion and Learning Objective	10
What should students learn from this?	10
Note for teachers:	10
Worksheet: CO ₂ and the Greenhouse Effect	11

About This Booklet

Welcome to the STEAM4Climate Student Activity Worksheet on Climate Change and Wet Bulb Temperature, an educational resource designed to complement the STEAM4Climate Teacher's Guide Booklet one. Developed as part of the Erasmus+ STEAM4Climate project, the booklet introduces the concept of wet bulb temperature, its effect on the human body, and its relevance in our warming climate. Students will conduct hands-on experiments to explore how heat and humidity impact thermoregulation. To explore the full collection of student worksheets and related teacher guides, visit [Steam4climate Website](#)

It is designed to guide you through hands-on activities and experiments that explore the impacts of extreme heat and humidity. It includes step-by-step instructions, discussion prompts, and real-world case studies to help deepen your understanding of climate-related challenges.

- ◇ Work through the activities in order to build on key concepts.
- ◇ Record your observations and reflections in a notepad.
- ◇ Engage in group discussions to explore solutions and share ideas.
- ◇ Use the additional exploration prompts to expand your learning beyond the classroom.

By actively participating in these activities, you will develop problem-solving skills, scientific thinking, and an awareness of how climate change affects human health and the environment. Get ready to experiment, explore, and innovate!

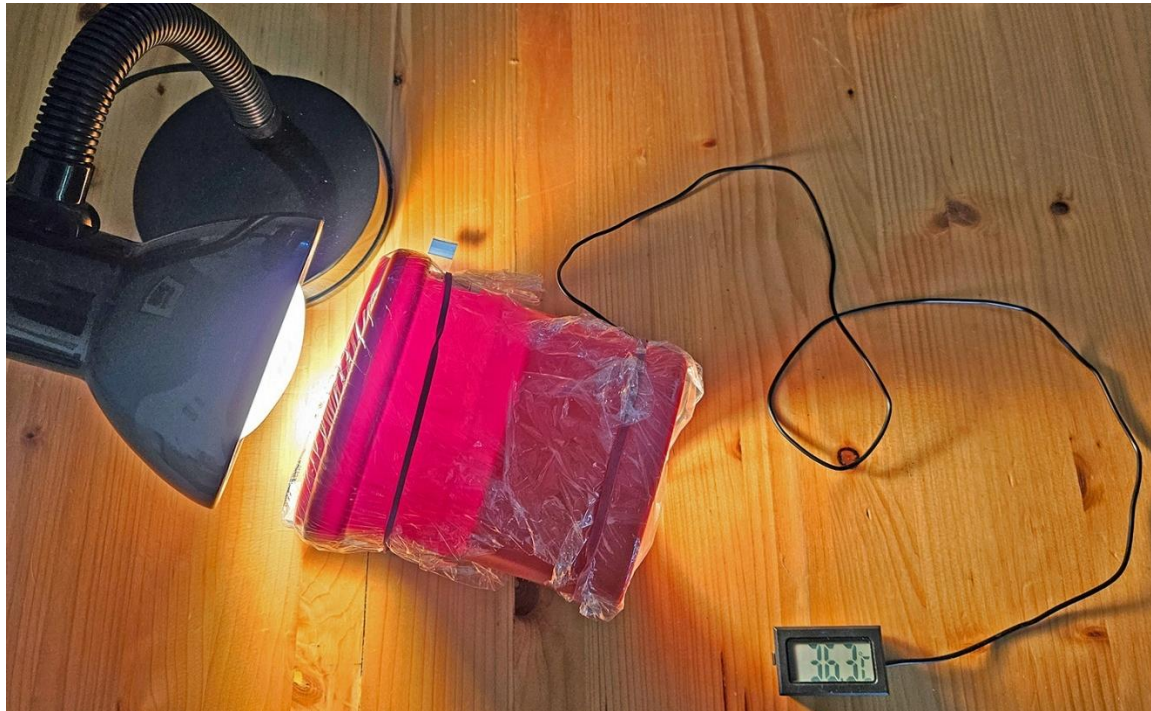
EU Project Consortium

The STEAM4Climate project received funding from the European Union's Erasmus + programme under grant agreement n°2023-1-PL01-KA220-SCH-000158670. The authors credited in this coursebook form part of the STEAM4Climate consortium. The project involves 6 partners and is coordinated by POLITECHNIKA WARSZAWSKA. More information on the project can be found on the [project website](#).

Creative Commons licence:

This document is licensed to the public under a Creative Commons Attribution-NonCommercial- NoDerivatives 4.0 International License.

Experiment CO₂ and the Greenhouse Effect



Gruppe	ohne CO ₂	mit CO ₂
1	30,6 °C	31,8 °C
2	47,2 °C	48,1 °C
3	46,7 °C	48,2 °C
4	44,6 °C	46,4 °C

Top: full setup of the experiment

Left: in-class setting

Right: some outcome of different groups

Materials List

- 1 **desk lamp** with a 60-watt incandescent bulb (preferably with a flexible neck)
- 1 **rectangular plastic container** (approx. 1.5 liters volume, search google for “*short radius bend drainpipe 15 degree*”)
- **Plastic wrap/cling film** (for sealing the container as airtight as possible)
- **2 rubber bands** (to secure the plastic wrap to the container)
- **1 digital thermometer with external probe**, measuring at least up to 50 °C (https://www.amazon.de/dp/B07TY6HRL4/?coliid=I1CBS8Z1MAEHQK&colid=1BWI33O8U8BR4&ref_=list_c_wl_lv_ov_lig_dp_it&th=1)
- **1 CO₂ inflator** (e.g., for bicycle tires) with CO₂ cartridge and a extension tube
Alternatively: Dry ice (with supervision, for advanced groups)
- **Stopwatch or clock** (e.g., phone)





Setup Instructions

1. Prepare the container:

- Place the probe of the digital thermometer in the center of the container's interior.
- Fill the container with ambient air (simply leave it open for a moment).

2. Seal the container:

- Cover the container tightly with plastic wrap and fix it with two rubber bands around the edge to make it as airtight as possible.

3. Position the lamp:

- Place the desk lamp approx. 5–10 cm away from the side of the container, so the light shines directly onto the container wall.
- Ensure that the thermometer display is visible outside the container.

4. Prepare the CO₂:

- Get the CO₂ inflator with cartridge ready, but do not use it yet.
-

Procedure

1. Phase 1 – Heating with Ambient Air:

- Turn on the lamp.
- Read and document the temperature inside the container every 2–3 minutes.
- Wait until the temperature inside the container reaches a stable maximum (no further increase for 5–10 minutes).
→ This usually takes about 5–10 minutes.

2. Phase 2 – Replace Air with CO₂:

- Remove one rubber band from a corner, gently lift the plastic wrap.
- Hold the CO₂ inflator at the opening and let CO₂ flow in for a few seconds (try to avoid letting in additional ambient air).
- The probe stays inside the container!
- Quickly reseal the container to be airtight.

3. Phase 3 – Heating with CO₂:

- Turn the lamp back on
- The temperature inside the container will usually drop slightly at first (the CO₂ is cooler than the previous air).
- As before, document the temperature every 2–3 minutes.
- Wait again until a stable maximum temperature is reached (about 15–25 minutes).

4. Phase 4 – Temperature Comparison:

- Compare and document both maximum values (with ambient air and with CO₂).
-



Expected Observations

- **With ambient air:**

The interior heats up due to the lamp and reaches a stable value after about 5-10 minutes (usually around 35–40 °C, depending on room temperature and setup).

- **After adding CO₂:**

The temperature inside the container initially drops slightly (the CO₂ is cooler).

- **With CO₂:**

After turning the lamp back on, the temperature rises again – but this time significantly more! The new maximum is typically **2–4 °C** higher than with ambient air.



Conclusion and Learning Objective

What should students learn from this?

- **CO₂ is a greenhouse gas:**

The experiment vividly demonstrates that a higher concentration of CO₂ in the air causes a closed space (or the atmosphere) to heat up more under light exposure.

- **Principle of the greenhouse effect:**

CO₂ allows visible light to pass through but absorbs the infrared (heat) radiation emitted by warmed surfaces. This traps more heat inside the container.

- **Relevance to climate change:**

The experiment provides a simple model for both the natural and the human-enhanced greenhouse effect, as it occurs on Earth with rising CO₂ concentrations.

Note for teachers:



For a meaningful comparison, perform the experiment at least twice (once with ambient air, once with CO₂). Carefully document temperature values and discuss the causes and effects together with the class.

Worksheet: CO₂ and the Greenhouse Effect

1. Observations

a) What was the maximum temperature inside the container with normal air?

Answer: _____

b) What was the highest temperature inside the container with CO₂?

Answer: _____

c) By how many degrees did the temperature increase after adding CO₂?

Answer: _____

2. Understanding the Experiment

a) Why did we cover the container with plastic wrap during the experiment?

Answer: _____

b) Why did the temperature drop right after the CO₂ was added?

Answer: _____

c) Why did the temperature rise higher with CO₂?

Answer: _____

3. Drawing Conclusions

a) What does this experiment show about the effect of CO₂?

Answer: _____

b) How is this experiment similar to what happens in Earth's atmosphere?

Answer: _____

c) In your own words, explain why CO₂ is called a greenhouse gas.

Answer: _____