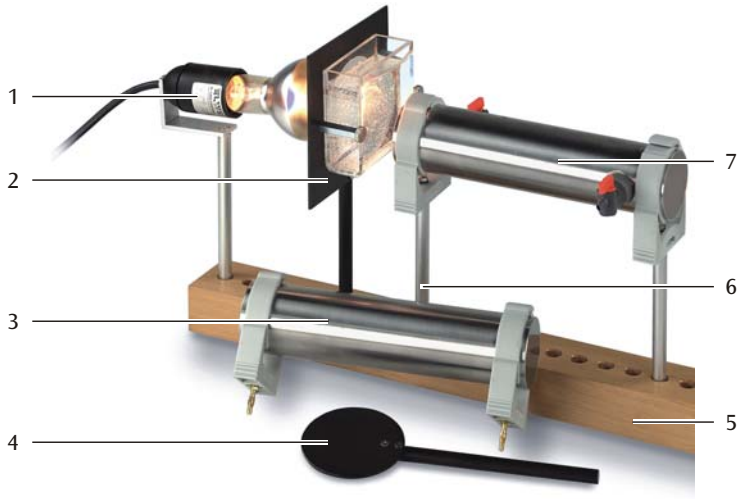
# Kit Greenhouse Effect U8460500

## Instruction manual

10/07 JS




1 Reflector filament lamp in stem-mounted socket
2 Rod-mounted cuvette
3 Absorption chamber
4 Metal disc on stem
5 Base rail
6 Support rods
7 Absorption chamber with taps

### 1. Safety instructions

Fire risk: special care is needed when filling the absorption chambers with flammable gases.

- Follow all fire protection regulations.
- Do not fill the absorption chambers close to naked flames.
- After completion of the experiments, open the taps, outside the building if possible, and flush the added gas out of the absorption chamber using the flexible tube provided.

### 2. Scope of delivery

1 Base plate, 450 mm x 70 mm
1 Lamp socket with mount
1 Incandescent reflector bulb, 60 W
1 Cuvette on mount
1 Black metal disc on mount
1 Absorption chamber
1 Absorption chamber with taps
2 Supporting rods for the absorption chambers
1 Roll of cellophane film
1 Silicone tube, 30 cm
1 Storage box

### 3. Description

The greenhouse effect kit can be used to demonstrate the way that human activity exacerbates the greenhouse effect in the earth's atmosphere.

A reflector filament lamp generates visible light and infrared radiation. The long-wavelength component of this is partly absorbed when the beam is passed through a water-filled cuvette, and the resulting radiation then has proportions of visible light and infra-red radiation that approximate closely to the radiation from the sun. This radiation is passed through an absorption chamber filled with either air or a mixture of air with a greenhouse gas, after which its intensity is measured by a Moll-type thermopile. It is found that the absorption of solar radiation is only slightly affected by adding a greenhouse gas to air.

To generate infra-red radiation of very long wavelengths, the water-filled cuvette is replaced by a

blackened metal disc, which becomes heated by the radiation from the filament lamp. This emits infra-red radiation that closely resembles the infra-red radiation emitted by the earth. Measuring the intensity of the transmitted fraction after this radiation has been passed through an absorption chamber, it can be observed that there is a considerable reduction when the absorption chamber is filled with a greenhouse gas.

For simplicity the greenhouse gas used in the experiment is butane, which is provided in liquid form in a bottle or can.

## 4. Preparation of absorption chambers

- If appropriate, seal the basic absorption chamber and the "absorption chamber with taps" at both ends with cellophane film.
- Alternatively, open the snap fittings at both ends of the absorption chamber and take the metal tube out of the support.
- Stretch the new film over the end of the tube and secure it with adhesive tape (Sellotape, Scotch tape, etc.).
- Put the metal tube back into the support and close the snap fitting.

**Also required:**

1 Butane gas refill canister (lighter gas)

- Open both taps of the "absorption chamber with taps".
- Connect the butane gas canister to one of the taps, using the thin flexible tube provided.
- Position the absorption chamber so that the second tap is directed upwards as an exit for the displaced air.
- Press the release nozzle for the butane gas can so that the gas flows into the absorption chamber.
- When the required amount of gas has entered the absorption chamber, close the tap.

Note:
The absorption chamber will now be usable for several hours. Alternatively, the gas can be admitted during the experiment. In that case allow the gas to flow in until the emerging long-wave infrared radiation shows a marked reduction of intensity as compared to normal air.

Instead of butane, the experiments can also be performed with a propane-butane mixture, such as is supplied in cartridges for gas torches. Here too it is essential to follow fire protection regulations. The absorption is about the same as with butane.

It is also possible to carry out the experiment with carbon dioxide. However, in that case, the absorption of long-wave infrared radiation is not so marked.

## 5. Experiment set-up

**Additionally required:**

| | |
|---|---|
| 1 Moll thermopile | U8441301 |
| 1 Microvoltmeter (230 V, 50/60 Hz) | U8530501-230 |
| or | |
| 1 Microvoltmeter (115 V, 50/60 Hz) | U8530501-115 |

Alternative:

| | |
|---|---|
| 1 Multimeter ESCOLA10 | U8531160 |
| 1 Measuring Amplifier S | U8532161 |
| 1 Transformer 12 V (230 V, 50/60 Hz) | U8475430-230 |
| or | |
| 1 Transformer 12 V (115 V, 50/60 Hz) | U8475430-115 |

- Insert the rod that holds the lamp socket into the farthest left hole of the base rail.
- Screw the reflector filament lamp in place and align it along the base rail.
- Fill the plastic cuvette with water and insert it into the next available hole nearest to the left-hand end.
- Place the absorption chamber on its supporting rods in the radiated beam, so that it is about 1 cm from the cuvette.
- Place the Moll thermopile at the right-hand end of the base rail and connect it to a voltmeter.
- Turn the Moll thermopile towards the incoming radiation and remove the protective cap.

## 6. Experiments

### 6.1 Measuring the intensity of "solar radiation"

- Place the water-filled cuvette, and the air-filled absorption chamber behind it, in the incoming beam.
- Measure the intensity of the transmitted radiation with the thermopile.
- Replace the air-filled absorption chamber with the one that contains butane, and again measure the intensity of the transmitted radiation with the thermopile.

Result of the measurements: the thermopile shows about the same intensity in both cases. Thus, butane only has a small effect on the absorption of solar radiation.

### 6.2 Measuring the intensity of the long-wave infrared radiation

- Place the black metal disc, and the air-filled absorption chamber behind it, in the incoming beam.
- Wait about two minutes for the black metal disc to become warm.
- Measure the intensity of the transmitted radiation with the thermopile.
- Replace the air-filled absorption chamber with the one that contains butane, and again measure the intensity of the transmitted radiation with the thermopile.

Result of the measurements: when butane is present in the absorption chamber, the thermopile shows a considerably lower intensity being transmitted than in the case of absorption by air alone.