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Station
Facade greening

TASK 1

After doing some research online, Lisa has a new question:
What systems are available for façade greening?
Use the *Facade Greening learning world* on the iPad.
Answer Lisa's question orally in your group.

TASK 2

Look at the photos of façade greening models.
Identify the type of façade greening and the plants.
Tip: Use the PlantNet app on the iPad to identify the plants.

Facade greening model 1



Photo: Hans G. Edelmann

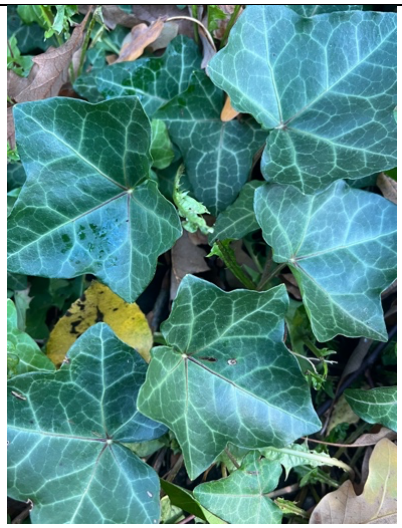


Photo: Juliane Eich

Type of facade greening:

Ground-based systems		**Wall-mounted system**
Self-climbing system	Scaffolding system	Modular system
☐	☐	☐

Plant species:

Common ivy (*Hedera helix*)	Three-pointed Virginia creeper *(Parthenocissus tricuspidata)*	Chinese gooseberry, kiwi (*Actinidia chinensis)*	Evergreen honeysuckle *(Lonicera henryi)*
☐	☐	☐	☐

Facade greening model 2



Photo: Jonas Bomba



Photo: Institute Biology Didactics

Type of facade greening:

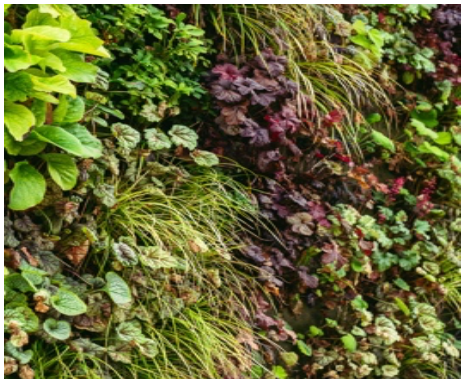
Ground-based systems		**Wall-mounted system**
Self-climbing system	Scaffolding system	Trough-bound system
☐	☐	☐

Plant species:

Common ivy (*Hedera helix*)	Japanese honeysuckle *(Parthenocissus tricuspidata)*	Clematis (*Clematis montana*)	Evergreen honeysuckle *(Lonicera henryi)*
☐	☐	☐	☐

Facade greening model 3





Photos: Krebs & Conrads, Jonas Bomba

Type of facade greening:

Ground-based systems		**Wall-mounted system**
Self-climbing system	Scaffolding system	Modular system
☐	☐	☐

Many different plants are often used in such systems. Take another look at your learning world Facade greening!

We can use apps (e.g. PlantNet) to quickly identify plants.

If you still have time (ask your supervisor!):

Try out the PlantNet app in the schoolyard so that you can identify plants as soon as you see such a system!

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Experiment - Station

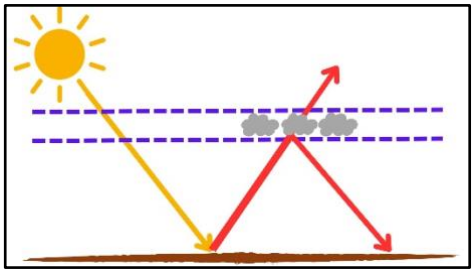
The Greenhouse Gas Carbon Dioxide



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_2) 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_2.**
More CO_2 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_2)

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 (measurement 1)	Temperature in °C after 1 minute (measurement 2)	Temperature in °C after 5 minutes (measurement 3)	Temperature in °C after 10 minutes (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

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Experiment - Station

Photosynthesis

EXPERIMENT



Photosynthesis

Research question:

How does photosynthesis in plants affect the composition of the air?

Your assumption (hypothesis):

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_____

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_____

Materials:

- ☐ Ivy
- ☐ Scissors
- ☐ Sample container
- ☐ CO_2sensor
- ☐ Lamp
- ☐ Clock (mobile phone or iPad)

Experiment procedure:

1. Cut a piece from the ivy plant.

2. Place the piece of ivy (plant) in the sample container.

3. Insert the CO_2 sensor into the upper opening of the sample container.

4. Place the sample container about 15 cm in front of the lamp.
   Switch on the lamp.

5. Start measuring the CO_2 concentration.
   Record the first measurement (**measurement 1**) in the table.

6. Wait 2 minutes.
   Stop measuring the CO_2 concentration.
   Record the second measurement (**measurement 2**) in the table.

Measurement table

CO_2 concentration (ppm) at the start of the measurement (measurement 1)	CO_2 concentration (ppm) after 2 minutes (measurement 2)

Describe your test results:

How much has the CO_2 concentration changed between measurement 1 and measurement 2?

_____

_____

_____

_____

_____

Text box: ppm
Ppm is a unit of measurement.
It stands for "parts per million".

A carbon dioxide concentration of 500 ppm means that 500 out of every million molecules are carbon dioxide.

Experiment evaluation:

Explain the results. Read the text box "Photosynthesis" for more information.

_____

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Text box: Photosynthesis

Do you know why many plants are green?
It's because of a substance called chlorophyll.
This substance is found in parts of plant cells called chloroplasts.

Chlorophyll can absorb the sun's light energy.
The plant uses this light energy to convert water and carbon dioxide into two other substances. These substances are sugar (glucose) and oxygen.

This process is called *photosynthesis*:

Carbon dioxide (CO_2) + water → sugar (glucose) + oxygen (O_2)

Plants need sugar to live. They do not need oxygen and release it into the air. If a plant is placed in a closed container and exposed to light, the oxygen concentration in the container increases.

Carbon dioxide (CO_2) + water ⟶ sugar (glucose) + oxygen (O_2)

Conclusion:

Compare the results with your assumption (hypothesis).

Tick the box:

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

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Experiment - Station

The Shadow Effect

EXPERIMENT



The Shadow Effect

Research question:

What influence do plants have on the warming of surfaces?

Your assumption (hypothesis):

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_____

_____

_____

Materials:

- ☐ Kitchen thermometer
- ☐ Wooden box or cardboard house
- ☐ Ivy
- ☐ Lamp
- ☐ Ruler
- ☐ Glass of water
- ☐ Clock (mobile phone or iPad)

Experiment procedure:

1. Measure the room temperature with the kitchen thermometer.
   Record the measured value in the table (**room temperature 1**).

2. Place the kitchen thermometer in the upturned box.
   Place a lamp 20 cm in front of the box. The closed side of the box should be illuminated by the lamp.
   Make sure that the thermometer is aligned with this side of the box.

3. Switch on the lamp.
   Measure the temperature inside the box after 150 seconds (2:30 minutes).
   Record the measurement in the table (**measurement 1**).
   Switch off the lamp.

4. Take the glass of water.
   Cool the kitchen thermometer to room temperature using the glass of water. However, the water may not necessarily be the same temperature as the room. Use your body heat as well. Record the measurement (room temperature) in the table (**room temperature 2**).

5. Cover (shade) the closed side of the box with leaves. Place the kitchen thermometer in the box. Place a lamp 20 cm in front of the side of the box that is shaded by the leaves. Switch on the lamp: the closed side of the box covered with leaves is illuminated by the lamp. Make sure that the thermometer is aligned with this side of the box.

6. Measure the temperature in the box after 150 seconds (2:30 minutes).
   Record the measurement in the table (**measurement 2**).

Table of measurements

Measurements Box without leaves		**Measurements Box with leaves (shading)**	
Temperature in °C (room temperature 1)	Temperature in °C (Measurement 1)	Temperature in °C (room temperature 2)	Temperature in °C (Measurement 2)

Describe your test results:

How high was the temperature change in °C for the box without leaves?

_____
_____

How high was the temperature change in °C for the box with leaves?

_____
_____

Experiment evaluation:

Explain the results.

_____

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_____

_____

Conclusion:

Compares the results with your assumption (hypothesis).

Tick the box:

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

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EXPERIMENT



Transpiration and evaporative cooling

Research question:

How does plant transpiration affect the composition of the air?

Your assumption (hypothesis):

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Materials:

Experimental Approach 1:

- ☐ 1 plant (cut flower)
- ☐ Glass with water
- ☐ Ink
- ☐ Knife
- ☐ Chopping board
- ☐ Spoon

ATTENTION

You will carry out <u>two</u> experimental approaches:

- In experiment 1 (observation): Transpiration is observed indirectly via the water uptake of a plant (cut flower).
- Experimental approach 2 (measurement): The air humidity is determined using the air humidity sensor.

Experiment procedure:

Experimental Approach 1:

1. Put some ink in the glass.
   Fill the glass with a little water.
   Stir the ink with a spoon.

2. Cut a piece off the stem of the cut flower crosswise.
   Cut off the leaves of the cut flower at the sides.
   Place the cut flower in the glass.
   Observe the cut flower over the next 60 minutes.

Describe your observations. It takes time for us to see changes.

_____

_____

_____

_____

Materials:

Experimental Approach 2:

- ☐ Humidity sensor (O_2 sensor)
- ☐ Ivy
- ☐ Scissors
- ☐ Lamp
- ☐ Sample container
- ☐ Clock (mobile phone or iPad)

Experiment procedure:

Experimental Approach 2:

1. Place the piece of ivy (plant) in the sample container.

2. Insert the O_2 sensor into the upper opening of the sample container.

3. Place the sample container at a distance in front of the lamp.
   Switch on the lamp.

4. Record the measured value in the table:

   - at the start
   - after 1 minute
   - after 3 minutes
   - after 5 minutes

Measurement table

Humidity at the start of measurement in %	Humidity after 1 minute in %	Humidity after 3 minutes in %	Humidity after 5 minutes in %

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

Experiment evaluation:

Both Experimental Approaches:

Explains the results. Also describes the effect of transpiration on the ambient temperature. Read the text box "evaporative cooling" (next page) for more information.

Tip:

Try this experiment:

1. Moisten your hands and forearms.
2. Use a piece of cardboard to fan air over your wet skin or blow on your wet skin.

What effect does this have?

Text box: Evaporative cooling

Plants absorb water from the soil through their roots. This water reaches the leaves, where some of it evaporates into water vapour and leaves the leaf through small openings called **stomata**.

For water to evaporate, i.e. change from a liquid to a gaseous state, it needs heat (energy). You can imagine that the water vapour carries this heat outside through the stomata like an invisible ‘backpack’. This cools the leaf.

Why is it cooler in the park than in the city in summer?
Many plants release a lot of water vapour at the same time. This water vapour carries a lot of heat into the air (atmosphere), for example through the wind. That is why it is often cooler in parks or under trees than on sealed surfaces.

This cooling effect is called **evaporative cooling**.

Conclusion:

Both Experimental Approaches:

Compare the results with your assumption (hypothesis).

Tick the box:

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

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