Effect of the soil temperature on the germination and growth of higher plants

Students use a temperature organ to investigate the effect of soil temperature on germination and growth.

Biology | Plant Physiology / Botany | Germination, growth, development

Difficulty level	Group size	Preparation time	Execution time
medium	-	20 minutes	45+ minutes

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General information

Application

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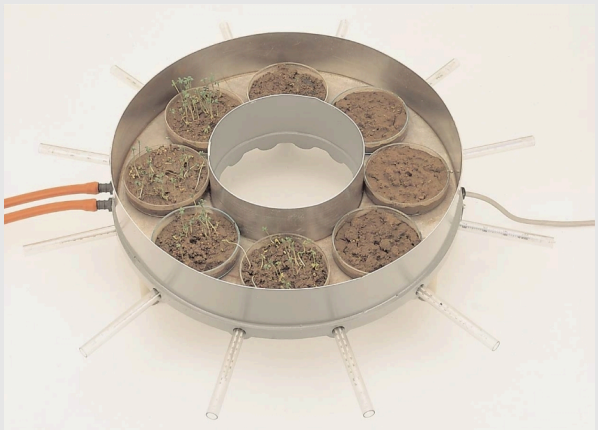

Experiment setup

Temperature is an environmental factor that plays an important role in genetically determined growth processes in plants.

The influence of different temperatures on the growth of garden cress (*Lepidium sativum*) is investigated in this experiment. In order to use the different temperature ranges simultaneously, the pupils in projects and students in the practical course use a so-called temperature organ.

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Other information (1/3)

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Prior knowledge

Students should already be familiar with the various external factors influencing plant growth.

Scientific Principle

With regard to temperature, there are ranges within which this environmental factor reaches the most favourable value for the germination and growth of a plant (preferred or optimum range).

Other information (2/3)

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Learning objective

Students will learn how to use a temperature organ to study the effect of soil temperature on germination and growth.

Tasks

Students are investigating the effects of soil temperature on germination of garden cress (*Lepidium sativum*). To do this, they determine the most favorable value for germination and growth of cress with the help of a temperature meter.

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Other information (3/3)

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Observations and results

- The germination and growth of the roots and shoots of the higher plants require a minimum temperature of the soil (table on the right).
- However, the organisms react negatively to too high temperatures, which leads to damage or even death of the plant. Between these two extremes is an optimal range, which is determined for the cress in the experiment.

Temperature	Plants
1-2°C	Rye, red clover, peas
2-3°C	Rapeseed
3-4,5°C	Beans, wheat
4-5°C	Oats, carrots, sugar beet, lupins
8°C	Potatoes
8-10°C	Corn

Safety instructions

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- The general instructions for safe experimentation in science lessons to be applied to this experiment.
- To keep the temperature within the necessary temperature range a circulating thermostat is required.

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Theory

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Genetically determined growth processes in plants are mainly induced or inhibited by certain phytohormones.

However, external factors such as light, temperature, water, oxygen and humidity play a crucial role in these processes. E.g. for each plant species there is a preferred temperature range for germination and growth.

The light dependence of certain seeds, such as garden lettuce (*lactuca sativa*) is very well known. In these seeds, the seed root will not emerge from the seed coat until the swollen seed receives no light; a few seconds or minutes are sufficient. Since a high inhibitory pressure is required for the seed root to burst through the seed coat, sufficient water must be available for germination. With regard to temperature, there are ranges within which this environmental factor reaches the most favourable value for the germination and growth of a plant (preferred or optimum range).

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Equipment

Position	Material	Item No.	Quantity
1	Temperature organ	65983-93	1
2	Rubber tubing, i.d. 8 mm	39283-00	2
3	Lab thermometer,-10..+50C	38055-00	6
4	Petri dish, d 100 mm	64705-00	5
5	Circulation thermostat, temperature range -10°C ... RT	08495-93	1
6	Hose clamp for 8-12 mm diameter	41000-00	8
7	Rubber tubing, i.d. 10 mm	39290-00	1
8	Tubing connector, ID 6-10mm	47516-01	2

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Set-up and procedure

Set-up

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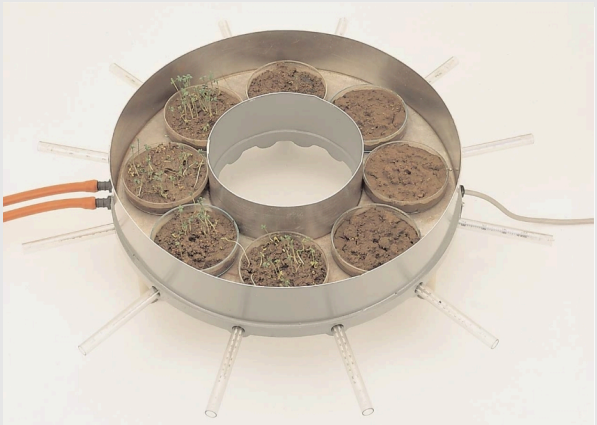
- About half an hour before starting the experiment, connect the temperature organ to the mains voltage and the water supplies. Switch on the heating and water systems for the temperature organ.
- During the equilibrium period, read the temperatures on all thermometers until the values remain constant. Make a note of these values.
- Fill five Petri dishes (100 mm diameter) to the brim with moist garden soil.
- Sprinkle equal amounts of cress seeds (e.g. 70 seeds) on each.



Experiment setup

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Procedure

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- Place the Petri dishes in the temperature organ.
- Check the soil temperature in the dishes daily during the experiment.
- Touch the soil daily to check the moisture and if necessary add water at the same temperature as the tray. The soil moisture should remain constant as much as possible throughout the experiment.
- Note down all measured values.
- Note the point at which the seed coats burst and germination begins (emergence of root and shoot from seed coat).
- After 4 to 5 days, stop the experiment and measure the average length of the cress plants in each petri dish and record all readings.

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Report

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Task 1

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What are the main causes of genetically determined growth processes in plants?

- ○ Genetically determined growth processes in plants are mainly caused by the seasons.
- ○ Genetically determined growth processes in plants are mainly caused by certain phytohormones.
- ○ Genetically determined growth processes in plants are mainly caused by the change from light to dark.

Check

Task 2

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What other factors play a decisive role in genetically determined growth processes in plants?

- ○ Psychological factors such as well-being, enough rest, care.
- ○ There are no other factors that play a role in genetically determined growth processes in plants.
- ○ External factors such as light, temperature, water, oxygen and humidity play a decisive role in these processes.

Check

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Task 3

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Choose the correct statements.

- [ ] In light-dependent plants, the seed root will not emerge from the seed coat until the swollen seed receives light; a few seconds or minutes is sufficient.
- [ ] Germination and growth of roots and shoots of higher plants not only require a minimum soil temperature, their growth rate also increases with rising temperature.
- [ ] The organisms react negatively to too high temperatures, which leads to damage or even death of the plant.

Check

Slide	Score / Total
Slide 13: Growth processes	0/1
Slide 14: External processes	0/1
Slide 15: Statements	0/3
Total	**0 / 5**

Solutions Repeat

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