

LEPIDIDIUM TEST

Can Cosmetic Chemicals Affect the Garden Cress Germination?

BACKGROUND

Biological tests help us understand how environmental conditions might harm living things. These tests often use bioindicator organisms, like certain plants or animals, which show changes in their behaviour, health, or appearance when the environment is polluted.

Garden cress, also known as *Lepidium sativum* (*Lepidium s.*) can be used as a bioindicator. It is a fast-growing, edible herb with a peppery flavour. It is commonly used in salads and as a garnish. This plant is easy to grow and is often used in educational settings to demonstrate plant growth and germination.

Garden cress is sensitive to various pollutants, cost-effective, and easy to handle, making it an excellent indicator of toxicity through changes in germination rates. It responds to environmental changes, such as pollution, by showing alterations in its growth and development. For example, when exposed to harmful substances, *Lepidium s.* may exhibit changes in germination rates, growth patterns, or overall health, making it a useful plant for monitoring environmental conditions.



And it doesn't even need a cape!

It's like the superhero of plants – fast, sensitive, and super easy to handle.



A germination test is a method used to determine the viability of seeds. It measures the percentage of seeds that are capable of sprouting and growing under optimal conditions.

In this experiment, students will determine the potential negative impact of chemicals from our daily cosmetics on the germination of *Lepidium s.* seeds.



AIM OF THE EXPERIMENT

To expose *Lepidium sativum* seeds to cosmetic products, monitor their germination compared to a control group, and analyse the effects of these chemicals on seed viability and early growth.

LEARNING OBJECTIVES

By the end of this experiment, students will be able to:

General Learning Objectives

- ✓ Gain a comprehensive understanding of how chemicals affect living organisms and ecosystems.
- ✓ Develop skills in designing and conducting scientific experiments.
- ✓ Increase awareness of the environmental impact of everyday products, particularly cosmetics, and their potential risks to plant life.

Specific Learning Objectives

- ✓ Identify and explain the effects of different concentrations of chemicals on seed germination.
- ✓ Set up and conduct a germination test using *Lepidium s.* seeds.
- ✓ Analyse the data collected from the experiment.
- ✓ Draw valid conclusions based on the results and connect them to the scientific principles learned.
- ✓ Apply findings to environmental risk assessment.

TIME

Part I: 45 min

Part II (after 48 h): 45 min

MATERIALS NEEDED



Equipment:

- Approx. 100 Garden cress seeds (*Lepidium s.*)
- Plastic or glass Petri dishes
- Filter paper
- Plastic Pasteur pipettes (droppers)
- Beakers (100, 250 and 500 mL)
- Volumetric flasks (100 mL)
- Measuring cylinders
- Plastic tray
- Tray cover (e.g. aluminium foil)
- Dark storage area
- Millimetre ruler

Chemicals:

- Tested chemical/cosmetic product (EXAMPLE: 30% hydrogen peroxide or Shampoo)
- Tap water (negative control)
- 1% solution of 0.1 M HCl or simply just vinegar (positive control)

SAFETY PRECAUTIONS

Before conducting this experiment, ensure you have read and understood the **General Safety Precautions** section of this handbook.

-  There are no additional safety precautions specific to this experiment.



EXPERIMENT SETUP



Step 1 → Prepare the Work Area

Ensure your workspace is clean and free from distractions. Set out all necessary materials. Wear your safety gear.



Clean workspace? Does that mean I have to tidy up my desk?



Yes, and no distractions! So, no checking your phone every five minutes.

Step 2 → Prepare the Experiment

Concentrations: Prepare 3 different concentrations (c_1 – c_3) or dilutions (R_1 – R_3) of tested chemical. You can also choose the cosmetic product. Test each concentration in 2 replicates (A and B).

TESTED CHEMICAL/COSMETIC PRODUCT: _____

PICTOGRAMS: _____

Volume: Each test solution should have a final volume of 100 mL.

If using a specific chemical:

Calculate the amount of stock solution (R_0) and tap water (H_2O) needed for each test solution (R_1 – R_2).

DILUTION		Chemical Concentration		Volume of Chemical (mL)	Volume of H_2O (mL)
R_0	Undiluted (stock)	c_0		/	/
R_1	10×	c_1			
R_2	100×	c_2			
R_3	1000×	c_3			

If using a cosmetic product:

Estimate rough dilutions based on volume percentages.

DILUTION		Product Concentration	Volume of product (mL)	Volume of H₂O (mL)
R₁	25%	C ₁		
R₂	10%	C ₂		
R₃	1%	C ₃		

Control Samples: Use tap water (C_{neg}) as negative control and 1% solution of 0.1 M HCl or vinegar as a positive control (C_{pos}).

Positive and negative controls are essential for validating the results. A positive control shows the expected effect to confirm the experiment works, while a negative control shows no effect to ensure any observed changes are due to the treatment being tested.

Petri dishes: Appropriately label the Petri dishes (e.g., c₁ A) and place them on a plastic tray. Label each Petri dish both on the bottom and the cover side to prevent mixing up the samples.

Garden cress seeds (*Lepidium s.*): Collect *Lepidium s.* seeds (3 tested concentrations in 2×10 replicates of each + 2 controls), all together approx. 100 seeds.

Step 3 → Conduct the Experiment

PROCEDURE

1. Cut appropriately sized circles from filter paper to fit precisely at the bottom of the Petri dish.
2. Using a dropper, moisten the substrate of each Petri dish with different concentrations of the chemical, product or water (2 mL/Petri dish). Use two (A and B) Petri dishes/replicates for each concentration.
3. Evenly distribute 10 *Lepidium s.* seeds on the moistened substrate in each Petri dish.
4. Place the Petri dishes with the tray in a dark place.
5. Leave the seeds to germinate for 48h in total on the tray in the dark.
6. (OPTIONAL) After 24 hours, add 1 mL of the appropriate concentration solution to the Petri dishes.



Looks like our garden cress is having a spa day with all these cosmetic treatments!

Step 4 → Monitor and Record Data

After 48 hours, measure the root length using a millimeter ruler.

Root Length Measurements

Concentration	C_{neg}		C_{pos}		C₁		C₂		C₃	
Replicate	A	B	A	B	A	B	A	B	A	B
Root 1 (mm)										
Root 2 (mm)										
Root 3 (mm)										
Root 4 (mm)										
Root 5 (mm)										
Root 6 (mm)										
Root 7 (mm)										
Root 8 (mm)										
Root 9 (mm)										
Root 10 (mm)										
Average Root Length (mm)										

ANSWER KEY QUESTIONS



Answer the questions either orally or in writing. Emphasize collaboration and critical thinking throughout the process!

1. Why do you think garden cress is a suitable bioindicator for environmental studies?
2. What factors can influence the germination rate of garden cress?
3. How did the different concentrations of the chemical affect the growth of *Lepidium s.* seeds?
4. Which concentration showed the most significant negative effect on seed germination?
5. How did the control groups (positive and negative) compare to the treated groups in terms of germination rates and plant health?

Let's think critically:

6. Based on the results, what recommendations can be made regarding the use of these chemicals in products that may impact plant life?
7. If you were to design a follow-up experiment, what additional variables or conditions would you include to further investigate the effects of these chemicals?
8. How can the results of a germination test with garden cress be applied to real-world environmental monitoring?

FOR EDUCATORS



Additional Activities/Extensions (Optional):

Propose a new experiment by modifying one variable – for example, select more concentrations of tested chemical/cosmetic product or add a different chemical or chemical mixture. You can also monitor the seed germination over different times (after 48, 72 and 96 hours) of exposure.

Optionally, photograph the Petri dishes daily and create a photographic collage of germination.

Adapting the Experiment for **Secondary School Students:**

- ➔ **Use Fewer Concentrations:** Reduce the number of samples to three (e.g., control, low, and high concentration) to simplify data collection and analysis.
- ➔ **Visual Observation:** Encourage students to make detailed visual observations of seed germination.

Example:

- ✔ **Objective:** Measure the effect of a household chemical (e.g., vinegar) or a cosmetic product (e.g. shampoo) on the seed germination process.
- ✔ **Data Collection:** Record root lengths and compare the average lengths across different concentrations and make a photo collage.

Adapting the Experiment for **Primary School Students:**

- ➔ **Visual Observation:** Children can learn about the germination in a simple and visually engaging way by observing seeds changes during a selected time.

Example:

- ✔ Enjoy creative activities like drawing and photographing results
- ✔ Draw and write about your observations in a journal or on a piece of paper each day. Paste the photos in your own journal or use them to create a collage.

General safety precautions



The following general safety precautions apply to all experiments in this handbook.

Please review them carefully before conducting any lab work. Some experiments may also have additional specific precautions listed within their respective tutorials.

-  **Follow Instructions:** Always listen to your teacher/educator/assistant and follow the lab instructions carefully. If you're unsure about any step, ask for clarification before proceeding.
-  **Know Safety Equipment:** Familiarize yourself with the location and proper use of safety equipment like eyewash stations and fire extinguishers.
-  **Be Careful with Glassware:** Exercise caution when handling and washing glassware to avoid breakage and injury.
-  **Safety Gear:** Always wear a lab coat, safety goggles, and gloves. Ensure you have closed-toe shoes and tie back long hair.
-  **Handle Chemicals Safely:** Handle chemicals and equipment with care. Never taste or sniff chemicals. Always label containers or tubes.
-  **Check Pictograms:** Before using any chemical, review the safety pictograms on the label to understand the hazards associated with it.
-  **Handle Solvents Carefully:** Use solvents in a fume hood to avoid inhaling fumes and ensure proper ventilation.
-  **Dispose of Waste Properly:** Follow proper procedures for disposing of chemical and biological waste. Do not pour chemicals down the drain unless instructed.
-  **Report Accidents:** Immediately inform your teacher/educator/assistant of any accidents, spills, or injuries, no matter how minor they seem.