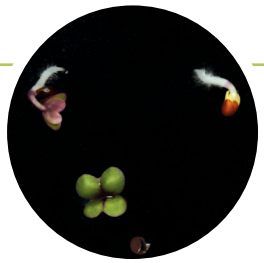
An Inquiry into Seed Germination

A Carolina Essentials™ Investigation



Overview

This NGSS-aligned activity is a student inquiry into the factors that affect seed germination. The activity can be used as an introductory activity for plant studies in biology or as an environmental impact investigation in earth science, environmental science, or agricultural science. Students in pairs or groups must fully design and carry out an investigation that begins with asking a question. They go on to define variables, detail a procedure, collect and analyze data, and share conclusions. After sharing class data, students generate a table of germination factors.

Life Science, Environmental Science
Grades: 6–12

Essential Question

What factors affect seed germination?

Investigation Objectives

1. Plan an investigation of a factor that affects seed germination.
2. Carry out the investigation and communicate the results to the class.

Next Generation Science Standards* (NGSS)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations • Plan and carry out an investigation of a factor that affects seed germination rates.	**LS1: From Molecules to Organisms: Structures and Processes** • Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)	**Stability and Change** • Feedback (negative or positive) can stabilize or destabilize a system.

Safety Procedures and Precautions

Ensure that students understand and adhere to safe laboratory practices when performing any activity in the classroom or lab. Students should not put their fingers into their mouths during these activities. They should wash and dry their hands after each activity. Demonstrate the protocol for correctly using the instruments and materials necessary to complete the activities, and emphasize the importance of proper usage. Use personal protective equipment, such as safety glasses or goggles, gloves, and aprons when appropriate. Model proper laboratory safety practices for your students and require them to adhere to all laboratory safety rules.

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TIME REQUIREMENTS

PREP	ACTIVITY
15-20 min	40 min

Teacher Prep: 15 to 20 min
Student Time: 20 to 30 min on day 1; 10 min for observations on days scheduled by the teacher

SAFETY REQUIREMENTS

MATERIALS (PER GROUP)

100–150 radish or rye grass seeds
Potting soil (2–3 cups)
5–10 plastic cups (4–8 oz)
2 plastic spoons
1 permanent marker
Light bank
1 spray bottle
Paper towels
1 plastic bucket or other container for moistening potting soil
Rulers and other measuring instruments depending on student investigation designs

REFERENCE KITS

Carolina STEM Challenge®: How to Train a Plant Kit

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Teacher Preparation and Disposal

Once investigations are complete, plants can be placed in a resealable bag, frozen, and disposed of in the trash.

Student Procedure

Experimental Design

1. List some factors you think may influence seed germination and seedling growth, and give a brief explanation of the expected influence.

2. Choose a factor from your list and develop a question about seed germination that you can answer through experimentation. The question for investigation is:

   State a hypothesis for your experiment in this form: "If . . . then . . . because . . ." (If this variable is changed in this way, it will produce this change for this reason.) A hypothesis is not a guess; it is a predicted outcome based on prior knowledge.

Experimental Procedure

1. Give a description of the procedure you will use to test your hypothesis. Be as specific as possible. Include:
   - Materials needed and use of the materials
   - Data to be collected
   - Details on how you will analyze the data
   - Expected outcomes

Data and Observations

1. Include a sample data table with variables and units.

Analysis and Discussion

1. How will you analyze the data you are collecting?
2. What will be graphed?
3. Construct sample axes with labels.

Conclusion

1. Prepare a short investigation presentation for the class.
2. After all groups present investigation conclusions, prepare a table that includes all factors investigated and details on how the factors affected seed germination and growth.

Teacher Preparation and Tips

This inquiry can be completed in pairs or small groups.

Conduct a class discussion to generate factors that can influence seed germination.

Synthesize student responses down to 4 or 5 factors that can be investigated in the classroom in a reasonable amount of time.

You may want to guide students/groups interested in the same factor to select different seed types. The results would then be slightly more generalizable.

Check each proposed investigation. Make certain only one factor is being investigated and that variables are defined and can be measured with the equipment available.

Look at each group's experimental design carefully. Make sure that the investigation is doable in the time you have allotted.

As a final presentation, compile all the class results organized by factor, then discuss the results.

The investigations should conclude with a master list of factors that affect seed germination (including how the factor affects germination).

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Experimental Design

1. List some factors you think may influence seed germination and seedling growth, and give a brief explanation of the expected influence.

   Planting depth: If planted too deep, seedlings will not be able to reach the surface and will die. If planted too near the surface, they may dry out and not germinate.

   Water: If the soil is too dry, seeds may not be able to absorb enough water to germinate. If the soil is too wet, the seeds may rot.

   Temperature: If the soil is too cold, seeds may not germinate.

   Weeds: If there are too many weeds, seeds may germinate but the seedlings may be weak.

   Fertilizer: If seedlings do not have fertilizer, they may grow poorly. If there is too much fertilizer, the seedlings may be burned.

   Light: If there is not enough light, seedlings may grow poorly.

2. Choose a factor from your list and develop a question about seed germination that you can answer through experimentation. The question for investigation is:

   Does planting depth affect how well seeds germinate?

3. State a hypothesis for your experiment in this form: "If . . . then . . . because . . ." (If this variable is changed in this way, it will produce this change for this reason.) A hypothesis is not a guess; it is a predicted outcome based on prior knowledge.

   If we plant seeds at different depths, the seeds planted deepest may germinate, but the seedlings will not reach the surface. There will be an optimal planting depth.

Experimental Procedure

We will plant radish seeds at different depths and record data on the number of seedlings that emerge above the soil level for each planting depth. Data will be displayed in a data table and as a histogram.

Our research indicates that radish seeds germinate in 2 days under good conditions. On this basis, we plan to allow 10 days from planting to the end of our trial. Since radish is a small seed, we predict that the seeds will germinate best at a shallow planting depth.

Materials

Radish seeds, 100
Potting soil, 3–4 cups
7-oz cups for planting seeds
Rulers

Variables that we will control

Number and type of seed planted
Temperature
Moisture
Light
Type of potting soil
Size of planting container

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Variable that we will change

Planting depth

Procedure

1. *Use point of scissors to make a hole for drainage in the bottoms of four 7-oz cups. Label cups with date planted and planting depth.*
2. *Fill cup 1 to a depth of 2 cm with moist potting soil. Scatter 25 radish seeds on the soil surface and fill the cup to a total depth of 8 cm with moist potting soil. Seeds are planted at a depth of 6 cm.*
3. *Fill cup 2 to a depth of 4 cm with moist potting soil. Scatter 25 radish seeds on the soil surface and fill the cup to a total depth of 8 cm with moist potting soil. Seeds are planted at a depth of 4 cm.*
4. *Fill cup 3 to a depth of 6 cm with moist potting soil. Scatter 25 radish seeds on the soil surface and fill the cup to a total depth of 8 cm with moist potting soil. Seeds are planted at a depth of 2 cm.*
5. *Fill cup 4 to a depth of 8 cm with moist potting soil. Scatter 25 radish seeds on the soil surface. Seeds are planted at a depth of 0 cm.*
6. *Set completed cups in tray under light bank. Check cups daily and water as needed.*
7. *Ten days from planting, count the number of seedlings and record results in the Seedling Data Table. Graph results.*

Data and Observations

Include a sample data table with variables and units.

Seedling Data Table

Planting Depth	0 cm	2 cm	4 cm	6 cm
Number of Seedlings	8	24	0	0

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Number of Seedlings

25									
24									
23									
22									
21									
20									
19									
18									
17									
16									
15									
14									
13									
12									
11									
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8									
7									
6									
5									
4									
3									
2									
1									
Planting Depth		**0 cm**		**2 cm**		**4 cm**		**6 cm**	

Analysis and Discussion

How will you analyze the data you collect?

What will be graphed?

Construct sample axes with labels.

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TEACHER NOTES

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