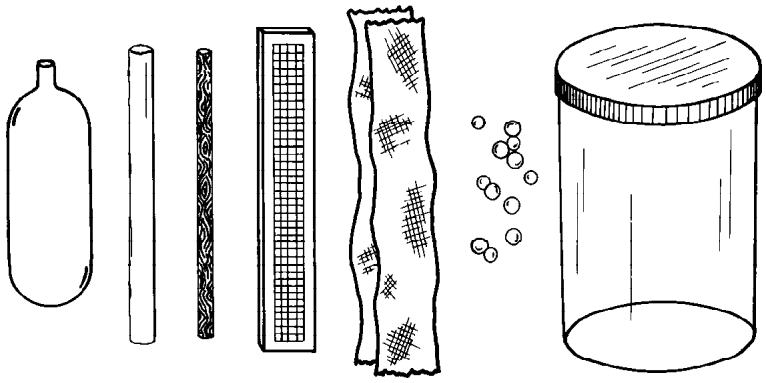
How Does a Seed Germinate?

One of the fascinating stages of a plant life cycle is *germination*. Most of us have planted seeds in the ground, watered them and watch seedlings emerge through the soil to being a new cycle in the spiral of life. Many students have watched seeds germinate on moist paper, observing the seed swelling, the seed coat splitting, the root emerging and the stem *(hypocotyl)* elongating. Germination is the awakening of the seed from the quiescent or dormant state. What actually happens when a seed germinates? We do not completely understand seed germination and scientists are very interested in learning more about it. Because germination holds so many unanswered questions, it can be an excellent topic for investigation.

When placed under favorable conditions, seeds of rapid-cycling *Brassica rapa*, Rbr, (Fast Plants) will germinate quickly. Rbr seeds respond to variations in their environment by varying their germination rate as well as their appearance during germination. With the following simple materials, students can investigate the interactions between the environment and germination.

Materials

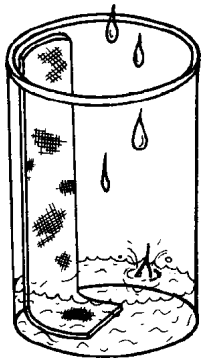
- metric ruler
- scissors
- 35 mm opaque film can
- clear plastic grid strips, 0.5 x 4 cm (photocopy 1 mm graph paper onto a transparency sheet, cut in strips)
- strips of soft paper toweling (1 x 4.5 cm)
- 4.5 cm piece of thin (2 - 3 mm diameter) clear or translucent straw
- 4.5 cm piece of thin bamboo food skewer measuring stick (cut these skewers in pieces with scissors)
- plastic pipette
- ultra-fine point permanent marking pen
- seeds



Procedure

To begin, it is useful for students to observe and record the events of germination.

1. Add 1-2 ml of water to the film can. Place a towel strip in the can so that it becomes wet with the water in the bottom of the can. The strip sticks to the wall of the can through the molecular forces of adhesion between the water and the plastic wall; the water is acting as an adhesive.



Place a clear plastic grid strip on the wet towel, then another wet towel on the grid strip to form a towel : grid strip : towel sandwich. The grid strip will stiffen the towel strips so they can be removed from the can.

Note

Each of these investigations uses quite a lot of seeds (15-30 per student). If your students are producing lots of Rbr seeds, these can be used. You can also use other seeds such as turnip, Chinese cabbage, radish, cabbage, mustard, etc. obtained from local garden stores.

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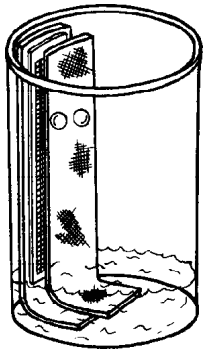
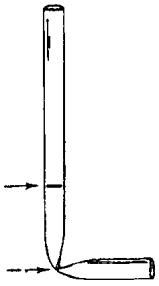
2. Place 2 seeds on the wet towel strip; they will also adhere to the towel through molecular forces of the water. Place the strips with the seeds against the can wall; the entire unit will adhere to the inside of the can.



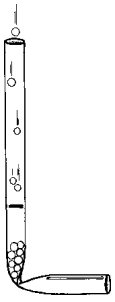
With the aid of a hand magnifying lens, observe, describe and record how the seeds look, feel and smell. If students have grown their own Rbr seeds, they could taste a seed by crushing it in their mouth at the tip of their tongue. It is best not to put commercial seeds in the mouth.

3. Take a 4.5 cm piece of thin plastic drinking straw, bend the bottom 0.5 cm sharply to form a fold in the straw and bite the fold between the front teeth to crimp the fold. With an ultra-fine point permanent marking pen and ruler, place a mark on the straw 1 cm from the bottom of the straw.

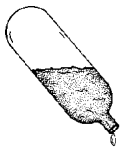


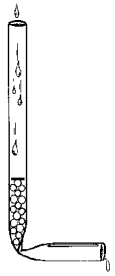
4. While counting the number, add seeds to the top of the straw until they have reached the 1 cm mark.

5. With a pipette add water to the top of the straw until it begins to drip from the bottom of the folded portion.

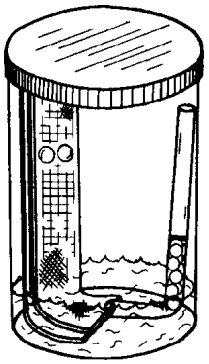


6. Place the measuring stick in the straw at the top of the seed column and mark it with the pen where it emerges from the straw.





7. Place the straw in the film can so the base of the straw is under the water. Put the cap on the can.



Observations and analysis

Consider all the various physical and chemical conditions of the seeds' new environment. Physical elements include temperature, gravity and light. Chemical components include water, oxygen, carbon dioxide, nitrogen and minerals.

Describe (measure) and record the particular environmental conditions that the seeds are subjected to in the experimental germination chamber.

Students should take their experiments home so they can periodically observe the responses of the seeds in the germination chambers.

Every few hours students should remove the cap, sniff the atmosphere in the can, observe the seeds on the towel strip and describe, measure, sketch and record what they see and smell.

Measure and graph the length of the Rbr roots and hypocotyl (dependent variable = y axis) over time (independent variable = x axis).

Measure the height of the seed column in the straw by marking the measuring stick. Remember to record the time of each measurement in hours or minutes after putting the seeds in the can. For a period of 24-48 hours graph the height of the the seed column (dependent = y axis) over time (independent = x axis).

After 24 to 48 hours, push the column of seeds onto a paper sheet with the measuring stick. Observe the appearance of various seeds from the column in relation to where they were in the column and compare them to the seeds germinating on the moist paper towel.

Ask some questions, develop a hypothesis, design and run an experiment.

Questions

- What environmental conditions are necessary for germination?
- How do other seeds germinate?
- Do germinating seeds of rapid-cycling brassicas give off chemicals?