

Chapter 24 Reproduction of Seed Plants

Investigating Germination and Seedling Development

Introduction

When conditions are suitable, a seed undergoes germination, or the development of an embryo into a seedling. For germination to occur, water, warmth, and oxygen must be available in the proper amounts. The amounts vary from species to species.

Germination can occur only in viable seeds, or seeds in which the embryo is alive. Not all viable seeds will germinate, even when given the proper amounts of water, warmth, and oxygen. Many seeds must go through a period of dormancy, during which the embryo is alive but not growing. Dormancy is an adaptation that prevents germination of the seed until conditions are suitable.

In this investigation, you will observe some of the processes associated with seed germination and seedling development.

Problem

What changes occur in a seed during germination and seedling development?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. What are the major environmental requirements for the germination of seeds?

2. Is a control needed for this study?

3. What is the advantage of using the *Brassica rapa* seeds for the study?

4. What parts of a new seedling are the hypocotyl, epicotyl, and primary root?

5. Why are no nutrients added to the water used to sprout the seeds?

Materials (per pair)

10 *Brassica rapa* seeds
petri dish
forceps
hand lens
filter paper

fluorescent plant lamp (if available)
base of a 2-L soft-drink bottle
metric ruler
colored pencils

Safety

Handle all glassware carefully. Do not eat any materials such as the seeds provided by your teacher or the seedlings produced. Note all safety alert symbols next to the steps in the Procedure and review the meanings of each symbol by referring to Safety Symbols on page 8.

Procedure

1. As shown in Figure 1, use a metric ruler and pencil to draw a line across the filter paper about 3 cm from the top edge. Label the bottom edge of the filter paper with the seed type, date, and name of one member of your group. **Note:** Be sure to use pencil to label the filter paper because ink will smear when water is added.

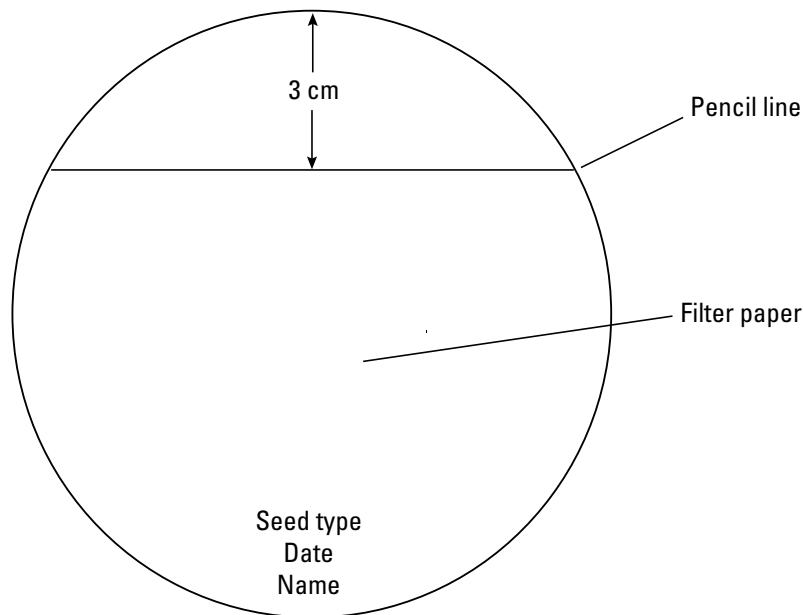




Figure 1

-  2. Place the filter paper in the top of a petri dish. Thoroughly wet the filter paper.
-  3. Use forceps to place 10 *Brassica rapa* seeds on the line you drew on the filter paper. Space the seeds out evenly across the line as shown in Figure 2.

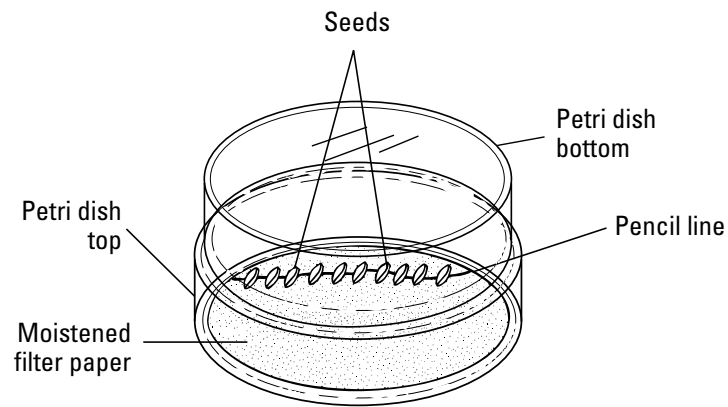


Figure 2

4. Cover the seeds by inserting the smaller bottom half of the petri dish into the top.
5. Carefully place the petri dish in the base of the 2-liter soft-drink bottle so that the seeds are at the top and the petri dish is tilted slightly. See Figure 3. Make sure that none of the seeds have fallen from their original positions. Slowly add water to the soft-drink bottle base from the side until the water reaches a depth of 2 cm.

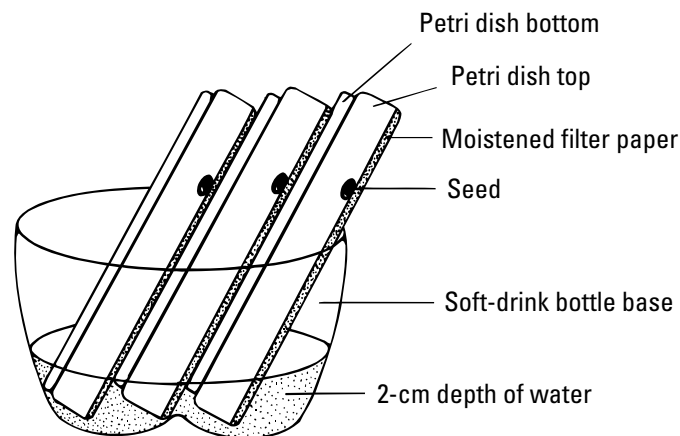


Figure 3

6. Place the soft-drink-bottle base under a fluorescent plant lamp. If a fluorescent lamp is not available, place the base near the best source of light in the room.
7. After 24 hours, observe the germination of the seeds. If necessary, use the hand lens to observe the germinating seeds. Note the number of seeds that have a split seed coat, an emerging radicle, hypocotyl, or epicotyl, or the appearance of a primary root and root hairs. Record the information in Data Table 1 on p. 186.
8. Measure the primary root length of each of the 10 seeds in millimeters and record this information in Data Table 2 on p. 186. If no primary root has emerged from a seed, record its length as 0 mm. Calculate the average root length for each of the 10 seeds and record this information in Data Table 2.

Data Table 1

Time	Number of Seeds					
	Split Seed Coat	Radicle	Primary Root	Root Hairs	Hypocotyl	Epicotyl
After 24 hours						
After 48 hours						
After 72 hours						

Data Table 2

Time	Root Length (mm)										
	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5	Seed 6	Seed 7	Seed 8	Seed 9	Seed 10	Average
After 24 hours											
After 48 hours											
After 72 hours											

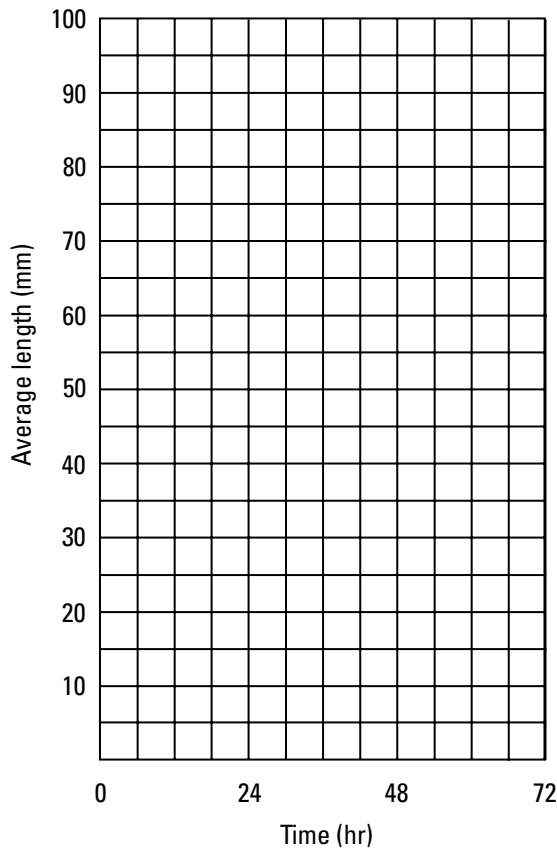
9. Measure the hypocotyl length of each of the 10 seeds in millimeters and record this information in Data Table 3. If no hypocotyl has emerged from a seed, record its length as 0 mm. Calculate the average hypocotyl length for each of the 10 seeds and record this information in Data Table 3.

Data Table 3

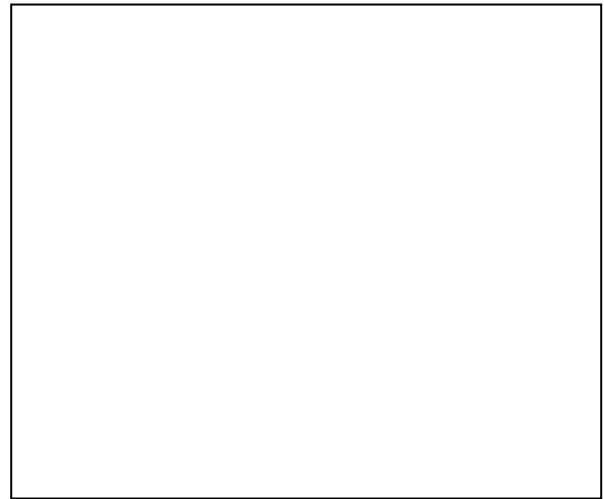
Time	Hypocotyl Length (mm)										
	Seed 1	Seed 2	Seed 3	Seed 4	Seed 5	Seed 6	Seed 7	Seed 8	Seed 9	Seed 10	Average
After 24 hours											
After 48 hours											
After 72 hours											

10. Repeat steps 8 and 9 after two more 24-hour periods. Record the information in Data Tables 1, 2, and 3.
11. On the graph on page 187, construct a line graph showing the average root length over the 72-hour observation period. On the same graph, construct a line graph showing the average hypocotyl length over the 72-hour observation period. Use pencils of different colors to construct the two line graphs. Label each line graph.

12. In the box labeled 72-hour-old *Brassica* seedling below, sketch one of your 72-hour-old seedlings. Label the hypocotyl, primary root, root hairs, cotyledons, and true leaves.
13. Calculate the growth rate of the root over the three days by dividing the average length by the period of time. For example $30 \text{ mm}/3 \text{ days} = 10 \text{ mm/day}$
14. Calculate the growth rate of the hypocotyl using the same method as above.



72-hour-old *Brassica* Seedling



Analysis and Conclusions

1. **Observing** What is the first structure to emerge from inside the seed?

2. **Inferring** What is the function of this structure?

3. **Formulating Hypotheses** Why is it important for the dry seed to take in water before it begins to germinate?

4. **Drawing Conclusions** How does a seedling benefit from having its radicle emerge before its leaves?

5. **Inferring** As the seedling grows, what part turns green and photosynthesizes?

Going Further

To observe the effect of light on seed germination and seedling development, prepare two petri dishes using the procedure described in this investigation. Completely wrap one of the dishes in aluminum foil and leave the other uncovered. Compare the rate of germination and the lengths of the primary roots and hypocotyls of the two sets of seeds. Construct data tables and compare the growth rates under the different conditions. You can also draw line graphs to show the growth rates. Write a simple summary of the results.