

CASE



Activity 5.2.3 Bean Sprouts

Purpose

Just as you started life as an egg, plants start life as an egg as well. The flower produces eggs in the ovary. Those eggs go on to become the next generation of plants once they are fertilized. Typically, plant eggs are called seeds. For a seed to become a new plant, they need the correct environment and nutrients to grow. Every living organism has certain requirements that must be met for growth and survival. Do plants need water to germinate? If so, how much? What other factors play a role in the germination of seed? Find out in this activity.

Materials

Per team of three students:

- 2L plastic bottle
- Stapler
- Scissors
- Permanent marker
- Thermometer
- Water

Per student:

- 10 bean seeds
- Paper towel
- Paper clip
- Pencil
- *Agriscience Notebook*

Procedure

Your teacher will assign you to a team of three. You and your team will conduct an experiment to understand the impact of water and temperature on seed germination. Each team member will set up a trial for a seed germination experiment and work as a team to complete the germination and observation components of this activity.

Part One – Setting Up the Experiment

1. Lay out a dry section of paper towel on your table.

2. Place 10 bean seeds along one edge of the paper towel, try to space them evenly from top to bottom. See Figure 1.
3. Carefully roll the paper towel tightly around the bean seeds once or twice.
4. Staple the paper towel between each seed to ensure that the bean seeds stay in place.
5. Continue to roll the paper towel and staple the ends to keep it rolled.
6. Carefully cut approximately four inches off the top of the plastic bottle with scissors.
7. Clean the plastic bottle with warm soapy water and rinse well.
8. Write all team members' names on the outside of the bottle toward the top of the bottle.
9. Draw a line on the outside of your team's plastic bottle approximately 1/3 from the bottom. This will be your water fill line.
10. Fill the bottle with water to the water fill line.

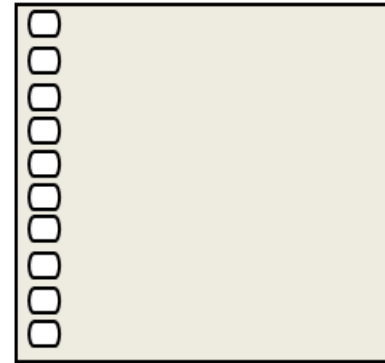


Figure 1. Seed Arrangements

11. Assign each member a roll number (1, 2, or 3). Use the permanent marker to record your roll number (1, 2, or 3) on one end of your paper towel roll. This will mark the top of the roll.
12. Place your seed roll in the bottle with the roll number at the top and secure it to the edge using the paperclip.
13. Once you have completed the experiment set up, your teacher will assign your team one of the following temperature treatments. Your teacher will show you where to place the bottle for your assigned temperature treatment.
 - Cold
 - Warm
 - Hot
14. Using the thermometer, determine the temperature of the area your team has been assigned and record in Table 1 on the student worksheet. Be sure to include the unit of measurement.
15. Store your team's bottle in the location specified by your teacher.

Part Two – Predictions

1. In the prediction column of Table 2 on the student worksheet, record which temperature treatment was assigned to your team.
2. With your teammates, determine what you predict will happen in this experiment. Use an X to indicate a seed that will not germinate. Draw an O to indicate a seed that will germinate.
3. Answer the prediction questions on the student worksheet.

Part Three – Maintenance

When instructed by your teacher, check the experiment bottle to make sure the paper towel rolls have not fallen. Maintain the water level by adding water as necessary, but use caution to avoid getting water on the paper towel rolls. Determine the current temperature and record in Table 1 on the student worksheet. Record the number of days elapsed at each temperature recording.

Part Four – Data Collection and Analysis

1. On the final day of the experiment, your teacher will instruct you to retrieve your bottle.
2. Record where the water level is in relation to the paper towel roll by making a mark with the permanent marker on the paper towel.
3. Remove your seed roll from the bottle.
4. Dispose of the water and bottle.
5. Carefully unroll the seed roll, keeping the bean seeds in their original position.

6. Record which seeds germinated and which did not in the actual column of Table 2 on the student worksheet. Use an X to indicate a seed that did not germinate. Draw an O to indicate a seed that did germinate.
7. Draw a line across the actual column Table 2 to indicate which seeds were submerged and label the line.
8. Draw a second line on the actual column of Table 2 to indicate the highest point on the paper towel that was damp and label the line.

9. Count the total number of seeds that germinated in all three team members' seed rolls.
10. Calculate germination percentage rate by setting up the problem as a proportion. See the example at right.
11. Answer the analysis questions on the student worksheet.
12. Share your results with other groups in the class. Record the percent germination of each treatment team in Table 3 and answer the final analysis question.
16. Follow your teacher's instructions to dispose of materials and clean up your work area.

G = number (#) of seeds germinated Y = percent (%) germination
$\frac{G}{30} = \frac{y}{100}$ $30 y = 100 G$ $y = \frac{100 G}{30}$
Figure 2. Germination Calculation

Conclusion

1. In this experiment, why were there seeds that did not germinate?

In the water

2. What role does water play in seed germination?

They need some but not too much.

3. What role does temperature play in seed germination?

The warmer the better

4. Based on what you learned, what do you think are the best conditions for bean seed germination?

Warm or hot

Name _____

Activity 5.2.3 Student Worksheet

Table 1. Temperature Observations

Treatment assigned:	
Day	Temperature
Starting Temperature	14.5 °C
Day __1__	33°C
Day _3__	35°C
Day ____	
Final Temperature	

Table 2. Predictions and Observations

X = seed that will not germinate			O = seed that will germinate			
	Roll 1		Roll 2		Roll 3	
Top	Predicted	Actual	Predicted	Actual	Predicted	Actual
1	X	O	X	O	X	X
2	X	O	X	O	X	X
3	X	O	X	O	X	X
4	X	O	O	O	O	X
5	O	O	O	O	O	X
6	O	O	O	O	X	X
7	O	O	O	O	X	X
8	O	O	O	O	X	X
9	X	O	O	X	X	X
10	X	X	X	X	X	X

Table 3. Germination Rate Class Comparisons

Cold Treatment	Warm Treatment	Hot Treatment
___0%___%	___80%___%	___90%___%
_____%	_____%	_____%

Prediction Questions

- What do you think will promote seed germination in your predictions?

Moisture in the beans and air.

- What do you think will inhibit seed germination in your predictions?

Analysis Questions

- How many of your team's seeds germinated?

8 seeds germinated

- What percent of your team's seeds germinated?

80%

- Explain the trends of germination in relation to the water level. Where was the best germination rate compared to the worst germination rate?

Everything germinated past the water level

- How did your predictions compare to actual germination? If your predictions were accurate, or if your predictions were incorrect, what is the reason?

It was close, except the top was, I didn't think the water would travel that much

_____ %	_____ %	_____ %
Average _____ %	Average _____ %	Average _____ %

- Based on the class results, did temperature affect germination of bean seeds? Why do you believe this is so?

The warmer the better, nothing can grow if it is frozen.