

The Jar That Warmed Up: What Are the Seeds Doing in the Dark?

Investigation question: Three sealed jars of pea seeds sit in a dark cupboard overnight. Which jar changes the indicator, warms up and grows, and what hidden process explains all three changes at once?

Evidence-based mystery

Groups of 4

2 sessions

Setup 10 · Activity 60 · Cleanup 10 min

MS-LS1-7 · assesses

MS-LS2-3 · supports

Name _____

Group _____

Date _____

Your role today

- ☐ **Jar manager:** Loads the seeds, places the indicator cup, seals each lid and labels the jar. Opens jars on day 2 only when the group is ready to record.
- ☐ **Indicator reader:** Compares the indicator cup against the printed color key on day 1 and day 2 and records the color and the match number.
- ☐ **Measurer:** Measures five seeds or sprouts from each jar with a ruler on day 2 and reads the class vacuum flask thermometers when asked.
- ☐ **Recorder and reporter:** Keeps the recording sheet, writes the group's predictions, and reports the group's day 2 results to the class table.

Safety

- Bromothymol blue is a mild skin and eye irritant and stains clothing. Wear goggles while pouring or opening jars, wipe spills with a wet towel and wash hands afterward. Use red cabbage juice if any student has a known sensitivity.
- Do not eat the seeds; soaked and boiled seeds in a sealed jar can grow mold within a day or two. Open day 2 jars at arm's length, not near the face, and discard contents in the trash, not the sink.
- Glass jars can break: carry one at a time with two hands, keep them off the edge of the desk, and tell the teacher about any crack. Plastic jars are an acceptable substitute. Screw lids on snugly, not wrenched tight, and if a lid bulges the teacher loosens it at arm's length.
- The boiled seeds are prepared by the teacher; students never handle hot water in this lab.
- Keep the indicator cup upright inside the jar; it must not touch the seeds or be swallowed by the sprouts' water.

Procedure

1. Day 1. Look at a few seeds from each of the three batches (living soaked, dry, boiled). Record what you see and feel on the recording sheet, then write your group's prediction for each jar: will the indicator change, will the jar warm, will the seeds grow?

2. Line each jar with a damp paper towel. Put about 40 g of one batch of seeds on the towel in each jar, keeping the batches separate. Label the jars A (living soaked), B (dry) and C (boiled).
3. Pour indicator into three small cups to the same depth (about 1 cm). Compare each cup to the color key and record the starting color number. Stand one cup upright on the towel in each jar, away from the seeds.
4. Seal each lid tightly. Record the time. Place all three jars in the dark cupboard. Read and record the two class thermos temperatures on the board.
5. Day 2 (about 24 hours later). Before opening anything, look through the glass: record the indicator color number for each jar and any visible change in the seeds (roots, swelling, color, moisture on the glass).
6. Read and record the two class thermos temperatures. Compute the change for each since day 1.
7. Open each jar at arm's length with goggles on. Remove five seeds or sprouts, lay them on a paper towel and measure the longest root or shoot on each in millimeters. Record all five and the average.
8. Report your group's indicator numbers and average lengths to the class table on the board. Compare your jar A with other groups' jar A.
9. Answer the recording-sheet questions, draw the matter-movement diagram, then work through the analysis questions individually before comparing in your group.

Record your observations

Lab 1 recording sheet: The jar that warmed up

Fill in the day 1 sections before the jars go into the cupboard. Fill in the day 2 sections before and after opening the jars, in the order the procedure gives. Use the color key numbers: 1 = blue, 2 = green, 3 = yellow.

Day 1: what we see and what we predict

Jar	What the seeds look and feel like now	Will the indicator change? (yes/no, and why)	Will the jar warm up? (yes/no)	Will the seeds grow? (yes/no)
A: living soaked				
B: dry				
C: boiled				

Day 2: observations

Jar	Indicator color number, day 1	Indicator color number, day 2	Changes seen through the glass	Lengths of five seeds or sprouts (mm)	Average length (mm)
A: living soaked					
B: dry					
C: boiled					

Class thermos temperatures

Thermos	Temperature day 1 (°C)	Temperature day 2 (°C)	Change (°C)
Living soaked seeds			
Boiled seeds			

-  Draw jar A as a system. Show the seeds, the indicator cup and the air. Use labeled arrows to show what you think moved from where to where during the 24 hours, and mark where energy was released.

1. Which of your predictions were right and which were wrong? For one wrong prediction, say what evidence changed your mind.

2. List every difference you recorded between jar A and jar C. Then name the one thing that is different about the seeds themselves in those two jars.

Analysis questions

3. The indicator turns from blue toward yellow when carbon dioxide dissolves in it. What does the day 2 color in jar A tell you, and why is the day 2 color in jar C important for that conclusion?

4. No light reached any jar. Where did the energy to warm the living-seed thermos and push out roots come from? Trace it back as far as you can.

5. Jar B had a damp towel just like jar A, but its dry seeds changed almost nothing. What does that tell you about what the water does, and what the water does not do, for the seeds?

- 6.** Write the word equation for cellular respiration. Next to each product and the energy, write the observation from this lab that is evidence for it. Which product did you have no evidence for, and how could you get some?

- 7.** If the sprouts kept growing in the dark, would the total dry mass of seed-plus-sprout go up, stay the same or go down? Explain where any missing mass would go.

- 8.** A gardener overwaters a potted plant until the soil is soaked for a week, and the plant dies even though it sits in a sunny window. Use what the jars showed to explain what happened to the roots.
