

Two Jars, One Lid: Does a Closed System Keep Its Mass?

Investigation question: If seeds sprout, leaves rot and water droplets form inside a sealed jar, does the jar's mass change, and how does an identical open jar behave over the same two weeks?

Physical model

Groups of 4

3 sessions

Setup 10 · Activity 65 · Cleanup 10 min

MS-LS2-3 · assesses

MS-LS1-6 · supports

Name _____

Group _____

Date _____

Your role today

- ☐ **Builder:** Measures and adds the soil, water, seeds and leaves to both containers in identical amounts and seals jar A with the lid and tape.
- ☐ **Mass recorder:** Zeroes the balance, masses each jar at every session, reads the display aloud to 0.1 g and records it. Masses each jar twice and records both.
- ☐ **Observer:** Writes the observations for both jars at every session: droplets, sprouts, color changes, mold, smell (open jar only), and takes or sketches a picture.
- ☐ **Checker:** Confirms the jars are labeled, returned to the same spot and not opened; checks each table row is complete before the group leaves.

Safety

- Mold will probably grow on the leaves. Do not open the sealed jar near your face; open it at the end only, at arm's length, and let any student with a mold allergy or asthma observe from a distance rather than handle the jars. Wear gloves and wash hands after every handling.
- Use plastic containers only; a dropped glass jar on a windowsill is a cut hazard.
- Potting soil can carry bacteria and fungi; keep it off faces, do not eat or drink during the lab, and wipe the bench afterward.
- Do not place a sealed jar in direct hot sun; heat can bulge the lid and the contents can spoil quickly.

Procedure

1. Label the containers A (sealed) and B (open) with your group name. Before adding anything, mass each empty container with its lid and record the values; this lets you check that the two jars start alike.
2. Build both jars exactly the same way: 1 cup of potting soil pressed level, 30 mL of water poured evenly over it, 20 seeds pressed lightly into the surface, and 2 crumbled dead leaves laid on top.
3. Put the lid on jar A and run tape around the seam so no air or water can leave. Put the lid on jar B only while carrying it, and remove it once the jar is in place; jar B stays open for the whole experiment.
4. Mass each finished jar twice (jar B with its lid off, the same way every time) and record both readings as day 0. Write the time of day. Record the first observations and make the day 0 drawing.

5. Fill in the boundary table: for each jar, decide what can cross its boundary (matter, energy, both, neither) and write a prediction with a reason for what each jar's mass will do over two weeks.
6. Place both jars side by side in the chosen spot. Nobody opens jar A, moves either jar to a different place, or adds anything to jar B until the last session.
7. Session 2 (day 3 to 5): mass each jar twice on the same balance, record, and write observations: droplets on the lid or walls, sprouts and their height, leaf color, mold, dryness of the soil surface in jar B.
8. Session 3 (day 10 to 14): mass each jar twice and record. Observe and make the final drawing. Compute the change in mass for each jar from day 0 to the final day using the average of the two readings each time.
9. With gloves on and the jar held at arm's length, open jar A over the bench. Note any smell, the wetness of the soil and the condition of the sprouts and leaves. Empty both jars into the compost or trash, wash the containers and your hands.
10. Answer the analysis questions on your own, then compare in your group and revise what you now disagree with.

Record your observations

Lab 2 recording sheet: Two jars, one lid

Mass each jar twice at every session and use the average. Jar B is always massed with its lid off. Record the date and time, because balances drift and so does the room.

Boundary table: what can cross?

System	Where is the boundary?	Can matter cross? (how)	Can energy cross? (how)	My prediction for its mass over two weeks, and why
Jar A (sealed)				
Jar B (open)				

Mass record (grams, to 0.1 g)

Session and date	Jar A reading 1	Jar A reading 2	Jar A average	Jar B reading 1	Jar B reading 2	Jar B average
Empty containers with lids, day 0						
Built jars, day 0						
Session 2, day ____						
Session 3, day ____						
Change, day 0 to final (final minus day 0)						

Observation record

Session	Jar A: droplets on lid or walls?	Jar A: sprouts (number, height), leaves, mold	Jar B: soil surface wet or dry?	Jar B: sprouts (number, height), leaves, mold
Day 0				
Session 2				
Session 3				

-  Draw jar A twice, side by side: on day 0 and on the final day. Label the soil, seeds or sprouts, leaves, water droplets and the air space, and draw the boundary as a heavy line. Add an arrow for each thing that crosses the boundary (light in, heat out) and write 'no matter crosses' on the lid.

1. Did the two jars start with the same mass within 1 g? If not, what might have differed, and does it matter for comparing the changes?

2. Describe the first change you could see in jar A and the first change you could see in jar B. Which cycle (water, carbon or nitrogen) does each belong to?

Analysis questions

3. Compute the change in mass for each jar from day 0 to the final session using the averages. Show the subtraction and state each result with its sign and unit.

4. Jar B's mass changed. Where did that matter go, in what form, and which process in the water cycle moved it across the boundary?

5. Inside jar A, seeds sprouted and leaves changed, yet its mass stayed within about 0.3 g of the start. Explain where the new sprout matter came from and where the leaf matter went, using the names of reservoirs inside the jar.

6. Is jar A a closed system for energy? Use the fact that the seedlings needed the windowsill, and the droplets on the lid, to support your answer.

7. Pool the class data: compute the average change in mass for all the A jars and for all the B jars. Why is the class average more trustworthy than your group's single pair?

8. Earth is like jar A, and the room is like the rest of the universe. Name two ways jar A is a good model of Earth as a system and two ways it is a poor one.

9. Suppose jar A were left sealed on the windowsill for a whole year. Predict what would happen to the sprouts, the leaves and the mass, and explain each prediction with a cycle.
