

The Ball That Got Heavier: Is Air Something?

Learning target: I can describe a puzzling observation about air and mass, and write a first explanation that I can test later.

Phenomenon exploration

About 25 min

Individual

MS-PS1-1 · supports

discussion

writing

Name _____

Date _____

Period _____

Directions

Read the description of the demonstration and study the figure. You will not be graded on whether your first explanation is right. You will be graded on how carefully you observe, how honestly you record what you already think, and how clearly you explain your reasoning. Answer every question in complete sentences.

You will need: This worksheet, Pencil

The demonstration

Ms. Ortega puts a flat basketball on a digital balance that reads to one tenth of a gram. The ball is limp but still holds its round shape because the leather is stiff. The balance reads **598.4 g**. She lifts the ball off, pumps forty strokes of air into it with a hand pump, wipes the needle dry, and puts the ball back on the same balance. Now it reads **603.1 g**. She pumps forty more strokes. The reading climbs again, to **607.7 g**. The ball looks exactly the same size as it did when it was flat; a tape measure around the middle gives the same 75 cm every time. Nothing was added that anyone could see.

Same ball, same size, different reading

Flat ball (0 pump strokes)

Balance reads 598.4 g

Distance around the ball: 75 cm

Feels soft when squeezed

Looks 'empty' inside

Pumped ball (40 pump strokes)

Balance reads 603.1 g

Distance around the ball: 75 cm

Feels hard when squeezed

Still looks 'empty' inside

Teaching data: the masses are invented to be realistic for a 7.1 liter ball, not measured in a real lab.

Part A: Notice and wonder

1. List three things you **notice** in the description or the figure. Use only facts that were observed or measured, not explanations. Include at least one number.

2. Write two questions you **wonder** about. At least one should be a question that could be answered by doing another measurement.

3. How much mass did the first forty pump strokes add? How much did the second forty strokes add? Show your subtraction for both.

Part B: What do you already think?

4. Which statement is closest to what you believe **right now**? Circle one. (There is no penalty for a wrong choice; this is a snapshot of your thinking.)

- ☐ **A.** Air is not matter; the pump must have pushed in tiny bits of dust or oil.
- ☐ **B.** Air is matter made of particles that are too small to see, and each particle has mass.
- ☐ **C.** The balance makes a mistake whenever an object is under pressure.
- ☐ **D.** The leather absorbed water from the pump and got heavier.

5. Pick a different option from the one you circled in q4. What observation from the demonstration makes that option hard to believe?

Part C: Your first explanation

6. Explain why the balance reading went up even though the ball looked the same and nothing visible was added. Your explanation must (a) say what the pump put into the ball, (b) say why that thing cannot be seen, and (c) say why the ball got harder to squeeze.

7. Predict: if Ms. Ortega opened the valve and let all the air hiss out, what would the balance read? Explain your prediction in one sentence.

8. A switched-off neon sign looks like an empty glass tube, yet it glows red when electricity flows through it. How is the neon tube like the basketball?

Sentence starters for Part C

If you are stuck on q6, begin with: 'The pump pushed _____ into the ball. We cannot see it because _____. The ball got harder because more _____ were packed into the same space, so they _____ against the inside of the ball.' Replace the blanks with your own ideas; you may cross out any starter that does not fit your thinking.

Design a check

The flat ball and the pumped ball have the same size, so the air around them pushes up on both equally. Now imagine the same experiment with a stretchy party balloon instead of a rigid ball. The inflated balloon is much bigger than the empty one. Write a short paragraph predicting whether the balance would show the full mass of the air that was blown in, more than that, or less than that, and why a bigger object in air might read differently. (Hint: think about why a helium balloon rises.)