

The Case of the Missing Mass

Properties of Matter & Conservation of Mass: Develop a model showing that matter is made of particles too small to be seen; measure and graph to show that the total weight of matter is conserved when substances are heated, cooled, or mixed; identify materials by their properties; and investigate whether mixing substances forms new substances.

Learning target: I can measure and describe properties of matter and explain why mass stays the same when matter changes.

Success looks like: Students use the vocabulary correctly, complete the mystery case, and score 80% or higher on the evidence-based exit ticket.

Materials: Student devices, the printed lesson worksheet (one per student), projector for the mini-lesson presenter.

LESSON AT A GLANCE

60 minutes

Time	Part	Teacher does	Students do
0:00-0:08	Warm-up	Project the warm-up. Circulate, then call on 2-3 students. Save question 3 for the debrief.	Answer Part 2 of the lesson worksheet; share with a partner.
0:08-0:20	Mini-lesson	Teach with the 4-step presenter. Run each quick check with the whole class.	Complete worksheet Parts 4-11 as each slide appears; answer checks with fingers.
0:20-0:48	Mystery Case	Launch The Case of the Missing Mass. Assign mission levels; circulate with the answer key.	Play solo or in pairs; record code pieces; complete any written evidence task.
0:48-0:52	Debrief	Ask 2 debrief questions and revisit warm-up question 3.	Finish worksheet Part 13 (prediction check + one thing learned).
0:52-1:00	Exit ticket	Hand out the exit ticket. Collect and sort with the mastery guide.	Answer with evidence independently.

Key vocabulary

Word	Student-friendly definition
Matter	Anything that has mass and takes up space.
Mass	The amount of matter in an object, measured in grams (g).
Volume	The amount of space something takes up, measured in mL or cm ³ .
Physical change	A change in size, shape, or state that makes no new substance.
Chemical change	A change that makes a new substance (clues: gas, color change, heat, light).

Word	Student-friendly definition
Conservation of mass	In a closed system, mass before a change equals mass after.

1. WARM-UP

0:00–0:08 · 8 min

Warm-up expectations (post these): Answer in Part 2 of the lesson worksheet (or on this sheet). Number each answer to match the question. Answer in complete sentences. For math, show your work. Work silently for 5 minutes, then share with a partner for 2 minutes. Be ready to share one answer with the class.

#	Question	Look for
1	List three properties you could use to describe a rubber ball.	Any three: color, shape, size, texture, bounciness (elasticity), mass, volume, hardness.
2	A backpack has a mass of 3 kg. You put a 1 kg book inside. What is the total mass? Explain how you know.	4 kg. Masses add: $3\text{ kg} + 1\text{ kg} = 4\text{ kg}$. Nothing was taken away.
3	Predict: If you melt a 50 g ice cube in a sealed bag, will the water weigh more, less, or the same? Why?	The same, 50 g. No matter entered or left the sealed bag; the water just changed state.

2. MINI-LESSON

0:08–0:20 · 12 min

Project the Lesson presenter from the room page. It runs the whole hour: target and agenda, warm-up with timer, hook vote, 4 teaching steps (key idea, interactive tool, turn and talk, check for understanding), I do / we do / you do, a work-time screen with a timer and expectations, debrief, and the exit ticket. Press N for teacher notes, T to pause the timer, and P to pick a student.

Hook (1 min): A 50-gram ice cube melts inside a sealed bag. What will the water weigh? Class vote: More than 50 g / Exactly 50 g / Less than 50 g

Step 1 (3 min): Matter has properties

Teach	Matter is anything with mass that takes up space. We describe it by properties we observe (color, hardness) and test (magnetism, conductivity, solubility).
Interactive tool	Visual: Liquid volume: read the bottom of the curve at eye level
Students do	List 3 properties of your pencil (color, hardness, shape, texture...).
Turn and talk	Is air matter? How could you prove it to someone who says no?
Worksheet Part 5A	Matter is anything that has MASS and takes up SPACE. We can test properties like magnetism, conductivity, and SOLUBILITY.
Check for understanding	Which property tells if a substance dissolves in water? Answer: (C) Solubility

Step 2 (3 min): Measure mass and volume

Teach	Mass is measured in grams on a balance. Liquid volume is measured in milliliters with a graduated cylinder. A box shape's volume is length $\times$ width $\times$ height.
Interactive tool	Visual: Volume of a box: $3 \times 2 \times 2$
Students do	Read the cylinder in the picture and write its volume in mL. Then find the box's volume: $3 \times 2 \times 2$.
Turn and talk	Why do scientists measure mass with a balance instead of just guessing by how big something looks?
Worksheet Part 6A	Mass is measured in GRAMS with a BALANCE. Liquid volume is measured in MILLILITERS with a graduated cylinder.
Check for understanding	What is the volume of the box shown in the tool? (cubic centimeters) Answer: 12

Step 3 (3 min): Physical vs. chemical change

Teach	A physical change changes size, shape, or state but makes no new substance. A chemical change makes a new substance. Clues: gas bubbles, new color, new smell, light, heat.
Interactive tool	Flip cards: Ice melting, Bread toasting, Paper cut in half, Iron rusting
Students do	Make two columns, Physical and Chemical. Sort the four flip cards.
Turn and talk	Melting ice and burning wood both change. What is the key difference between them?
Worksheet Part 7A	A PHYSICAL change makes no new substance. A CHEMICAL change makes a new substance. Clues include gas BUBBLES and a new color.
Check for understanding	Baking soda and vinegar fizz. Which kind of change is it? Answer: (D) Chemical, because a new gas forms

Step 4 (3 min): Conservation of mass

Teach	In every change, particles are rearranged, not created or destroyed. In a closed system, mass before equals mass after. If gas escapes an open cup, the scale drops, but the matter still exists.
Interactive tool	Simulation: Fizz it open, then sealed. Watch the scale.
Students do	Predict what the scale will show, open and sealed. Then watch and check.
Turn and talk	The open cup lost mass. Where did that matter go? Is it gone forever?
Worksheet Part 8A	In a CLOSED system, the mass before a change EQUALS the mass after. If a gas escapes, the scale reading goes DOWN.
Check for understanding	Sealed flask: 200 g before fizzing. What does it weigh after? Answer: (D) 200 g

I do: worked example (shown one step at a time)

1. Problem: 30 g of water + 5 g of salt are stirred together. The salt seems to disappear. What is the total mass?
2. Step 1: The salt particles did not vanish. They spread out through the water.
3. Step 2: Nothing left the cup, and nothing was added.
4. Step 3: $30\text{ g} + 5\text{ g} = 35\text{ g}$.
5. Answer: 35 g. Mass is conserved.

What to say on every slide is in the presenter script PDF.

We do: guided practice

A sealed bag holds 40 g of vinegar and 5 g of baking soda. They fizz and the bag puffs up. What does the bag weigh now?

1. Find the starting mass: $40\text{ g} + 5\text{ g} = 45\text{ g}$.
2. Is the system open or closed? The bag is sealed, so it is closed.
3. The fizzing made a new gas (a chemical change), but the gas is trapped in the bag.
4. Nothing entered or left, so the mass stays the same.

Answer: 45 g

You do: independent check (2 min)

An OPEN cup holds 150 g of water and a 10 g antacid tablet. After fizzing, the scale reads 157 g. What happened to the other 3 g? (A) The scale is broken (B) It turned into water (C) It escaped into the air as a gas (D) It was destroyed

Answer: (C) It escaped into the air as a gas. Students who miss it: 3-minute reteach at the teacher table, then start the room at the Explorer level.

Misconception: "Dissolved things disappear and have no mass." The particles are still there and still have mass.

Misconception: "Gas has no mass." Gas is matter. When it escapes an open container, the scale drops because matter left.

Misconception: "Ice weighs more than water because it is solid." Freezing changes volume a little, but mass stays the same.

3. MYSTERY CASE: THE CASE OF THE MISSING MASS

0:20–0:48 · 28 min

Launch: project the start screen, read the story aloud, and assign mission levels (Explorer = extra support, Agent = on level, Legend = challenge). Students can open Supports any time for read-aloud, bigger text, a word bank, and a scratch pad.

- Evidence files can be opened in any order. Tell students detectives always read the whole file before answering.
- Pairs can be "lead detective" and "note taker." The note taker records the code pieces as they are found.
- For the debrief, ask students which piece of evidence was most convincing and why.

Students turn in: the completion code plus their copied "turn in your work" block (Canvas Text Entry).

4. DEBRIEF

0:48–0:52 · 4 min

1. Go back to the hook question. What will the melted ice cube weigh, and how do you know?
2. Which puzzle made you rethink an idea you had about matter?
3. Why do scientists seal a container when they test conservation of mass?

Close the loop: return to warm-up question 3. Answer: The same, 50 g. No matter entered or left the sealed bag; the water just changed state.

5. EXIT TICKET

0:52–1:00 · 8 min

Print the exit ticket PDF (page 2 is the key and mastery guide). Every item requires evidence: Part A asks students to justify each choice, Part B asks for an explanation, and Part C applies the standard to a new situation using Claim-Evidence-Reasoning. Sort results into Mastered, Approaching, and Beginning to plan tomorrow's groups.

LESSON RESOURCES

Resource	How it fits the lesson
Warm-up worksheet (PDF)	Optional standalone warm-up (also Part 2 of the lesson worksheet), with a key.
Mini-lesson presenter	Projectable, step-by-step interactive lesson with tools and quick checks (room page).
Lesson worksheet (PDF + key)	One printable packet students complete during the whole lesson: short fill-ins and quick checks in 13 small parts that match the presenter slides.
The Case of the Missing Mass (.html)	The mystery case for Canvas, with differentiated levels, supports, and a turn-in.
Exit ticket (PDF + key)	Evidence-based check with a rubric and a mastery sorting guide.
PhET: Density and States of Matter (extra)	Free browser simulations for mass, volume, and states of matter. https://phet.colorado.edu/
Mystery Science: Chemical Magic (extra)	Short video-led lessons on mixtures and reactions (free tier available). https://mysteryscience.com/
Crash Course Kids (extra)	Five-minute videos on matter and conservation of mass. https://www.youtube.com/@crashcoursekids
PBS LearningMedia (extra)	Search "conservation of mass grade 5" for clips and interactives. https://www.pbslearningmedia.org/

ANSWER KEY: THE CASE OF THE MISSING MASS

Evidence File #1: Suspect 1: The Vanishing Sugar (code piece: S)

1. What really happened to the sugar? -> It dissolved and spread out evenly in the water
2. If Maya added another 15 g of sugar, what would the scale read? -> 295 g
3. True or false: Dissolving is a physical change. -> True

Evidence File #2: Suspect 2: The Shrinking Snowman (code piece: C)

1. What would the scale read after the snow melted in the sealed container? -> 620 g
2. What mistake did Jamal make? -> He confused volume (space) with mass (amount of matter)

Evidence File #3: Suspect 3: The Magic Fizz (code piece: A)

1. How many grams of matter seemed to "disappear"? -> 2 g
2. Where did the 2 grams go? -> Gas bubbles escaped into the air
3. How could Lily redesign her experiment to prove mass is conserved? -> Do it in a sealed bottle with a balloon on top

Evidence File #4: The Clue Sort (code piece: L)

1. Sort each science fair observation. -> Physical change: Crushing a can, Glass shattering, Butter melting, Sugar dissolving | Chemical change: A banana turning brown, Milk souring and smelling bad, Fireworks exploding, Steel wool rusting

Evidence File #5: The Final Report (code piece: E)

1. Which statement should go in your report? -> Matter was not destroyed in any project. It dissolved, changed state, or escaped as a gas.
2. A sealed bag has 60 g of vinegar and 10 g of baking soda. What will it weigh after fizzing? (Enter grams.) -> 70 g
3. The judge's report is almost done. Tap the sentence that explains where Lily's "missing" mass went. -> "Lily's fizzing made a gas that escaped into the air."
4. Final report for the judge: Did Lily's fizzing experiment really make 2 grams of matter disappear forever? Write a claim, evidence, and reasoning. -> Written response (CER). Model: I claim that Lily's matter did not disappear. The missing 2 grams escaped into the air as a gas. The tablet and water started at $5\text{ g} + 100\text{ g} = 105\text{ g}$, but "The open cup then weighed 103 g" after it fizzed. This happens because fizzing is a chemical change that makes a new gas. The cup was open, so the gas escaped. In a closed system, conservation of mass means it would still weigh 105 g.

Final code: SCALE