Solutions Can Change Look, Not Matter

Date Created: August 31, 2026
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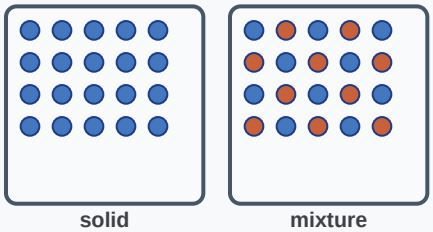
Lesson:

Read the passages and examples below to review how matter stays the same when substances dissolve into a solution. Then, for each question, find the mistake in the student's claim and fix it. Start your answers with these sentence starters: "The error is…" and "The evidence that matter is conserved is…"

> When a substance dissolves, it may seem to disappear. It does not vanish. It spreads out in the liquid, so you cannot see it easily.

Same sugar, spread out



solid
Before: sugar grains in

mixture
After: sugar spread

The same amount of sugar is in both boxes. After mixing it is spread out, so you cannot see it.

> Before mixing, substances have their own properties. Sugar crystals look grainy, salt looks tiny and white, and hot chocolate mix looks powdery. Water is clear and flows easily.

After mixing, the new solution can look different. Lemonade may look cloudy or pink, and hot chocolate may turn brown. The liquid changes in appearance, but the matter is still there.

What changes and what stays the same

Changes when it dissolves
how the drink looks
you can no longer see the grains
the color of the liquid

Stays exactly the same
the total mass
the amount of matter
the substances are still there

Dissolving changes what you SEE. It does not change how much matter is there.

A good clue is mass. If you measure the substances before mixing and then measure the solution after mixing, the total mass stays the same if nothing is lost. Matter is conserved.

The scale tells the truth

	Mass before mixing	Mass after mixing
Lemonade	10 g sugar + 150 g water = 160 g	160 g of lemonade
Salt water	6 g salt + 120 g water = 126 g	126 g of salt water
Hot chocolate	8 g mix + 180 g milk = 188 g	188 g of hot chocolate

The mass after mixing equals the mass before. Nothing was lost - you just cannot see it any more.

If a student says the sugar disappeared in lemonade because it cannot be seen, that is an error. The sugar is still in the lemonade, just spread out evenly. The evidence is the same total mass before and after mixing.

> In a swimming pool, a small amount of pool cleaner can dissolve in water. The cleaner may not be visible, but it does not disappear. It becomes part of the solution and still has mass.

Sugar: 5 grams + water: 100 grams = before mixing total: 105 grams. After mixing, lemonade still has 105 grams if nothing spills.

Salt: 3 grams + water: 200 grams = before mixing total: 203 grams. After mixing, the salty water still has 203 grams.

Hot chocolate mix: 8 grams + milk: 120 grams = before mixing total: 128 grams. After mixing, the drink still has 128 grams if all of it stays in the cup.

Instructions:

Read each student claim carefully. Find the mistake, explain it, and give the correct science idea. Use mass before and after mixing as evidence in your answer.

1. Mia mixes 5 grams of sugar with 100 grams of water for lemonade. She says, 'The sugar disappeared because I cannot see it anymore.' What is the error in Mia's thinking, and what is the correct idea?

2. A student mixes 3 grams of salt with 200 grams of water. They write, 'The water now weighs 200 grams, so the salt must be gone.' What is wrong with this claim? Give the correct total mass after mixing.

3. A student says the lemonade has more mass because it has more liquid. Is the student correct? Compare these two cases: a lemonade pitcher with 7 grams of sugar and 93 grams of water, and a hot chocolate mug with 9 grams of mix and 91 grams of milk. Explain why the student is right or wrong.

4. A pool cleaner mix starts with 2 grams of cleaner and 50 grams of water. A student says, 'Because the cleaner cannot be seen, the total mass is only 50 grams now.' What does this situation show about matter in solutions?

5. A student says, 'Lemonade can look cloudy after mixing, so its matter changed into something new.' Why is this explanation not correct?

6. At home, 4 grams of hot chocolate mix are stirred into 96 grams of milk. The cup still has all of its drink. A student says, 'The mix is gone because I cannot see the powder.' What should you say to correct the student?

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(Answer Key)

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1. Mia mixes 5 grams of sugar with 100 grams of water for lemonade. She says, 'The sugar disappeared because I cannot see it anymore.' What is the error in Mia's thinking, and what is the correct idea?
Hint: Use the total mass before and after mixing.

Expected Key Points:
- States that the sugar did not disappear
- Explains that it dissolved and spread out in the water
- Uses mass before and after as evidence that matter is conserved

Evaluation Criteria: Full credit if the response identifies the error, explains that dissolved sugar is still present, and uses the unchanged total mass as evidence. Partial credit for naming only one correct idea.

Explanation: Sugar does not disappear when it dissolves. It spreads out in the water, so it is harder to see. The total mass stays the same if nothing is lost.

2. A student mixes 3 grams of salt with 200 grams of water. They write, 'The water now weighs 200 grams, so the salt must be gone.' What is wrong with this claim? Give the correct total mass after mixing.
Hint: Add the masses before mixing.

Expected Key Points:
- Explains that the salt is still in the solution
- Adds 3 grams and 200 grams correctly
- Gives 203 grams as the total mass after mixing

Evaluation Criteria: Full credit if the student says the salt is still there and gives 203 grams. Partial credit for correct reasoning without the final number, or correct number without explanation.

Explanation: The claim is wrong because the salt did not vanish. If nothing spills, the total mass after mixing is 203 grams.

3. A student says the lemonade has more mass because it has more liquid. Is the student correct? Compare these two cases: a lemonade pitcher with 7 grams of sugar and 93 grams of water, and a hot chocolate mug with 9 grams of mix and 91 grams of milk. Explain why the student is right or wrong.
Hint: Add the masses in each case.

Expected Key Points:
- Adds 7 grams and 93 grams to get 100 grams
- Adds 9 grams and 91 grams to get 100 grams
- Compares the totals correctly
- Explains that the student is wrong because the totals are equal, so neither case has more mass

Evaluation Criteria: Full credit: student correctly finds both totals, states that the totals are equal, and explains why the student's claim is wrong. Partial credit: student gets one correct total or makes a mostly correct comparison with a small error. No credit: student only repeats the prompt, gives no totals, or compares only one ingredient.

Explanation: The student is not correct. The lemonade total is 100 grams because 7 + 93 = 100. The hot chocolate total is also 100 grams because 9 + 91 = 100. The totals are equal, so neither case has more mass. Total mass depends on all the materials added together.

4. A pool cleaner mix starts with 2 grams of cleaner and 50 grams of water. A student says, 'Because the cleaner cannot be seen, the total mass is only 50 grams now.' What does this situation show about matter in solutions?
Hint: Think about what the cleaner does in the water.

Expected Key Points:
- States that the cleaner dissolves but does not disappear
- Uses the total starting mass of 52 grams
- Explains that matter is conserved

Evaluation Criteria: Full credit if the student explains that the cleaner is still present and gives the correct total mass. Partial credit for either the concept or the number.

Explanation: This shows that matter is conserved. The cleaner dissolves, but it is still there in the solution, so the total mass is 52 grams if nothing is lost.

5. A student says, 'Lemonade can look cloudy after mixing, so its matter changed into something new.' Why is this explanation not correct?
Hint: Think about appearance versus mass.

Expected Key Points:
- Explains that appearance changed, not the matter itself
- Mentions that the dissolved substance is still present
- References unchanged mass or conservation of matter

Evaluation Criteria: Full credit if the response says a new look does not mean new matter. Partial credit for noting only that the look changed.

Explanation: The look of the lemonade can change, but the matter is still there. The sugar or mix is spread out in the liquid, and the total mass stays the same if nothing spills.

6. At home, 4 grams of hot chocolate mix are stirred into 96 grams of milk. The cup still has all of its drink. A student says, 'The mix is gone because I cannot see the powder.' What should you say to correct the student?
Hint: Use the mass before mixing.

Expected Key Points:
- States that the powder dissolved, not vanished
- Gives the total mass of 100 grams
- Connects the idea to matter staying conserved

Evaluation Criteria: Full credit if the student corrects the claim and gives the mass after mixing. Partial credit for a correct explanation without the number, or vice versa.

Explanation: You should say the powder dissolved and spread out in the milk. It is still in the drink, and the total mass is 100 grams if nothing is lost.