Density Detectives

Ask how heat and pressure change the density of air.

P.7.5B.3 "Ask questions to explain how density of matter (observable in various objects) is affected by a change in heat and/or pressure."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each change in heat or pressure, circle words that tell what happens to mass or volume, and number the four examples. Use your marks to help you ask questions about density.

Air That Rises, Sinks, and Squeezes

1. At a summer fair, a burner warms the air inside a hot-air balloon. The warmed air spreads out, so each liter inside the balloon contains less mass than a liter of cooler air outside. Air can leave through the opening at the bottom, so the balloon does not simply trap more and more air as it heats. With less mass packed into the same amount of space, the air inside is less dense and the balloon can rise. The fabric and basket still add weight.

2. Cold air can show the opposite pattern. Open a freezer door and you may feel a stream of chilly air near your feet. As air cools, its particles move more slowly, and a given amount of air can take up less space when outside pressure stays about the same. The mass of that amount of air has not changed, but it occupies a smaller volume and becomes denser. This helps explain why the cooled air moves downward past warmer air in the room.

3. Heat is not the only change that matters. Imagine a clear syringe with its tip sealed and air trapped inside. Pushing the plunger increases the pressure on the trapped air. Its mass stays the same, but its volume shrinks, so its density rises. Pulling the plunger lowers the pressure and lets the same air spread out, lowering its density. A bubble rising through water can also expand as surrounding pressure drops, if its gas stays inside. A larger volume with the same mass means lower density.

2 ANSWER WITH EVIDENCE

Use the passage

1. Write a question about how the burner changes the density of air inside the balloon. Then answer it using mass and volume.

2. Write a question about how cooling changes the density of air near the freezer. Then answer it using mass and volume.

3. Write a question about how pushing the syringe plunger changes the trapped air's density. Then answer it using mass and volume.

4. Write a question about how a drop in pressure affects the density of a bubble rising through water. Then answer it using mass and volume.

3 YOUR TURN

Your own words

Choose a gas-filled object not named in the passage, and assume no gas escapes. Write one question about heating its gas and one about increasing the pressure on its gas. Answer both using mass and volume.

ANSWER KEY

Density Detectives

GRADE 7 · P.7.5B.3

PART 1 · READ AND MARK

Underline each change in heat or pressure, circle words that tell what happens to mass or volume, and number the four examples. Use your marks to help you ask questions about density. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Write a question about how the burner changes the density of air inside the balloon. Then answer it using mass and volume.	**Question: How does heating the air change its density? Answer: The warm air spreads out, and some leaves the balloon. Each liter contains less mass, so the air inside is less dense.**
2	Write a question about how cooling changes the density of air near the freezer. Then answer it using mass and volume.	**Question: Why does cooling make the air near the freezer denser? Answer: A given amount of air keeps the same mass but takes up less volume, so its density increases.**
3	Write a question about how pushing the syringe plunger changes the trapped air's density. Then answer it using mass and volume.	**Question: What happens to the trapped air's density when the plunger raises the pressure? Answer: Its mass stays the same while its volume shrinks, so its density increases.**
4	Write a question about how a drop in pressure affects the density of a bubble rising through water. Then answer it using mass and volume.	**Question: How can lower pressure change the rising bubble's density? Answer: If its gas stays inside, the bubble expands. The same mass fills more volume, so its density decreases.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I chose a flexible, sealed plastic bag filled with air. How would heating the air change its density if the pressure around the bag stayed the same? The air would spread out, so the same mass would fill more volume and become less dense. What would happen if I squeezed the bag without heating it? The pressure on the air would rise. The same mass would fill less volume, making the air denser.

Accept questions phrased differently if they connect a specific heat or pressure change to density. Explanations should correctly relate mass and volume, and the bubble answer should account for the gas staying inside.