**Increasing the pressure**

This balloon is filled with air.

The air inside the balloon has pressure.

Which of these will increase the pressure of air in the balloon?

**Put a tick** *(✓)* **next to all the correct answers.**

|  |  |  |
| --- | --- | --- |
| Higher  **A**  temperature | More air  added | Balloon is  **C**  squashed |
|  | **B** |  |

*Physics > Big idea PMA: Matter > Topic PMA4: Particle explanations > Key concept PMA4.2: Pressure*

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| --- |
| **Diagnostic question** |
| **Increasing the pressure** |

**Overview**

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| --- | --- |
| Learning focus: | The pressure of a fluid is a measure of how hard its particles are pushing each other apart, and it is proportional to the size of the force exerted by the fluid on a surface. |
| Observable learning outcome: | Identify factors that can increase the pressure of a fluid. |
| Question type: | Simple multiple choice |
| Key words: | Pressure, quantity, temperature, volume |

|  |  |
| --- | --- |
| **P** | **PRIOR UNDERSTANDING**  This diagnostic question probes understanding of ideas that are usually taught at age 11-14, to aid transition from earlier stages of learning. |

**What does the research say?**

Students generally understand increases in pressure, such as when a tyre is inflated, and make links between the amount of a gas squashed into a container and its pressure (Sere, 1985; Besson, 2004).

In a study of students age 17-18 (n = 378) Sanger et al. (2013) found that 85% understood how particle speeds increased with temperature, but only about half correctly described how this changed the pressure of gas inside a container.

In a separate study, of students age 15 (n=120), Besson (2004) found that 64% understood that when a gas is squashed its pressure increases and its volume decreases. In contrast, 28% of the sample thought that the volume of a gas does not change when it is squashed.

**Ways to use this question**

Students should complete the question individually. This could be a pencil and paper exercise, or you could use an electronic ‘voting system’ or mini white boards and the PowerPoint presentation.

The answers to the question will show you whether students understood the concept sufficiently well to apply it correctly.

If there is a range of answers, you may choose to respond through structured class discussion. Ask one student to explain why they gave the answer they did; ask another student to explain why they agree with them; ask another to explain why they disagree, and so on. This sort of discussion gives students the opportunity to explore their thinking and for you to really understand their learning needs.

*Differentiation*

You may choose to read the questions to the class, so that everyone can focus on the science. In some situations it may be more appropriate for a teaching assistant to read for one or two students.

**Expected answers**

A, B and C all cause the pressure to increase.

**How to respond - what next?**

Increasing the temperature of air makes particles of air move more quickly on average. The particles push apart with more force when they collide and they collide more often, which increases the pressure of the air. As increased pressure inside the balloon makes it expand, some students may think that pressure is reduced because particles are further apart. Others may think that pressure is the same as before because the balloon is ‘in balance’ with the pressure of air around it, and may not have taken into account the extra force of the balloon compressing the gas that is caused by its further expansion.

Most students will understand that adding more air increases pressure of the balloon, although some may think that pressure remains the same for the reasons described above.

A significant minority of students are likely to have the misunderstanding that squashing a gas does not change its volume. Some of these students may still hold the naïve view that particles of air are embedded in a gas that fills the space between them. Others may think that the separation of particles is determined only by temperature and that squashing the balloon shifts the position of air particles, but does not change its overall volume.

If students have misunderstandings about the factors that can increase the pressure of a fluid, it can help to challenge their misunderstanding by showing demonstrations of how different factors affect the pressure of a gas:

* Taking a partially inflated balloon out of a freezer and placing it in a bowl of hot water shows an increase in pressure as the air pushes on the balloon with more force.
* Blowing up a balloon adds air and again shows an increase in pressure as the air pushes on the balloon with more force.

*(N.B. The effect of pressure on a balloon is more obvious when a previously inflated balloon is used that has lost some of its elasticity.)*

* Squashing air in a sealed syringe demonstrates that squashing a gas increases the pressure of the gas as the air pushes on the plunger with more force.

N.B. In each of these demonstrations it is important to distinguish between the pressure that the air has, and the force that the air exerts on the walls of the balloon or the plunger of the syringe. Pressure is an intensive property of the air, and force is the result of an interaction between the air and a surface.

**Acknowledgments**

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Images: Peter Fairhurst (UYSEG).

**References**

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