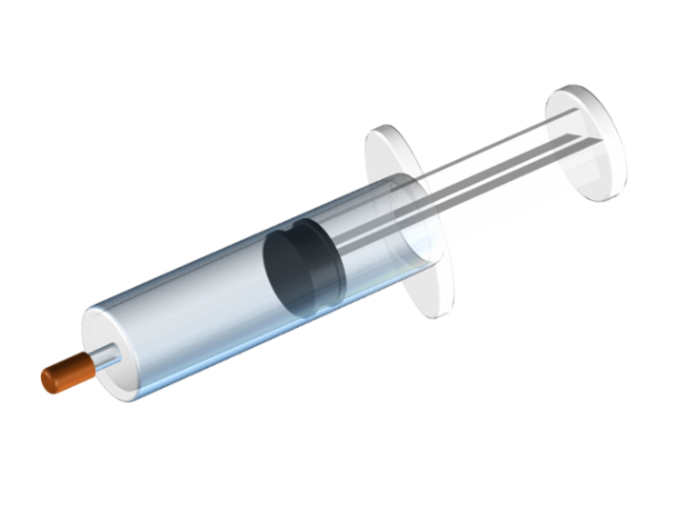
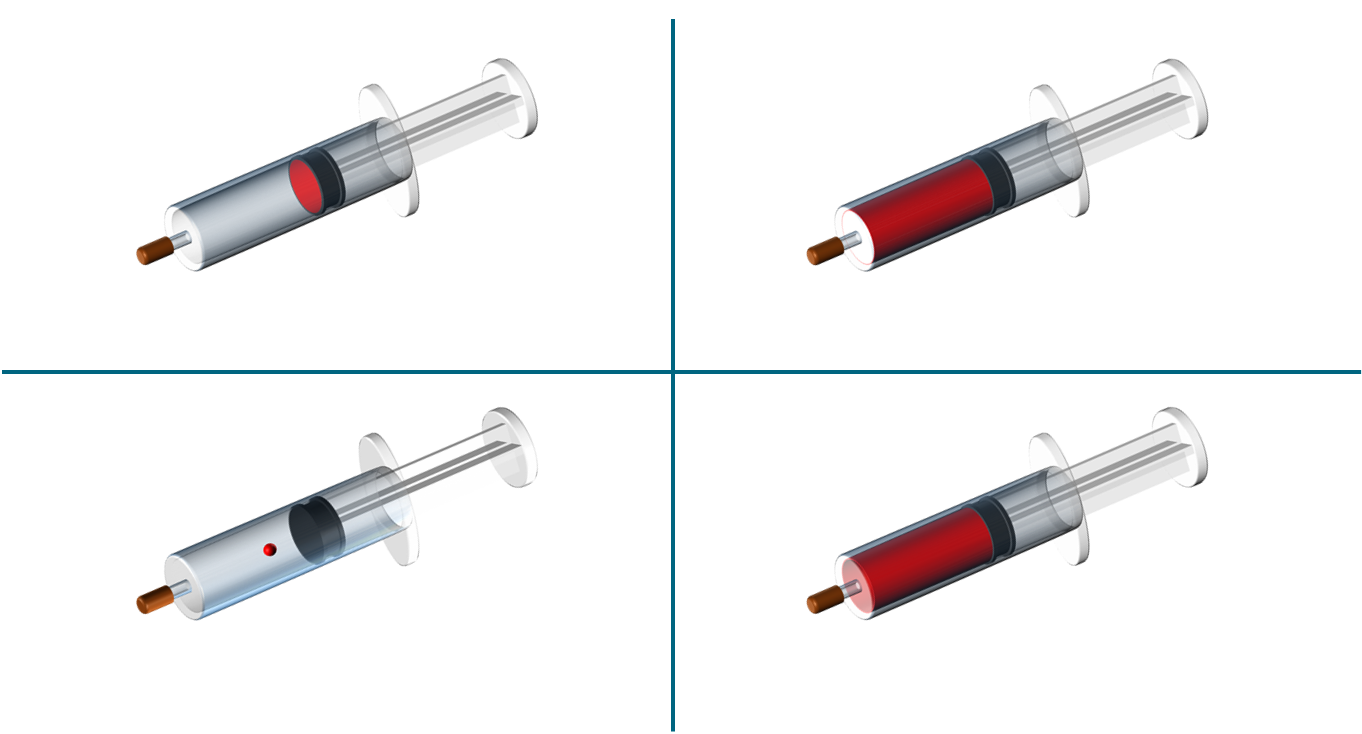
**More pressure**

Air is squashed in a sealed syringe.

The more the air is squashed; the bigger the pressure the air has.



Where in the syringe does the air have the biggest pressure?



**A** At the end of the plunger.

**B** At the edge of the barrel.

**C** In the middle of the syringe.

**D** Same pressure everywhere.

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

|  |
| --- |
| **Diagnostic question** |
| **More pressure** |

**Overview**

|  |  |
| --- | --- |
| 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: | Explain why the pressure of a fluid is a scalar quantity that is equal in all directions. |
| Question type: | Simple multiple choice |
| Key words: | Pressure, particle |

**What does the research say?**

Psillos (1999) examined how textbooks develop an understanding of pressure and found that they nearly always introduce pressure as a measure of how concentrated a force is and use the equation ‘P=F/A’ to define it. Usually, examples of solids pushing down onto a surface are used to consolidate understanding and in these examples surface pressure is a vector quantity acting in one direction. From such an introduction, students can interpret pressure wrongly as a ‘pressing force’ and may (as some textbooks do) describe a fluid ‘exerting a pressure’.

In contrast to pressure between solid surfaces, pressure in a fluid is a scalar quantity, yet few students think of pressure acting in all directions in air or water (Driver et al., 1994).

Following large scale studies of students’ conceptions about gases (n=600, age 11-13) and fluids (n=944, age 14-20) by Séré (1986) and Besson (2004) respectively, both researchers conclude that there is a need for students to systematically reason how the motion of particles cause pressure effects, as a preliminary step in the study of pressure. Ideas about the movement of particles in a fluid can then be used to explain why the force on a surface, F = P x A.

This question explores how students apply an understanding of the particle model to a gas that 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 answer**

D Same pressure everywhere.

**How to respond - what next?**

Particles in a gas are in constant motion and frequently bounce off each other in random directions to spread evenly throughout a container. If a gas is squashed, its particles quickly scatter off each other to spread out evenly again, in all directions.

Pressure in a gas can be thought of as a measure of how hard its particles are pushing each other apart. If pressure in one part of a gas is increased, scattering of particles quickly evens out pressure throughout the gas.

Students who think about pressure as a pressing force may choose answers A or B. The end of the plunger (A) is the area over which force is applied to the gas, and the side of the barrel (B) is the area over which the compressed gas presses with a force.

A few students may choose answer C because they think squashing forces all push towards the centre, or they may have a mental image of particles bouncing off the sides of the syringe and clashing more often in the centre.

If students have misunderstandings about why the pressure of a fluid is a scalar quantity that is equal in all directions and the same size throughout a compressed gas, it can help to revise understanding of the particle model of liquids and gases. Careful questioning can elicit understanding of how squeezing a liquid or gas in one direction causes the movement of particles in all directions through the fluid, until they are evenly spaced out and pressure is equal throughout the fluid.

The following BEST ‘response activities’ could be used in follow-up to this diagnostic question:

* Response activity: Gas pressure
* Response activity: Bottled gas

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Image: Peter Fairhurst (UYSEG).

**References**

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