

Physics &gt; Big idea PMA: Matter &gt; Topic PMA4: Particle explanations



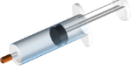

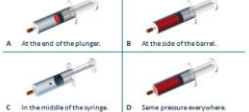




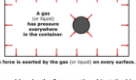



## Key concept (age 14-16)

### PMA4.2: Pressure

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.				
As students' conceptual understanding progresses they can:	<div> <div>CONCEPTUAL PROGRESSION</div> <div></div> </div>				
	Identify factors that can increase the pressure of a fluid. <b>P</b>	Explain why the pressure of a fluid is a scalar quantity that is equal in all directions.	Explain the effect of temperature change on the pressure of a fixed volume of fluid.	Distinguish between pressure and force.	Interpret the equation $F = P \times A$ .
Diagnostic questions	Increasing the pressure	Squashing air More pressure	Hot air Cold air	Doubling up	Force and pressure
Response activities		Gas pressure Bottled gas		Big fish, little fish	

Key:

**P** Prior understanding from earlier stages of learning

Increasing the pressure	Squashing air	More pressure	Hot air	Cold air																																													
<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Increasing the pressure</b></p> <p>This balloon is filled with air. The air inside the balloon has pressure.</p>  <p>Which of these will increase the pressure of air in the balloon? Put a tick (✓) next to all the correct answers.</p> <p>A Higher temperature <input type="checkbox"/> B More air added <input type="checkbox"/> C Balloon is squashed <input type="checkbox"/></p>  <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Squashing air</b></p> <p>Air is trapped in a sealed syringe. The more the air is squashed, the bigger the pressure the air has.</p>  <p>These statements are about what happens when air is squashed in the syringe. For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I think this is wrong</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A Particles of air are pushed closer together using the length of the syringe.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Particles of air are pushed closer together across the width of the syringe.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Particles of air in the syringe bounce off each other harder in all directions.</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>		I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A Particles of air are pushed closer together using the length of the syringe.					B Particles of air are pushed closer together across the width of the syringe.					C Particles of air in the syringe bounce off each other harder in all directions.					<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>More pressure</b></p> <p>Air is trapped in a sealed syringe. The more the air is squashed, the bigger the pressure the air has.</p>  <p>Where in the syringe does the air have the biggest pressure?</p> <p>A At the end of the plunger <input type="checkbox"/> B At the side of the barrel <input type="checkbox"/></p>  <p>C In the middle of the syringe <input type="checkbox"/> D Same pressure everywhere. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Hot air</b></p> <p>The lid on this can is airtight. Air is trapped in the can. The balls represent particles that the air is made of. The air in the can is at room temperature.</p>  <p>The temperature of the air in the can is increased by heating.</p> <p>1. What happens to the speed of the particles of air? Put a tick (✓) in the box next to the best answer.</p> <p>A The particles move more quickly. <input type="checkbox"/></p> <p>B The particles keep moving at the same speed. <input type="checkbox"/></p> <p>C The particles move more slowly. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Cold air</b></p> <p>The lid on this can is airtight. Air is trapped in the can. The balls represent particles that the air is made of. The air in the can is at room temperature.</p>  <p>The temperature of the air in the can is lowered by putting it into a freezer.</p> <p>These statements are about the air after it has cooled down. For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I think this is wrong</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A Particles are closer together.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Particles hit the can with less force.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Particles collide with each other less often.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D The pressure of the air is smaller.</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Developed by the University of York Science Education Group and the Salters' Institute. 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<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Doubling up</b></p> <p>The particle diagram represents particles of gas inside a box. The gas has a large pressure and pushes on the walls of the box.</p>  <p>What happens if the amount of gas is doubled and the volume is doubled? Put a tick (✓) in the box next to the best answer.</p>  <p>Pressure of the gas. Force on the walls of the box.</p> <p>A Goes up. <input type="checkbox"/> B Goes up. <input type="checkbox"/> C Stays the same. <input type="checkbox"/> D Stays the same. <input type="checkbox"/></p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Force and pressure</b></p> <p>A gas can exert a force on an object because it has pressure. A gas can exert a force on the walls of its container because it has pressure. Like gases, liquids have pressure and exert a force on a surface.</p>  <p>A force is exerted by the gas (or liquid) on every surface.</p> <p>a. What changes would make the force on the object the biggest? Put a tick (✓) in the box next to the best answer.</p> <p>A Triple the pressure – nothing else. <input type="checkbox"/></p> <p>B Double the pressure and double the size of the object. <input type="checkbox"/></p> <p>C Double the pressure and half the size of the object. <input type="checkbox"/></p> <p>D Triple the size of the object – nothing else. <input type="checkbox"/></p> <p>b. Which equation best explains your answer to the last question?</p> <p>A <math>F = P \times A</math> <input type="checkbox"/> B <math>F = \frac{P}{A}</math> <input type="checkbox"/> C <math>F = P + A</math> <input type="checkbox"/></p> <p>Force is equal to the pressure times the area of the surface. Force is equal to the pressure divided by the area of the surface. Force is equal to the area of the surface added to the pressure.</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Gas pressure</b></p> <p>This bottle is filled with a gas.</p>  <p>Explain how gas pressure is caused by the particles of gas. Tick one statement in each row to explain how.</p> <table border="1"> <thead> <tr> <th></th> <th>Particles in the gas move quickly in all directions.</th> </tr> </thead> <tbody> <tr> <td>1 They exert a few million every second.</td> <td>They exert hundreds of million every second.</td> </tr> <tr> <td>2 They do not get very far before they collide with another particle or the walls of the bottle.</td> <td>They are more likely to hit another particle.</td> </tr> <tr> <td>3 They are more likely to hit another particle.</td> <td>They are more likely to hit the walls of the bottle.</td> </tr> <tr> <td>4 They are more likely to hit another particle.</td> <td>They are more likely to hit the walls of the bottle.</td> </tr> <tr> <td>5 They are more likely to hit another particle.</td> <td>They are more likely to hit the walls of the bottle.</td> </tr> <tr> <td>6 Gas pressure is caused when particles push on the walls of their container.</td> <td>Gas pressure is caused when particles hit the walls of their container.</td> </tr> <tr> <td>7 The harder and more often the collisions, the higher the pressure.</td> <td></td> </tr> </tbody> </table> <p>Developed by the University of York Science Education Group and the Salters' Institute. 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Gas pressure is caused when particles hit the walls of their container.	7 The harder and more often the collisions, the higher the pressure.		<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Bottled gas</b></p> <p>This drinks bottle is full of a gas.</p> <ul style="list-style-type: none"> <li>• It contains about 10 000 000 000 000 000 000 particles of gas.</li> <li>• The average speed of each particle is about 500 metres per second.</li> </ul>  <p>To answer:</p> <p>1. Explain why the gas particles are spread out evenly throughout the whole of the bottle.</p> <p>2. What happens if the temperature of the gas is increased?</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Big fish, little fish</b></p> <p>Particles of water move quickly in all directions. Water pressure is caused when particles push each other apart.</p>  <p>Some students are talking about the effect of water pressure on the shark and on the small fish.</p> <p>Charlie: The pressure on the shark is the same as the pressure on the small fish, so that it isn't squashed.</p> <p>Edwards: The water presses on the shark with more force than on the fish, because it has a bigger surface.</p> <p>Fatimah: The force on each 1cm<sup>2</sup> of the shark is the same as the force on each 1cm<sup>2</sup> of the small fish.</p> <p>To answer:</p> <p>1. Who is right about the effect of water pressure on the shark and the fish? Explain your answer.</p> <p>2. Who is wrong about the effect of water pressure on the shark and the fish? What would you say to help them understand?</p> <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>																													
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