

Physics > Big idea PMA: Matter > Topic PMA4: Particle explanations

Key concept (age 14-16)

PMA4.1: Density

Progression toolkit: Density

Learning focus	Density, the mass of material in 1m^3 or in 1cm^3 , is dependent on both the mass of its particles and their spatial arrangement.				
As students' conceptual understanding progresses they can:	<div> <div>CONCEPTUAL PROGRESSION</div> <div></div> </div>				
	Describe characteristics of objects or substances with high (or low) densities. P	Compare the density of objects that differ in both mass and volume. P	Explain the equation $\rho = m/V$ and use it to make calculations.	Use the particle model to explain differences in density.	Explain why the density of water in its solid state is less than the density of water in its liquid state.
Diagnostic questions	Comparing density	Density by numbers	Defining density	Particle characteristics	Cold water
	Railway sleepers				
Response activities			Measuring density	Modelling density	Particle anomaly

Key:

P Prior understanding from earlier stages of learning

Comparing density	Railway sleepers	Density by numbers	Defining density	Particle characteristics																				
<p>Comparing density</p> <p>These blocks are the same size.</p> <p>Block A Mass = 100g</p> <p>Block B Mass = 150g</p> <p>Which block has the bigger density? Put a tick (✓) in the box next to the best answer.</p> <p>A. Block A has the bigger density. <input type="checkbox"/></p> <p>B. Block B has the bigger density. <input type="checkbox"/></p> <p>C. The density of both blocks is the same. <input type="checkbox"/></p> <p>These blocks have the same mass.</p> <p>Block A</p> <p>Block B</p> <p>Which block has the bigger density? Put a tick (✓) in the box next to the best answer.</p> <p>A. Block A has the bigger density. <input type="checkbox"/></p> <p>B. Block B has the bigger density. <input type="checkbox"/></p> <p>C. The density of both blocks is the same. <input type="checkbox"/></p>	<p>Railway sleepers</p> <p>Sleepers hold railway tracks in place. They make sure that the tracks are fixed at the right distance apart. Railway sleepers can be made of wood or concrete.</p> <p>With the gaps to describe the difference between each type of railway sleeper, you should only use the words mass and density.</p> <p>Mass and density</p> <p>A concrete railway sleeper has more _____ than a wooden sleeper that is the same size. Concrete has a bigger _____ than wood. It has more _____ in the same volume.</p> <p>A concrete railway sleeper with the same _____ as a wooden one is thinner in the middle and has a smaller volume.</p> <p>A wooden railway sleeper is hard to lift up because it has a big _____. If it is cut into different sized pieces, each piece will have a different _____. The _____ of each piece will be the same.</p>	<p>Density by numbers</p> <p>1. Which block has the biggest density? A. Mass = 1344 g, Volume = 150 cm³ B. Mass = 1200 g, Volume = 150 cm³ C. Mass = 1310 g, Volume = 150 cm³</p> <p>2. Which block has the biggest density? A. Mass = 1000 g, Volume = 145 cm³ B. Mass = 1000 g, Volume = 15 cm³ C. Mass = 1000 g, Volume = 47 cm³</p> <p>3. Which block has the biggest density? A. Mass = 200 g, Volume = 80 cm³ B. Mass = 800 g, Volume = 40 cm³ C. Mass = 1300 g, Volume = 160 cm³</p>	<p>Defining density</p> <p>Objects float if their density is less than the density of water. They sink if their density is higher.</p> <p>Which statement describes the density of an object? Put a tick (✓) in the box next to the best answer.</p> <p>A. The weight of the object. <input type="checkbox"/></p> <p>B. The amount of mass it contains. <input type="checkbox"/></p> <p>C. The amount of mass it has in a particular volume. <input type="checkbox"/></p> <p>D. The weight of the object for a particular volume. <input type="checkbox"/></p>	<p>Particle characteristics</p> <p>Everything is made from particles. The particles model help us think about the particles in different substances or materials.</p> <p>These statements are about the particles in solids, liquids and gases. For each statement, tick (✓) or cross (X) to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure it's right</th> <th>I think it's right</th> <th>I think it's wrong</th> <th>I am sure it's wrong</th> </tr> </thead> <tbody> <tr> <td>A. All particles have mass.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. All particles have a volume.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. A substance or material is made of particles - nothing else.</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		I am sure it's right	I think it's right	I think it's wrong	I am sure it's wrong	A. All particles have mass.					B. All particles have a volume.					C. A substance or material is made of particles - nothing else.				
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Simple multiple choice	Focused cloze	Simple multiple choice	Simple multiple choice	Confidence grid																				
<p>Cold water</p> <p>Ice floats on water.</p> <p>What do you think about the density of ice? Put a tick (✓) in the box next to the best answer.</p> <p>A. Ice has a lower density than water. <input type="checkbox"/></p> <p>B. Ice has the same density as water. <input type="checkbox"/></p> <p>C. Ice has a higher density than water. <input type="checkbox"/></p> <p>Which two statements best explain your last answer? Put a tick (✓) next to one of these answers.</p> <p>A. The particles in ice and water are identical. <input type="checkbox"/></p> <p>B. The particles in ice have more mass than those in water. <input type="checkbox"/></p> <p>C. The particles in ice have less mass than those in water. <input type="checkbox"/></p> <p>...and put a tick (✓) next to one of these answers.</p> <p>D. There are more particles in 1cm³ of ice than in 1cm³ of water. <input type="checkbox"/></p> <p>E. There are fewer particles in 1cm³ of ice than in 1cm³ of water. <input type="checkbox"/></p> <p>F. The number of particles in 1cm³ of ice is the same as in 1cm³ of water. <input type="checkbox"/></p>	<p>Measuring density</p> <p>Density of an object is the amount of mass it has in a particular volume.</p> <p>Density = Mass ÷ Volume $p = m \div V$</p> <p>Some students are discussing the units that density is measured in.</p> <p>Sam: volume can be measured in cm³ or m³.</p> <p>Tristan: density is usually measured in kg/m³ or kg/cm³.</p> <p>Willow: 1 litre of water has a mass of 1 kg, so the density of water is 1 g/cm³.</p> <p>Viola: density has two different units. The number calculated is the same for both.</p> <p>To answer:</p> <p>1. Who is right about measuring density? 2. Who is wrong about measuring density? 3. Write your own description of the units used to measure density. Include all the important detail.</p>	<p>Modelling density</p> <p>Some students are using models to explain why some substances have a higher density than others. They are using balls of modelling clay and iron nails.</p> <p>To answer:</p> <p>1. State three ways in which these are good models for exploring density.</p> <p>2. State three ways in which these are not accurate models for exploring density.</p> <p>3. Use the particle model to explain why some substances have a higher density than others.</p>	<p>Particle anomaly</p> <p>Ice floats in water and a piece of rock sinks.</p> <p>To do:</p> <p>Draw particle diagrams for the rock and water and ice.</p> <p>Particles in rock</p> <p>Particles in water</p> <p>Particles in ice</p> <p>To answer:</p> <p>1. Why does rock have a higher density than water?</p> <p>2. Why does ice have a lower density than water?</p> <p>3. What is wrong with the particle diagram that shows the particles in ice?</p>																					
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Two-tier multiple choice	Talking heads	Critiquing a representation	Application and practice																					