

Physics > Big idea PMA: Matter > Topic PMA1: Heating and cooling

Key concept (age 11-14)

PMA1.1: Temperature

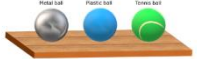
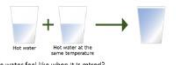


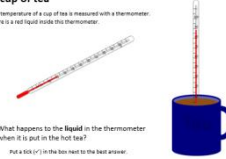

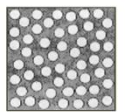

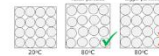
Progression toolkit: Temperature

Learning focus	Temperature is a measure of the average speed at which the particles in a substance or material are moving.				
As students' conceptual understanding progresses they can:	<div>CONCEPTUAL PROGRESSION</div>				
	Predict the temperature of different materials that are all in thermal equilibrium with the room. P	Predict the temperature reached by mixing samples of water that are all at the same temperature. P	Describe the arrangement and movement of particles in a substance in the solid and liquid states.	Describe the changes in particles of a substance or material when its temperature is changed.	Explain the changes in volume of solids and liquids when their temperature is changed.
Diagnostic questions	Three balls	More water	Particle model SL	Pie tin particles	A cup of tea
Response activities	Water and sand		Particle diagram of a liquid	Ouch!	
				Expansion model	

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

Three balls	More water	Particle model SL	Pie tin particles	A cup of tea																																																																		
 <p>Three balls have been on a shelf for three days.</p> <p>What do you think about the temperature of each ball?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th>Statements</th> <th>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. All three balls have the same temperature</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. The metal ball has the lowest temperature</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. The tennis ball has the highest temperature</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Statements	Am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A. All three balls have the same temperature					B. The metal ball has the lowest temperature					C. The tennis ball has the highest temperature					 <p>What will the water feel like when it is mixed?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <tbody> <tr> <td>A. Hotter</td> <td></td> </tr> <tr> <td>B. The same temperature</td> <td></td> </tr> <tr> <td>C. Colder</td> <td></td> </tr> </tbody> </table>	A. Hotter		B. The same temperature		C. Colder		 <p>Imagine you could see the particles in this block of lead.</p> <p>Which diagram best matches what you would see?</p> <table border="1"> <tbody> <tr> <td>A. Particles not moving</td> <td>B. Particles shaking on the spot</td> </tr> <tr> <td>C. Particles moving freely</td> <td>D. Particles not moving</td> </tr> </tbody> </table>	A. Particles not moving	B. Particles shaking on the spot	C. Particles moving freely	D. Particles not moving	 <p>In the oven the pie tin heats up to 180°C.</p> <p>What do you think happens to the particles?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th>Statements</th> <th>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. They get heavier</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. They get bigger</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. They move more quickly</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D. They push into each other with more force</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>E. They change shape</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Statements	Am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A. They get heavier					B. They get bigger					C. They move more quickly					D. They push into each other with more force					E. They change shape					 <p>1. What happens to the liquid in the thermometer when it is put in the hot tea?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <tbody> <tr> <td>A. Its temperature goes up and it expands (gets bigger)</td> <td></td> </tr> <tr> <td>B. Its temperature goes up</td> <td></td> </tr> <tr> <td>C. Its temperature goes up and it contracts (gets smaller)</td> <td></td> </tr> </tbody> </table>	A. Its temperature goes up and it expands (gets bigger)		B. Its temperature goes up		C. Its temperature goes up and it contracts (gets smaller)	
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Confidence grid	Simple multiple choice	Simple multiple choice	Confidence grid	Two-tier multiple choice																																																																		
Water and sand	Particle diagram of a liquid	Ouch!	Expansion model																																																																			
 <p>What happens to the temperature of water when it is heated?</p> <p>What happens to the temperature of sand when it is heated in the same way?</p> <p>Apparatus:</p> <ul style="list-style-type: none"> Bunsen burner Heat resistant mat Beaker Test tube holder Test tube rack Thermometer Stop watch Stirring rod Any sand <p>Method:</p> <ol style="list-style-type: none"> Half fill a beaker with water. Use a thermometer to measure its temperature. Heat the water in a Bunsen burner for 30 seconds. Take the water out of the flame and give it a stir. Measure its temperature. Repeat the water for 30 seconds heat more times. Measure the temperature of the water each time it is heated. Repeat the investigation using sand instead of water. <table border="1"> <thead> <tr> <th>How many times it was heated</th> <th>Temperature of water / °C</th> <th>Temperature of sand / °C</th> </tr> </thead> <tbody> <tr> <td>Before heating</td> <td></td> <td></td> </tr> <tr> <td>1</td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> </tr> <tr> <td>3</td> <td></td> <td></td> </tr> </tbody> </table>	How many times it was heated	Temperature of water / °C	Temperature of sand / °C	Before heating			1			2			3			 <p>This diagram is from a textbook. It is a diagram of the particles in a liquid.</p> <p>To answer:</p> <ol style="list-style-type: none"> What are three things that make this a good diagram? What are three things that make this diagram wrong? How would you change these to make it better? 	 <p>John has baked his fruit pie. It is very hot. When he takes it out of the oven he burns himself on the tin.</p> <p>Some students are talking about why they think the hot pie tin burnt John.</p> <p>Reifer: particles in the metal push into John's skin and damage it.</p> <p>Orfer: particles in the metal are vibrating very quickly.</p> <p>Emilio: the tin is heating John's hand.</p> <p>Nathan: the temperature moves into John's skin.</p> <p>Muhammad: you can't even see the particles with a microscope.</p> <p>To answer:</p> <ol style="list-style-type: none"> Which answer do you think explains how John's hand was burnt? Which answer do you think is wrong? Explain why John did not burn himself when he put the pie into the oven. 	 <p>Heating a solid makes it expand. The particles in the solid are too small to see. How do you think what happens to the particles in a solid when it expands?</p> <p>Three statements help to explain the heat model:</p> <table border="1"> <tbody> <tr> <td>Bigger particles are made of more stuff.</td> <td>Heating a solid does not make it heavier.</td> </tr> <tr> <td>Faster particles push each other apart.</td> <td>Gaps between the particles are bigger.</td> </tr> <tr> <td>Hotter air flows up.</td> <td>Faster particles hit our skin harder and might damage it.</td> </tr> <tr> <td>Bigger particles do not hit our skin harder.</td> <td>Nothing has been added to the solid.</td> </tr> </tbody> </table> <p>To answer:</p> <ol style="list-style-type: none"> Which statements help to explain why model 1 is correct? Which statements help to explain why model 2 is wrong? Model 1 is called the 'bigger particle model'. The bigger particle model states that particles become more quickly at a higher temperature. Use this model to explain what happens to the particles in a solid when it expands. 	Bigger particles are made of more stuff.	Heating a solid does not make it heavier.	Faster particles push each other apart.	Gaps between the particles are bigger.	Hotter air flows up.	Faster particles hit our skin harder and might damage it.	Bigger particles do not hit our skin harder.	Nothing has been added to the solid.																																												
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