

Physics > Big idea PMA: Matter > Topic PMA3: Energy of moving particles

Key concept (age 11-14)

PMA3.3: Specific latent heat

Learning focus	Specific latent heat (of a particular change of state) is the amount of energy needed to change the state of 1 kg of a substance without changing its temperature.				
As students' conceptual understanding progresses they can:	<div> <div>CONCEPTUAL PROGRESSION</div> <div></div> </div>				
	Describe the arrangement and movement of particles in a substance in the solid, liquid and gas states. P	Use the particle model to describe what happens to a substance when it changes state. P	Make and understand calculations using the equation $E = m \times L$	Interpret a heating curve and explain physical changes to a substance that is heated from the solid state to the liquid state, or from the liquid state to the gas state.	Interpret a cooling curve and explain physical changes to a substance that is cooled from the gas state to the liquid state, or from the liquid state to the solid state.
Diagnostic questions	A particle model for the solid, liquid and gas states	Cheese on toast	Hidden energy	Boiling point	Freezing point
		Boiling water			
		The state of water		Melting point	
Response activities		The state we're in		Faster melting	

Key:

P Prior understanding from earlier stages of learning

A particle model for the S, L & G states	Cheese on toast	Boiling water	The state of water	Hidden energy																				
<p>BEST STUDENT WORKSHEET</p> <p>A particle model for the solid, liquid & gas states</p> <p>All substances are made of particles. A lot of particles are not shaped as a ball, but they are usually drawn as circles on diagrams. This is just to make the diagrams easier.</p> <p>(Particles do not really have different colours either.)</p> <p>The diagrams in these questions all show particles of water.</p> <p>1. Which is the best diagram to show the particles in ice?</p> <p>A. Particles not moving. B. Particles vibrating on the spot. C. Particles moving freely. D. Particles not moving.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>Cheese on toast</p> <p>When you cook a hot egg it is called cheese on toast. Under the grill the cheese melts and becomes a liquid.</p> <p>Which statement best explains why the cheese becomes a liquid? Put a tick (✓) in the box next to the best answer.</p> <p>A. Some of the cheese molecules get smaller. B. Some of the cheese molecules are destroyed. C. The cheese molecules change into water molecules. D. The cheese molecules are more loosely connected to each other.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>Boiling water</p> <p>When both water is a gas, the water is going to make a boiling egg.</p> <p>Which statement best explains what happens when water boils? Put a tick (✓) in the box next to the best answer.</p> <p>A. The molecules are destroyed. B. The mass of the molecules decreases. C. The molecules become separated from each other. D. The molecules break down into hydrogen and oxygen atoms.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>The state of water</p> <p>Water can be in a solid state, a liquid state or a gas state.</p> <p>Which statement do you think best describes what happens as a substance changes state? Put a tick (✓) in the box next to the best answer.</p> <p>A. The type of molecules of the substance changes. B. The mass of the molecules of the substance changes. C. The shape of the molecules of the substance changes. D. The connection between molecules of the substance changes.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>Hidden energy</p> <p>Energy is needed to change a substance from its solid state into its liquid state, or from its liquid state into its gas state. Different amounts of energy are needed for each change of state. Different amounts of energy are needed to change the state of different substances. The amount of energy needed can be calculated.</p> $\text{Energy} = \text{Mass} \times \text{Specific latent heat}$ $E = m \times L$ <p>These statements are about specific latent heat (L in J kg⁻¹). For each statement, tick (✓) one column 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. Specific latent heat, L, is $\frac{E}{m}$</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. 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<p>BEST STUDENT WORKSHEET</p> <p>Boiling point</p> <p>A tray of water is heated in an oven. The temperature of the water is measured as it heats up and starts to steam.</p> <p>1. Which graph shows how temperature changes as the water is heated?</p> <p>A. B. C. D.</p> <p>2. What do you think is the best reason for your first answer? Put a tick (✓) in the box next to the best answer.</p> <p>A. At the boiling point heating separates molecules. B. At the boiling point heating lifts molecules into steam. C. At the boiling point heating increases the speed of molecules. D. At the boiling point heating gives molecules more temperature.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>Melting point</p> <p>Ice is kept inside a freezer. The temperature of the freezer is -10°C.</p> <p>As soon as the ice is taken out of the freezer it is placed in a beaker and its temperature is measured. Its temperature is measured each minute until ten minutes after all the ice has melted. The melting point of ice is 0°C.</p> <p>These statements are about the melting point of ice. For each statement, tick (✓) and write 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. The temperature of ice taken out of the freezer is 0°C.</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. 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Its melting point is 40.3°C. Its freezing point is 40.3°C. Some salt was warmed to 60°C in a boiling tube. As it cooled its temperature is measured using a thermometer.</p> <p>1. As it cools, when does salt reach its freezing point? Put a tick (✓) in the box next to the best answer.</p> <p>A. As soon it starts to change into its solid state. B. When about half of it is in a solid state. C. Only when all of it is in a solid state.</p> <p>2. After it reaches its freezing point, when does the temperature of salt start to fall again? Put a tick (✓) in the box next to the best answer.</p> <p>A. As soon it starts to change into its solid state. B. When about half of it is in a solid state. C. Only when all of it is in a solid state.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>The state we're in</p> <p>Some students are modelling changing states. They want to show how solids melt and how liquids boil.</p> <p>To answer:</p> <ol style="list-style-type: none"> State three ways in which this is a good representation of changing states. State three ways in which this is not an accurate representation of changing states. Use the particle model to describe how solids melt and liquids boil. <p>Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p>BEST STUDENT WORKSHEET</p> <p>Faster melting</p> <p>Ice is kept inside a freezer. The temperature of the freezer is -10°C. As soon as the ice is taken out of the freezer it is placed in a beaker and its temperature is measured. Its temperature is measured each minute until ten minutes after all the ice has melted.</p> <p>1. Add a second line to the graph to show how you think temperature will change if the ice is heated with a burner burner.</p> <p>2. Explain why you think the temperature will change like this?</p> <p>3. Investigate how the temperature of ice changes as it is heated.</p> <p>4. Observe. Record the measurements needed to plot both lines on a graph. Plot a graph with both lines.</p> <p>5. Explain. Have your prediction and explanation correct? Try to improve your first explanation to explain what happens more clearly.</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 www.BestEvidenceScienceTeaching.org © University of York Science Education Group. 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