

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

Progression toolkit: Thermal store of energy

Learning focus	Each different material will have more energy in its thermal store if either its temperature or mass is increased.				
As students' conceptual understanding progresses they can:					
Diagnostic questions	Identify which of two objects or substances has the most energy in its thermal store when the only difference between them is temperature.	Identify which of two objects or substances has the most energy in its thermal store when the only difference between them is their mass.	Explain the difference between energy (in a thermal store) and temperature.	Describe how the specific heat capacity of a material affects the amount of energy in its thermal store.	Use the equation $E = mc\Delta T$ to calculate the energy needed to increase the temperature of a material. B
Response activities	Thermal store of energy	Three bears Hot fill	Specific heat capacity		
Response activities		The same Bunsen	Energy vs temperature	Hot metal	How much energy?

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

<p>Thermal store of energy</p> <p>BEST STUDENT WORKSHEET</p> <p>Thermal store of energy</p> <p>Let's have outside building a fireman. She is a very cool.</p> <p>1. Which drink will warm up the most?</p> <p>2. Which drink has most energy in its thermal store?</p> <p>A B </p> <p>C D </p> <p>3. Which bowl of porridge has most energy in its thermal store?</p> <p>A B </p> <p>C D </p> <p>Developed by the University of York Science Education Group and the Salter's 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>Three bears</p> <p>BEST STUDENT WORKSHEET</p> <p>Three bears</p> <p>They just back from a long trip. They just back from a long trip. They just back from a long trip.</p> <p>75 °C 30 °C 45 °C</p> <p>Read each statement about the bears' porridge. What do you think about each one?</p> <p>For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th>Statement</th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I'm not sure</th> <th>I think this is wrong</th> <th>I'm sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A. Baby Bear has the most energy in the porridge.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. Mommy Bear has more spoonfuls of porridge than Baby Bear.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. The amount of porridge Baby Bear porridge has more energy than the amount of porridge Mommy Bear has.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D. Mommy Bear has more energy in her porridge than Baby Bear.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Developed by the University of York Science Education Group and the Salter's 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>	Statement	I am sure this is right	I think this is right	I'm not sure	I think this is wrong	I'm sure this is wrong	A. Baby Bear has the most energy in the porridge.						B. Mommy Bear has more spoonfuls of porridge than Baby Bear.						C. The amount of porridge Baby Bear porridge has more energy than the amount of porridge Mommy Bear has.						D. Mommy Bear has more energy in her porridge than Baby Bear.						<p>Hot fill</p> <p>BEST STUDENT WORKSHEET</p> <p>Hot fill</p> <p>Let's get people mix up ideas about temperature and energy.</p> <p>For in the gaps to complete each sentence. You should only use the words energy and temperature.</p> <p>Energy or temperature?</p> <ol style="list-style-type: none"> _____ is a measure of how hot or cold something is. A thermometer measures _____. A candle flame has a bigger _____ than a bath of lukewarm water. A bath of lukewarm water has a bigger _____ than a white hot spark. A cup of boiling water has the same _____ as a kettle full of boiling water. Adding water at 40°C to a cup of water at 40°C increases its _____. <p>Developed by the University of York Science Education Group and the Salter's 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>Specific heat capacity</p> <p>BEST STUDENT WORKSHEET</p> <p>Specific heat capacity</p> <p>Two metal balls are heated to 100°C in an oven. The mass of each ball is the same. The balls are put on top of a block of wax. The metal balls melt the wax. This is what happens.</p> <p>Lead ball Mass = 100g Starting temperature = 100°C</p> <p>Steel ball Mass = 100g Starting temperature = 100°C</p> <p>Read each statement about the metal balls. What do you think about each one?</p> <p>For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th>Statement</th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I'm not sure</th> <th>I think this is wrong</th> <th>I'm sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A. 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What do you think will happen?</p> <p>Explain</p> <p>Why do you think this will happen?</p> <p>Now carry out the investigation</p> <p>Observe</p> <p>Record how much the temperature goes up for each volume of water.</p> <p>Explain</p> <p>Were your prediction and explanation correct? If not, can you explain what you observed?</p> <p>Developed by the University of York Science Education Group and the Salter's 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>
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<p>Energy vs temperature</p> <p>BEST STUDENT WORKSHEET</p> <p>Energy v temperature</p> <p>This model uses Janet's to represent energy. Each one has a value of energy.</p> <p>Activity 1</p> <ol style="list-style-type: none"> Your teacher divides the class into two groups. One group is twice as big as the other. Each group is given some Janets to share out equally between themselves. <p>To answer:</p> <ul style="list-style-type: none"> How many Janets has each person got? Which group has the higher temperature? Which group has the higher energy? <p>How do you explain your answers?</p> <p>Activity 2</p> <ol style="list-style-type: none"> Each person takes one Janet (out of all the other ones back). Each group adds up how many Janets are now left. <p>To answer:</p> <ul style="list-style-type: none"> Which group has got the most energy? Which group has the higher temperature? <p>How do you explain your answers?</p> <p>Developed by the University of York Science Education Group and the Salter's 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>Hot metal</p> <p>BEST STUDENT WORKSHEET</p> <p>Hot metal</p> <p>These cubes are made out of metal. They are put into a beaker of water. Each one is put into a new beaker with 100cm³ of cold water.</p> <p>Predict</p> <p>Does the steel have more than twice the energy in its thermal store than the lead? What will you observe if it does?</p> <p>Explain</p> <p>What are the reasons for your prediction?</p> <p>Now carry out the investigation</p> <p>Observe</p> <p>Measure how much the temperature of the water goes up for each metal.</p> <p>Explain</p> <p>Were your prediction and explanation correct? If not, can you explain what you observed?</p> <p>Developed by the University of York Science Education Group and the Salter's 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>How much energy?</p> <p>BEST STUDENT WORKSHEET</p> <p>How much energy?</p> <p>The energy needed to heat an object can be calculated using:</p> $E = m \times c \times \Delta T$ <p>E = energy (Joules) m = mass (grams)</p> <p>c = specific heat capacity (Joules per gram °C) ΔT = increase in temperature (degrees C)</p> <p>To answer:</p> <ol style="list-style-type: none"> A steel ball has a mass of 10g. The specific heat capacity of steel is 0.5 J/g °C. How much energy is needed to heat the steel ball by 30°C? using: $E = m \times c \times \Delta T$ $E = 10 \times 0.5 \times 30$ $= 150$ 150 Joules of energy are needed. A steel ball has a mass of 10g. The specific heat capacity of steel is 0.5 J/g °C. How much energy is needed to heat the steel ball by 30°C? A little concrete is used. The specific heat capacity of water is 4.2 J/g °C. How much energy is needed to heat the water by 80°C? A cold concrete is used. The specific heat capacity of water is 4.2 J/g °C. How much energy is needed to heat the water by 80°C by 80°C? <p>Developed by the University of York Science Education Group and the Salter's 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>																																																														
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