

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



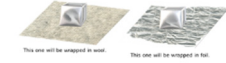

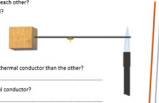
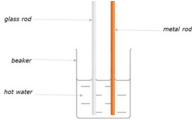

Progression toolkit: Conductors and insulators

Learning focus	Heating makes the particles in a material move more quickly. Heating raises the temperature quickly throughout a good thermal conductor, and very slowly through a good thermal insulator.				
As students' conceptual understanding progresses they can:					
Diagnostic questions	Hot soup	Conductor survey		Ice melt	Warm feeling
Response activities		Hot rods	Hot vibrations		Cool rod
As students' conceptual understanding progresses they can:	Describe the speed at which the temperature increases along a thermal conductor compared to a thermal insulator.	Identify materials that are good thermal conductors or good thermal insulators.	Use the idea of vibrating particles to explain heating by thermal conduction.	Explain how insulators can be used to slow down heating and cooling.	Explain why it is common for thermal insulators to feel warm and thermal conductors cold. B

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

<p style="text-align: center;">Hot soup</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Hot soup</p> <p>Lily is heating up some tomato soup for her lunch.</p>  <p>All in the gaps in this passage about heating soup. You should only use the words conductor and insulator.</p> <p>Tomato soup</p> <p>Lily is heating some soup in a pan. The pan is made from metal which is a good _____. All of the pan gets hot quickly.</p> <p>When she holds the handle of the pan she doesn't burn herself because the handle is a good _____.</p> <p>Lily notices that the end of the wooden spoon she is stirring with does not get hot. Wood is not a good _____.</p> <p>Lily eats the soup in a bowl on her knee. She rests it on a newspaper which is a good _____.</p> <p>When Lily leaves her spoon in the soup for too long she finds out it is a good _____.</p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;">Conductor survey</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Conductor survey</p> <p>Some materials are good thermal conductors. Some materials are insulators.</p>  <p>What do you think about conductors and insulators? For each statement, tick (✓) one column to show what you think.</p> <table border="1"> <thead> <tr> <th>Statements</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 Metals are good thermal conductors</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Trapped air is a good insulator</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Insulators have a higher temperature than good conductors</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D Insulators can help to keep things cold</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>E Things move quickly through a conductor by heating</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A Metals are good thermal conductors					B Trapped air is a good insulator					C Insulators have a higher temperature than good conductors					D Insulators can help to keep things cold					E Things move quickly through a conductor by heating					<p style="text-align: center;">Ice melt</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Ice melt</p> <p>Can you change how long it takes for an ice cube to melt? What do you think happens if we wrap up the ice cube?</p>  <p>This one will be wrapped in wool. This one will be wrapped in foil.</p> <p>1. Which ice cube will melt first? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th>Statements</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 Ice wrapped in foil</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Ice wrapped in wool</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C No difference</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>2. Why do you think this will happen? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <tbody> <tr> <td>A Wool has more energy than the foil</td> <td></td> </tr> <tr> <td>B Insulators keep things up</td> <td></td> </tr> <tr> <td>C Foil heats and cools quickly</td> <td></td> </tr> <tr> <td>D Foil is a good thermal conductor</td> <td></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A Ice wrapped in foil					B Ice wrapped in wool					C No difference					A Wool has more energy than the foil		B Insulators keep things up		C Foil heats and cools quickly		D Foil is a good thermal conductor		<p style="text-align: center;">Warm feeling</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Warm feeling</p> <p>What often feels cold when you touch it? What usually feels warm?</p>  <p>Read these statements about why metal feels cold and wood feels warm. What do you think about each one? For each statement, tick (✓) one column to show what you think.</p> <table border="1"> <thead> <tr> <th>Statements</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 Energy from the thermal store of your hand moves easily through the metal</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Energy from the thermal store of the wood moves into your hand</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Energy from the thermal store of your hand does not move easily through wood</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D The wood feels warm because your hand is warm</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A Energy from the thermal store of your hand moves easily through the metal					B Energy from the thermal store of the wood moves into your hand					C Energy from the thermal store of your hand does not move easily through wood					D The wood feels warm because your hand is warm					<p style="text-align: center;">Hot rods</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Hot rods</p> <p>Metals are good thermal conductors. Do metals all conduct as quickly as each other? Does glass conduct as well as metal?</p> <p>Predict</p> <p>Do you think one metal is a better thermal conductor than the other? Do you think glass is a good thermal conductor?</p>  <p>Explain</p> <p>Why do you think you are right?</p> <p style="text-align: center;">Now carry out the investigation</p> <p>Observe</p> <p>For each rod record the time taken for the drawing pin to fall off.</p> <p>Explain</p> <p>Were your prediction and explanation correct? If not, can you explain what you observed?</p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>
Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong																																																																																			
A Metals are good thermal conductors																																																																																							
B Trapped air is a good insulator																																																																																							
C Insulators have a higher temperature than good conductors																																																																																							
D Insulators can help to keep things cold																																																																																							
E Things move quickly through a conductor by heating																																																																																							
Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong																																																																																			
A Ice wrapped in foil																																																																																							
B Ice wrapped in wool																																																																																							
C No difference																																																																																							
A Wool has more energy than the foil																																																																																							
B Insulators keep things up																																																																																							
C Foil heats and cools quickly																																																																																							
D Foil is a good thermal conductor																																																																																							
Statements	I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong																																																																																			
A Energy from the thermal store of your hand moves easily through the metal																																																																																							
B Energy from the thermal store of the wood moves into your hand																																																																																							
C Energy from the thermal store of your hand does not move easily through wood																																																																																							
D The wood feels warm because your hand is warm																																																																																							
<p style="text-align: center;">Focused cloze</p>	<p style="text-align: center;">Confidence grid</p>	<p style="text-align: center;">Two-tier multiple choice</p>	<p style="text-align: center;">Confidence grid</p>	<p style="text-align: center;">Predict, explain, observe, explain practical/demonstration</p>																																																																																			
<p style="text-align: center;">Hot vibrations</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Hot vibrations</p> <p>A metal rod and a glass rod are placed in some very hot water. A short time later the top of the metal rod is hot. The top of the glass rod feels cool.</p>  <p>Put all of the statements describe thermal conduction in any order. Five statements describe thermal conduction in a water.</p> <ol style="list-style-type: none"> Sort the statements into two groups. Use the statements to describe how thermal conduction works. <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;">Cool rod</p> <p style="text-align: center;">STUDENT WORKSHEET</p> <p>Cool rod</p> <p>Sometimes in a practical, glass rods are used for stirring. They can be used to stir hot liquids.</p>  <p>Some students are talking about the glass rod.</p> <p>Charlie: You can hold a glass rod and melt the other end of it in a Bunsen flame.</p> <p>Brenda: Glass is a conductor because it feels cold.</p> <p>David: Plastic warms your hand because it is an insulator. Glass doesn't.</p> <p>Freya: Thermometers are made from glass and they need to be conductors.</p> <p>Ella: The glass rod sucks energy out of your hand.</p> <p>To answer:</p> <ol style="list-style-type: none"> Who is right about the glass rod? Explain your answer. What mistakes do you think the other students made? What would you say to them to help them to understand? Do you think glass is a conductor or an insulator? Explain your answer. <p style="font-size: small;">Developed by the University of York Science Education Group and the Salter's Institute. This resource has been created, reviewed and adapted for copyright by Best Evidence Science Teaching Ltd. © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>																																																																																						
<p style="text-align: center;">Sequencing</p>	<p style="text-align: center;">Talking heads</p>																																																																																						