

## Key concept (age 11-14)

### PFM3.3: Turning effects

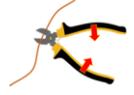
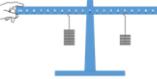
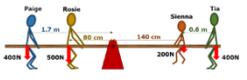
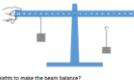
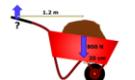
#### Progression toolkit: Turning effects

<b>Learning focus</b>	If a force acts on a pivoted object, the object turns about its pivot: the size of the turning effect depends on the size of the force and on its (perpendicular) distance from the pivot.				
<b>As students' conceptual understanding progresses they can:</b>					
<b>As students' conceptual understanding progresses they can:</b>	<p>Recall that a bigger applied force and/or a longer lever gives a larger turning effect.</p> <p><b>P</b></p>	<p>Identify levers and their pivots, and describe what they do.</p>	<p>Predict the relative size of different turning effects by comparing forces applied and lengths of levers.</p>	<p>Predict where to place different sized weights on either side of a pivoted beam, in order to make it balance.</p>	<p>Calculate the size of the turning effect.</p> <p><b>B</b></p>
<b>Diagnostic questions</b>	Open door	What's a lever?	Wire cutters	To tip or not to tip?	See-saw calculations
<b>Response activities</b>	Lids off		Balance beam	Wheelbarrow	

Key:

**P** Prior understanding from earlier stages of learning

**B** Bridge to later stages of learning

<p style="text-align: center;"><b>Open door</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Open door</b></p> <p>The classroom door has been left open.</p>  <p>How much force does it need to push the door shut? Put a tick (✓) in the box next to the best answer.</p> <p>A More force pushing at A. <input type="checkbox"/></p> <p>B More force pushing at B. <input type="checkbox"/></p> <p>C The same amount of force pushing at A or B. <input type="checkbox"/></p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;"><b>Lids off</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Lids off</b></p> <p>The lids of these jars need off.</p>  <p>Which lid needs less force to twist off? Put a tick (✓) in the box next to the best answer.</p> <p>A The one on jar X. <input type="checkbox"/></p> <p>B The one on jar Y. <input type="checkbox"/></p> <p>C They both need the same force. <input type="checkbox"/></p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;"><b>What's a lever?</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>What's a lever?</b></p> <p>Sometimes it is easy to open a lever. Joints (levers) are difficult to spot.</p> <p>Is there a lever in each picture? For each lever you see, draw a cross on its pivot.</p>  <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;"><b>Wire cutters</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Wire cutters</b></p> <p>Hannah is struggling to cut a thick wire. She squashes the wire cutters in the middle of the handles.</p>  <p>How can Hannah double the turning effect of the wire cutters, and double the force on the wire? Put a tick (✓) in the box next to 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 am sure this is wrong.</th> </tr> </thead> <tbody> <tr> <td>A Squash with the same force, close to the pivot.</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>B Squash with twice the force, in the middle of the handles.</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>C Squash with the same force, at the tip of the handle.</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>D Squash with twice the force, anywhere on the handle.</td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. 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Which way will the balance tip when Aiden leaves go?</p> <p>A It will tip to the left. <input type="checkbox"/></p> <p>B It will tip to the right. <input type="checkbox"/></p> <p>C It will not tip. <input type="checkbox"/></p> <p>b. What is the best reason for your last answer?</p> <p>A There is a bigger force. <input type="checkbox"/></p> <p>B There is a longer lever. <input type="checkbox"/></p> <p>C Force x distance is the same on both sides. <input type="checkbox"/></p> <p>D Force x distance is bigger. <input type="checkbox"/></p> <p>E Force x distance is bigger. <input type="checkbox"/></p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. 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<p style="text-align: center;"><b>See-saw calculations</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>See-saw calculations</b></p> <p>Four children are sitting on a see-saw. They try to make it balance.</p>  <p>1. Calculate the turning effect of each of the children. Choose from the answer's below.</p> <table border="1"> <tr> <td>240 Nm</td> <td>280 Nm</td> <td>400 Nm</td> <td>600 Nm</td> </tr> <tr> <td>800 Nm</td> <td>20 000 Nm</td> <td>40 000 Nm</td> <td>80 000 Nm</td> </tr> </table> <p>2. Which way does the see-saw tip? (Use your answers from question 1 to work this out.)</p> <p>A It will tip to the left. <input type="checkbox"/></p> <p>B It will tip to the right. <input type="checkbox"/></p> <p>C It will not tip. <input type="checkbox"/></p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	240 Nm	280 Nm	400 Nm	600 Nm	800 Nm	20 000 Nm	40 000 Nm	80 000 Nm	<p style="text-align: center;"><b>Balance beam</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Balance beam</b></p> <p>Aimee has put four weights onto the balance beam. She is holding the beam level.</p>  <p><b>Predict</b></p> <p>Where should Aimee put a set of three weights to make the beam balance?</p> <p><b>Explain</b></p> <p>Explain why she should put the weights here.</p> <p style="border: 1px solid black; padding: 2px; display: inline-block;">Investigate to see if you are right.</p> <p><b>Observe</b></p> <p>Record the number of weights and distance on each side of the beam when it balances. Do this five times using different weights on each side.</p> <p><b>Explain</b></p> <p>Have your prediction and explanation correct? Describe a rule that predicts where to put different weights to balance the beam.</p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;"><b>Wheelbarrow</b></p> <p style="text-align: center;"><b>BEST</b> STUDENT WORKSHEET</p> <p><b>Wheelbarrow</b></p> <p>A wheelbarrow makes it easier to lift a heavy pile of soil. How can you work out what force is needed to lift 80 kg of soil? (Lifting 80 kg straight up needs a force of 800 Newtons.)</p>  <p><b>To do</b></p> <p>Use these statements to describe how to calculate the force needed to lift the wheelbarrow.</p> <p>Some of the statements are not needed.</p> <table border="1"> <tr> <td>The turning effect = length of the lever x the force to lift the wheelbarrow.</td> <td>The force to lift the wheelbarrow = length of the lever x the weight of soil.</td> </tr> <tr> <td>Work out the turning effect of the soil.</td> <td>Change 20 cm into metres.</td> </tr> <tr> <td>The force to lift the wheelbarrow = turning effect ÷ by length of the lever.</td> <td>The turning effect needed to lift the wheelbarrow is turning effect of soil.</td> </tr> <tr> <td>The length of the lever is 1.2 m.</td> <td>The length of the lever is about 1.7 m.</td> </tr> <tr> <td>Add 1.2 m to 0.2 m to find the length of the lever.</td> <td>Multiply 0.2 m by 800 N.</td> </tr> <tr> <td>Divide both sides by the length of the lever.</td> <td>Multiply 20 cm by 800 N.</td> </tr> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. The document may have been edited. Download the original from <a href="http://www.BestEvidenceScienceTeaching.org">www.BestEvidenceScienceTeaching.org</a> © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	The turning effect = length of the lever x the force to lift the wheelbarrow.	The force to lift the wheelbarrow = length of the lever x the weight of soil.	Work out the turning effect of the soil.	Change 20 cm into metres.	The force to lift the wheelbarrow = turning effect ÷ by length of the lever.	The turning effect needed to lift the wheelbarrow is turning effect of soil.	The length of the lever is 1.2 m.	The length of the lever is about 1.7 m.	Add 1.2 m to 0.2 m to find the length of the lever.	Multiply 0.2 m by 800 N.	Divide both sides by the length of the lever.	Multiply 20 cm by 800 N.		
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