

Physics > Big idea PFN: Forces and motion > Topic PFM3: More about force

Key concept (age 11-14)










PFM3.1: Mass and weight

Progression toolkit: Mass and weight

Learning focus	Mass is a measure of the amount of matter an object or substance is comprised of and weight is the force needed to support the object or substance.				
As students' conceptual understanding progresses they can:	<div>CONCEPTUAL PROGRESSION</div>				
	Describe weight as the force needed to support an object or substance.	Describe mass as a measure of the amount of matter in an object or substance.	Explain the relationship between the weight and mass of an object that is caused by a gravitational force.	Explain why the measured weight of an astronaut changes as they take off in a rocket. B	Explain why an astronaut orbiting the Earth is weightless. B
Diagnostic questions	Which weighs more?	The biggest mass	Weight on the Moon	Blast off!	A very tall tower
			Moon food		Falling weight
Response activities	Weight	Mass cans	Bathroom scales	Moving weight	

Key:

B Bridge to later stages of learning

Which weighs more?	The biggest mass	Weight on the Moon	Moon food	Blast off!																																																																																																				
<p>BEST STUDENT WORKSHEET</p> <p>Which weighs more?</p> <p>A large bag of feathers hangs on a spring scale. A small bag of metal bolts hangs next to the feathers. Both force meters are at zero.</p>  <p>What do you think about metal and the feathers? For each statement, tick (✓) one column to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>100% sure it's true</th> <th>75% sure it's true</th> <th>50% sure it's true</th> <th>25% sure it's true</th> <th>100% sure it's false</th> </tr> </thead> <tbody> <tr> <td>A. The same force is needed to lift both.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B. The metal is harder to lift than the feathers.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C. There is more gravity pulling on the feathers.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D. The feathers weigh the same as the metal.</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p><small>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.</small></p>		100% sure it's true	75% sure it's true	50% sure it's true	25% sure it's true	100% sure it's false	A. The same force is needed to lift both.						B. The metal is harder to lift than the feathers.						C. There is more gravity pulling on the feathers.						D. The feathers weigh the same as the metal.						<p>BEST STUDENT WORKSHEET</p> <p>The biggest mass</p> <p>On Earth, Albert measured the force the Christmas tree pulled. It was 40 N. How big is the tree's mass?</p> <p>a. Which of these do you think has the biggest mass? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A Metal weight</th> <th>B Cardboard box</th> <th>C Bottle of water</th> <th>D Impossible to know</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>b. What is the best reason for your answer? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A It is the biggest.</th> <th>B It is made of the heaviest material.</th> <th>C It is made of the most metal.</th> <th>D It is the one that needs most force to lift it.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A Metal weight	B Cardboard box	C Bottle of water	D Impossible to know		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		A It is the biggest.	B It is made of the heaviest material.	C It is made of the most metal.	D It is the one that needs most force to lift it.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>BEST STUDENT WORKSHEET</p> <p>Weight on the Moon</p> <p>An astronaut is on the Moon. She is measuring the force needed to lift a hammer.</p>  <p>On Earth it takes 20 Newtons to lift a hammer. a. What force is needed to lift the hammer on the Moon?</p> <table border="1"> <thead> <tr> <th></th> <th>A 0 Newton</th> <th>B 5 Newton</th> <th>C 20 Newton</th> <th>D 30 Newton</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>b. What is the best reason for your last answer? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A There is no gravity on the Moon.</th> <th>B The force of gravity is different on the Moon.</th> <th>C It is the same hammer.</th> <th>D There is no air on the Moon.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A 0 Newton	B 5 Newton	C 20 Newton	D 30 Newton		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		A There is no gravity on the Moon.	B The force of gravity is different on the Moon.	C It is the same hammer.	D There is no air on the Moon.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>BEST STUDENT WORKSHEET</p> <p>Moon food</p> <p>An astronaut is preparing to go to the Moon. Food for space travel is measured out carefully.</p>  <p>Which way of measuring food works on the Moon?</p> <table border="1"> <thead> <tr> <th></th> <th>A Balance</th> <th>B Spring balance</th> <th>C Both</th> <th>D Neither</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A Balance	B Spring balance	C Both	D Neither		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>BEST STUDENT WORKSHEET</p> <p>Blast off!</p> <p>Paul's rocket is about to launch to the Moon. He thinks: The first Moon landing was on 20th July 1969. The last Moon landing was in December 2012.</p>  <p>a. What happens to the weight of an astronaut as she blasts off? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A Her weight gets bigger.</th> <th>B Her weight stays the same.</th> <th>C Her weight gets smaller.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>b. What is the best reason for your last answer? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A Her mass does not change.</th> <th>B The force of gravity on her does not change.</th> <th>C Her mass and the force of gravity on her do not change.</th> <th>D The force of gravity on her changes.</th> <th>E The rocket makes her speed up very quickly.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A Her weight gets bigger.	B Her weight stays the same.	C Her weight gets smaller.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		A Her mass does not change.	B The force of gravity on her does not change.	C Her mass and the force of gravity on her do not change.	D The force of gravity on her changes.	E The rocket makes her speed up very quickly.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	100% sure it's true	75% sure it's true	50% sure it's true	25% sure it's true	100% sure it's false																																																																																																			
A. The same force is needed to lift both.																																																																																																								
B. The metal is harder to lift than the feathers.																																																																																																								
C. There is more gravity pulling on the feathers.																																																																																																								
D. The feathers weigh the same as the metal.																																																																																																								
	A Metal weight	B Cardboard box	C Bottle of water	D Impossible to know																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A It is the biggest.	B It is made of the heaviest material.	C It is made of the most metal.	D It is the one that needs most force to lift it.																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A 0 Newton	B 5 Newton	C 20 Newton	D 30 Newton																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A There is no gravity on the Moon.	B The force of gravity is different on the Moon.	C It is the same hammer.	D There is no air on the Moon.																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A Balance	B Spring balance	C Both	D Neither																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A Her weight gets bigger.	B Her weight stays the same.	C Her weight gets smaller.																																																																																																					
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																					
	A Her mass does not change.	B The force of gravity on her does not change.	C Her mass and the force of gravity on her do not change.	D The force of gravity on her changes.	E The rocket makes her speed up very quickly.																																																																																																			
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																			
Confidence grid	Two-tier multiple choice	Two-tier multiple choice	Simple multiple choice	Two-tier multiple choice																																																																																																				
<p>BEST STUDENT WORKSHEET</p> <p>A very tall tower</p> <p>The International Space Station is 400 km above the Earth. A very tall tower is built to put satellites into space. It is 400 km tall.</p>  <p>Some boys are talking about what it would be like on top of the tower.</p> <p>Albert: You would float because you are in space. Brandon: You weigh the same as you do on the ground. Declan: There is no air to breathe. Cameron: The force of gravity is less than it is on the ground.</p> <p>Talk about your answers to these questions: 1. How do you think it is right about what it is like on top of the very tall tower? Explain your answer. 2. What mistakes do you think the other made? After you've said your say to them to help them to understand?</p> <p><small>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.</small></p>	<p>BEST STUDENT WORKSHEET</p> <p>Falling weight</p> <p>Albert is on a fun fair ride called 'Stuck In It'. It drops the riders from the top of a tall tower. Albert sits on a bathroom scales to weigh himself.</p>  <p>The riders start to fall. a. What happens to the weight Albert measures? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A His weight goes up.</th> <th>B His weight stays the same.</th> <th>C His weight goes down.</th> <th>D He becomes weightless.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p>b. What is the best reason for your last answer? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A Albert speeds up very quickly.</th> <th>B The force of gravity on Albert stays the same.</th> <th>C Albert's seat belt is too tight.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A His weight goes up.	B His weight stays the same.	C His weight goes down.	D He becomes weightless.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		A Albert speeds up very quickly.	B The force of gravity on Albert stays the same.	C Albert's seat belt is too tight.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>BEST STUDENT WORKSHEET</p> <p>Weight</p> <p>On Earth, Albert measures a box. The box has a weight of 100 Newtons. He takes it to the Moon.</p>  <p>What can you say about the weight of the box? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>A Its weight is the same as on Earth.</th> <th>B Its weight is less than on Earth.</th> <th>C Its weight is more than on Earth.</th> <th>D Its weight is measured in kilograms.</th> </tr> </thead> <tbody> <tr> <td></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p><small>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.</small></p>		A Its weight is the same as on Earth.	B Its weight is less than on Earth.	C Its weight is more than on Earth.	D Its weight is measured in kilograms.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<p>BEST STUDENT WORKSHEET</p> <p>Mass cans</p> <p>Two cans are hanging on a stand. The cans have the same mass. One has more mass than the other one.</p>  <p>Read! What will happen if you push each can with the tip of your finger? What will you hear? Explain! Why do you think you will hear that? Push each with the tip of your finger. Push lightly.</p> <p>Observe! Describe what you hear when you push each can. Explain! How can you explain and explain correctly? Try to improve your first explanation to explain what happens more clearly.</p> <p><small>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.</small></p>	<p>BEST STUDENT WORKSHEET</p> <p>Bathroom scales</p> <p>Bathroom scales measure the force that pushes down on them. They automatically change the number of Newtons they show. Do bathroom scales measure mass or weight - or both?</p>  <p>Fill in the gaps to remember what happens to John when he goes to the Moon. You also have to use the words mass and weight.</p> <p>Mass or weight? John stands on his bathroom scales. He is pushing down with a force of 436 Newtons. This means he has a mass of 436 N. The scales tell him he has a mass of 43.6 kg. John visits the Moon. On the way he floats inside his space-ship because he has no mass. He still has mass. John likes space food and eats a lot. His body is now made of more matter, so he has a bigger mass. On the Moon he can be lifted with just 90 Newtons. On the Moon he has a smaller mass.</p> <p><small>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.</small></p>																																																																								
	A His weight goes up.	B His weight stays the same.	C His weight goes down.	D He becomes weightless.																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
	A Albert speeds up very quickly.	B The force of gravity on Albert stays the same.	C Albert's seat belt is too tight.																																																																																																					
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																					
	A Its weight is the same as on Earth.	B Its weight is less than on Earth.	C Its weight is more than on Earth.	D Its weight is measured in kilograms.																																																																																																				
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																																																																																																				
Talking heads	Two-tier multiple choice	Simple multiple choice	Predict, explain; observe, explain	Focused cloze																																																																																																				

Moving weight

BEST

Moving weight

A force meter can be used to measure the weight of an object. Weight is measured in Newtons.

Predict

What happens to the weight of an object when the force meter is:

- pulled upwards very quickly?
- moved downwards very quickly?

.....

.....

Explain

Explain why you think this will happen.

.....

.....

Carry out the investigation

Observe

Describe how the pointer moves.
(You won't be able to take exact measurements)

.....

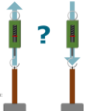
.....

Explain

Were your prediction and explanation correct?
Try to improve your first explanation to explain what happens more fully.

.....

.....



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.

Predict, explain; observe, explain