



# Unbalanced forces and motion

## Components

	NAME	DESCRIPTION	AUDIENCE
	<i>Unbalanced forces and motion</i> teachers guide	The guide shows how images of sporting players and equipment can be used to engage interest in effects of unbalanced forces on motion.	teachers
	<i>Looking at motion</i> presentation	A collection of images related to sport promotes discussion about effects of unbalanced forces on motion.	students
	<i>Causes of motion</i> worksheet	Students place arrows on images to show directions that forces are acting and the direction of motion.	students

## Purpose

To **Engage** students' interest in effects of unbalanced forces on motion of objects.

## Outcomes

Students understand that unbalanced forces affect motion of objects by causing them to accelerate, decelerate or change direction.

## Activity summary

ACTIVITY	POSSIBLE STRATEGY
Teacher shows the presentation, <i>Looking at motion</i> , which includes images of sports and sporting equipment.  For each slide, teacher asks: <ul style="list-style-type: none"> <li>• How do you know unbalanced forces are acting?</li> <li>• What unbalanced forces are acting?</li> </ul>	teacher-led discussion
If the presentation is shown on an IWB, students can be invited to draw arrows on the slides to show directions that forces act, and direction of motion.  Alternatively, students can add arrows to images in the worksheet, <i>Causes of motion</i> .	individuals
Teacher-led discussion around the question, 'What do we need to know to predict effect(s) unbalanced forces will have on objects?'	whole class

## Technical requirements

The teachers guide and worksheet require Adobe Reader (version 5 or later), which is a free download from [www.adobe.com](http://www.adobe.com). The worksheet is also available in Microsoft Word format. QuickTime version 7 or later is required to view the video. This is a free download from [www.apple.com/quicktime](http://www.apple.com/quicktime).

A high-quality MP4 version of the video with subtitles is also available on CD-ROM or download from the SPICE website.

## Information for teachers

The presentation, *Looking at motion*, includes a series of images in which unbalanced forces affect motion of objects by causing them to accelerate, decelerate or change direction. Teachers can use these images to identify student misconceptions about force and how motion is affected by forces applied to objects in particular the force of gravity.

SLIDE	DESCRIPTION
2	<b>A basketball approaches a hoop</b> You can tell unbalanced forces are acting on the basketball because its velocity is changing. From the moment it leaves a player's hand, the only forces acting on it are gravity (vertically downwards) and air resistance (opposing the direction of motion). Gravity causes the ball to accelerate downwards throughout its flight.
3	<b>Hammer after release</b> Unbalanced forces of gravity and air resistance are the only forces acting. Gravity causes the hammer to accelerate downwards throughout its flight.
4	<b>Ball in contact with a boot</b> The applied (unbalanced) force has caused the ball to accelerate off the ground. Once in flight the only unbalanced forces acting are gravity and air resistance. Gravity causes the ball to accelerate downwards throughout its flight.
5	<b>Windsurfer moving on the ocean surface</b> The force of gravity is in balance with a normal force. If the windsurfer is accelerating, applied force (air pressure) pushing against the sail and air resistance are unbalanced. If the windsurfer is moving with constant velocity applied force and air resistance are in balance.
6	<b>A bowling ball striking pins</b> Gravity and normal force are in balance. (The bowling ball loses kinetic energy as it strikes the pins and slows down.) Contact with the pins causes the bowling ball to decelerate. Horizontal forces are no longer in balance.
7	<b>Rugby players in a scrum</b> All forces are in balance (provided the scrum is stationary or moving with constant velocity).
8	<b>A cue strikes a billiard ball</b> Gravity and normal force are in balance. Applied force from motion of the cue accelerates the ball. Horizontal forces are unbalanced.
9	<b>A tennis ball as it is hit</b> The tennis ball changes direction as it accelerates off the racket. Horizontal forces are therefore unbalanced.
10	<b>A tennis ball in flight</b> A tennis ball in flight has unbalanced forces acting on it. Gravity causes the ball to accelerate downwards through its flight. Air resistance opposes motion of the ball.
11	<b>A bouncing tennis ball</b> The ball is stationary on the ground for a very short period of time before it bounces back. Gravity and normal force are in balance and there are no horizontal forces acting. As the tennis ball approaches and leaves the court there is a change in direction, (deceleration and acceleration). Forces in this situation (gravity and normal force) are unbalanced.

Table 1: Content of presentation, *Looking at motion*

## Image credits

- 'basketball net' by jgareri/iStockPhoto. Used under licence, [www.istockphoto.com/stock-photo-12040963-basketball-net.php?st=e409158](http://www.istockphoto.com/stock-photo-12040963-basketball-net.php?st=e409158)
- 'hammer throw' by Phil Sussman (US Army), PD-USGOV, [commons.wikimedia.org/wiki/File:Hammerthrow\\_wire.jpg](https://commons.wikimedia.org/wiki/File:Hammerthrow_wire.jpg)
- 'Ronan O'Gara kicks a conversion' by Éamonn Ó Muiri, CC-BY-2.0, [www.flickr.com/photos/68518558@N00/461481062](http://www.flickr.com/photos/68518558@N00/461481062)
- 'windsurfer in front of Dragon Island, Dakhla' by Nomadz, GFDL, [commons.wikimedia.org/wiki/File:Dakhla\\_Trip\\_1409.JPG](https://commons.wikimedia.org/wiki/File:Dakhla_Trip_1409.JPG)
- 'bowling' by Escuela Virtual de Deportes, CC-BY-SA-2.5, [commons.wikimedia.org/wiki/File:EVD-bolos-124.jpg](https://commons.wikimedia.org/wiki/File:EVD-bolos-124.jpg)
- 'scrum in match at Clermont Auvergne' by Zegreg63, GFDL, [commons.wikimedia.org/wiki/File:Mélée\\_ASM\\_Clermont\\_Auvergne-SC\\_Albi.jpg](https://commons.wikimedia.org/wiki/File:Mélée_ASM_Clermont_Auvergne-SC_Albi.jpg)
- 'To pot the red' by Michael Maggs, CC-BY-SA-3.0, [commons.wikimedia.org/wiki/File:To\\_pot\\_the\\_red.jpg](https://commons.wikimedia.org/wiki/File:To_pot_the_red.jpg)
- tennis match photos provided by Tristan Clemens, The University of Western Australia
- 'tennis ball bouncing' by Viktor Viktor (mostphotos), used under licence, [www.mostphotos.com/2690536/the-impact-tennis-ball-bouncing-off-the-tennis-court](http://www.mostphotos.com/2690536/the-impact-tennis-ball-bouncing-off-the-tennis-court)

## Acknowledgements

Designed and developed by the Centre for Learning Technology, The University of Western Australia.  
Production team: Graham Baker, Alwyn Evans, Jenny Gull, Michael Wheatley, with thanks to Bob Fitzpatrick and Wendy Sanderson.

## Associated SPICE resources

*Motion 1: Unbalanced forces and motion* may be used in conjunction with related SPICE resources to address the broader topic of motion.

DESCRIPTION	LEARNING PURPOSE
<p><i>Motion (overview)</i></p> <p>This learning pathway shows how a number of SPICE resources can be used to teach concepts of motion.</p>	
<p><i>Motion 1: Unbalanced forces and motion</i></p> <p>Images from various sports stimulate discussion of effects of forces on motion of objects.</p>	<b>Engage</b>
<p>The sequence overview contains suggested <b>Explore</b> activities suitable for use at this point.</p>	<b>Explore</b>
<p><i>Motion 2: Profile of a runner</i></p> <p>A 100 m race is used as a context for analysing motion, velocity and acceleration.</p>	<b>Explain 1</b>
<p><i>Motion 3: Tennis ball motion</i></p> <p>Students use equations of motion to analyse slow-motion footage of a bouncing tennis ball.</p>	<b>Explain 2</b>
<p><i>Motion 4: Sporting injuries</i></p> <p>A biomechanist and surgeon provide perspectives on knee injuries in athletes. Data on injuries, for a range of sports, are analysed. Students make connections between prevalence of injuries and forces in the human body.</p>	<b>Elaborate</b>

## SPICE resources and copyright

All SPICE resources are available from the Centre for Learning Technology at The University of Western Australia ("UWA"). Selected SPICE resources are available through the websites of Australian State and Territory Education Authorities.

Copyright of SPICE Resources belongs to The University of Western Australia unless otherwise indicated.

Teachers and students at Australian and New Zealand schools are granted permission to reproduce, edit, recompile and include in derivative works the resources subject to conditions detailed at [spice.wa.edu.au/usage](http://spice.wa.edu.au/usage).

All questions involving copyright and use should be directed to SPICE at UWA.

Web: [spice.wa.edu.au](http://spice.wa.edu.au)  
Email: [spice@uwa.edu.au](mailto:spice@uwa.edu.au)  
Phone: (08) 6488 3917

Centre for Learning Technology (M016)  
The University of Western Australia  
35 Stirling Highway  
Crawley WA 6009