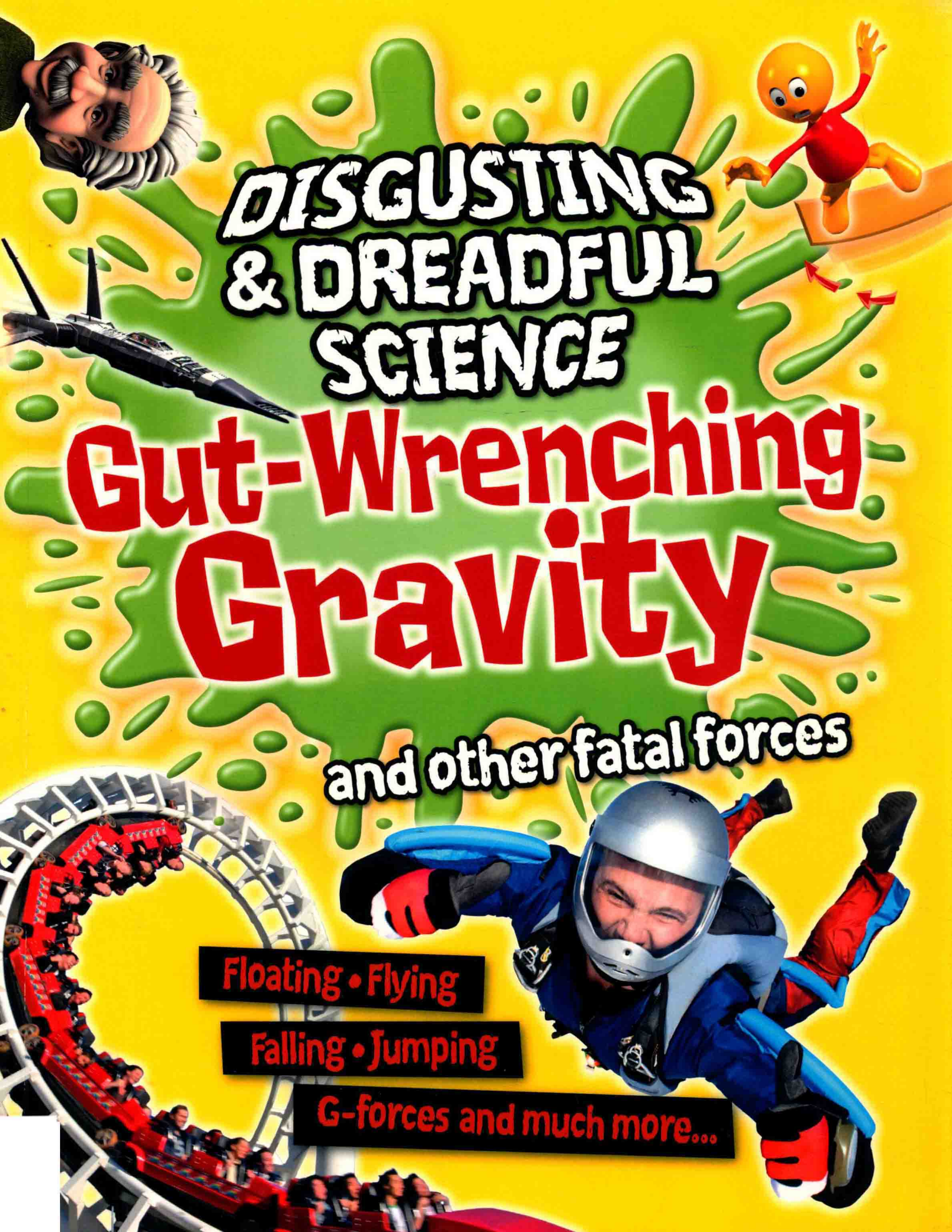
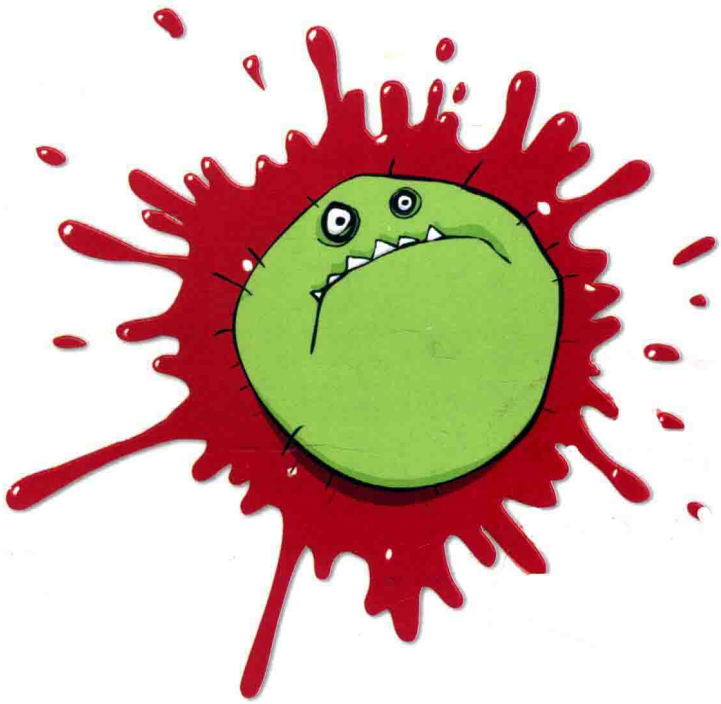

DISGUSTING & DREADFUL SCIENCE
Gut-Wrenching Gravity
and other fatal forces
Floating • Flying
Falling • Jumping
G-forces and much more...

DISGUSTING & DREADFUL SCIENCE

Gut-Wrenching Gravity

and other fatal forces



by Anna Claybourne

FRANKLIN WATTS
LONDON•SYDNEY

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All other illustrations by Graham Rich

Teaching and literacy notes

These notes and activities will help you to make the most of this book with your child or class.

READING

- Challenge the reader to find information fast by using the index. For instance, where can you read about Isaac Newton, and what did he discover?
- Words in bold are in the glossary. Encourage the reader to use the glossary.
- Look up the word 'gravity' in a good dictionary. What other meanings does it have?

WRITING

- Turn to page 4 to read a list of actions relating to forces. Although gravity holds enormous objects in place, such as the Earth and the Moon, it is actually quite a weak force. Imagine you are kicking a ball. How do gravity and other forces play their part in this action? Write some sentences that focus on the forces at work. tart with: 'Gravity pulls me down, keeping my feet on the ground.'
- This book is packed with quirky information about gravity, perfect material to create a quiz. Write your own quiz on the subject of gravity to test out your friends' knowledge of the subject.
- Read about life with very low gravity on board the International Space Station on pages 28 and 29. Do some more research about life on the space station. How do astronauts stop themselves and all their equipment from floating around? Write an information report about everyday life on board the space station.
- Read about friction on pages 20 and 21. When a cyclist puts on his/her brakes, how does friction slow the bike down? Write an explanation.
- Read about Sir Isaac Newton on pages 18 and 19. Do some more research and write a biography of this great scientist.

SPEAKING AND LISTENING

- Talk about the book. What do people like about it? What do they not like about it? How many points would they give it out of 10?

ACROSS THE CURRICULUM

HISTORY

- Find out more about Galileo Galilei, an extraordinary scientist, astronomer and mathematician who lived in the 17th century in Italy. He worked out that if there was no air resistance, a feather and a rock would fall at the same speed. Use the Internet to find the NASA film clip that shows the experiment in action on the Moon during the Apollo 15 space mission.

SCIENCE

- Experiment with paper plane designs to see which one works best. To fly, the paper plane design has to balance out four forces – drag, gravity, thrust and lift.
- Find your pencil's centre of gravity. Keep shifting your pencil along the tip of your finger until it balances. Mark the spot. It is the pencil's centre of gravity. Now add a pen lid or pencil eraser to either end of the pen. Find the pencil's new centre of gravity.

Contents

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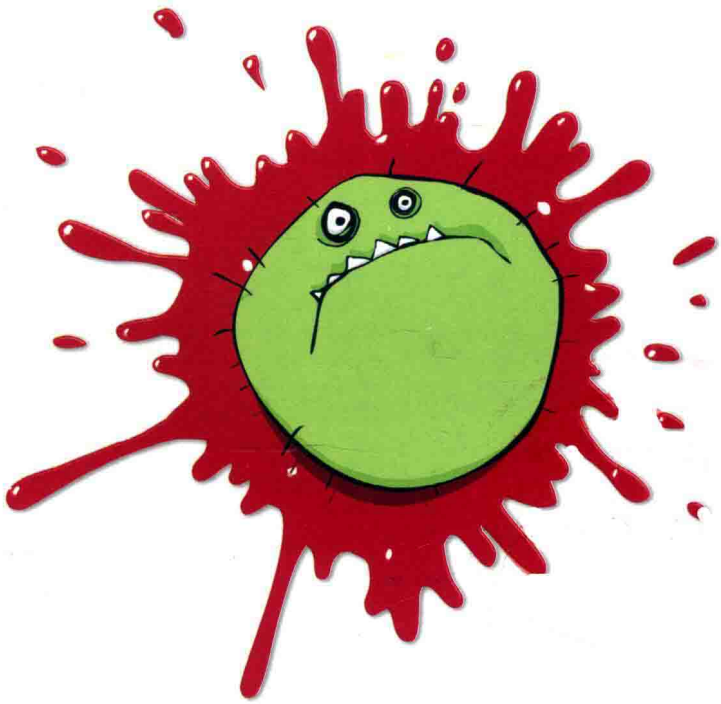

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Contents

Feel the force!

Oops! CRUNCH! Ouch! If you trip over your shoelaces and go flying, you soon fall flat on your face. You are dragged violently towards the ground by a fearsome force called gravity. Gravity acts like a PULLING force. So when you fall over, you really are being pulled to the ground.

We'll force you!

Gravity is just one of the forces that pull, push, squeeze and shove us around, all day long. We're so used to them, we often don't notice them – but they affect everything we do.
Here are a few you might recognise...

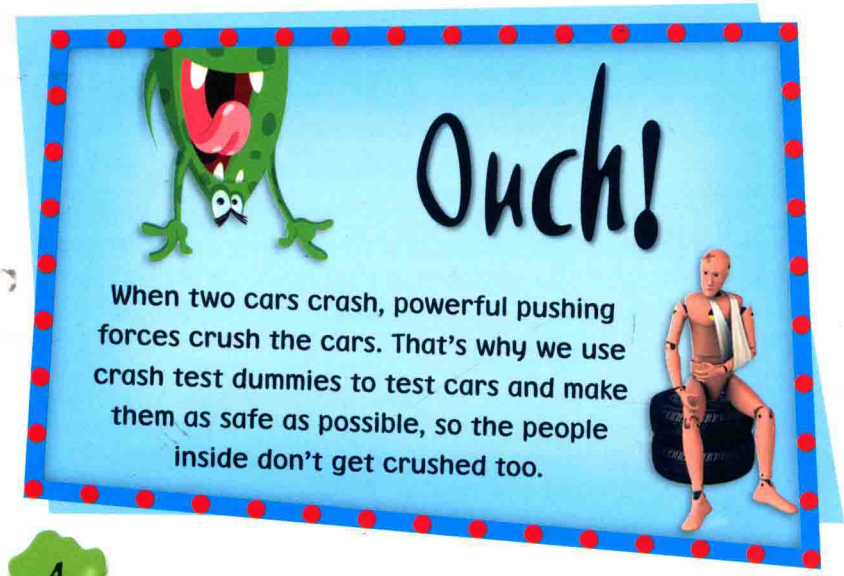
PUSH – when you kick a ball, you push it with your foot

PULL – when you pull your socks up to get them onto your feet

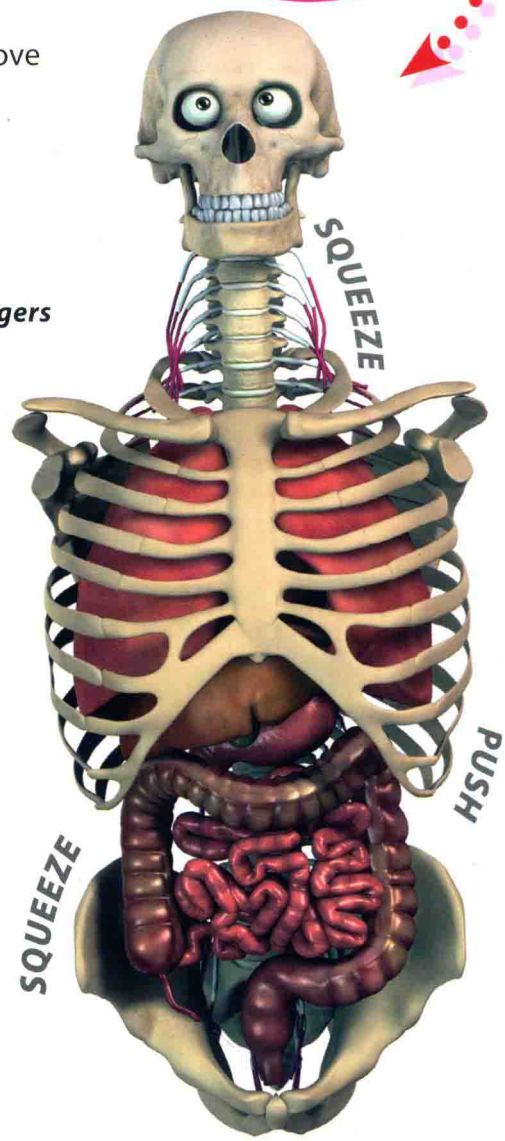
SQUEEZE – when you SQUELCH a handful of slime between your fingers

STRE-E-ETCH – when you pull an elastic band, then ping it across the room

SCRAPE – when your chair scrapes on the floor with an ear-splitting screech!



Pushes and pulls make your body work, too. Muscles PULL to make your bones move. When you eat, tubes SQUEEZE tight to PUSH the food along – and to PUSH out your poo!



Balanced forces

If an object isn't moving, it's because the forces acting on it are balanced. If a cake sits on a plate, gravity is pulling it down, but the plate is in the way and stops the cake from falling. The plate is actually pushing it up. The two forces balance each other and the cake stays still.

See for Yourself

Diving board

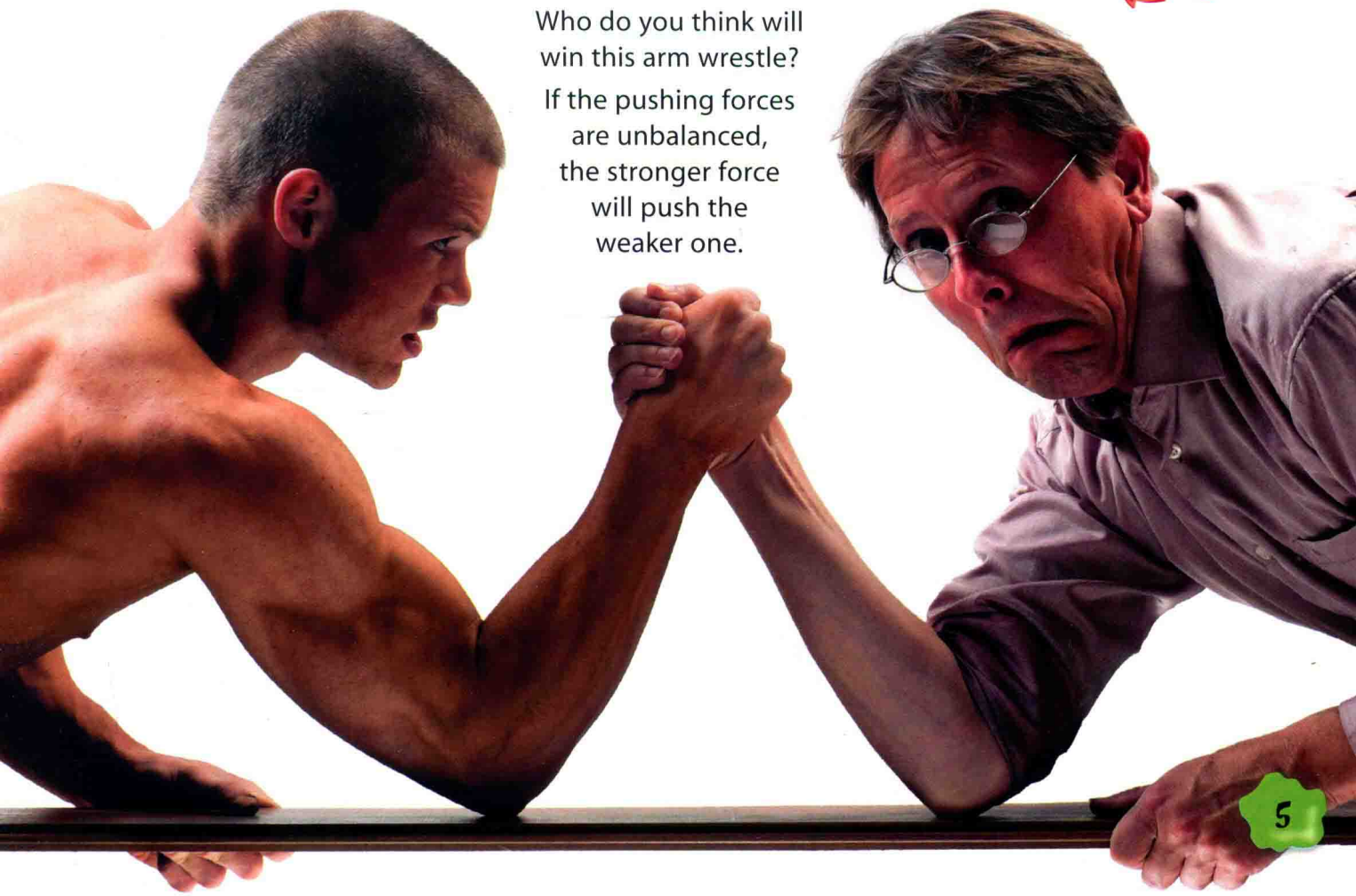
Hold a wooden or plastic ruler on the edge of a table, and stand a toy figure on the end. Gently pull down the tip of the ruler, then let it go.

You PULL down on the ruler. The ruler springs back and PUSHES the figure up. After a daring leap, gravity PULLS the figure to the ground.

Unbalanced forces

Who do you think will win this arm wrestle?

If the pushing forces are unbalanced, the stronger force will push the weaker one.



The mystery of gravity

Gravity is everywhere. It makes an egg splat on the floor when you drop it. It makes snot dribble out of your nose. It lets you pour juice into a glass, play ball games and have a shower. Gravity can be a drag when you're carrying a heavy bag, but it can be fun too, when you're sledging, skiing or skydiving.

I'm floating away!

Imagine life without gravity! Nothing would stay where you put it. You couldn't walk down the street – you'd just float around. The air would be filled with random objects. Except there wouldn't be any air, either! Gravity holds air in place around our planet, allowing us to breathe. So, as you can see, it's pretty important.

A universe of gravity

Everything on Earth (right) is pulled towards the centre of the planet by gravity, but it's not just the Earth that has gravity. Every object – including the Moon, a pebble, a pea, and you yourself – has a pulling force that draws it towards other objects. The more massive an object is, the more powerful its gravity. Small objects have such weak gravity we don't notice it, but Earth's gravity is so strong it pulls on us and everything else nearby.

On Earth, there's actually no such thing as 'down'.

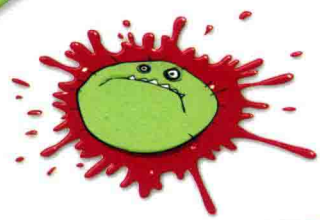
How does it do it?

How can one object pull on another across empty space? Where exactly does the pulling power of gravity come from? The truth is... wait for it... we don't actually know! Gravity is a massive mystery. The world's greatest minds are still trying to figure out why it's there and how it works.

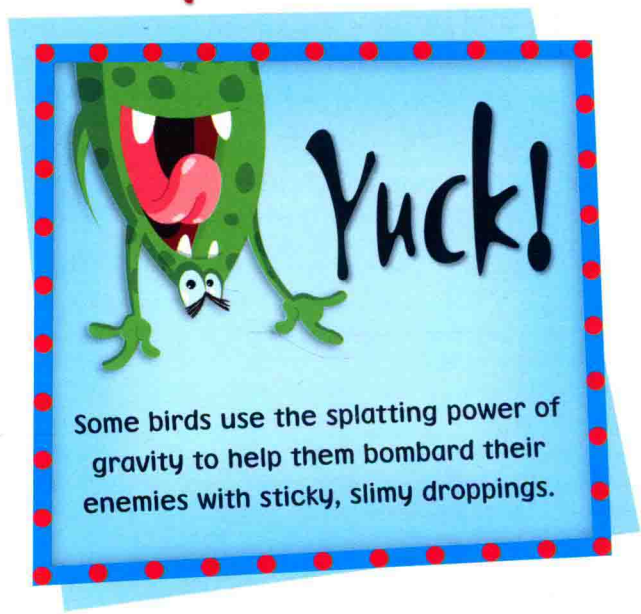
Yuck!

Scientists have found that when toast falls off a table, it really does usually land on the buttery side. That's because, as it tips off the table, it starts to spin. In the time it takes gravity to pull the toast to the floor, it only has time to spin 180 degrees, or half a full turn – so it's upside-down when it lands.

Splat!



Stand back! Cow dung (below) can make a mighty splat as it hits the ground! The further something falls, the bigger the mess when it lands. As an object falls towards the Earth, it speeds up, or accelerates. The longer it falls for, the faster it falls. That's why you can jump off a low wall and land safely (most of the time!) but what if you fell off a high cliff?



Faster...faster...faster

On Earth, falling objects speed up by 9.8 metres per second, for every second that goes by. That's quite a lot – equivalent to about 35 km/h. With each second that passes, the object falls 35 km/h faster. As you can imagine, after just a few seconds, a falling object is zooming as fast as a speeding train.

Floaty and Fluffy

The speed of a falling object is affected by air resistance – that is, air getting in its way. Light, fluffy objects like feathers catch a lot of air, which slows them down, but a rock or a person falls much faster. If there was no air resistance, a feather and a rock would fall at the same speed.

Drop it!

Imagine you climbed up a 100-metre skyscraper, and dropped a rotten tomato off the top.
Look out below!

AFTER 1 SECOND
Your tomato is already moving faster than you could run! It's falling at
35 km/h

AFTER 2 SECONDS
It's just past
70 km/h

AFTER 3 SECONDS
It's plummeting down at almost
106 km/h

AFTER 4 SECONDS
Your tomato is travelling at a breakneck speed of
140 km/h
Then it hits the ground...
SPLAT!

DID YOU KNOW?

A mouse could fall off the same skyscraper and survive unharmed. Even though it would land at a scary speed of over 140 km/h, the mouse isn't heavy enough for this to damage its body.

See for Yourself

Water balloon splats

Fill several balloons with water (use the same amount of water for each one) and tie them closed. Then try dropping them from different heights off the ground – 0.5 metres, 1 metre and 1.5 metres (*you'll need to go outside for this!*)
How far does a balloon have to fall to make it splat?
Can you make a bigger splat by dropping it from higher up?
To get your balloons even higher, throw them up in the air.
Record your results on a chart, like this.

	Height	Diameter of splat
1st drop	0.5 m	No splat
2nd drop	1 m	?
3rd drop	1.5 m	?
4th drop	3 m	?

Don't forget to clean up the bits of balloon afterwards. They can be hazardous to wildlife.

Deadly gravity

Living with gravity can be DREADFULLY dangerous. Whether it's you falling over, or something falling on top of you, gravity's pulling force can cause all kinds of deadly disasters.

Aarrrrggghhhh!

Base jumpers and skydivers throw themselves out of aeroplanes or off cliffs and mountains for fun. Falls of more than about 15 metres without a parachute are usually deadly for humans, but some people are lucky. During the Second World War (1939-45), British Royal Air Force gunner Nick Alkemade jumped from his burning plane. He fell about 5,500 metres and prepared to die. Instead, a pine tree broke his fall and he landed in soft snow. He was unhurt except for a sprained ankle.

A skydiver in free fall, enjoying the pull of Earth's gravity.

Falling from space

Sometimes, bits of rock flying through space come close enough to the Earth to be pulled in by its gravity. They often burn up as they fall through the atmosphere and we see them as 'shooting stars'. Some, called meteorites, fall all the way to Earth. If they hit someone, it could be deadly. In 2009, a pea-sized meteorite hit 14-year-old Gerrit Blank as he walked to school in Germany – luckily he wasn't badly hurt. If a really big space rock, or asteroid (left), hit us it could wipe out life on Earth!

Get out of the way!

Gravity often causes terrifying natural disasters. It pulls floodwater, avalanches, landslides and frazzling hot volcanic lava downhill. The further they flow, the faster they go, flattening anything in their path.

Snow might be fun, but an avalanche is terrifying and deadly when it's hurtling towards you at over 160 km/h!

Fatal fall

In the past, the guillotine was used to behead criminals – and sometimes kings and queens! The guillotine's sharp, heavy blade was pulled up into a high position using a rope. When it was let go, gravity pulled the blade down. **CHOP!**

Yikes!

People often said that a detached head pulled a funny face after being chopped off. As an experiment, a doctor named Dr Beurieux tried talking to a guillotine victim, Henri Languille, after he lost his head in 1905. "I called in a strong, sharp voice: 'Languille!'" said the doctor. "I saw the eyelids slowly lift up... and undeniably living eyes fixed themselves on mine." Scary!

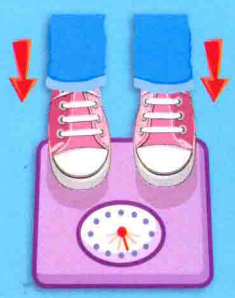
Gut-wrenching g-forces

You might have heard of fighter pilots and racing drivers enduring massive 'g-forces'. Strong g-forces can make you feel dizzy, throw up, collapse unconscious, and even die! So, what are they?

See for Yourself

Feel supergravity

Try jumping and landing again on bathroom scales *(Be careful! Just do a small jump so you don't break them)*. Look at the scales as you land and you'll see them showing an increased reading, as you decelerate and your g-force goes up. The same thing happens sometimes when you're in a lift and it lands on the ground floor.



Extra gravity

The 'g' in g-force stands for gravity and 1g means the force of gravity you feel on Earth. A force of 2g means twice the force of Earth's gravity, and so on. When you accelerate (speed up) or decelerate (slow down), you feel a pushing force. In an aeroplane, you feel 'pushed' back into your seat at take off. On a bus, you are pushed forward if it stops suddenly. These are g-forces. When we experience them, we feel a force greater than gravity.

Wheeee!

You experience g-forces when you swoop up and down on a rollercoaster, or when you're in a car that turns a corner, pushing you sideways. If you fall, then hit the ground, your body experiences multiple gs as you suddenly decelerate.