A Series of Impossible Questions

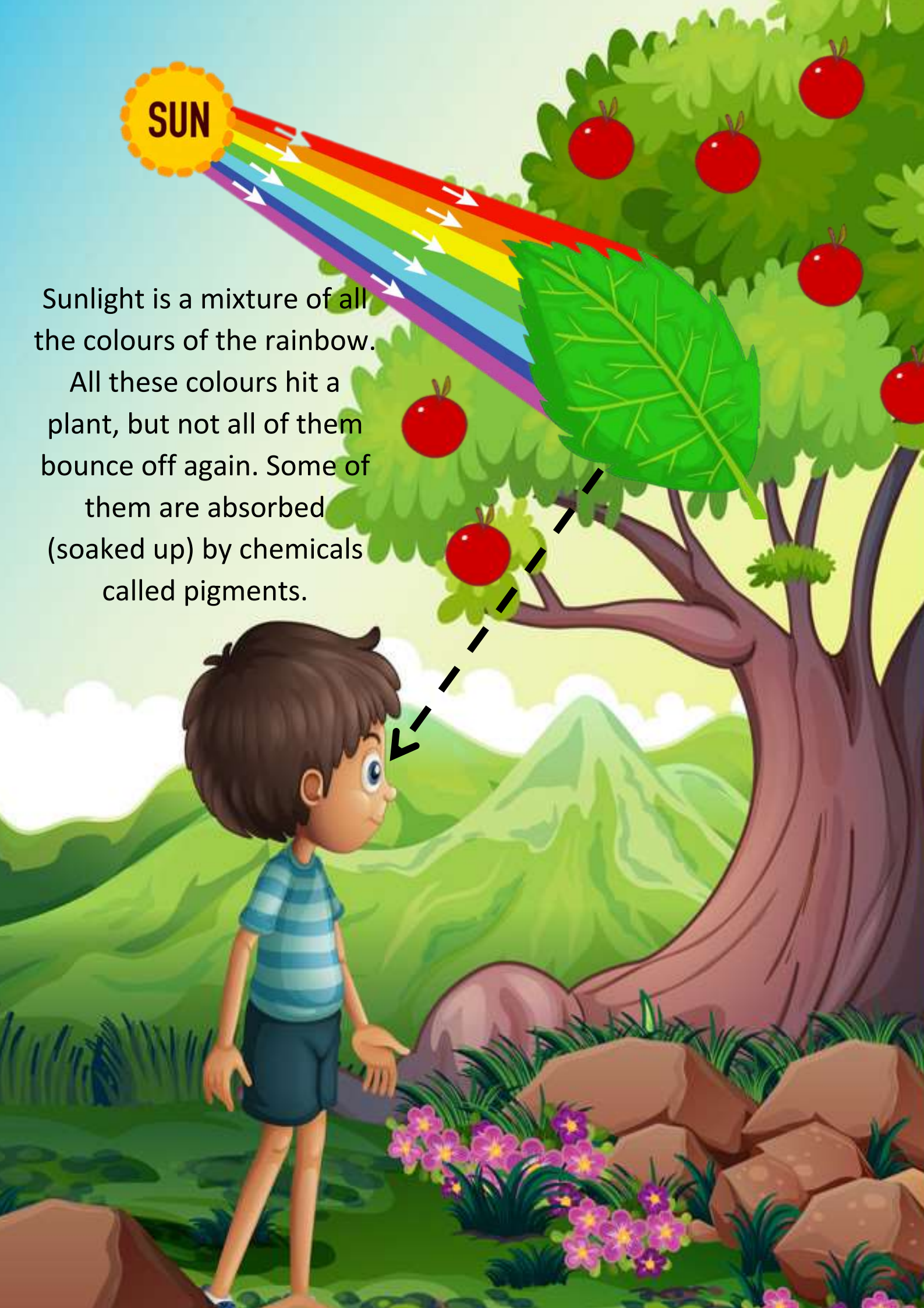
By Isabel Thomas

Why are Plants Green?

THINK
DIGITAL ACADEMY


This question is both impossible and possible to answer! Let’s start with the possible part.

We see plants (and everything else) because light bounces off them towards our eyes.



Sunlight is a mixture of all the colours of the rainbow. All these colours hit a plant, but not all of them bounce off again. Some of them are absorbed (soaked up) by chemicals called pigments.

Most plants contain a pigment called chlorophyll, which soaks up blue and red light, but reflects green.


SUN
If only green light bounces off a plant towards our eyes, we see the leaf as green!

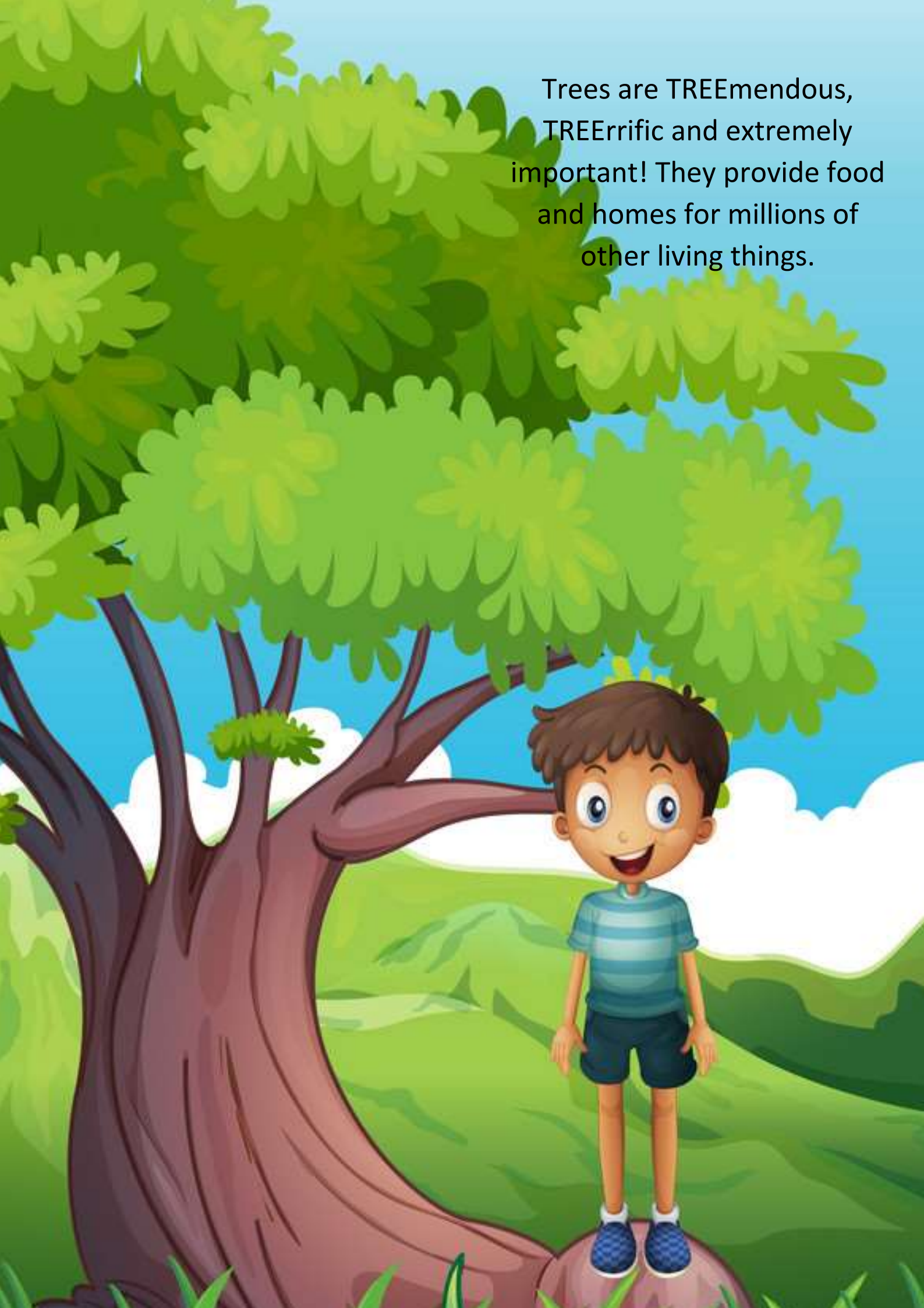
Now for the impossible part of the question – why do leaves bounce away green light in the first place? Leaves use the light they soak up to make food for the plant, so why not have black leaves that absorb EVERY colour?

Some scientists think it’s by accident – because the ancestor of all plants happened to be green. Other scientists think that it’s not just an accident – and that bouncing away green light actually helps plants.

Have you noticed how black surfaces, like a road, get hotter than white ones on a sunny day? If a plant soaked up ALL the colours in sunlight, it might overheat, or become damaged (like our skin gets sunburned).

We’ll never know for sure. but imagine if you could avoid slapping on sunscreen ever again, just be becoming green! Would you?


How Many Trees are there in the Whole World?


Trees are TREEmendous, TREErrific and extremely important! They provide food and homes for millions of other living things.


They clean up the air and anchor the soil in place. And their only waste products are water and the oxygen that we breathe!

So, when we hear that humans are chopping down trees at an alarming rate, we want to know how many are left. We grab a clipboard and head to our nearest forest.


And then … we realise
there are so MANY trees
that counting each one
would take far too long.


But don’t put your clipboard away yet. We can still estimate – or make a best guess.

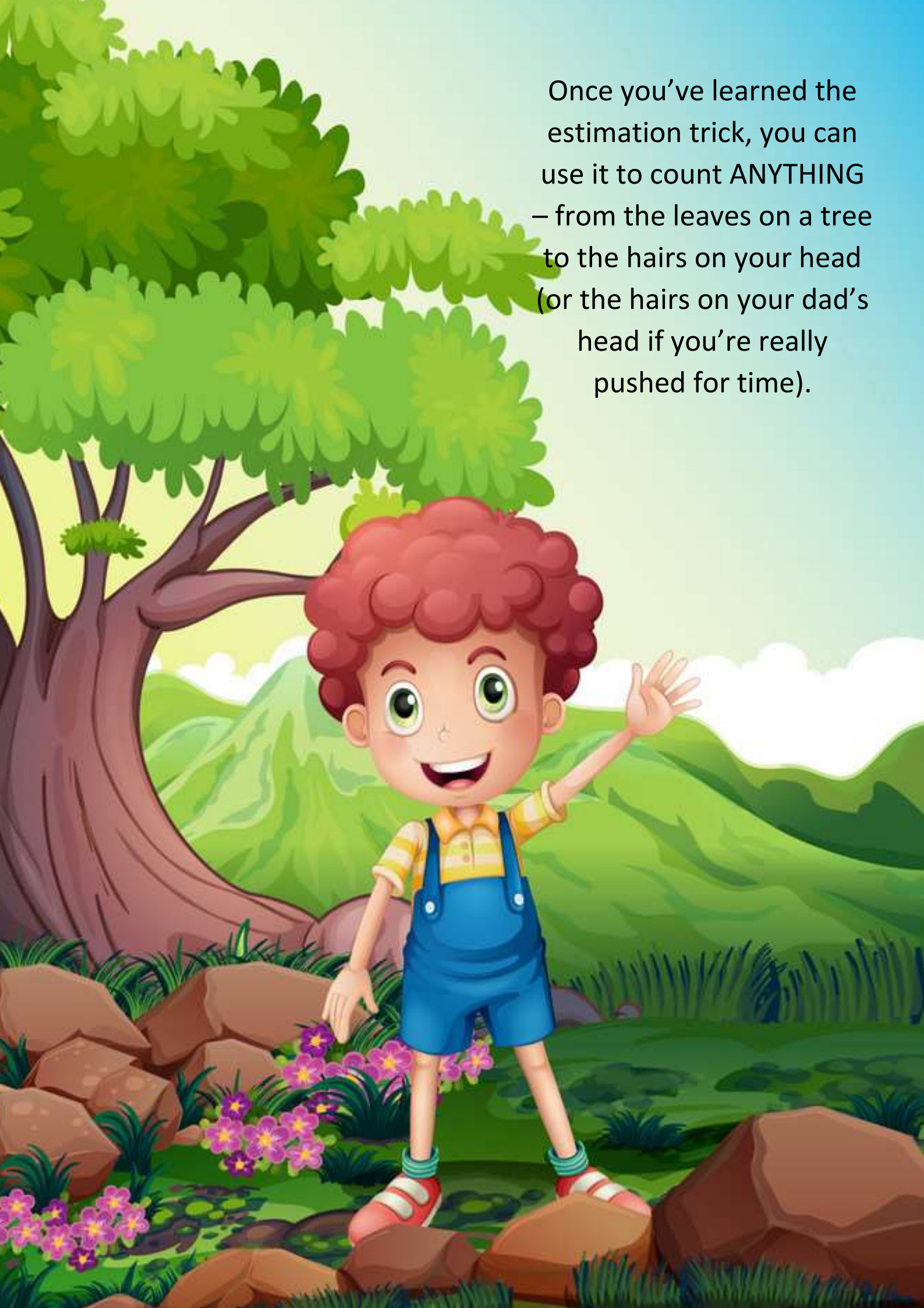
Imagine that you wanted to know how many blades of grass are in your back garden.

It would take too long to count each one, but you could throw a hula hoop on the lawn and count every blade inside it.

Then you work out how many hula hoops it takes to cover the whole lawn, and multiply the numbers together to find your estimate.

To estimate how many trees are growing on a whole PLANET, a team of scientists used their own version of the hula hoop – as big as two football field – to sample trees in thousands of places around the world.

Then they let computers crunch data, and discovered that there are about 3.041 trillion trees on the planet – around 400 for every person on Earth!

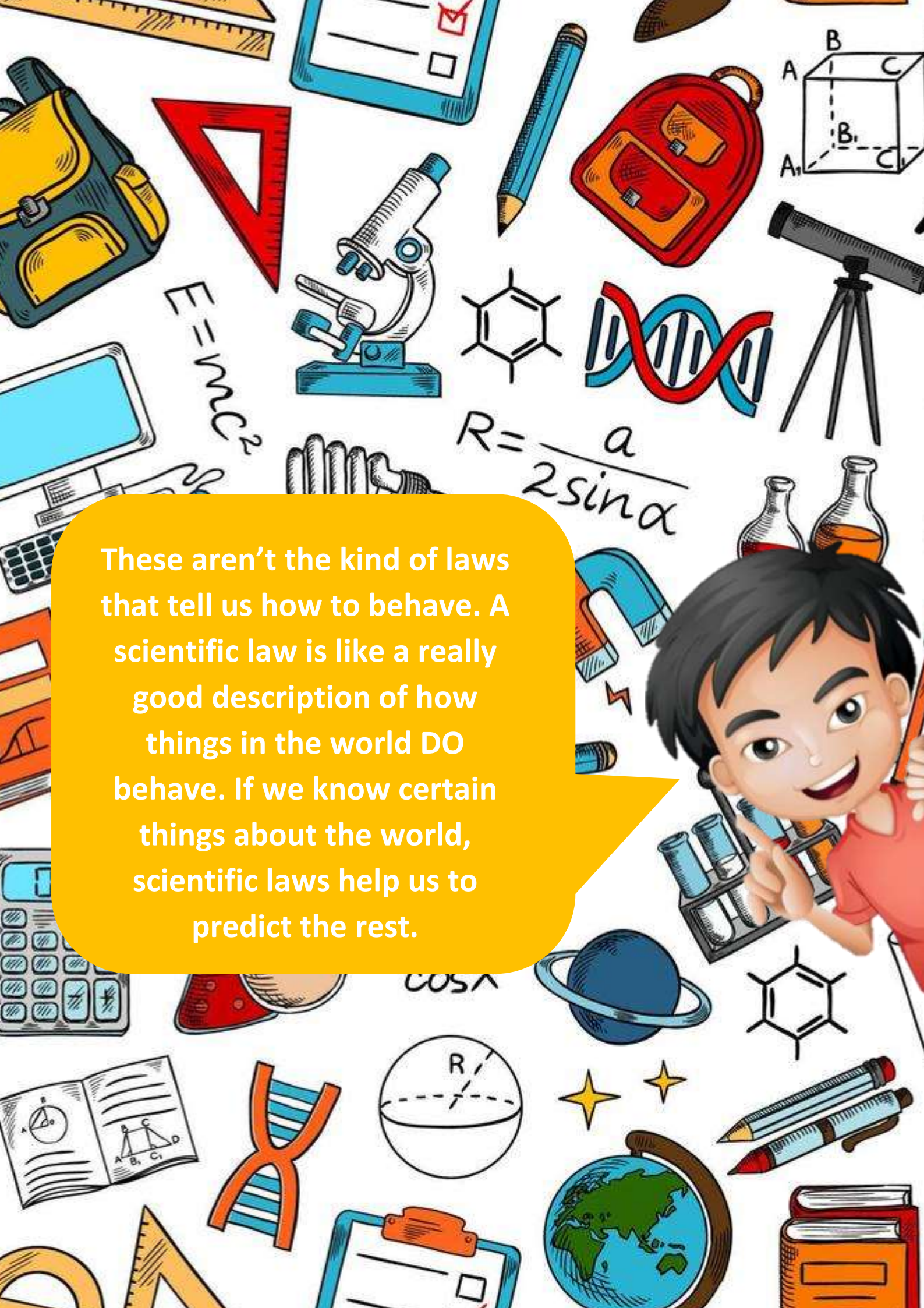


Once you've learned the estimation trick, you can use it to count ANYTHING – from the leaves on a tree to the hairs on your head (or the hairs on your dad's head if you're really pushed for time).


Pick your own impossible counting question, find your own version of the hula hoop, and start sampling!

How Heavy is Earth?

It’s impossible to pop an entire planet on to a pair of scales.
But scientists CAN weigh a planet using scientific laws.


These aren't the kind of laws that tell us how to behave. A scientific law is like a really good description of how things in the world DO behave. If we know certain things about the world, scientific laws help us to predict the rest.


Just over 300 years ago, a scientist and all-round brainbox called Isaac Newton wrote down one of the most famous scientific ideas of all – the law of gravity.

It tells us that Earth’s gravitational pull is what gives us weight.

This means that if you were in outer space, with no gravity pulling on you, you would weigh nothing. This is the position Earth is in – so technically it's weightless!

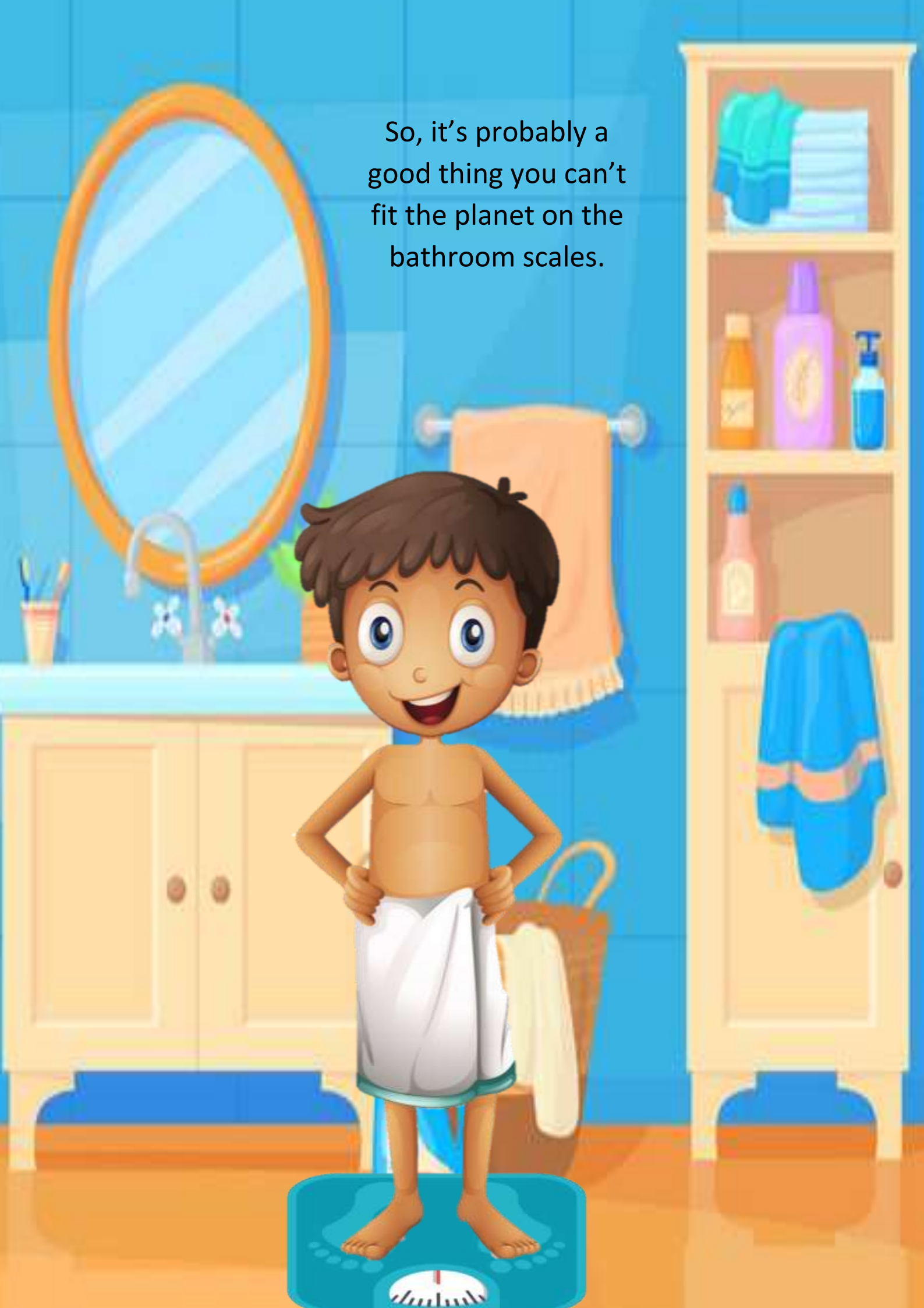
However, don’t put those scales away yet,
because we can calculate Earth’s mass.


We often use the words ‘mass’ and ‘weight’ in the same way, but mass is actually a measure of how much ‘stuff’ something is made from.

This doesn’t change as we move around the universe. A typical ten-year-old would have a mass of about 32 kg whether they were standing on Earth, Mars or the Moon.

With just three pieces of information – your mass, your weight and your distance from the centre of the planet – mathematicians can use the law of gravity to calculate Earth's mass too.

It works out at around 6 x 1024 kg, which is a short way of writing 6,000,000,000,000,000,000,000,000 (6 quadrillion) kg.


So, it’s probably a good thing you can’t fit the planet on the bathroom scales.


Why is it Easier to Balance on a Moving Bike?

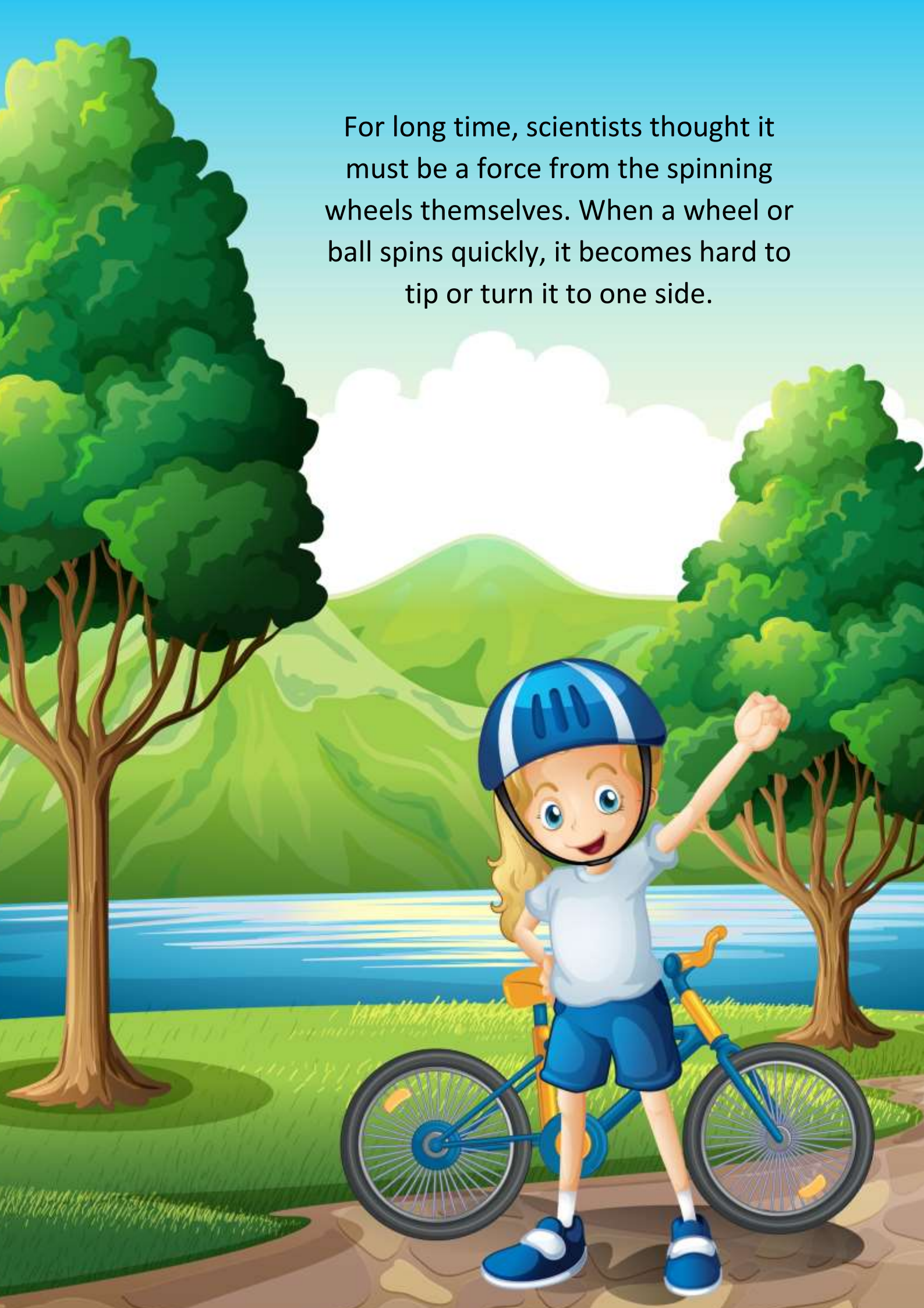
It’s strange that we struggle to walk a tightrope or a beam, but on wheels just 3 cm wide we can:

Zoooooom down hills … leap through the air … and lean into corners … without tipping over!


It’s far harder to balance on a bike that’s standing still. But what are the forces (pushes or pulls) that stop bikes tipping over when they’re moving?
100s

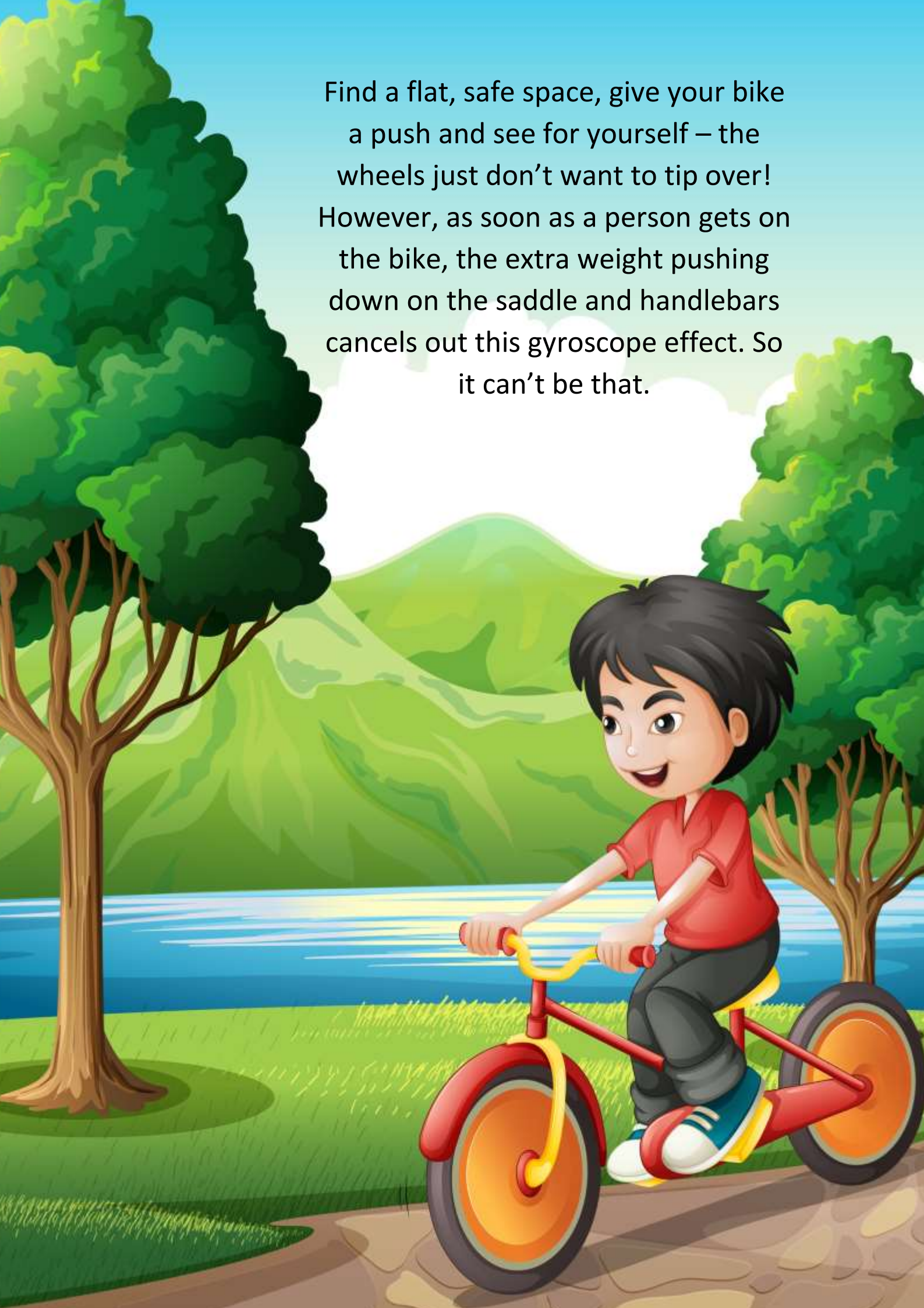
Bicycles were invented at least 200 years ago, but scientist still find this question impossible to answer once and for all!

For long time, scientists thought it must be a force from the spinning wheels themselves. When a wheel or ball spins quickly, it becomes hard to tip or turn it to one side.



An objective like this is known as a gyroscope, and it’s super stable.

This helps to explain why a bike without a rider can balance itself if it's going fast enough.


Find a flat, safe space, give your bike a push and see for yourself – the wheels just don’t want to tip over! However, as soon as a person gets on the bike, the extra weight pushing down on the saddle and handlebars cancels out this gyroscope effect. So it can’t be that.

Next, scientists looked at the shape of bikes themselves. The part that connects the handlebars and front wheel is titled backwards, creating a gap called the trail. It helps to make a bike more stable.

But one team of scientists built a bike without a trail, and it could still balance itself. Like the gyroscope effect, the trail can’t be the only reason we find it easy to balance on a moving bike.


The shape of a bike is definitely important in helping it balance – it's why most bikes share a very similar design. However, it IS possible to fall off a bike (we've all done it), so something else must be going on too.

The way that your weight gets spread out when you're sitting on a bike is very important too. The centre of gravity is lower at the front of the bike than at the back. This causes the front wheel to automatically turn in the direction you are falling, instantly steering the bike back underneath you again.


The missing part of the puzzle is YOU! As you pedal along enjoying the view, your brain is secretly hard at work.

It detects every tiny wobble, and long before you even realise you're tipping over, it tells your muscles to make tiny changes that keep you upright, such as moving your body, pedalling harder on one side, or steering a fraction to one side. It takes a while for your brain to learn to do this on autopilot, which is why beginner cyclists are wobblier.

Although scientists still don’t fully understand how bikes stay up, they know that each piece of the puzzle is equally important to stop you falling off.


Where Do Bruises Come From and Where Do They Go?

Ouch! We usually notice the fall, scrape or bump that causes a bruise to appear. The way in which they disappear is quieter and more mysterious.

Bruises form when tiny blood vessels just underneath your skin get damaged, letting a little blood leak out. . The blood gets trapped, making that area of skin look darker than the skin around it.

The exact colour of a bruise depends on the colour of a person's skin, and on how old the bruise is. At first, bruises often look dark brown, black, red or purple.


This is because blood is bright red,
thanks to a colourful chemical called
haemoglobin that carries oxygen
around your body.

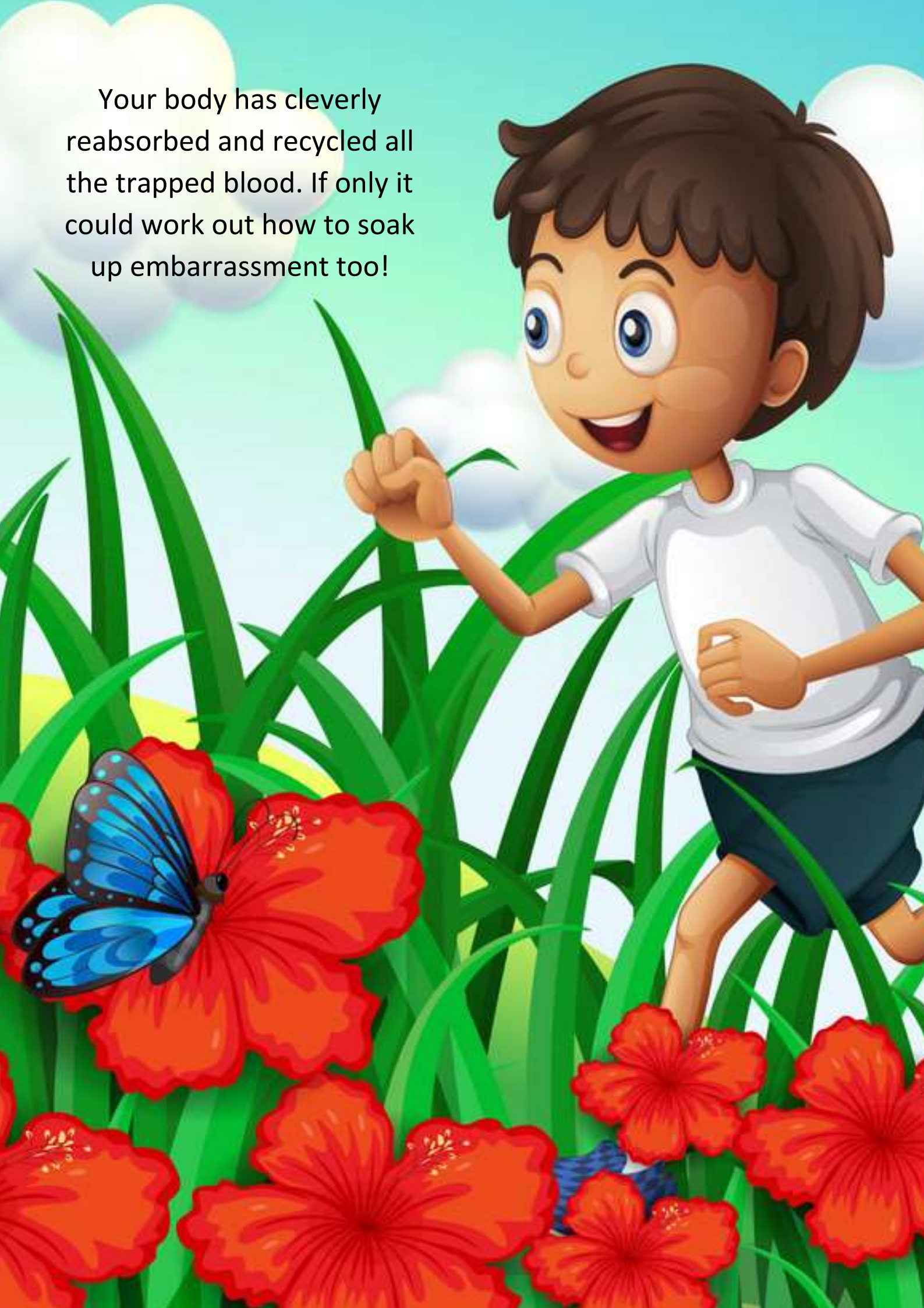
Your body soon soaks the oxygen back up, and the trapped blood (and the bruise) becomes bluish.

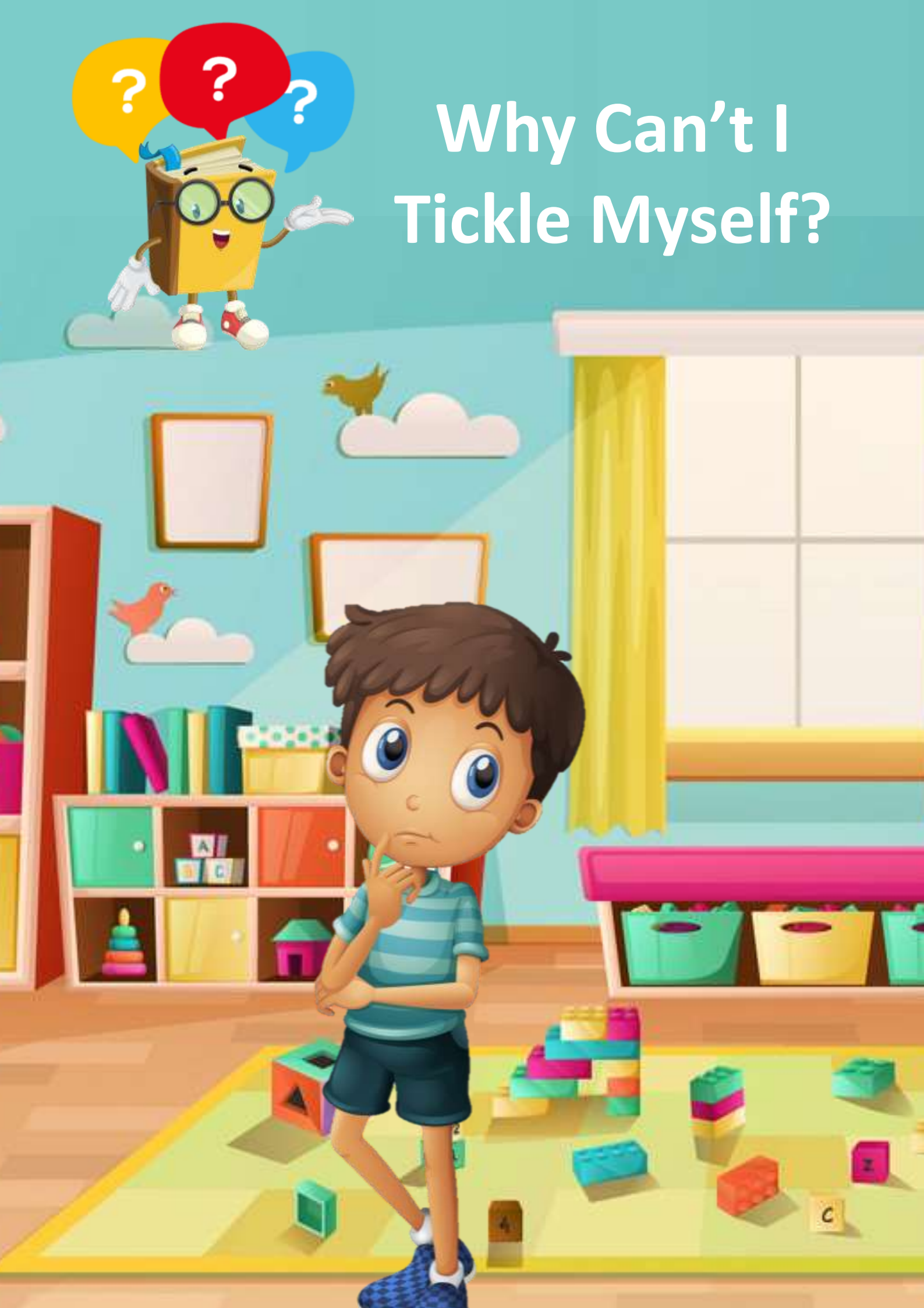
Next, your body starts to break up the haemoglobin bit by bit, to help the new red blood cells. At first it forms a greenish substance called biliverdin. If your bruises turn green, it's biliverdin you're seeing.

Your body continues picking off and soaking up what it needs, breaking the biliverdin down even more to form bilirubin. This substance is light brown or yellow, so your bruise may look brown or yellow too.

Finally, after around two weeks, the bruise disappears altogether.

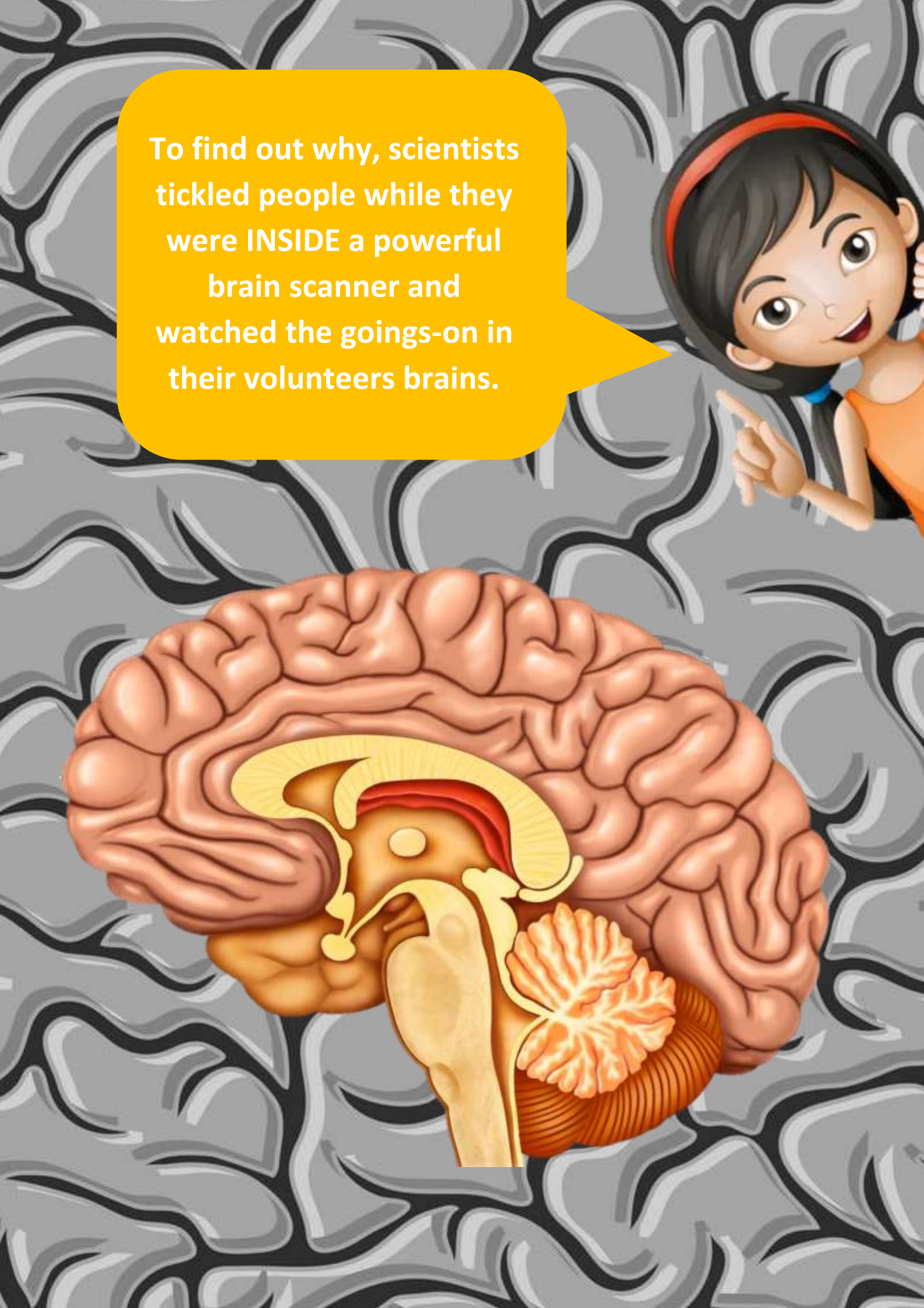
Your body has cleverly reabsorbed and recycled all the trapped blood. If only it could work out how to soak up embarrassment too!



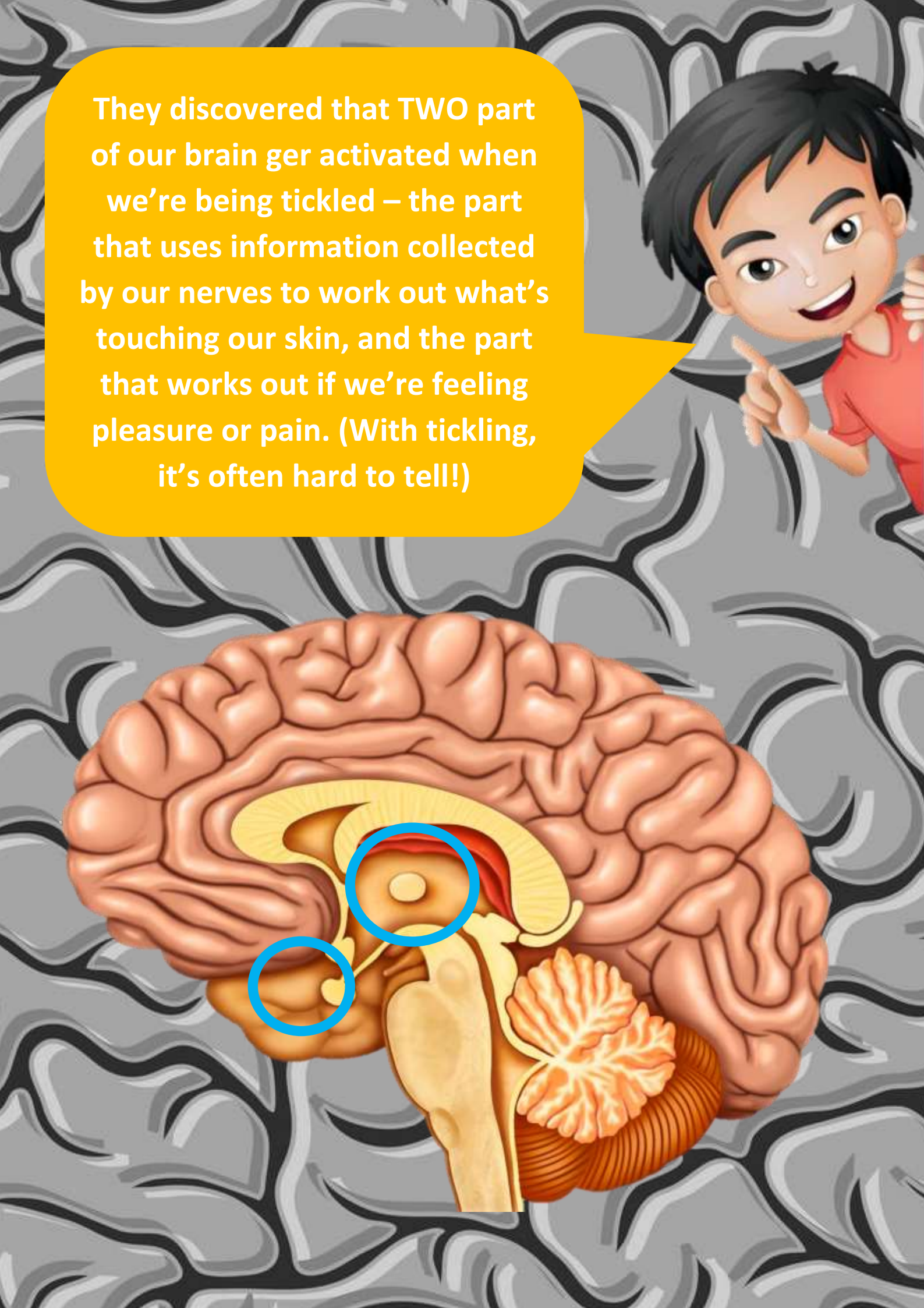

Why Can't I
Tickle Myself?

Track down a member of your family and tell them you're going to tickle them in the name of science. Watch what happens when you do.

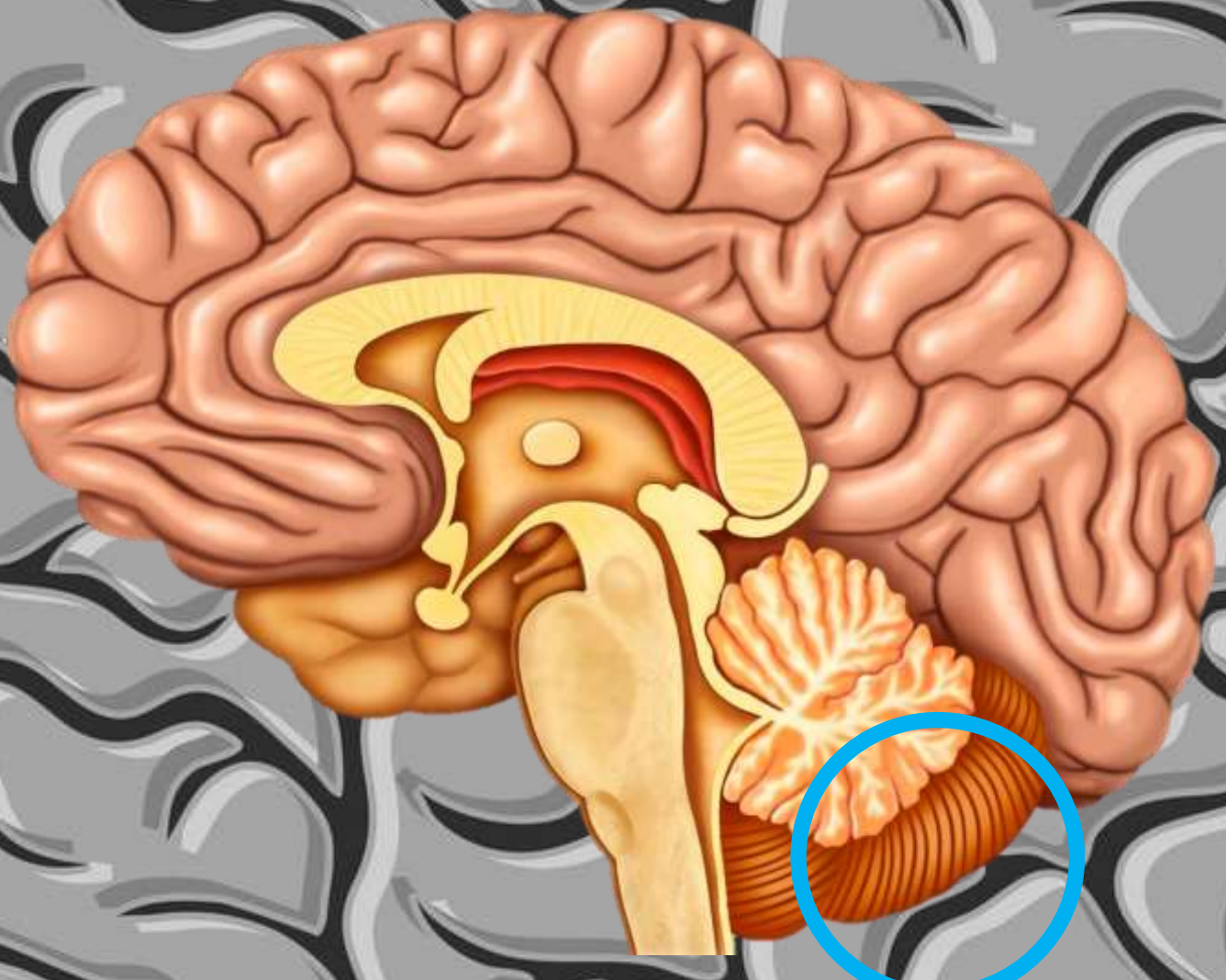

Next, ask them to try tickling themselves. Do they wriggle, giggle and squirm in the same way? Most people find it IMPOSSIBLE to tickle themselves.


To find out why, scientists tickled people while they were INSIDE a powerful brain scanner and watched the goings-on in their volunteers brains.

They discovered that TWO part of our brain ger activated when we're being tickled – the part that uses information collected by our nerves to work out what's touching our skin, and the part that works out if we're feeling pleasure or pain. (With tickling, it's often hard to tell!)



However, when we try to tickle ourselves, a THIRD part of our brain gets involved. This part predicts what it's going to feel like.



Before the message from your skin even reach your brain, the third part has reacted – by sending out signals that tell the normally tickle-sensitive parts of your brain to ignore what's about to happen.

This ability to ignore things can be extremely helpful. It stops you collapsing into giggles every time you wash under your chin or put your hands on your hips.

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