That AWESOME PHYSICS

IN YOUR HOUSE

b4u publishing

THE AMAZING THEATRE OF PHYSICS & TOMÁŠ KOPECKÝ
THAT AWESOME PHYSICS IN YOUR HOUSE

THAT

AWESOME PHYSICS

IN YOUR HOUSE

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Ugh, physics! How can you read that?!
Don't show me those horrible pictures!
I can't look at them!

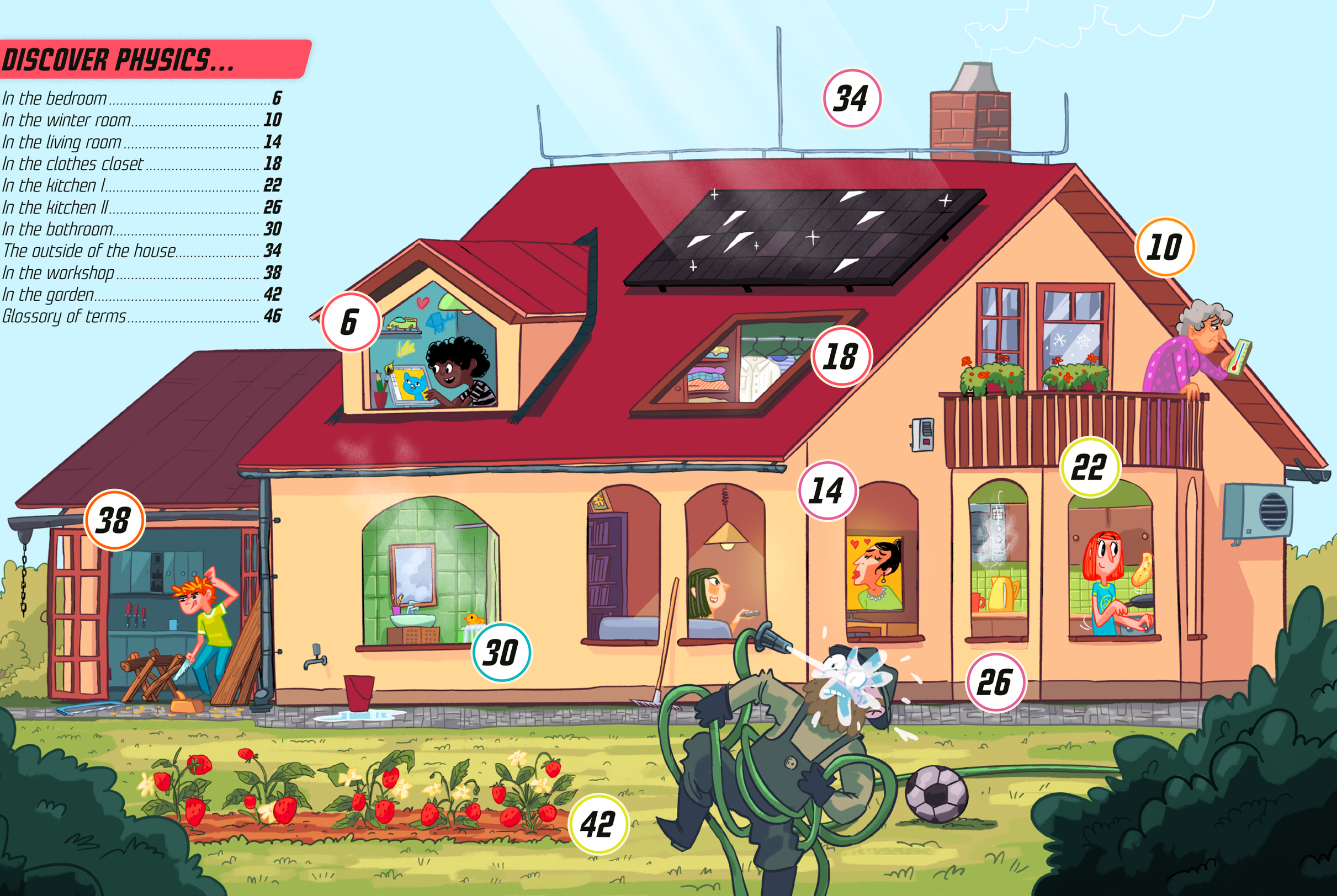
Oh, come on, physics is great...
You can find it all around you. Look!

The fact that you nearly fell
off your chair is physics...

That sound you're
making is physics...

Even your dazzlingly
white t-shirt is physics!

DISCOVER PHYSICS...



1 IN THE BEDROOM

You know your own bedroom better than anyone else. You know where each toy goes, that you broke the chair, and you also remember how much it hurt when you fell out of the bed. But do you know how the toys and the things in your bedroom work?

FORCES

Centre of Gravity

All of the things around us have one point which we call the centre of gravity. When we know where it is, it's easy to say when a thing will fall and when it'll stay put. Try it with this book. As long as the centre of gravity is above the table, it won't fall. As soon as you shift the centre of gravity into the air, the book will fall to the floor.

When won't it fall?

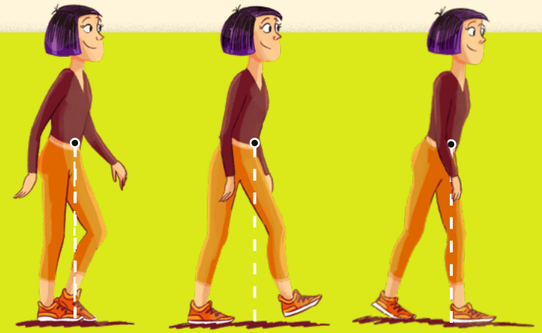
Regularly shaped things like a sheet of paper or a book have their centre of gravity in the middle. A ring also has its centre of gravity in the middle, even though the ring is not actually there. And we humans have our centre of gravity somewhere near our belly button.

FORCES

Rocking on a chair

Do you like rocking on your chair as well? Just be careful you don't fall backwards. You always have to rock so that your centre of gravity doesn't shift beyond the back legs of the chair. The centre of gravity always has to be above the point of contact with the ground, otherwise we fall.

FORCES



Balance in every step

It's the same with walking. When you are standing, your centre of gravity is above your feet. When you are walking, you tilt your centre of gravity away from your foot and you are falling until you get back over the other foot. Walking is really just a series of controlled falls. Nice, eh?

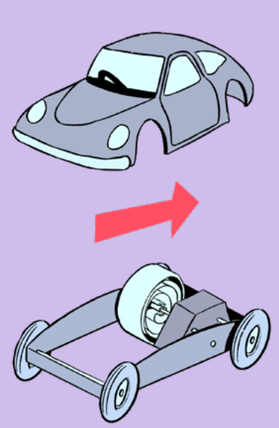
CONVERSION OF ENERGY

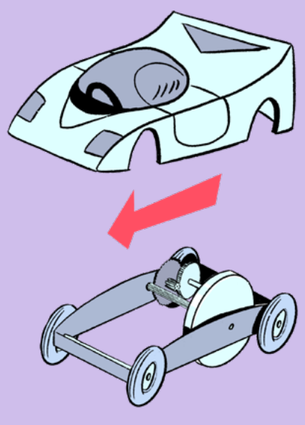
A flywheel toy car

And then there are flywheel cars. With these you have to first of all rotate the wheels in the direction you want the car to go. And then with the help of some cogs these rotating wheels turns a heavy wheel that we call the flywheel. The flywheel then keeps turning for a long time and helps to keep the car moving for a fair distance, even across the whole of your bedroom. You've probably heard of a flywheel before – they are used in lots of other devices. Satellites even take them into space to help them steer.

A spring-loaded toy car

Some toy cars move by themselves even though they don't have batteries. How do they do this? There are two possible ways. The simpler one is a spring-loaded toy car – that's the kind you have to pull backwards. The spring inside is wound, which transfers energy to some cogs which spin the car's wheels quickly forwards. The further you pull the car back, the faster it'll go.


We load a spring like this...


...and a flywheel like this

How are colours made?

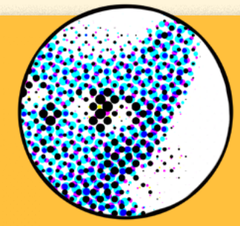
The world is colourful, and that makes it cheerful and beautiful. Right now you are looking at the page of a book, where light is reflected, but another time you might be looking at a screen, which shines by itself. Is there a difference here?

How to mix the right colour

Let's paint

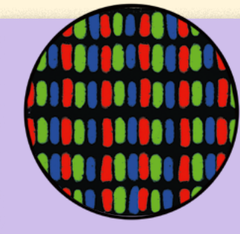
When you paint with poster paints or watercolours, the more paint you add, the darker a colour you get. That's why the most common colour used by painters is white. They mix it with other colours to get different shades.

Painters like to have as many shades as possible, but they could actually make do with just blue, red and yellow. These are the primary colours, which they then combine with black and white. In fact, house painters do something very similar when they add a small amount of paint to white to get the shade they want. Try mixing yellow and blue watercolours or poster paints at home. Do you know what colour you'll get? Isn't it the one we have on the screen?



Printing colours

A printer's palette of colours is different from a painter's. This palette is not even the same as the one you see on a computer screen. If you open up a printer and look inside, you'll find yellow, magenta, cyan and also black. A printer doesn't need white because it prints onto white paper. Under a microscope, the printed sheet looks like a mass of coloured dots.



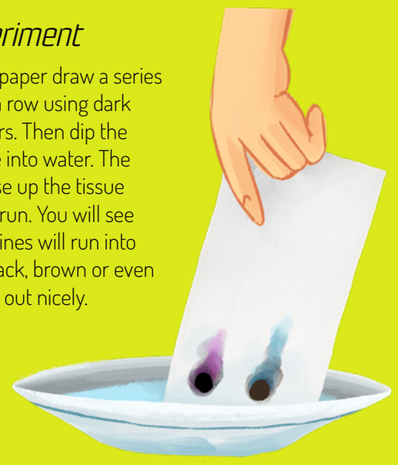
Colours on a screen

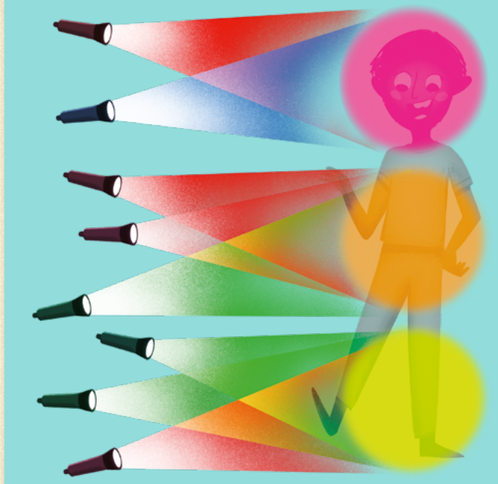
Have you ever looked at a screen through a magnifying glass? Try it out with a computer, a TV or even a mobile phone. If you don't have a magnifying glass, place a tiny drop of water on the screen. You'll see small dots which we call pixels. If we were to magnify them under a microscope, they'd look something like this. The shape of the pixels is different on different screens, but you will always find three colours there: red, green and blue. Do you know why these three in particular?

It's because we can use these three colours to mix lights in the same way our eye does. Sometimes red, blue and green are called the primary colours because we can mix them together to make nearly all the other colours. And because light and light together equals even more light, you end up with lighter and lighter colours.

A colour experiment

On a piece of tissue paper draw a series of coloured dots in a row using dark water-based markers. Then dip the bottom of the tissue into water. The water will start to rise up the tissue and the colours will run. You will see that some of these lines will run into different colours. Black, brown or even purple should come out nicely.





Let's mix lights!

If we shine red light and blue light together, we get magenta. Red light and green light make yellow, and blue light and green light make cyan. And what about orange? We still just need our three primary colours, but we have to combine different strengths of light. To get orange you have to use a little green and more red. And if you'd like lime green, then you'd need to use less red and more green light. And it's not just screens which do this, but also colour LEDs or LED strips.

2 IN THE WINTER ROOM

When everything is covered in snow, people can be divided into two groups. The first type rush excitedly outside and are not content until they look like snowmen, while the second type prefer to watch the dancing snowflakes from the window... In either case, there is a lot to explore!

CHANGES OF STATE

Magical icicles

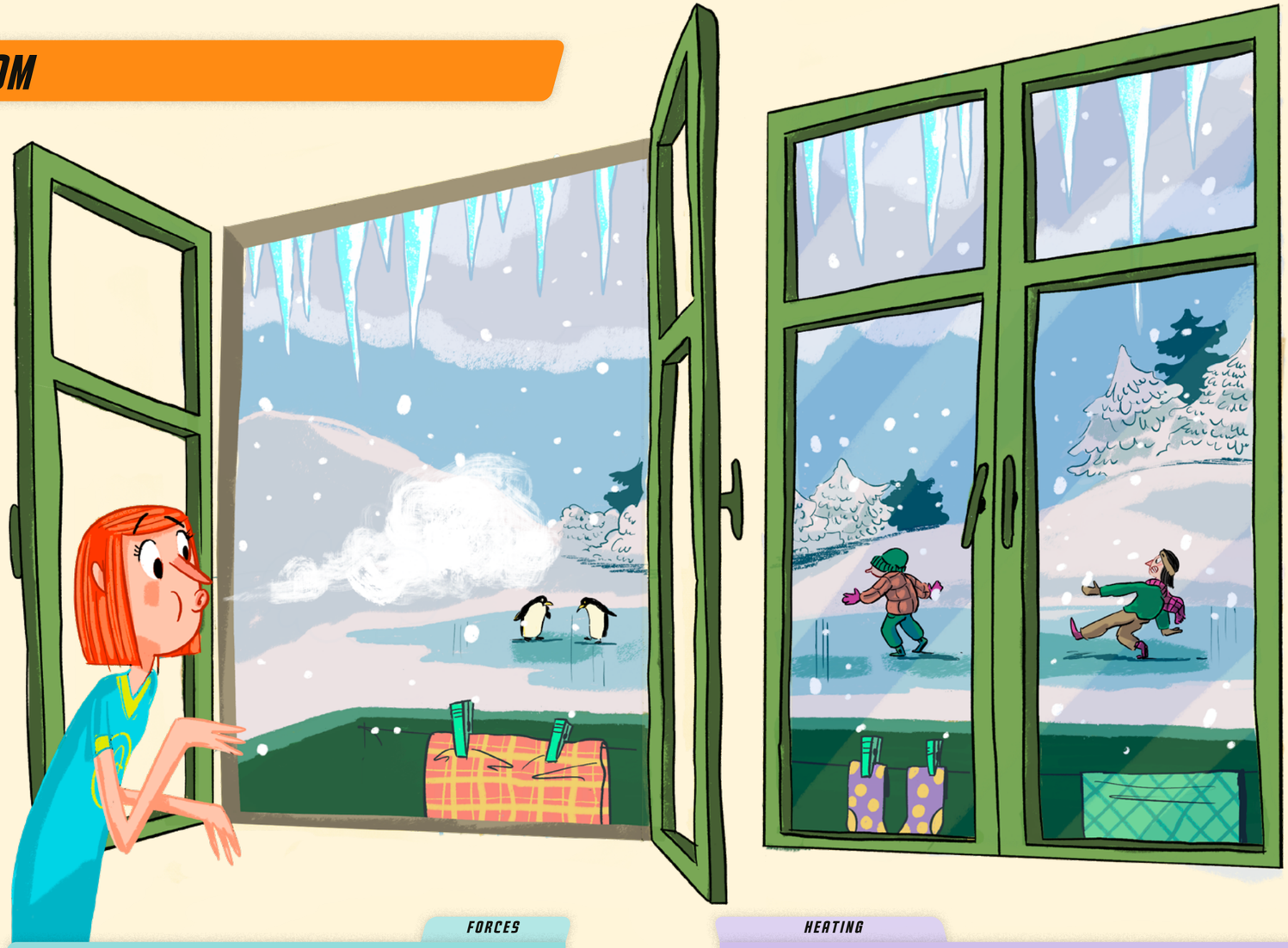
Who would have thought that icicles needed heat? How are they actually formed? The warm house heats up the snow that has fallen on the roof and it begins to slowly melt and drip down as if it's on a slide. It stops right at the edge of the roof, where it eventually freezes again.

STRUCTURE

Unique snowflakes

No two snowflakes are alike. But they do have something in common. They all radiate out from the centre in six directions. This is because they are formed from tiny crystals which have six sides. Each one then falls to the ground by a different route, growing as it does so. Its final shape depends on how damp and cold the air it passes through is. So if you look at a snowflake through a magnifying glass, you can discover its whole life story!

Each snowflake is an original!



FORCES

Inspiration from penguins

Uh-oh, a glacier... How to cross its frozen surface without getting hurt? Try following in the footsteps of penguins, who have a lot of experience walking across ice. They take small steps and always tread carefully, putting their whole weight onto each foot. Your walk will have a funny wobble to it, but at least you'll be safe! Normally we take longer steps, which makes it easier for us to lose our footing.

HEATING

Is it cold there or not?

Dressing to go outside in winter can be quite tricky, and at times even a thermometer is of no help. Sometimes our teeth chatter when the temperature is around zero, while at other times it can be really freezing and yet we feel OK. How is this possible? The wind is to blame! When it begins to pick up, we immediately think it has got colder. This is because the wind blows away the layer of air which our body has heated up around us. And because it has to work hard to reheat it, we feel cold right then.

CHANGES OF STATE

Does laundry dry in winter?

In summer all of our clothes dry perfectly, which is no big surprise. They are warmed by the sun's rays, which gradually makes the water evaporate. But what about in winter? Surely laundry will freeze in winter! But that doesn't matter. Ice can evaporate as well, and it doesn't even need to melt to do so, particularly on a dry, frosty day or if it's windy. We call this sublimation.

CHANGES OF STATE

How to make a cloud

Brr, it's cold! So cold so you can see your breath. Has it ever occurred to you that you are actually creating your own small cloud just by breathing? Along with lots of different gases, you always breathe out a small amount of invisible water vapour as well. When you breathe out into the cold, the vapour transforms into droplets of water, which we then see as a cloud. Clouds in the sky are formed in a similar way.

GLOSSARY OF TERMS

Changes of state

The materials around us have various forms. For example, we know water as ice when it freezes or as steam when it boils. Water, then, can be found in all three states – as a solid, liquid or gas. And, like water, most of the materials around us can be found in all three states. If you heat up a material enough, it will melt to become a liquid. We can then heat this up until it evaporates and becomes a gas. We can cool a gas until it liquifies or even until it freezes into the form of a solid material. In this book, though, we have concentrated on water because we come across it most often and it is by far the most important in our lives.

Conversion of energy

Sometimes people say they have no energy. Energy, though, can't just disappear. It just changes into a different form. For example, you might use the energy in your muscles to do lots of work, to kick a ball, or to warm your hands by rubbing them. We can't produce energy – we always have to get it from somewhere. We can use the energy given off by the Sun, the energy from water cascading in a river, or even the energy stored in a bar of chocolate.

Electricity

It would be impossible to imagine today's world without electricity. It heats our water, spins the blender, cools the fridge, and charges our mobile phones. It is produced in power stations and then runs along cables to our homes. We know a lot about it today and we can use it to help us, but it has taken inventors and scientists a long time to figure all of this out.

Energy

We need energy at home for many different things – for lighting or for heating rooms or the water for a bath. This is why it is so important where we get our energy from and how it gets into our home. We can all influence how much energy we use and what we use it for. And we can all influence where we get our energy from. It is important for us to find a balance between our consumption and respect for the environment.

Flowing

You can come across flows in water and air. Anything that flows is called a fluid in physics. Water can flow in a river or in a pipe. Air can rise when it is warm, it can blow like the wind, and we can use an airflow to vacuum at home. We also say that electricity flows, but we have kept this separate in our book.

Forces

When we apply force in the right direction we can move something, turn it or even crush it. We use forces to interact with all the things around us, even if we don't exactly mean to. The Earth pulls at us, the chair pushes against us, friction is against us when we're moving. But what if you want to rest for a while? On Earth we are never completely free from the reach of forces, but when these forces are in balance it seems to us as if they didn't exist.

Heating

Nature likes to have things in balance. And so warm things heat up everything around while cooling themselves until the temperature is the same everywhere. How quickly this happens depends on the materials involved. Metals, for example, are excellent heat conductors, and so a metal teaspoon quickly heats and cools. On the other hand, wood, water and air are very poor heat conductors.

Light

In order to see something, light has to enter our eyes, and not only directly from the Sun, from a fire or from a lamp. We can also see things which themselves do not shine. However, the light has to reflect from them into our eyes. Our eyes can cope with light from red, yellow, green, blue and purple colours. This rainbow of colours continues but the human eye cannot see it. We then no longer call it light but radiation.

Measuring

If we want precise answers to our questions, then we have to start measuring. And the more precise the answer, the more precise the measurement we need. This is why scientists work on coming up with better and better measuring instruments. However, even simple measuring – perhaps with an ordinary ruler – can be a science. You have to know what you're doing to avoid all the mistakes which might affect the measurement and give the wrong results.

Radiation

Light is a form of radiation, but there are many types of radiation which we can't see. Even the heat from the Sun is radiation. Or ultraviolet radiation which gives us a tan, or X-rays at the doctor's which allow us to look at broken bones. There is radiation from a wi-fi signal or the radio, and it heats up our food in a microwave oven. Radiation is all around us but it is more difficult to understand because our eyes can't see it.

Senses

Our senses provide us with information about the world around us. We can see it, hear it, smell it, taste it and touch it. In reality we have more than these traditional five senses – for example, we can sense temperature and time. However, we rely upon sight and sound the most. This is why it is so difficult for people if these senses stop working either partially or completely. Fortunately, today we are able to help our senses and make up for many imperfections.

Structure

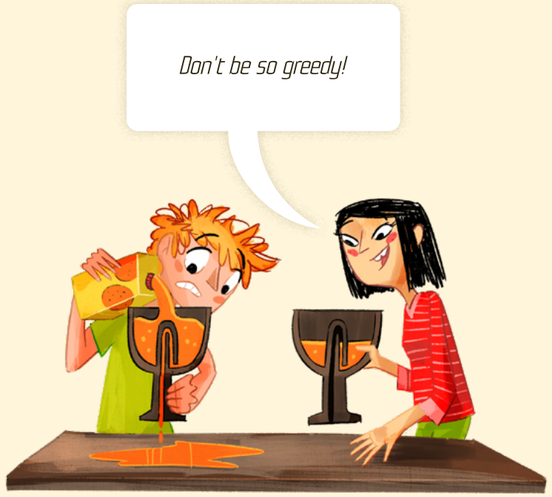
It is fascinating to look at the world of small things and even smaller things. And it might seem as though this world has nothing in common with our own, but the opposite is true. If we really want to understand why some things melt when we just hold them in our hand, others form beautiful crystals, while others shine like silver, then we have to dive deep into the material itself and investigate what it is made from and how it is structured.

Water pressure

Just as our rucksack might press on our shoulders, water can press on us too because it also weighs something. The layer of water on the surface presses on the water just below it. They both then press on the water below and so on and so on, until the layer of water at the bottom has quite a weight on its back. At the bottom, then, the water can really press hard on something. You might not notice this if you dive just under the surface, but deep-sea divers or sea creatures living at the bottom have to cope with water pressure.

The Amazing Theatre of Physics

The Amazing Theatre of Physics is a group of people who make a living by showing other people experiments. We want people to notice the world around them and to be aware of the laws which governs it. After all, the world is more beautiful when you know how it works.



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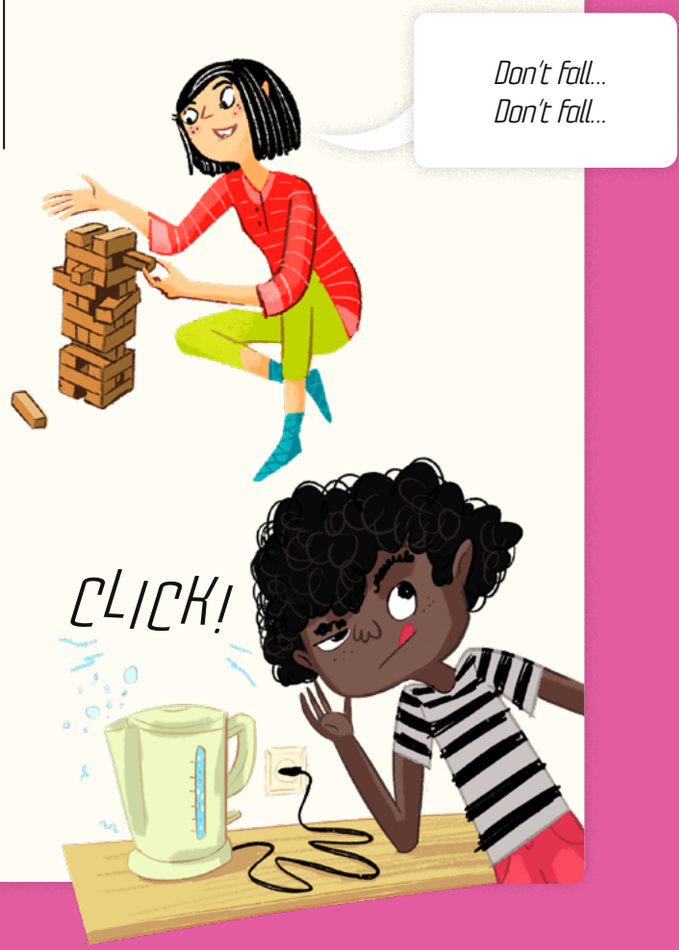
Fearlessly written by:
THE AMAZING THEATRE OF PHYSICS
Amusing and soothing illustrations by:
TOMÁŠ KOPECKÝ

Isn't physics just an awwwwful science? Well, let's take a closer look at it, and where better to start than in your own bedroom at home. Could it be lurking in the underfloor heating beneath your bed? Has it secretly disguised itself as a reflective t-shirt in the closet? Maybe it wandered into that dusty old fuse box which mysteriously switches itself off from time to time... But why does that happen?
Whether physics attracts you like a magnet or makes you cower in terror under your desk – have no fear and read this book. It will show you how fascinating physics is and, most importantly, that it really can be found everywhere.

Gradually explore the whole house from floor to ceiling, from a happily bubbling kettle in the kitchen to a pipe with a strange bend (and an even stranger smell) in the toilet, and discover where changes of state, electricity, radiation and all the forces are hiding. And you can look forward to amazing experiments! A word of warning, though – one of them might make your hair stand on end!



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