Written by **LENKA KARPÍŠKOVÁ** and **JIŘÍ VLACH**
Illustrated by **TOMÁŠ KOPECKÝ**

# The AMAZING CHEMISTRY

## IN YOUR HOME

albatros

LENKA KARPÍŠKOVÁ | JIŘÍ VLACH | TOMÁŠ KOPECKÝ
THE AMAZING CHEMISTRY IN YOUR HOME

# THE PERIODIC TABLE OF ELEMENTS

63 — number of protons
chemical symbol — **Eu** — Europium — name of element

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 **H** Hydrogen | | | | | | | | | | | | | | | | | 2 **He** Helium |
| 3 **Li** Lithium | 4 **Be** Beryllium | | | | | | | | | | | 5 **B** Boron | 6 **C** Carbon | 7 **N** Nitrogen | 8 **O** Oxygen | 9 **F** Fluorine | 10 **Ne** Neon |
| 11 **Na** Sodium | 12 **Mg** Magnesium | | | | | | | | | | | 13 **Al** Aluminum | 14 **Si** Silicon | 15 **P** Phosphorus | 16 **S** Sulfur | 17 **Cl** Chlorine | 18 **Ar** Argon |
| 19 **K** Potassium | 20 **Ca** Calcium | 21 **Sc** Scandium | 22 **Ti** Titanium | 23 **V** Vanadium | 24 **Cr** Chromium | 25 **Mn** Manganese | 26 **Fe** Iron | 27 **Co** Cobalt | 28 **Ni** Nickel | 29 **Cu** Copper | 30 **Zn** Zinc | 31 **Ga** Gallium | 32 **Ge** Germanium | 33 **As** Arsenic | 34 **Se** Selenium | 35 **Br** Bromine | 36 **Kr** Krypton |
| 37 **Rb** Rubidium | 38 **Sr** Strontium | 39 **Y** Yttrium | 40 **Zr** Zirconium | 41 **Nb** Niobium | 42 **Mo** Molybdenum | 43 **Tc** Technetium | 44 **Ru** Ruthenium | 45 **Rh** Rhodium | 46 **Pd** Palladium | 47 **Ag** Silver | 48 **Cd** Cadmium | 49 **In** Indium | 50 **Sn** Tin | 51 **Sb** Antimony | 52 **Te** Tellurium | 53 **I** Iodine | 54 **Xe** Xenon |
| 55 **Cs** Caesium | 56 **Ba** Barium | | 72 **Hf** Hafnium | 73 **Ta** Tantalum | 74 **W** Tungsten | 75 **Re** Rhenium | 76 **Os** Osmium | 77 **Ir** Iridium | 78 **Pt** Platinum | 79 **Au** Gold | 80 **Hg** Mercury | 81 **Tl** Thallium | 82 **Pb** Lead | 83 **Bi** Bismuth | 84 **Po** Polonium | 85 **At** Astatine | 86 **Rn** Radon |
| 87 **Fr** Francium | 88 **Ra** Radium | | 104 **Rf** Rutherfordium | 105 **Db** Dubnium | 106 **Sg** Seaborgium | 107 **Bh** Bohrium | 108 **Hs** Hassium | 109 **Mt** Meitnerium | 110 **Ds** Darmstadtium | 111 **Rg** Roentgenium | 112 **Cn** Copernicium | 113 **Nh** Nihonium | 114 **Fl** Flerovium | 115 **Mc** Moscovium | 116 **Lv** Livermorium | 117 **Ts** Tennessine | 118 **Og** Oganesson |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 57 **La** Lanthanum | 58 **Ce** Cerium | 59 **Pr** Praseodymium | 60 **Nd** Neodymium | 61 **Pm** Promethium | 62 **Sm** Samarium | 63 **Eu** Europium | 64 **Gd** Gadolinium | 65 **Tb** Terbium | 66 **Dy** Dysprosium | 67 **Ho** Holmium | 68 **Er** Erbium | 69 **Tm** Thulium | 70 **Yb** Ytterbium | 71 **Lu** Lutetium |
| 89 **Ac** Actinium | 90 **Th** Thorium | 91 **Pa** Protactinium | 92 **U** Uranium | 93 **Np** Neptunium | 94 **Pu** Plutonium | 95 **Am** Americium | 96 **Cm** Curium | 97 **Bk** Berkelium | 98 **Cf** Californium | 99 **Es** Einsteinium | 100 **Fm** Fermium | 101 **Md** Mendelevium | 102 **No** Nobelium | 103 **Lr** Lawrencium |

I'm a gas—what the heck am I doing among these metals?

Do you want to be friends with us metals?

We're a friendly bunch of metals—real softies.

Apparently, we silver-colored metals all look alike . . .

. . . but not me!

We're the brains of your mobile phone!

We're your brains—and your body too!

Watch out! You don't want to mess with us.

Leave us alone! We don't want to be friends with anyone.

We're radioactive. We break down before you even notice us.

We're the most expensive of all metals.

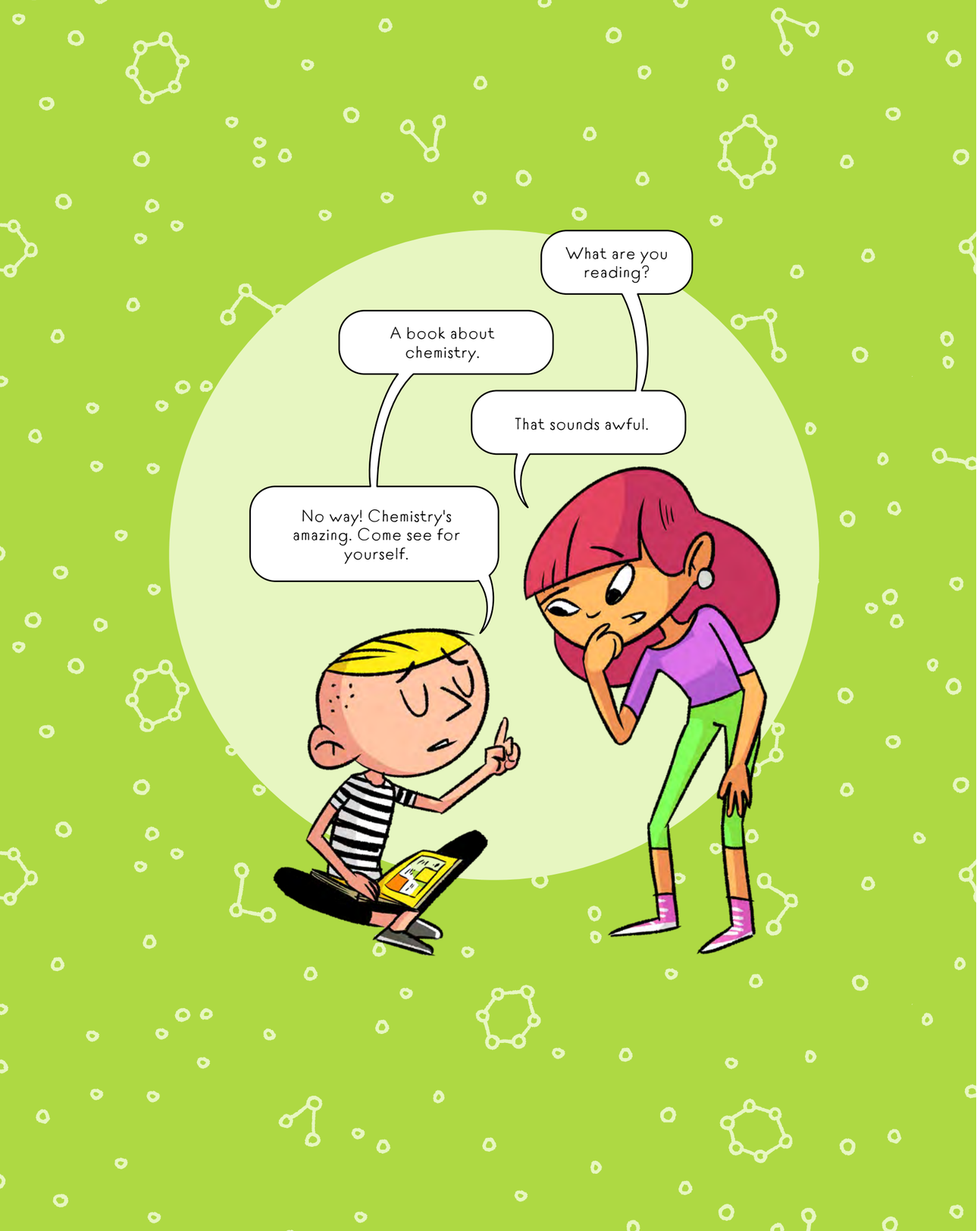
We can poison your whole life!

Nobody knows us . . .

Nobody knows us . . . and we're radioactive!

Uranium!

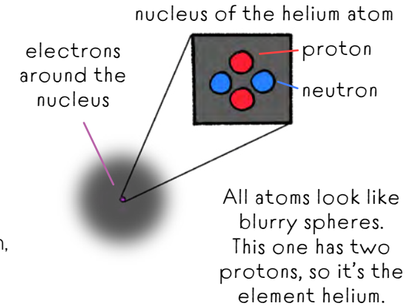
There's more information about the periodic table in the introduction.




# INTRODUCTION

## What are elements?

Everything around us is made up of tiny particles called atoms. And inside them are even smaller particles: protons, neutrons, and electrons. When atoms have the same number of protons, we say they are the same chemical element. Elements are substances like gold, helium, oxygen, or uranium. Each element has its own chemical symbol—for example, Au for gold and He for helium.




## Why does the periodic table look like this?

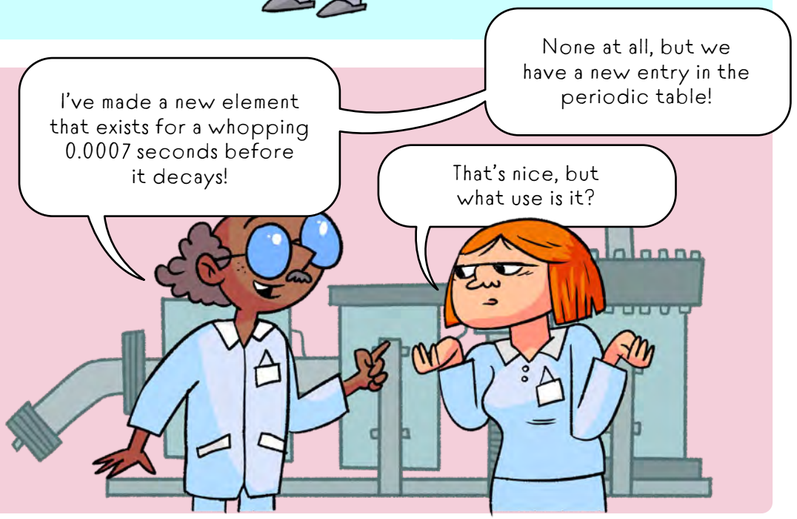
If elements are arranged according to the number of protons, why is it not just a list from 1 to 118? Why do we need a table? Well, it's because there are electrons as well as protons in atoms. Elements look different and behave differently according to how many electrons they have and where these electrons live. Elements in the same column of the periodic table tend to look very similar and act similarly too. So we don't have to remember everything about each of the 118 elements; we just need to know about a few columns and rows.

## What is the periodic table?

We know of 118 elements. To help people make sense of them, a scientist named Dmitri Mendeleev created the periodic table of elements in the 19th century. Back then, his table was a little emptier than it is today because lots of elements hadn't been discovered yet. But one thing has been the same since the beginning: elements are arranged in the periodic table according to how many protons they have (this is called the atomic number).


## Can all the elements be found in nature?

Some elements are not found in nature and have been artificially created by people in a lab. There are 24 of these in total, and all of them have 95 or more protons. These elements tend to be radioactive, which means they don't exist for long because they break down into other elements and particles.



# 2 THE KITCHEN

If there's one room that's full of tasty treats and sumptuous smells, it's the kitchen. There's a stove you can use to whip up a delicious meal, an oven with tempting scents wafting out of it, and the door to the secret, chilly world of the fridge, where you can always find something nice to eat—that is, unless it's past the expiration date!

HUMAN BODY

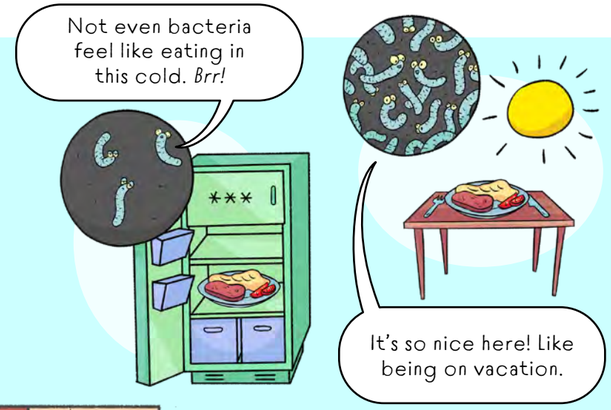
## Why does our breath stink after eating garlic?

There's a reason people say hell stinks of sulfur: Wherever there's sulfur, there's usually a hellish stench. And it's the same with garlic. It has chemicals in it that contain sulfur, and that's what gives it such a strong smell. The problem is that it leaves the body mainly through the lungs, so your breath really stinks after eating garlic. If you have a big bowl of garlic soup—no matter how much you brush your teeth afterward—you won't get rid of that stinky breath.

MICROORGANISMS

## Why does food go bad?

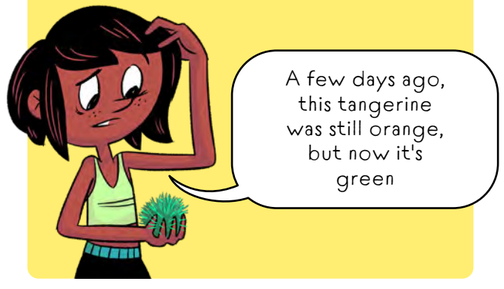
Bacteria are all around us. Some of them are good and help us digest food, while others are pests and can cause various illnesses. And some of them like to feast on our food. When they've eaten their fill, they leave behind chemicals that can be poisonous for our bodies. That's why we can get sick after eating spoiled food. Luckily, we have a weapon against bacteria: it's called the fridge. Bacteria don't do well in the cold, so food stays fresh longer in the fridge.




MICROORGANISMS

## Good and bad molds

Can I eat that moldy bread? You'd better not, unless you want to be sick. Some of the molds that grow on bread or tangerines can be poisonous, so it's best to throw out those kinds of spoiled food immediately. But not all molds are bad. Some are actually quite tasty—for example, the mold in Camembert or blue cheese. And some molds can even kill bacteria! It's thanks to them that we have antibiotics, which can be used to treat strep throat and other serious illnesses.





FOOD

## The stink of rotten eggs

It's easy to tell if eggs are rotten: they would be incredibly stinky. It probably won't surprise anyone that sulfur has a hand in this. When eggs go bad, a chemical called hydrogen sulfide is produced, and it contains sulfur, which makes the eggs smell horrible.

GASES

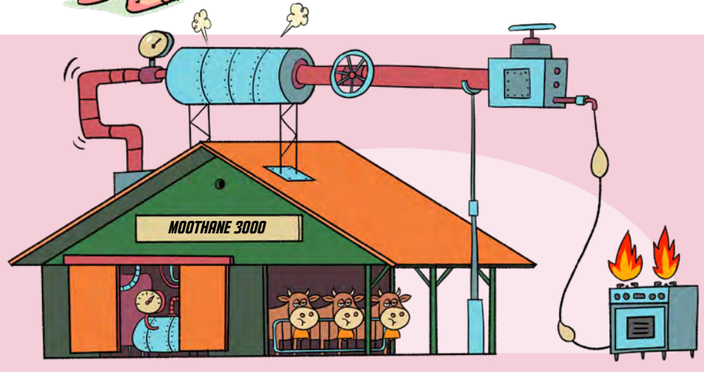
## Why does gas stink?

Natural gas smells pretty awful—but not on its own. That stink is added to it so that if there were a gas leak, we would at least be able to smell it if not see it. Can you guess which element makes gas smell? That's right, it's sulfur! It's also sulfur that makes the gases that come out of our bowels stink.


GASES

## Cookers and cows

If you have a gas stove at home, it likely uses natural gas. Natural gas is mostly a flammable gas called methane. Funny enough, cows belch and fart out a lot of it. If someone came up with a way to capture cow farts, maybe we could cook with them!




FOOD

## Why do onions make us cry?

Onions are pesky vegetables! Whoever cuts into one starts crying. That's because when an onion is split, it sprays chemicals into the air that then transform into a new, even peskier chemical. When it gets into our eyes, it sets off an alarm, and we cry until all the nasty stuff is gone.

# 4 THE LIVING ROOM

You can do all kinds of things in the living room—for example, have breakfast with your family or friends. But why is it that breakfast tastes so good? Where do those soft doughnuts come from, or the sweet honey we put in tea? Quick, get up! Come have something to eat!

REACTIONS

## Fizzy tablets

Fizzy tablets are fantastic. You toss one in some water, and it transforms into flavored, bubbly water. For fizzy tablets to fizz, they have to contain two things: citric acid and baking soda. These two powders are compressed together into a tablet. Until they come into contact with water, nothing happens. But as soon as the tablet touches water, the citric acid and baking soda dissolve and begin to react with each other and fizz. This produces carbon dioxide, filling the water with bubbles.


GASES

## Bubbly bread

Fresh homemade bread can be soft and fluffy—thanks to carbon dioxide. It's a gas that's produced in the dough during kneading or baking. Its bubbles make bread rolls bigger and fluffier. But how does it get into the bread in the first place?


## Made either from yeast . . .

Yeasts are microorganisms that are added to dough. They eat sugar and turn it into carbon dioxide, which puffs up the dough. But it takes a while, which is why you have to allow time for yeast dough to rise.

## . . . or from baking soda

Baking soda, or bicarbonate of soda, reacts with acids like yogurt or molasses to produce carbon dioxide—the reaction starts immediately so get it into the oven fast! For recipes that don't include something acidic use baking powder instead, which just needs liquid to create bubbles. Both make cakes light and airy.



* This is really doughy.

NATURE

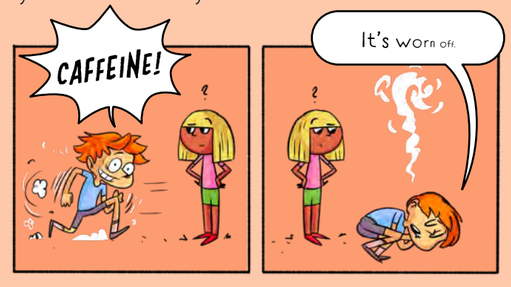
## Colored eggs

Eggs are popular at breakfast time. But why are eggs sometimes brown and sometimes white? It depends on many factors, but mainly on the breed of the hen. A white leghorn lays white eggs and a Rhode Island Red lays brown eggs. And you can often predict the egg color from the color of the hen's earlobes! There are even hens that can lay green or blue eggs. They get their color from the same pigment that's in bruises. Fascinating, right?


HUMAN BODY

## Caff-what?

A hot drink with breakfast warms us up. Grown-ups often choose tea or coffee because they contain caffeine, which helps them feel awake and alert. But caffeine is a bit of a trickster—it makes the brain think it's not tired, even when it is. Once it wears off, you can suddenly feel really sleepy! That's why coffee isn't suitable for kids. Your body and brain need real rest, not a caffeine cover-up. So stick to water, milk, or juice—your brain will thank you later!




NATURE

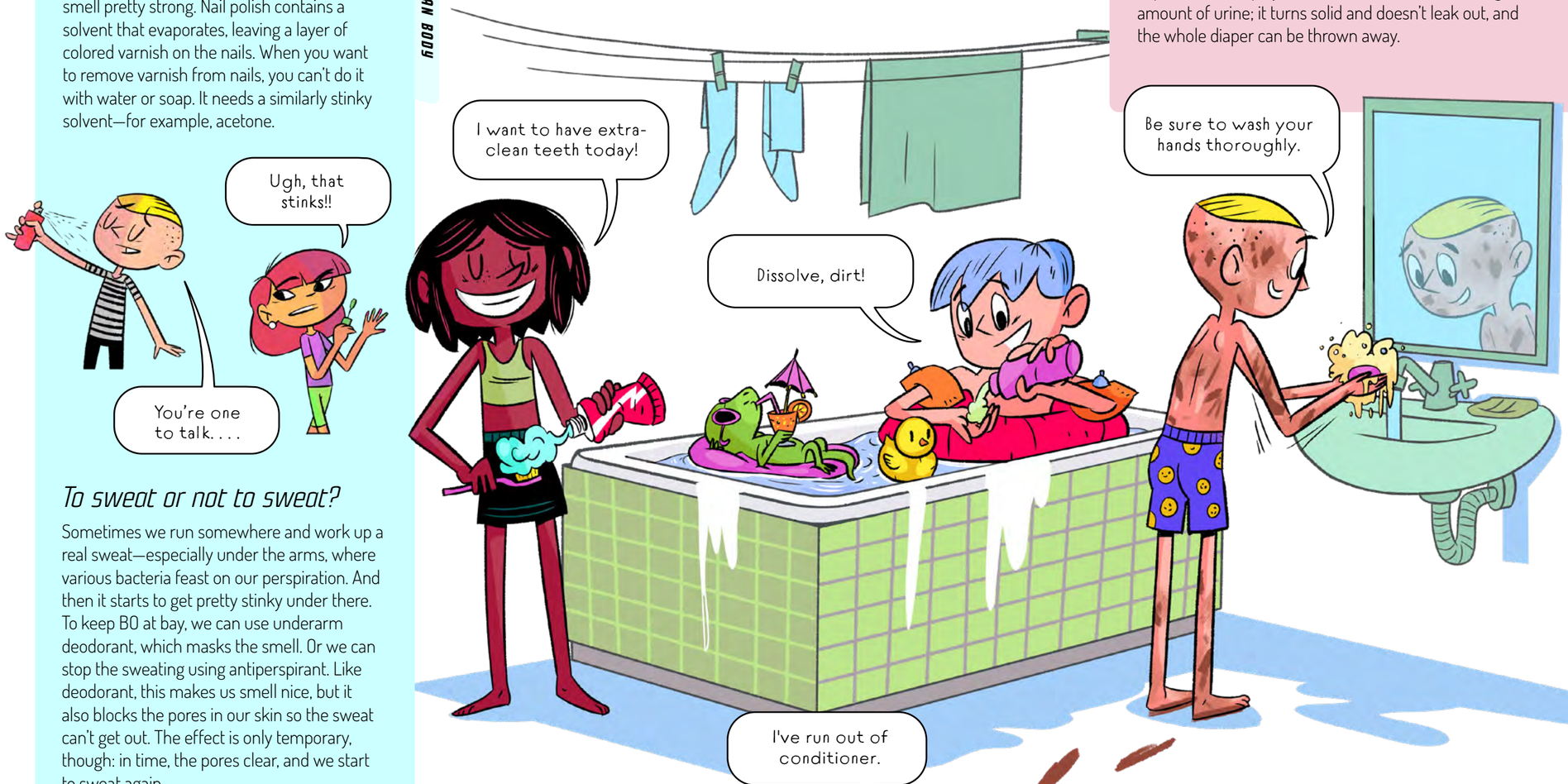
## Sweet and sticky

They say life should be sweet. And if you want to sweeten your tea at breakfast time, honey is a great choice. Bees make honey from the sweet nectar of plants. They take the nectar back to the hive, where other bees repeatedly drink it and then bring it back up again. This gets the nectar nice and thick. As soon as the bees are happy with the result, they pack the thickened nectar into a honeycomb and start flapping their wings at it so that as much water as possible evaporates. This creates a thick mass full of sugar, which is actually sweet, delicious honey. Who'd have thought something so wonderful has passed through so many stomachs?


The interesting thing about honey is it never goes bad. If any nasty bacteria were to get into it, they simply wouldn't survive. That's because honey has so much sugar that it would suck all the water out of the bacteria. On top of that, honey contains chemicals from the bees' stomachs, such as hydrogen peroxide, which would cause those germs a lot of trouble.

# 5 THE BATHROOM

The bathroom is a magical place. People go into it dirty and emerge a little while later transformed, clean and fragrant. How are these magic tricks really done?




HUMAN BODY

## Rainbow nails

When someone paints their nails, it can smell pretty strong. Nail polish contains a solvent that evaporates, leaving a layer of colored varnish on the nails. When you want to remove varnish from nails, you can't do it with water or soap. It needs a similarly stinky solvent—for example, acetone.




## To sweat or not to sweat?

Sometimes we run somewhere and work up a real sweat—especially under the arms, where various bacteria feast on our perspiration. And then it starts to get pretty stinky under there. To keep BO at bay, we can use underarm deodorant, which masks the smell. Or we can stop the sweating using antiperspirant. Like deodorant, this makes us smell nice, but it also blocks the pores in our skin so the sweat can't get out. The effect is only temporary, though: in time, the pores clear, and we start to sweat again.

HUMAN BODY

## A condition for beautiful hair

If you have long hair, after washing it, you probably reach for the conditioner. That's because shampoo strips your hair of oils. Without them, your hair is dry, dull, and lifeless. Dry hair is also more prone to static electricity, so when you brush it, it sticks out in every direction. But conditioner coats hair in a thin layer that prevents all these ailments.

MATERIALS

## A soggy lifesaver

When a baby's wearing a diaper, it's best for everyone if nothing spills out and everything stays inside. That's why there's a layer of material in a diaper we call a superabsorbent polymer. This is able to absorb a huge amount of urine; it turns solid and doesn't leak out, and the whole diaper can be thrown away.

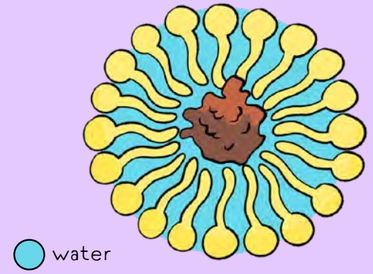
How much water can a superabsorbent polymer soak up?

ATOMS AND MOLECULES

## A people-cleaner

If you look at soap under a really powerful microscope, it looks a little like worms. They've got a head at one end and a tail at the other. When there's dirt on something that can't be washed off with water, soap worms come to the rescue! They stick their tails in the dirt and bite into the water with their heads. By doing this, the worms connect the dirt to the water, making it easy to wash off.

How soap works




PRODUCTION

## How is soap made?

Soap isn't exactly a new invention—the ancient Babylonians figured out it was good to be clean and smell nice. It wasn't hard to make soap: you just had to get hold of some fat and ash and boil them together. The interesting thing is that the production of soap hasn't changed that much in 5,000 years. These days, fats are boiled with soda, a chemical that's found in ash. There's a good chance your soap was once a cow, since beef fat is most often used.

## What a mess!

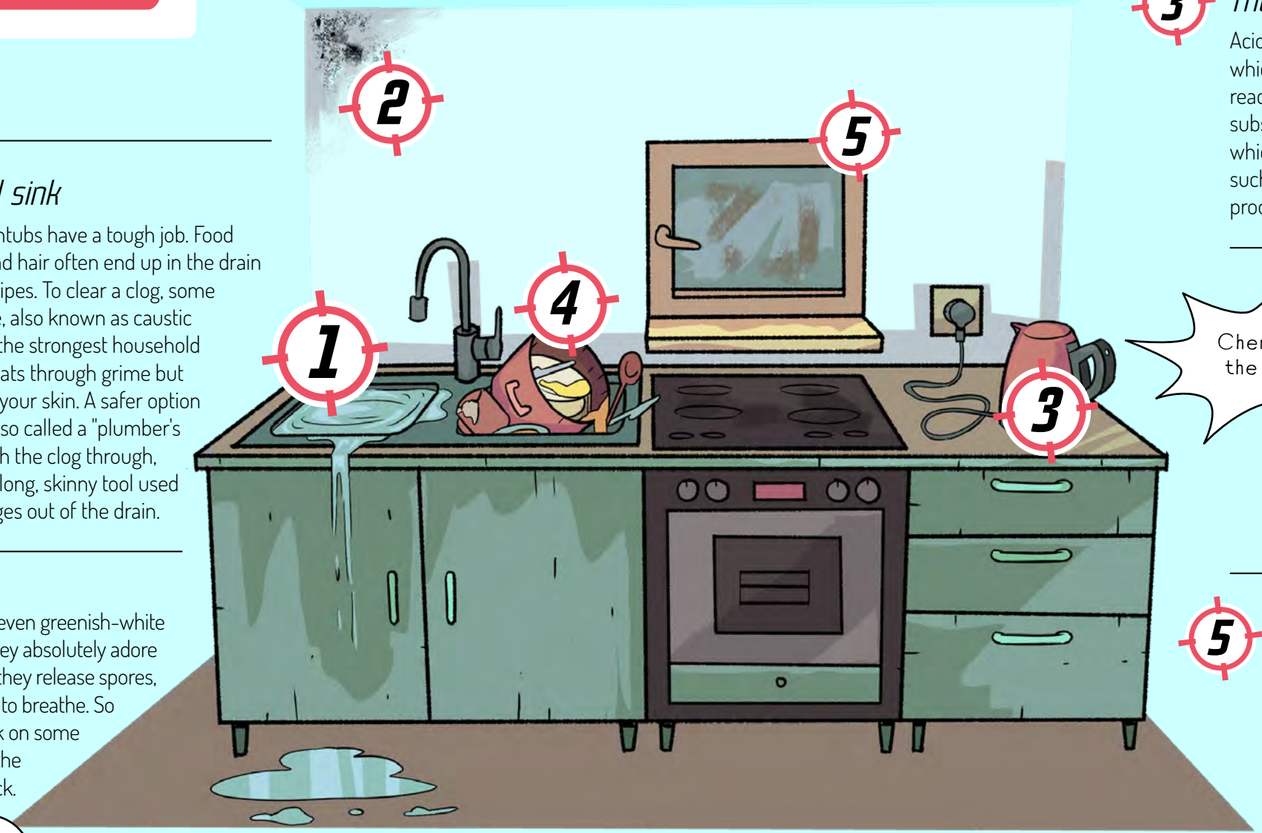
There's a solution to every problem—and a cleaning product for every type of dirt.


### 1 A blocked sink

Sinks and bathtubs have a tough job. Food scraps, dirt, and hair often end up in the drain and clog the pipes. To clear a clog, some people use lye, also known as caustic soda—one of the strongest household chemicals. It eats through grime but can also burn your skin. A safer option is a plunger, also called a "plumber's helper," to push the clog through, or a snake—a long, skinny tool used to pull blockages out of the drain.

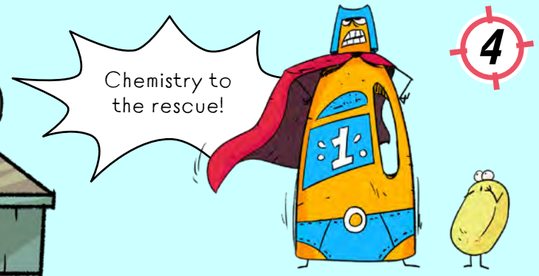
### 2 Mold

Molds are fungi that can look like black spots or even greenish-white clumps. They thrive in warm, damp places, so they absolutely adore bathrooms. The nasty thing about molds is that they release spores, and if there are a lot of them, people find it hard to breathe. So it's best to crack down on mold. Bleach can work on some surfaces, but the best thing to do is to get rid of the moisture problem, or the mold will just grow back.




### 3 The electric kettle

Acids like vinegar or lemon juice dissolve limescale, which is mostly calcium carbonate. The acid reacts with the calcium carbonate, creating new substances—one of them is carbon dioxide gas, which makes bubbles! That's why acidic ingredients such as acetic or citric acid are used in cleaning products to remove limescale from kettles and taps.




### 4 Dishes

Detergents are used for greasy things like dishes. They're the superheroes of the soap world! That's because they contain surfactants—special molecules that grab onto both water and grease, helping them mix. This breaks up the grease so it can be washed away.

### 5 The window

The most important thing when cleaning windows is that there are no smudges left on them! That's why glass cleaners contain a lot of alcohol, which quickly evaporates so you can see in the mirror without any smears.



**!** The main chemical in bleach is sodium hypochlorite. Hypochlorite attacks mold, bacteria, pigments, your skin . . . basically anything it comes across. It produces stinky chemicals that are good to air out, so you might want to open a window.

PRODUCTION

### Paper towels

Not all paper is soft and white. Some paper towels are brown and feel a bit rough—definitely not something you'd want as toilet paper! That's because they've been paper before. They're made from recycled paper: shredded, boiled, cleaned, and turned into new paper. It might not look fancy, but it helps save trees. So next time you see a brown paper towel, you'll know it's doing a good job for the planet—even if it feels like it could sand wood!

PRODUCTION

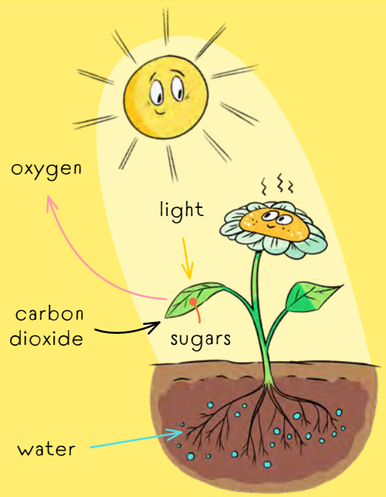
### Nothing but cellulose

Both absorbent cotton and paper are made mostly of cellulose, but what's the difference between them? Each comes from a different source! Absorbent cotton is made from the downy white tufts surrounding the seeds of the cotton plant. Paper, on the other hand, is made from trees, potatoes, and rocks. Seriously! Cellulose comes from wood, which is ground up, boiled in chemicals, and pressed. Starch (for instance, from potatoes) is added to the paper to make it stronger and limestone to make it less see-through.

# 7 THE GARDEN

In a garden, there may be lots of plants that will someday produce sweet tomatoes, delicious potatoes, or crunchy carrots. Before that happens, they need a lot of tender, loving care. But what do they actually want?

NATURE




## What do plants have for breakfast?

When the sun comes up in the morning, plants can start their breakfast. That's because plants use sunlight to make oxygen and sugars out of water and carbon dioxide. And that's how plants get their energy. But a happy plant needs much more than that, just as people wouldn't be healthy if they only ate sugar.


PRODUCTION

## Where to get fertilizer

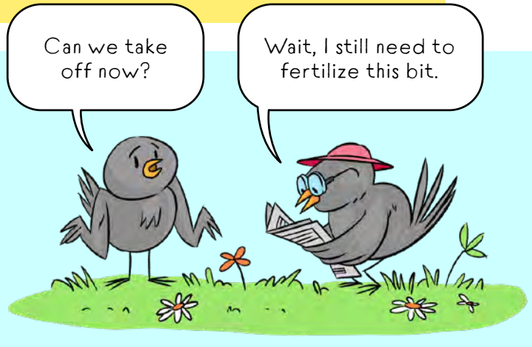
The more people there are in the world, the more food we need to grow, and that takes a lot of fertilizer. But what to make it from? Well, from air! We've got no shortage of air, right? And it's nearly all nitrogen, a real feast for flowers. It just needs to be prepared in such a way that plants can absorb it. That's why airborne nitrogen is used to make ammonia, a really smelly chemical, which is then turned into a kind of fertilizer called nitrate. This made life so much easier for people that the man who invented the method for producing ammonia, Fritz Haber, was awarded a Nobel prize!

MICROORGANISMS

## The water's blooming

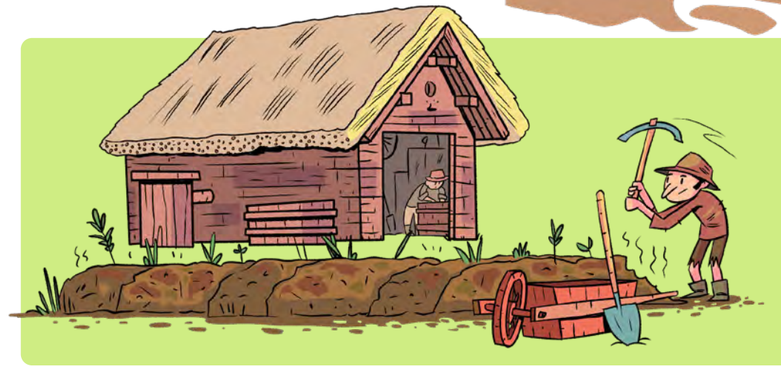
Plants in gardens and fields thrive when they get a good dose of fertilizer. But there's a catch. When it rains, the water washes the fertilizer into rivers, ponds, and lakes. This nutrient-rich water is a paradise for cyanobacteria, green bacteria that grow and grow until the whole pond is green. And it's poisonous for fish and other animals. If you go for a dip in this green water, you'll probably come out red, as it can give you a nasty rash. . . .


NATURE




## What else do plants need?

Lots of minerals! To make sure there are plenty of them, fertilizers are added to the soil. They usually contain three elements: nitrogen, phosphorus, and potassium. These fertilizers are called NPK after the chemical symbols for these elements. Another good fertilizer is guano—aka bird or bat droppings. In the old days, mountains of bird droppings were mined for this purpose!



## How did they do it in the Middle Ages?

Nowadays you can buy fertilizer in any shop, but it wasn't always like that. Getting fertilizer used to be hard, smelly work. First you had to find lots of excrement—the more the better. It didn't matter if it came from an animal or human. Then you piled it up, poured urine over it, and after a year or so, crystals of an excellent fertilizer called nitrate would form on it. Then you had to pluck up the courage to go and collect them. It's a good thing this smelly job is a thing of the past. . . .

PRODUCTION

# 10 THE GARAGE

The garage is home to lots of things, but its main occupant is the car. It needs to be vacuumed and washed before you can head off on a trip!

MATERIALS


## A comfortable interior

The first cars that took to the roads 150 years ago may not have had doors, a roof, or lights, but they did have comfy leather seats. Modern cars are full of pleasant materials, most of them synthetic. When the first cars were made, these materials hadn't been invented yet. Now we can produce synthetic vegan leather, which is made from polyurethane instead of animals. This is the same material that's used to make mattresses and sponges.

MATERIALS

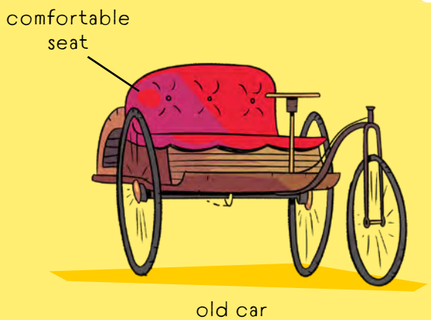
## A tin can full of tin cans

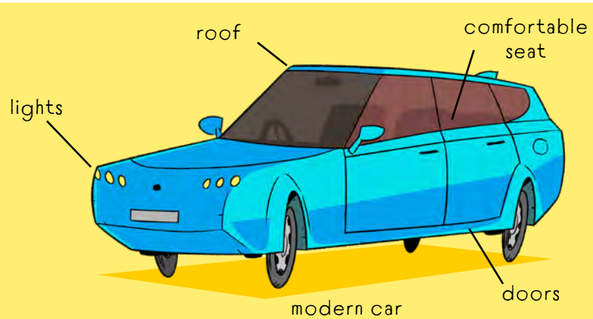
A passenger car is basically two tons of steel on wheels. Steel is a really solid metal, but it's awfully heavy. What if you wanted a fast racing car that would take off like a rocket? It would definitely help if the car were lighter. A lighter car's body could be made from aluminum and magnesium. Aluminum is also used to make cans. So does that mean a car is a tin can as well?

REACTIONS

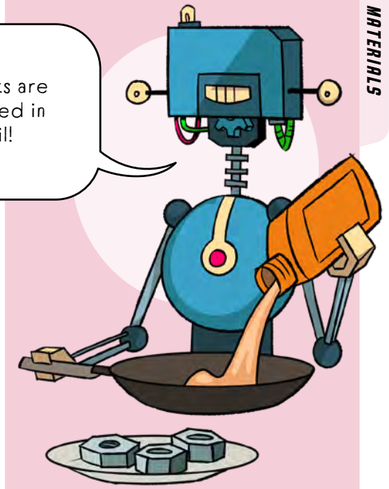
## Magical hydrogen

Electric cars don't always have to be charged from a socket. Some seem to perform miracles. Fill them up with hydrogen and—abracadabra!—they start moving, leaving behind nothing but clean water. But how do they do it? Well, they have something inside them called a "fuel cell." This is a battery made of hydrogen and oxygen, which is taken from the air. Hydrogen and oxygen combine to form harmless water, electricity is produced, and the car can drive off. Pure magic!


MATERIALS



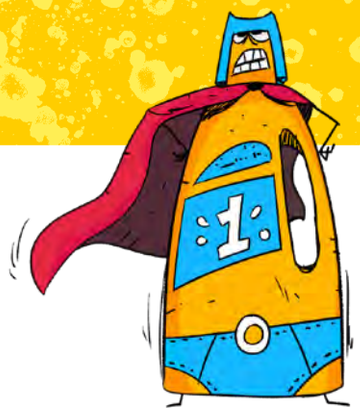

## A slippery helper

For an engine to work properly, it needs to be well greased with motor oil. Just to be clear, this is not the kind of oil you find in a kitchen. This stuff's made from petroleum and is very similar to diesel. If you were to fry food in it, in the best case scenario it would give you diarrhea. Similar oils are used as laxatives.

REACTIONS

## A private car wash

All it takes is a bit of rain and there's mud everywhere. It doesn't matter if it gets on our shoes, but the car windshield is a different story. The wipers alone can't always cope with that kind of dirt; they need a chemical helper: windshield wiper fluid. It contains mainly water and alcohol to keep the glass clean and streak-free. Sometimes there's also smelly ammonia in it, though. It's like a chemical gecko that eats all the flies off the glass.



*Written by* ***LENKA KARPÍŠKOVÁ*** *and* ***JIŘÍ VLACH***
*Illustrated by* ***TOMÁŠ KOPECKÝ***

Does the word *chemistry* make your hair stand on end? Come check out the chemistry around us and you'll see that it's not so scary! This book will guide you around the whole house and show you that there's lots of amazing chemistry at work in ordinary things. Do you know why geckos hate frying pans? Or how many stinky chemicals can be found in a kitchen? Or why batteries explode?

Together we'll investigate each room in the house, and you'll soon discover that there's chemistry at every turn—whether it's a tasty breakfast or the horrible chemicals in a laundry room. Thanks to some excellent experiments, you'll experience chemistry firsthand and find out how far this fascinating world extends. Spoiler: it's absolutely everywhere!


**LOOK**
SCIENCE IS ALL AROUND US!

Also available:



ISBN 978-80-00-07572-3
51795
9 788000 075723

albatros

$17.95
Printed in China
by Leo Paper Group Ltd.
www.albatrosbooks.com

albatros_books_ Albatros Books Albatros Books US

MIX
Paper | Supporting responsible forestry
FSC® C020056