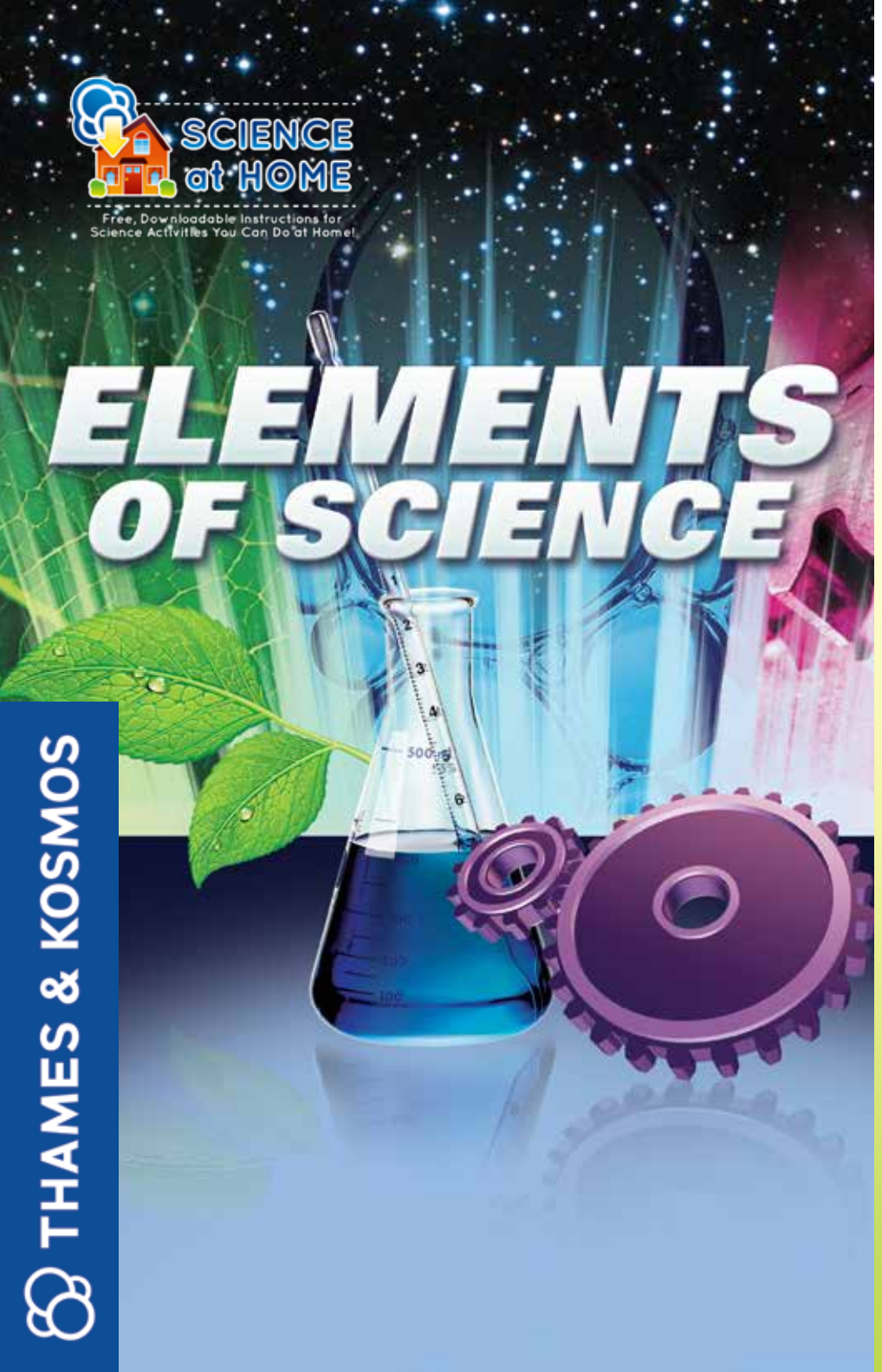


Advice for Supervising Adults

Children are curious by nature. They want to investigate, explore, and understand their environment. The Elements of Science experiment series will help your child do all those things.

A wealth of natural phenomena are explained in a simple and enjoyable style, and explored more closely in safe yet exciting series of experiments. This will also come in handy in school, because these same themes will come up in elementary school and again later in physics, biology, and chemistry classes.

We are, therefore, addressing this to you and filling you in on what you should do. Page through the activity sheets and pay special attention to the **safety rules**. Then select the experiments that seem the most appropriate for your child. Some of the experiments for which **assistance or supervision by parents** is especially necessary are marked with the adjacent symbol.

Before starting the experiments, discuss these safety suggestions with your child.

Read and follow the instructions, the safety rules and the first aid information and keep them for reference.

The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.

This experimental series is for use only by children over 10 years.

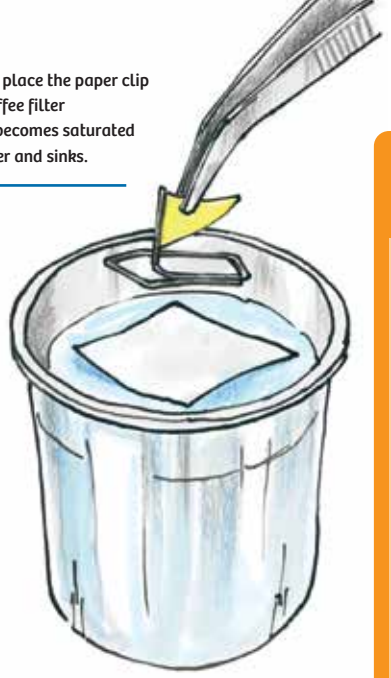
Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.

The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments.

The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided.

Experiments with Water

We will start our experiments with an everyday liquid. Everyday, but totally essential to life: without water, no living creature could survive. It even makes up over 60 percent of the human body. This is reason enough to turn our research curiosity toward it. On top of that, this substance possesses some fascinating properties.



You must place the paper clip on the coffee filter before it becomes saturated with water and sinks.

Load-bearing Skin

Let's test how much the "water skin" can hold.

You will need: 1 large measuring cup, *1 piece of string or woolen yarn,* 1 small piece of a coffee filter, *tweezers,* 1 paper clip, *scissors, water, ruler*

Here's how: Cut a piece of string about 3 cm (1 in) long and lay it very carefully on top of the water. It will remain resting on top of the "skin." The water has to be quite fresh and clean (completely free of soap or detergent!), and you must place the string very carefully. You can try the same thing with the paper clip. Cut a piece of coffee filter and place it on top of the water, now carefully place the paper clip on it. The paper will gradually go under but not the paper clip. You might need to use tweezers for this delicate procedure.

Did you know...

...that surface tension plays an important role in daily life and in nature?

Surface tension ensures that water drops form little round balls on a pane of glass or a leaf. It enables water striders and other small animals to walk on the water's surface. The force between water molecules glues the hairs of a paintbrush (and your hair after showering) together. And it keeps tent materials and umbrellas waterproof. Because the water molecules hold onto one another so strongly, it is hard for them to penetrate through the fine openings between the materials' fibers.

Water striders, which grow up to 15 mm long, hunt their prey while running on the water. The water's surface tension makes this possible.

What's going on? The water molecules hold onto one another so strongly that they resist being separated by the string or paper clip — even though the paper clip is much heavier than the same amount of water.

Soap Relaxes Water

You will need: 1 large measuring cup, pipette, a piece of coffee filter, 1 paper clip, *small piece of string or woolen yarn from Experiment 2, scissors, dish soap, 1 saucer, 1 deep dish, ground pepper, soap, water*

Here's how: Repeat the load-bearing skin experiment, but this time add a small piece of soap or a drop of dish soap to the water. Now the skin will seem much weaker, and it will no longer be able to hold the piece of string or paper clip.

What's going on? The soap molecules push themselves between the molecules of water, which can no longer attract each other so strongly.

Supplemental Experiment

Fill the dish with water and sprinkle the surface evenly with pepper. If you then drop a little soap on one side, the pepper powder will immediately shoot over to the other side. The soap destroys the skin of water where you drop the soap in. It works similarly to when you puncture a balloon: the skin breaks and pulls away from the hole, and takes the pepper particles with it.

Sticky Water

You don't always have to use glue: plain water can be used to stick things together, too.

You will need: Plastic plate, *water*

Here's how: Place a few drops of water on the bottom of a plastic plate and press it against a smooth surface — say, a windowpane or a mirror. Even on a vertical surface, the plate will stay stuck. And if you want to remove it, you have to pull hard.

What's going on? Water molecules don't just attract each other, they also develop forces of attraction for other substances — in this case, glass and plastic. This phenomenon is known as **adhesion**.

Did you know...

...that we often encounter adhesion in everyday life?

Glues are materials that have a particularly strong and long-lived adhesive property. Adhesion also makes it possible for wax to rise up a candlewick.
Adhesion draws groundwater through tiny spaces in the ground to the roots of plants and makes it climb up fine tubes in tree trunks to the leaves up above. On the other hand, it is also at fault when tea or coffee dribbles down the outside of the pot when you pour it.

Sugar, the Artist

Not only does sugar taste good, it can also paint. Don't believe it? Then see for yourself!

You will need: 1 small measuring cup, food coloring, *1 tablespoon, 1 sugar cube, a shallow plate, water*

Here's how: Pour just enough water onto the plate to cover the bottom. Slowly add 10 drops of the food coloring to the sugar cube and place it carefully in the middle of the plate. It will create a star-like design with many fine colored threads spreading out from the sugar. After a little while, the water will become evenly colored.
Repeat the experiment with warm water (bathwater temperature). Now it will spread out more quickly.

What's going on? The sugar solution spreads out in the water and takes the dye with it. Every substance strives to spread itself out as evenly as possible in the space available to it.

The ball of clay goes under — the clay boat floats!

Clay Boat Ahoy!

Why do ships float? A small stone will sink, even though it is lighter than a rowboat. A much heavier plank of wood, on the other hand, will stay on the surface. What secret is behind these facts?

You will need: clay, 1 large measuring cup, a small spoon, *water*

Here's how: Make a ball out of some of the clay and toss it into the measuring cup half-filled with water. It will sink. Fish the ball out again and reshape it into a little boat. Set the clay boat carefully on the water's surface. It floats! If you now start to add water into the boat with the spoon, the water level in the measuring cup will rise. But still the ship floats, until its "cargo" gets to be too much and it sinks.

What's going on? It is not the absolute weight of an object that determines whether it will float. What matters is whether an object weighs more than the quantity of water that it displaces when it

is dropped in. The ball of clay is somewhat heavier than the water it displaces, so it sinks. But if you shape it into a little boat, you increase the quantity of water it displaces. Even though its weight stays the same, the reshaped clay now floats.

A Trip to the Dead Sea

You may already have noticed it while swimming in the ocean: you float higher in seawater than in the water in a swimming pool or a lake. You have to make less effort to keep from sinking. That's even more true in the Dead Sea, an extremely salty sea between Israel and Jordan. There, you can lie flat on the water and read the paper as comfortable as can be, floating as if you were a cork. It must have something to do with the salt content of the water. Let's experiment.

You will need: *2 drinking glasses, 1 teaspoon, table salt, 1 fresh egg*

Here's how: Fill the first drinking glass half full of water and place the egg in it. The egg will sink. Now put three full teaspoons of salt into the second glass, half-fill with water, and stir. Place the egg in it. Now, the egg will rise to the surface.

What's going on? If you want to make an object float, there are two ways to do it. Either give it more buoyancy, or make the liquid in which you want the object to float heavier. You have taken the latter approach here, by adding salt to the water. Saltwater weighs more than the same quantity of fresh water. Therefore, an object needs to displace less of it in order to float.

Tip

If your egg wouldn't sink in the plain water, it might not be fresh. As an egg sits, water evaporates through the shell, so the egg becomes lighter the longer it is kept.

Where's the Sugar?

Do you like sweetened tea? If so, you add sugar to it. Have you ever wondered where the dissolved sugar actually goes?

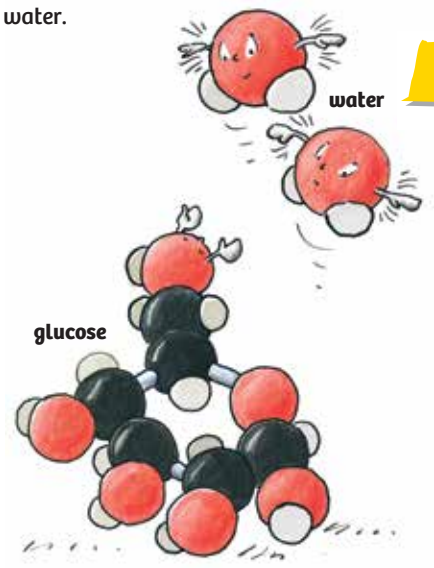
You will need: 2 large measuring cups, *sugar, 1 teaspoon, deep dish, table salt*

Here's how: Fill one measuring cup with water, add a full teaspoon of sugar, and stir. The sugar will gradually disappear. But it isn't completely gone. As you know, the sugar-water tastes sweet. So the sugar must be in the water somewhere.

Repeat the experiment with two measuring cups. Pour cold water in the first one and warm water in the second. In which one does the sugar dissolve more quickly?

Heat accelerates the dissolving process. Keep adding sugar to each cup until no more will dissolve. In which cup could you "hide" more sugar?

Sugar dissolves noticeably faster in warm water than cold water.



Natural salt works: sea salt crystallizes in flat basins.

What's going on? Here too, those tiny particles known as molecules are at work. The water molecules push between the sugar molecules and separate them from the sugar crystals. Each one is surrounded by a swarm of water molecules and floats off. The individual molecules are much too small to see, so the dissolved sugar is invisible. The higher the water temperature, the quicker the water molecules move and, thus, the better and faster they can free the sugar molecules.

Supplemental Experiment

Pour your sugar solution onto a plate and place the plate on the heater. Over the course of a few days, the water will evaporate (in other words, the water molecules escape into the air), and the sugar reappears as a white crust. When the water disappears, the sugar molecules collect and become visible again. The sugar crystallizes. It works even better with a salt solution — beautiful salt crystals will form on the plate.

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