EXPERIMENTS

We can no longer get by without electricity in our homes. In this chapter, you will get to know a few of its basic properties, and you will learn about all the things you can do with switches and lights.

Electric motors produce rotation from electric current. You can also use your electric motor to tell the direction in which current is flowing through your circuit.

How would you like to explore the secret powers of magnetism? Dive into this mysterious world, which has been put to use by early seafaring explorers and today's high-tech engineers alike.

What does electricity have to do with magnetism? Find out in the experiments in this chapter.

TIP!
You will find supplemental information in the "Check it out" sections on pages 22, 23, 30, 31, 49, 63, and 64.

COMPONENTS

Presenting the assembly components!

This list presents brief descriptions of all the components in the kit, along with illustrations.

Component	Description	Illustration
Battery case Item No. 704484 Never directly connect these terminals to each other. The batteries and wires can heat up and explode, not to mention that the batteries will be quickly used up.	This power pack supplies the electricity for the experiments. Before starting the experiments, you will have to install two 1.5-volt AA batteries (also known as penlight or LR6 batteries) inside it, as indicated in the battery compartment. You can then obtain electric current from the box's two terminals.	
Red light Item No. 706415	Later on, electricity will light up this bulb. That will show you that electrical current is flowing.	
Green light Item No. 706417	This is just like the red light, except it's a different color.	
Yellow light Item No. 706416	Again, this is just like the red light, except it's a different color.	
Motor Item No. 706414	When electrical current flows through it, the motor and its yellow propeller will turn quite quickly.	
Two-way switch Item No. 705055 Quantity: 2	Depending on the setting of the switch, one or the other of two contact plugs will be electrically connected.	
Push button Item No. 705054	If you push the button, you create an electrical connection between the terminals. But the connection is only maintained as long as you keep pressing it.	

EXPERIMENT 14

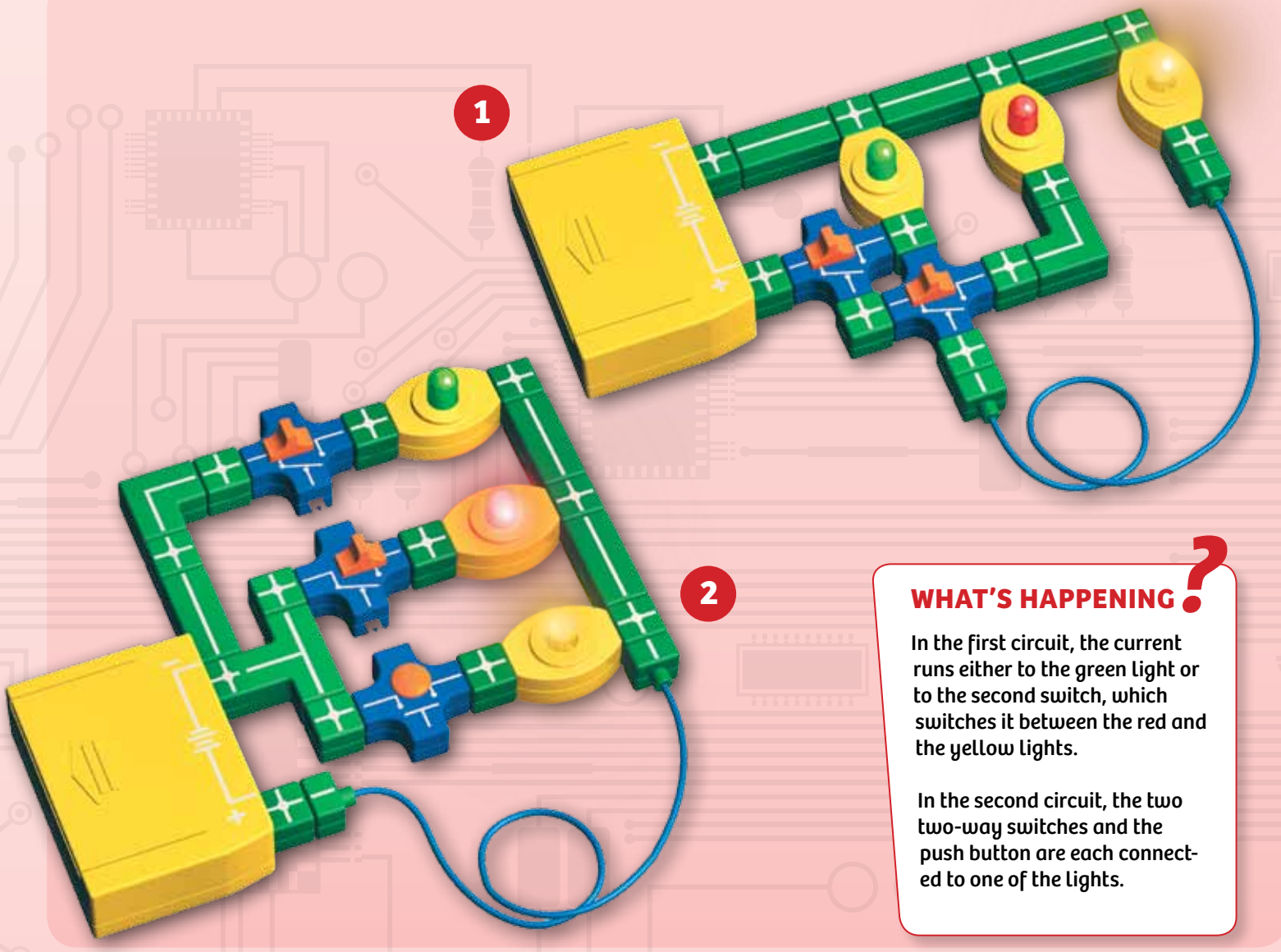
Your own traffic light

Of course, red and green are also the colors that traffic signals use to tell drivers or pedestrians whether they are allowed to proceed through an intersection or cross the street. Traffic lights also use the color yellow. Would you like to be able to control three different lights?

HERE'S HOW

Assemble the circuit exactly as shown in figure 1. If you do it right, you can choose whether to have the green, red, or yellow bulb light up. Trace the course of the current with your finger.

In the traffic lights used in some countries, the yellow light can shine at the same time as the red one, or at the same time as the green one. This setup can't do that, but the one shown in figure 2 can. In this one, the first switch provides current to the green light, while the other one controls the red light, and you can use the push button to switch on the yellow light whenever you want.



WHAT'S HAPPENING?

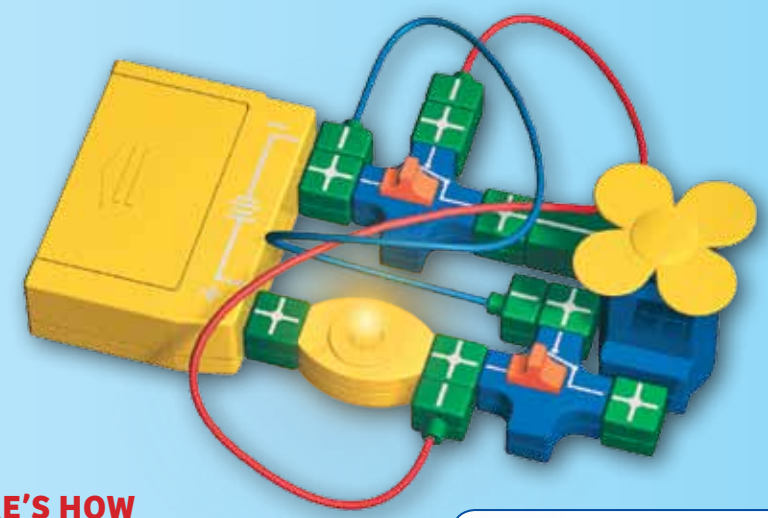
In the first circuit, the current runs either to the green light or to the second switch, which switches it between the red and the yellow lights.

In the second circuit, the two two-way switches and the push button are each connected to one of the lights.

EXPERIMENT 22

Current control

How can you check and make sure that a certain switch setting won't result in a short-circuit — that is, a direct connection between the two battery terminals? The simplest way is to monitor the current flow with a light bulb.



HERE'S HOW

You can see that the circuit matches the one in Experiment 21 ("Quick change"), except in this case a light is attached directly to one of the battery terminals.

On the other side, you will insert an I-connector to make the components fit together again.

Try all the switch settings. When does the bulb light up? Does anything occur to you as you watch the brightness of the light when the motor comes on?

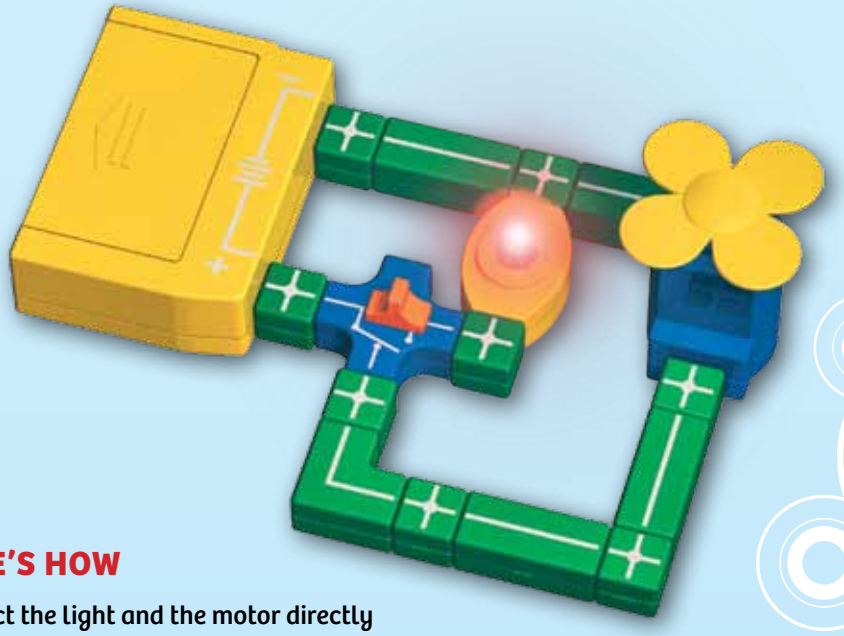
WHAT'S HAPPENING?

By lighting up, the bulb shows you when current is flowing. So you can be sure that when it doesn't light up, there's no circuit. At the moment that the motor starts up, the bulb is dimmer than it is after that point. This shows that the motor is consuming more current at that moment. Only once it's running at full speed does its electricity requirement drop again.

EXPERIMENT 23

Motor or light

You can use the two-way switch to switch the current back and forth between different loads. Try it with the light and the motor.



HERE'S HOW

Connect the light and the motor directly to one of the battery terminals on one side, and connect the other side of each component to a different terminal of the two-way switch.

Now you can choose whether to make the bulb light up or the motor run.

WHAT'S HAPPENING?

Depending on the setting of the switch, the current will run through the light or through the motor.

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HERE'S HOW IT CONTINUES

Secure the bar magnets a few millimeters apart on the table and see what kinds of patterns they form (figure 4).

Now hold the two bar magnets against the top of the box (figure 5). Of course, they will attract some of the iron powder.

WHAT'S HAPPENING?

As the iron particles show, the magnetic force seems to pour out of the poles and follow an arching path back to the opposite pole, with that path reaching a few millimeters out into the surrounding area.

That is because the iron particles themselves turn into little magnets when they are close to another magnet.

You already know about this from Experiment 32 (Contagious magnetism). The particles orient themselves according to the poles of the magnet, and stick together in chains. That's how the pattern is created out of thousands of tiny magnets.

TIP!

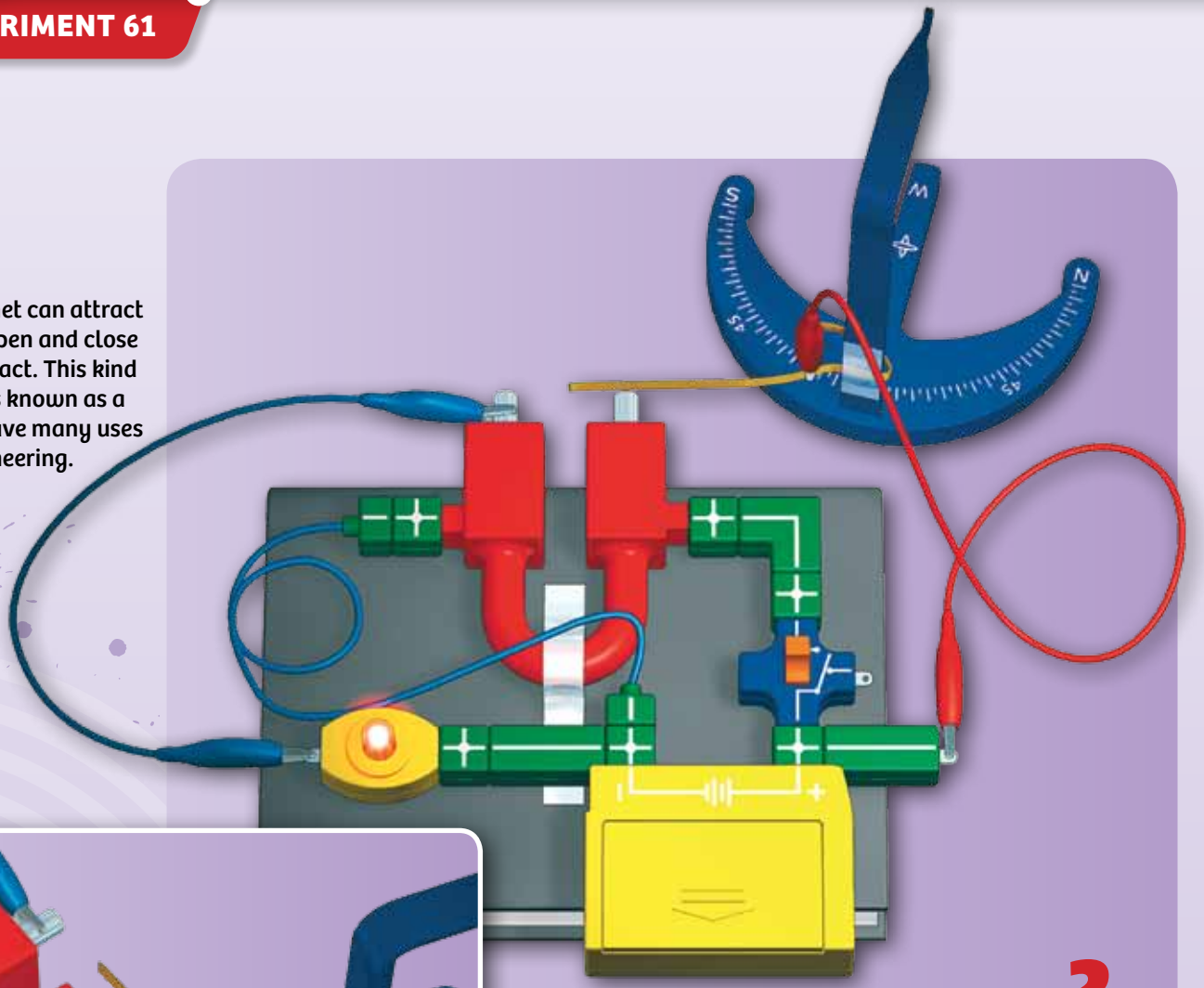
When unlike poles are facing each other, you can create an actual bridge of iron powder from one to the other. That won't work with equal poles.

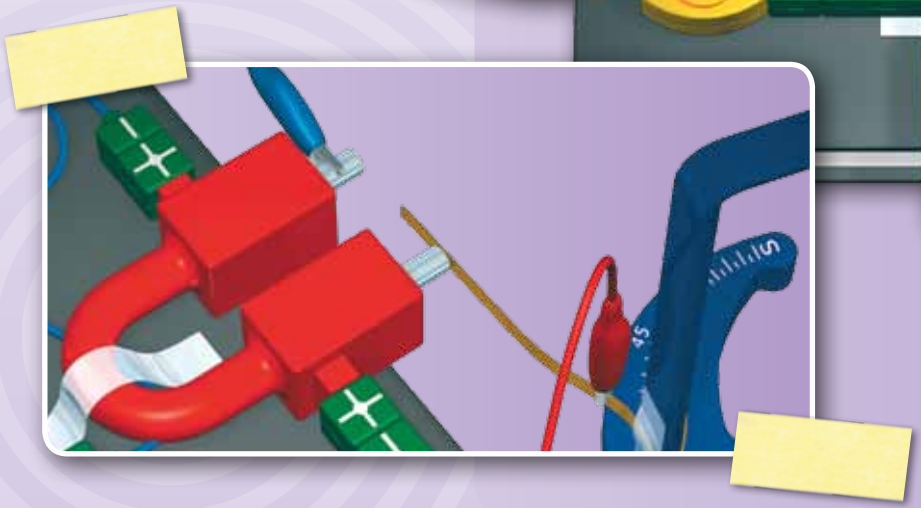
MAGNET FIELD

You can picture magnetic force as lines projecting out from one magnetic pole, running through the surrounding space, and then re-entering the other pole. These so-called **magnetic lines of force** are just a simple conceptual model, of course. In reality, a magnet is altering the space around it by giving it the property of being able to exert force on pieces of iron. Physicists call this kind of altered space a field. So there's a **magnetic field** all around the magnet, with the strength of the field falling as you get farther away from the magnet.

Remote control

If an electromagnet can attract iron, it can also open and close an electrical contact. This kind of arrangement is known as a "relay." Relays have many uses in electrical engineering.





HERE'S HOW

Remove the metal prong fastener strip from a folder, and use a piece of sandpaper to roughen up its surface to about three centimeters from both ends. Attach the fastener strip to the hanger device by partly wrapping the strip around it and then securing it with tape. Its end should be about three centimeters above the table surface when the hanger is standing upright.

Connect the horseshoe electromagnet to the battery case via switch, plug wire, and X- and L-connectors.

Assemble a second circuit with light, I-connectors, and both alligator wires. One of the alligator wires will lead from the light to one of the bare poles of the horseshoe electromagnet. Clamp one end of the other wire to the battery's second terminal and the other end to the metal fastener strip, near where you attached it.

Arrange the horseshoe electromagnet and the hanger in such a way that the magnetic poles and the strip are at the same height. Place a book under the horseshoe electromagnet if necessary.

The magnet should only touch the metal strip when it is switched on. When that happens, one of the two bare arms of the horseshoe electromagnet should touch a part of the metal strip that you rubbed bare.

Now, when you send current through the electromagnet, the bulb will light up. What do you see when you switch the current off?

WHAT'S HAPPENING?

The electromagnet attracts the metal strip to touch its pole. When that happens, the electric circuit is closed and the light shines. When you break the circuit, the light turns off and the strip springs back.