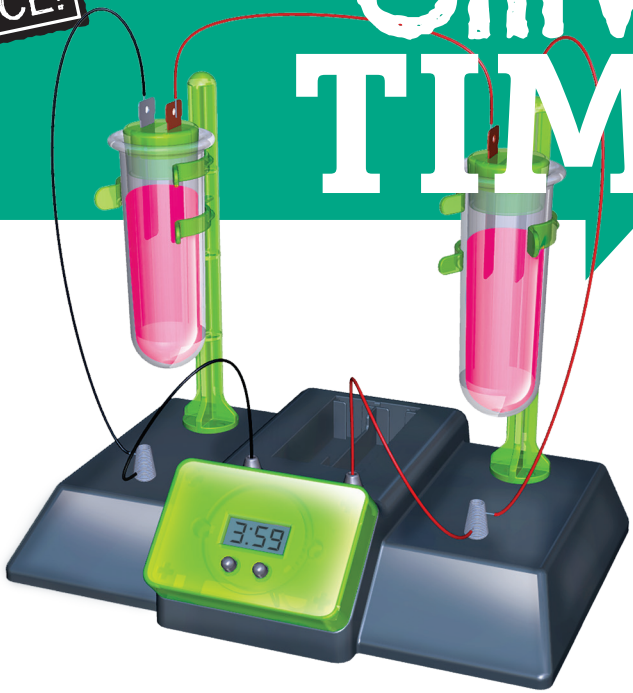
GEEK & CO. SCIENCE!

PROJECT KIT

Ages 8+

SliMe TIME



THAMES & KOSMOS

WARNING — This set contains chemicals and/or parts that may be harmful if misused. Read cautions on individual containers and in manual carefully. Not to be used by children except under adult supervision.

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Safety information

WARNING.
Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.
Keep the packaging and instructions as they contain important information.
This kit contains functional sharp-pointed wires and sharp-edged electrodes. Do not injure yourself!
If you use beverages or foodstuffs from the household to run the clock, the solutions must be disposed of after use. Never drink them. Wash your hands and clean the work area after doing the experiments.
Do not replace foodstuffs in original container. Dispose of immediately, especially if they came into contact with the electrodes.
Do not leave your slime clock filled with beverages or foodstuffs for a long period of time. Bacteria or mold could grow.
If the clock is used often, the electrodes will develop a dark coating. You can clean the dry electrodes with sandpaper.
Keep small children and animals away from the filled clock.
Read the notes on experimenting with batteries on the inside back cover.

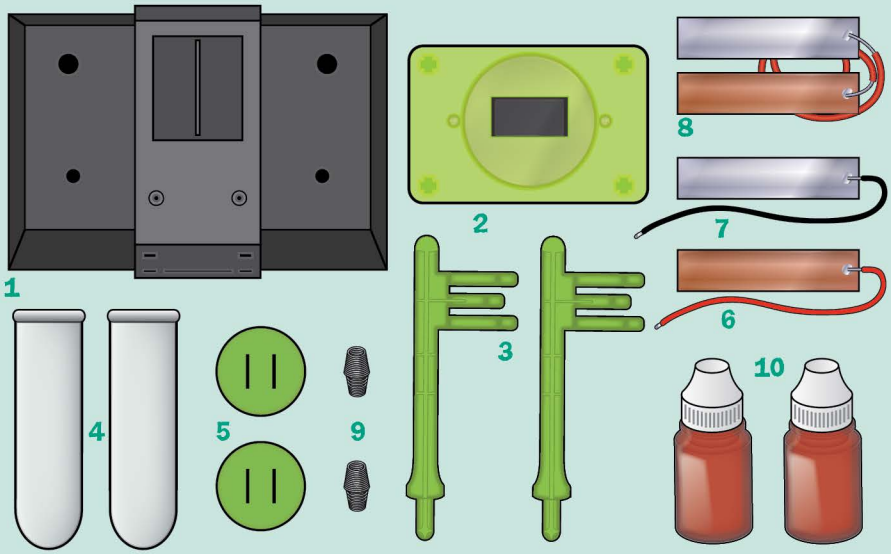
Information about the slime solution

The slime solution is non-toxic, but it must not be ingested. Avoid any contact with the eyes and mouth. Wear clothing that can get stained, such as old clothing or a smock, because the slime solution may cause stains that cannot be washed out of clothing. Keep all tablecloths, curtains, and carpets away from the experiment area. Be careful handling the filled clock so it does not spill and cause stains.

Notes on disposal of electrical components

None of the electrical or electronic components in this kit should be disposed of in the regular household trash when you have finished using them. Instead, they must be delivered to a collection location for the recycling of electrical and electronic devices. The symbol on the product, instructions for use, or packaging will indicate this. The materials are reusable in accordance with their designation. By reusing or recycling used devices, you are making an important contribution to the protection of the environment. Please consult your local authorities for the appropriate disposal location.

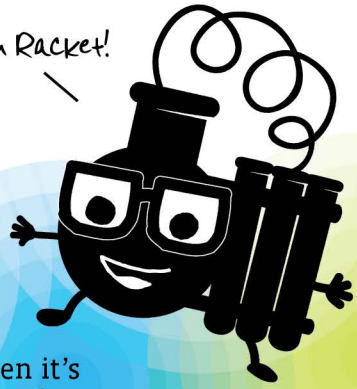
KIT CONTENTS



1	Base plate with battery holder
2	Digital clock
3	Test tube holders (2)
4	Test tubes (2)
5	Test tube caps (2)
6	Copper electrode
7	Zinc electrode
8	Copper and zinc electrode pair
9	Contact springs (2)
10	Slime solution bottles (2)

YOU WILL ALSO NEED: *Water, paper towels, various liquids (for example, diluted vinegar, cola, soda water, lemonade, tomato juice, oil, milk, fruit juice), two AA batteries (1.5-volt, type AA/LR6)*

Hey Slimy Timers!



Ready to make a cool electro-goop-powered clock? In this kit, you will assemble a device that uses a simple type of battery to generate electricity to power the clock. You will learn all about the electrochemical reaction that makes this happen, and a lot of interesting stuff about batteries! Most importantly, you'll have this rad slime clock to tell you when it's time to play! Racket the Geeker will be your guide!

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PART 1

IT'S SLIME TIME

Assembling the slime clock

You will need:

Base plate with battery holder, digital clock, test tube holders (2), test tubes (2), test tube cap (2), copper electrode, zinc electrode, copper and zinc, electrode pair, contact springs (2)

Here's how:

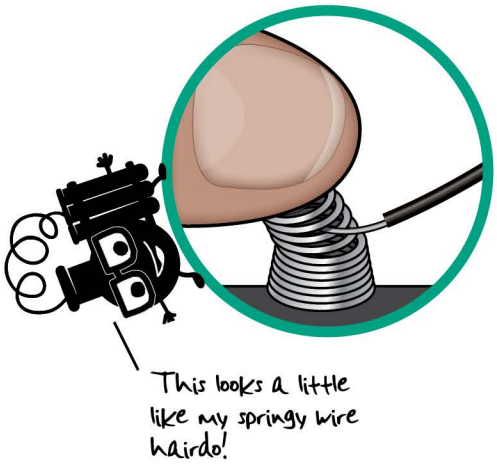
1. Lay the gray plastic base plate on the table in front of you.
2. Insert the two metal contact springs into the holes on the top-front of the base plate.

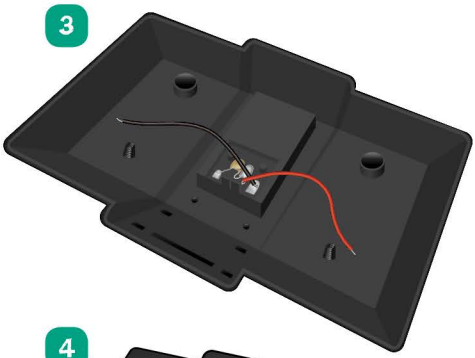
3 Flip the base plate over. Make sure the red and black wires from the battery holder are not connected to anything. You will not be using the batteries at this time.

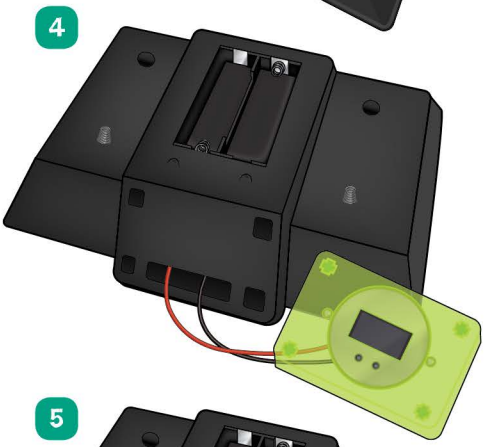
4 Flip the base over again. Insert the wires from the clock into the rectangular hole.

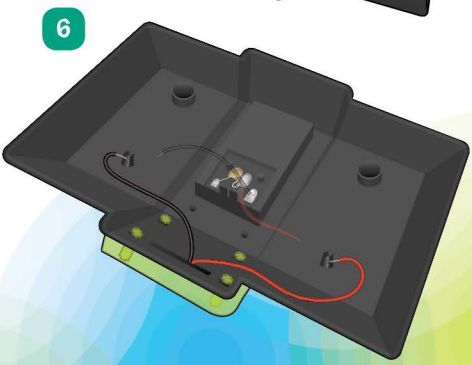
5 Mount the clock onto the base.

6 Flip the base over again. Insert the wires from the clock into the contact springs. Connect the black wire from the clock to spring on the left (as viewed with the base upside down). Connect the red wire from the clock to the spring on the right.









7 Insert the test tube holders into the base.

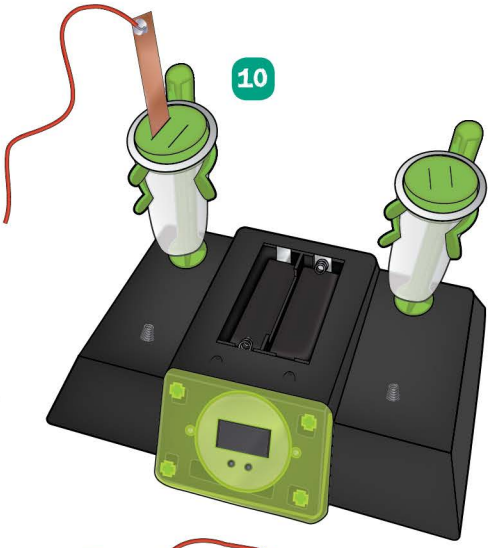
8 Insert the clear test tubes into the test tube holders.

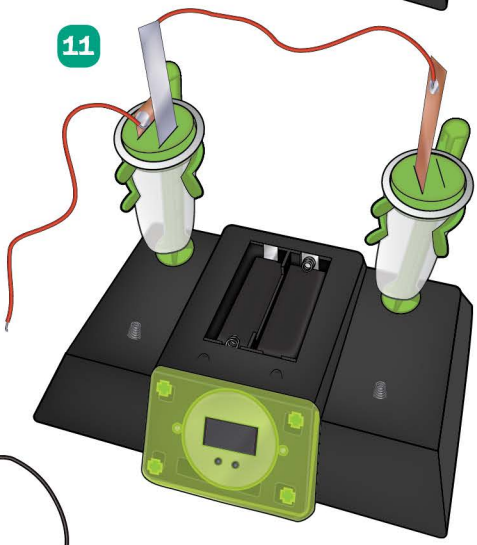
9 Insert the test tube caps into the test tubes.

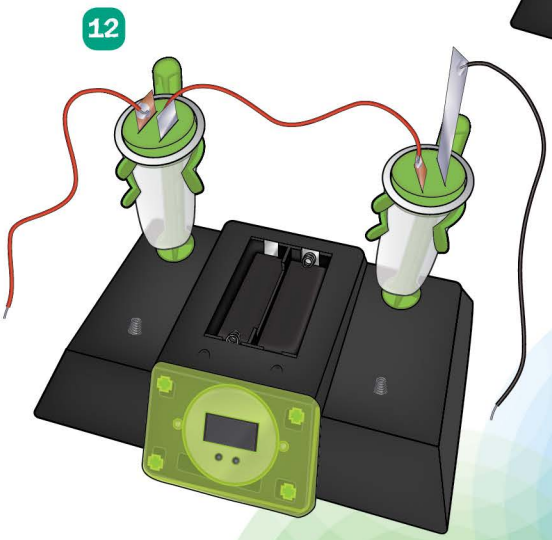
10 Inspect the electrodes: Copper is a metal that has a reddish color. Zinc is a metal with a silver color. Insert the copper electrode with red wire into the left slot on the left test tube.

11 Insert the zinc electrode from the zinc-copper electrode pair into the right slot on the left test tube. Insert the connected copper electrode into the left slot on the right test tube.

12 Insert the zinc electrode with the black wire into the right slot on the right test tube.



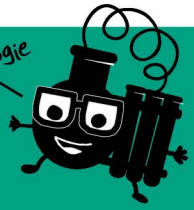




13 Insert the red wire into the contact spring on the left and the black wire into the contact spring on the right.

And you're done! The slime clock is ready to be filled with slime!

PART 2 IT'S ELECTRIC!



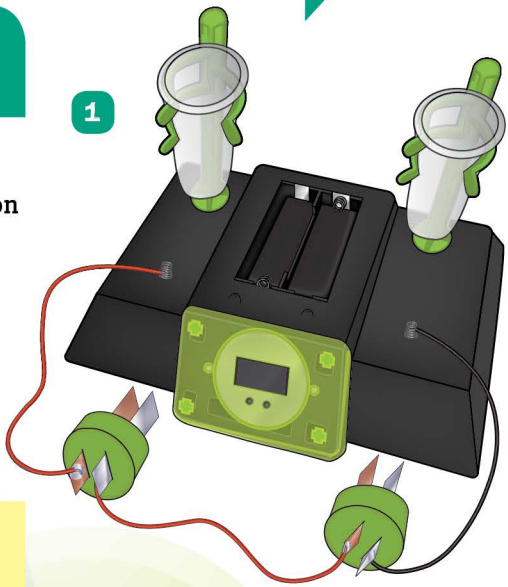
Filling the slime clock

You will need:

Assembled slime clock, slime solution bottles, *water*

Here's how:

1 Remove the test tube caps. Lay them on the table as shown.



NOTE! The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.

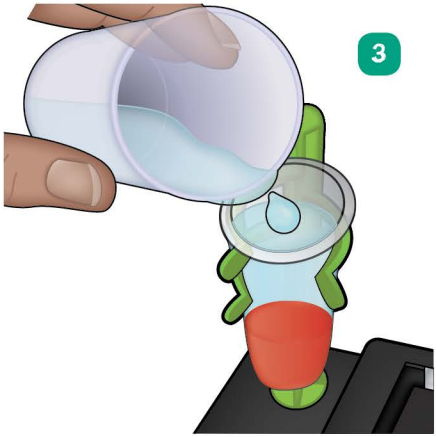
2 Fill both test tubes about a quarter of the way with the red slime solution.

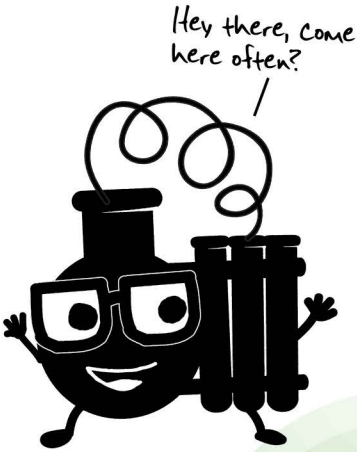
3 Fill both test tubes with water the rest of the way up. Swirl or stir the solution a little to get the water and slime to mix.

4 Reinsert the test tube caps with the electrodes in them into the test tubes. The electrodes should be immersed in the liquid.

5 Now your clock will start running! You will see numbers and blinking double dots on the display.

Your clock has power! Now you can set the time.





PART 3

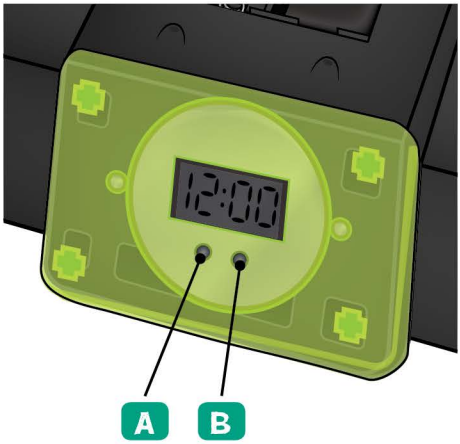
WHAT'S THE TIME?

How to read the clock's display

Under the display, you will see two buttons. We will call them:

A and B .

A is on the left and B is on the right.



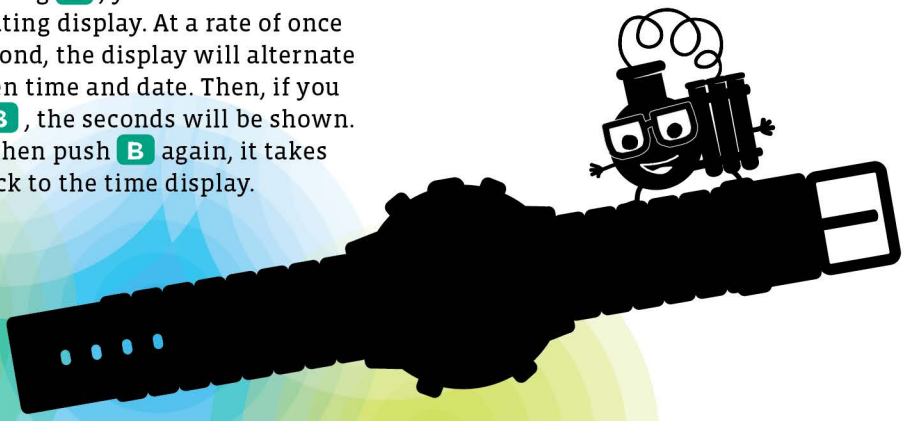
Your clock has two display modes:

Time Display

This shows the time on the display, in hours and minutes. When you push B , it shows a date display — the month and the day. After a few seconds, the time will be displayed again automatically.

Alternating Display

By pushing A , you switch to the alternating display. At a rate of once per second, the display will alternate between time and date. Then, if you push B , the seconds will be shown. If you then push B again, it takes you back to the time display.



How to set your clock

IMPORTANT!
To set the date and time, you have to switch the clock to the alternating display mode.

1	Press A	This takes you to the month setting mode.
2	If you then press B, you can set the display to the current month. The displayed number will increase by 1 each time you press, and switches back to 1 (January) after 12 (December).	
3	Press A	This takes you to the day setting mode.
4	Then press B to get the correct day. The displayed number increases by 1 with every push, and switches back to 1 after 31.	
5	Press A	This takes you to the hour setting mode.
6	By pressing B, you can set the current hour. The displayed number increases by 1 with every push, and switches back to 1 after 12. You will see that there is a letter A behind the number, which stands for a.m. or morning. After you press 12 times, the letter switches to P — for p.m., or afternoon/evening. You will have to be sure to set the letter correctly depending on whether it is, say, 8 in the morning or 8 in the evening.	
7	Press A	This takes you to the minute setting mode.
8	Press B in order to set the minutes. The displayed number increases by 1 with every push, and switches back to 00 after 60.	
9	Press A	Now the correct time is shown on the display!

GEEK OUT!

HOW DOES THE SLIME CLOCK WORK?

As soon as the electrodes are immersed in the liquid, they release positively-charged metal **ions** due to the action of the acids in the slime. The electrodes receive negatively-charged electrons in return. These electrons are then able to move freely in the metal.

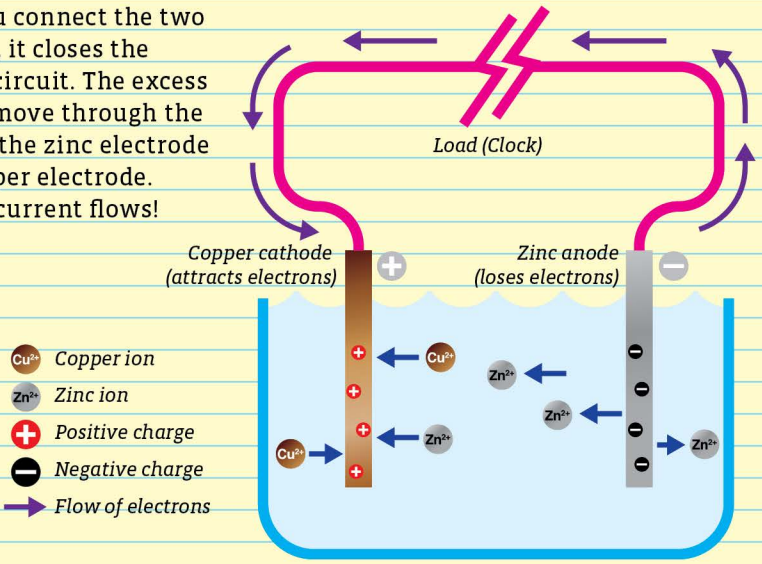
That happens in the copper as well as the zinc, but there's an important difference. The copper atoms are very reluctant to accept back any electrons, while a lot of electrons collect very quickly in the zinc sheet.

Now, if you connect the two electrodes, it closes the electrical circuit. The excess electrons move through the wire from the zinc electrode to the copper electrode. Electrical current flows!

This is an **electrochemical cell** that produces electrical energy from spontaneous **oxidation-reduction (redox) reactions**. In this type of cell, there is an anode and a cathode. The **anode** is the electrode where **oxidation** (loss of electrons) occurs. The zinc electrode is the anode.

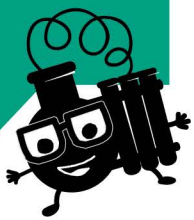
The **cathode** is the electrode where **reduction** (gain of electrons) takes place. The copper electrode is the cathode.

Diagram of redox reaction



PART 4

ELECTROCHEMICAL EXPERIMENTS



Testing other electrolytes

You will need:

Assembled slime clock, *water, paper towel, various liquids (for example, diluted vinegar, cola, soda water, lemonade, tomato juice, oil, milk, fruit juice)*

Here's how:

1. Start by disconnecting the two electrode wires from the two contact springs. Remove the electrodes from the test tubes and rinse them off. Take the tubes off the assembly board and pour any used solution down the drain.
2. Rinse out the test tubes and clean the sink to avoid any stains. Dry all the pieces with a paper towel.
3. Re-mount the test tubes in the holders and clamp the wires into their proper contact springs.
4. Fill the two test tubes with one of the liquids, almost all the way up to the rim.
5. Close the tubes with the lids and insert the electrodes through the slits as described in Part 1.
6. Write your observations below! Repeat with the other liquids.

Record your findings!

LIQUID	DOES IT WORK?	HOW LONG DOES IT WORK?

GEEK OUT!

DIFFERENT TYPES OF BATTERIES

WET CELL

The electrolyte in a wet cell battery is a liquid. The earliest batteries were wet cells. Your slime clock is a wet cell.

DRY CELL

The electrolyte in a dry cell is a more solid paste but with enough liquid in it for current to flow. They don't spill and therefore they can be used in any orientation. Standard batteries (AAA, AA, 9V) are dry cells.

MOLTEN SALT

Molten salt batteries use a molten salt as the electrolyte. They are very hot and must be installed with a lot of insulation.

Some common batteries are:

Zinc-carbon: anode: zinc; cathode: carbon rod and magnesium dioxide

Alkaline: anode: zinc; cathode: magnesium dioxide

Lithium: anode: lithium; cathode: magnesium dioxide or various other chemicals

Zinc-air: anode: zinc; cathode: oxygen in the air

Silver oxide: anode: zinc; cathode: silver oxide

The Electrode Rodeo

The metal sheets immersed in the lemonade are the electrodes of the slime clock battery. It is crucial that they are made of different materials. The electrodes in this kit are made of **copper** and **zinc**. The slime is the battery's conductive liquid, also known as an **electrolyte**. It has to contain a little acid for the battery to work.

Raw copper

Raw zinc

ELECTROPLATING

The electrons react with the positive zinc particles in the conductive liquid. That gradually creates a layer of zinc on the copper electrode. This process is called **electroplating**. When that happens, no more current can flow, since both electrodes outwardly consist of the same material. You can get the current flowing again by cleaning the metal sheets with a little sandpaper and using a new batch of acidic solution.

PART 5

POWERING UP WITH BATTERIES

Running the clock on battery power

You will need:

Assembled slime clock, water, *paper towels, 2 x AA batteries (1.5-volt, type AA/LR6)*

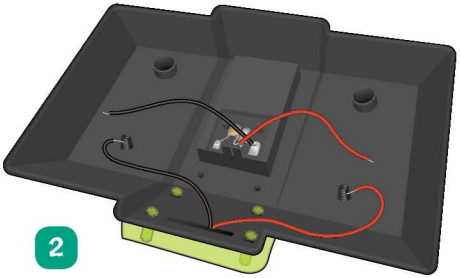
Here's how:

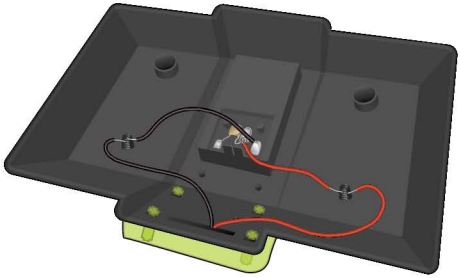
1. Disconnect the electrode wires from the two contact springs. Remove the electrodes from the test tubes and rinse them off. Take the tubes off the assembly board and pour any used solution down the drain.

2. Flip the base plate over. Bend the underside of the contact springs and insert the wires from the battery compartment. Insert the black wire into the spring on the left and the red wire into the spring on the right, as viewed upside-down.

3. Insert the two AA batteries into the battery compartment. Make sure that the + and − signs on the batteries match up with the signs in the compartment.

The clock runs on battery power!





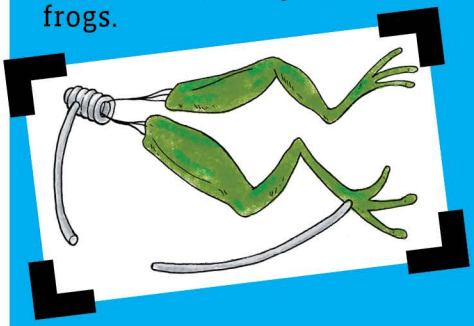
CAUTION! Be sure to have an adult check that you have connected all the wires correctly!

GEEK OUT!

WHO INVENTED THE BATTERY?

The development of a constantly flowing electrical current began by accident. In 1786, while the Italian anatomy professor **Luigi Galvani** was dissecting a dead frog, he observed that the frog's muscles suddenly jerked as if subjected to an electric shock. This happened at just the moment when he simultaneously touched the muscles with instruments made out of two different metals. He assumed that he had discovered a kind of "animal electricity" in the frogs.

Alessandro Volta



The actual explanation was discovered shortly thereafter by his fellow countryman, the physics professor **Alessandro Volta**. He determined that the instruments themselves were supplying the electrical current. They just had to be connected by a liquid capable of conducting electricity — like a salt solution, fruit juice, or in this case, the body fluid of the dead frog.

Alessandro Volta tried out different combinations of metals; zinc combined with silver or copper worked the best. He also discovered that he could increase the power of the current source if he connected lots of pairs of metal to one another in a battery. For the first time, this invention was something that could provide a steady source of current, rather than just producing sparks.

GEEK OUT!

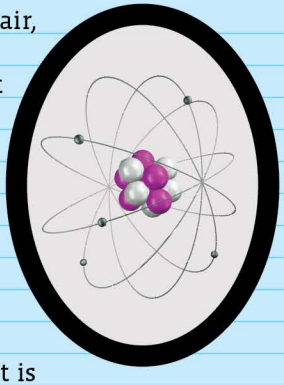
A BIG PILE OF VOLTS

You've probably used batteries lots of times, but you may not know the history of them or how they work. As mentioned before, it was Italian physicist Alessandro Volta who discovered in 1800 that the power of electric current could be increased by connecting lots of pairs of metal to each other. And it was by connecting metal pairs that he invented the battery (he called it a **voltaic pile**), which for the first time could provide a steady flow of current rather than mere sparks.

A **battery** is a device that stores chemical energy to make it available as electrical energy. Batteries are commonly used as power sources in household and industrial applications, and battery production is a multi-billion dollar industry. There are tons of different types of batteries, such as the silver-oxide batteries used in watches and calculators, the rechargeable lithium ion batteries used in digital cameras, and even paper batteries, made of paper and carbon nanotubes, that are useful for their lightness and biodegradability. The batteries you've probably used the most are alkaline batteries, which are found in everyday appliances from your electronic toothbrush to your portable radio.

GEEK OUT!

ATOMS, IONS, AND ELECTRICAL CHARGE



All the substances that make up our world, such as air, water, and rocks, are made of tiny building blocks known as **atoms**. For a long time, scientists thought that these building blocks could not be broken down any further, although we know better today.

In fact, atoms are composed of even smaller particles. These include a **nucleus**, which contains positively-charged **protons**, around which fly tiny, negatively-charged **electrons**.

Normally, an atom has an equal number of protons and electrons, meaning that it has neither a positive nor a negative charge — in other words, it is electrically neutral.

If the number of electrons doesn't match the number of protons, the atom has a positive or negative charge. A charged atom is known as an **ion**.

GO FLY A KITE

The American scientist **Benjamin Franklin** experimented with electricity. He hypothesized that lightning bolts were just electric sparks, only bigger and louder. To prove that, in 1752 he performed a dangerous experiment. It is said that he flew a kite during a thunderstorm and was able to create sparks at the end of the string. The wet kite string conducted the electricity of the storm down toward the ground. As he knew, electrical current can be conducted through a metal wire. This is how he got the idea for lightning rods, using metal rods attached to the highest point of built structures to protect them from lightning. Some historians and scientists are skeptical about whether or not Franklin actually conducted his kite experiment, but it makes a good story!

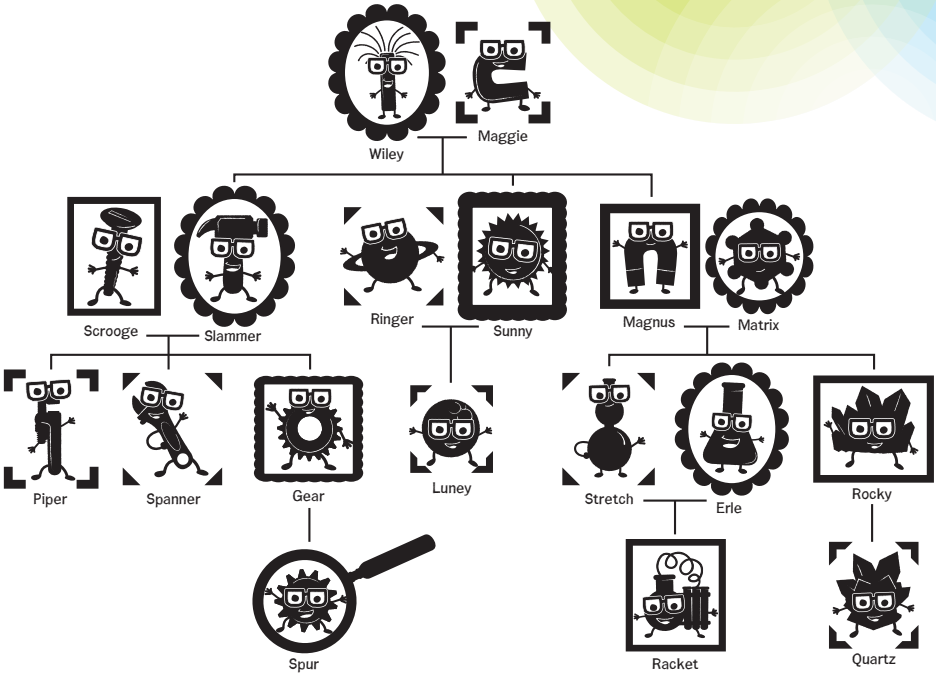
Kosmos Quality and Safety

More than one hundred years of expertise in publishing science experiment kits stand behind every product that bears the Kosmos name. Kosmos experiment kits are designed by an experienced team of specialists and tested with the utmost care during development and production. With regard to product safety, these experiment kits follow European and US safety standards, as well as our own refined proprietary safety guidelines. By working closely with our manufacturing partners and safety testing labs, we are able to control all stages of production. While the majority of our products are made in Germany, all of our products, regardless of origin, follow the same rigid quality standards.

Notes on experimenting with batteries

Warning. Only for use by children aged 8 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep the packaging and instructions as they contain important information.
The wires are not to be inserted into socket-outlets. Never perform experiments using household current! The high voltage can be extremely dangerous or fatal!
Two AA batteries (1.5-volt/LR6) are required, which could not be included in the kit due to their limited shelf life.
Different types of batteries or new and used batteries are not to be mixed.
Do not mix old and new batteries.
Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
Always insert batteries in the right polarity orientation, pressing them gently into the battery compartment.
Non-rechargeable batteries are not to be recharged. They could explode!
Rechargeable batteries are only to be charged under adult supervision.
Rechargeable batteries are to be removed from the toy before being charged.
Exhausted batteries are to be removed from the toy.
The supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.
Dispose of used batteries in accordance with environmental provisions.
Be sure not to bring batteries into contact with coins, keys, or other metal objects.
Avoid deforming the batteries.
Have an adult check the clock before you use it so you can be sure it was assembled properly!

MEET THE GEEKERS!



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Original manual layout: Ted McGuire, Dan Freitas

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