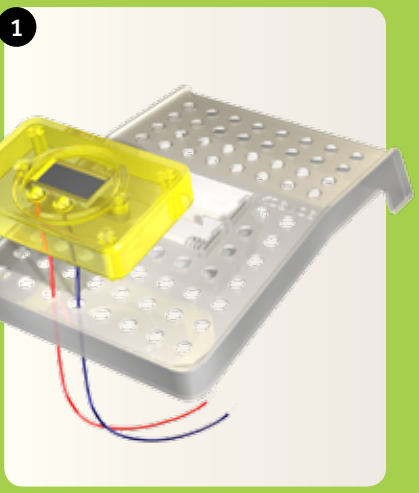
How to Assemble Your Clock

YOU WILL NEED:

› Digital clock, assembly board with battery compartment, 2 contact springs



STEP 1

Guide both digital clock wires through the holes in the assembly board, as shown in the illustration.

Position the digital clock on the sloping section of the assembly board.

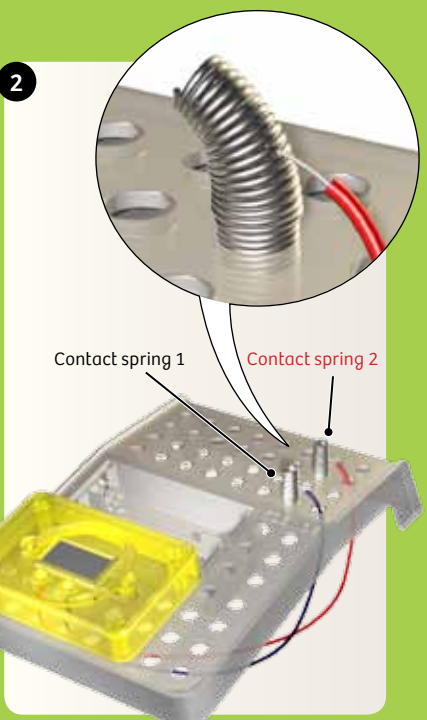
STEP 2

Firmly insert both contact springs narrow-side-down into the assembly board. The picture shows the correct position.

Guide the **black wire** from the bottom through the hole next to **contact spring 1.** Guide the **red wire** through the contact board next to **contact spring 2.**

When you bend the contact springs to the side, it creates gaps in which you can clamp the ends of the wires.

Clamp the digital clock's **black wire** in **contact spring 1** and the **red wire** in **contact spring 2.**



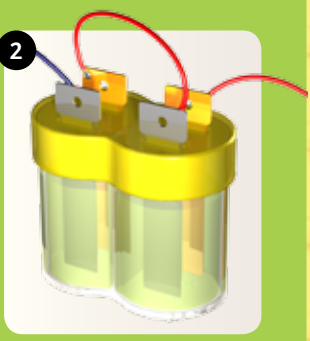
Starting Up the Lemonade Clock!

EXPERIMENT 1

YOU WILL NEED:

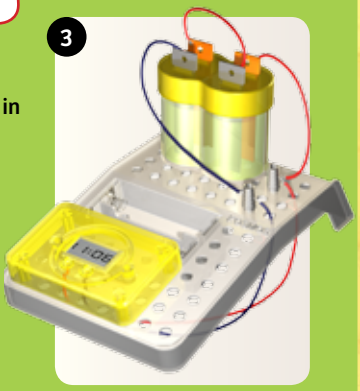
› Assembly board with digital clock, cup for liquids, cup lid, 2 copper sheets, 2 zinc sheets, *lemonade or lemon soda*

1. Fill the two chambers of the cup with lemonade or lemon soda up to about 1 cm beneath the rim. This will be your battery's **conducting liquid.**



2. Put the lid on the cup. Slide one reddish copper sheet and one silver-colored zinc sheet through the slits of each chamber.

CAUTION! Do not let the sheets touch each other! The pair of sheets connected by the red wire must not be inserted together into a single chamber.



3. Mount the cup on the assembly board as shown in the illustration. Clamp the cup's **black wire** into **contact spring 1** and the **red wire** into **contact spring 2.**

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

WHY? As soon as the electrodes are immersed into the liquid, they release positively-charged metal ions from the sheets due to the action of the acids in the lemonade, getting back 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 sheets, it closes the electrical circuit. The excess electrons move from the zinc electrode to the copper electrode. Electrical current flows!

Would you like to know what electrodes, ions, and electrons are? Then take a look at the "Check It Out" section!

Battery Power for Your Clock

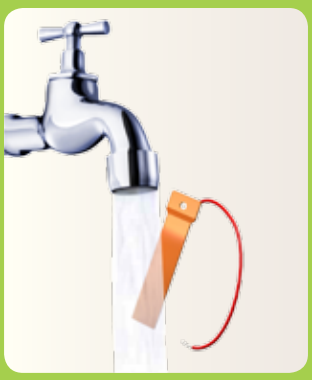
EXPERIMENT 3

YOU WILL NEED:

› Assembled board with digital clock, *water, paper towel, 2 x AA batteries (1.5-volt, type AA/LR6/penlight)*

Start by releasing all wires from the contact springs and pulling them out through the assembly board from underneath. Remove the contact springs from the assembly board. Pull the metal sheets out of the cup of liquid and rinse them off. Take the cup off of the assembly board. Pour the liquid from the cup down the drain. Rinse out the cup and clean the sink to avoid any stains.

Dry all the pieces with a paper towel and place them back in their packaging.

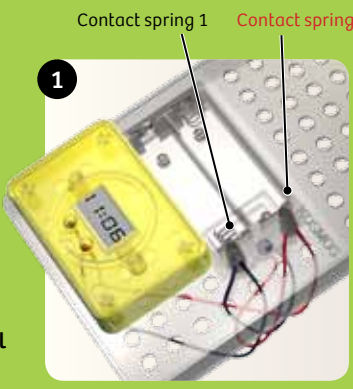


STEP 1

Insert the two contact springs into two holes next to the battery compartment.

Guide the **black wires** next to **contact spring 1** through the assembly board holes from beneath and the **red wires** in the same way to **contact spring 2,** as shown in the illustration.

Connect the **black wire** from the battery compartment and the **black wire** from the digital clock to **contact spring 1** and the **red wire** from the battery compartment and the **red wire** from the digital clock to **contact spring 2.**



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

STEP 2

Now you just have to insert the two batteries into the battery compartment. Make sure that the + and - signs on the batteries match up with the signs in the compartment.

WHY? The clock runs because you have now replaced the lemonade battery with ordinary batteries. The ordinary batteries supply electricity to the clock just like the lemonade battery did.

Check It Out

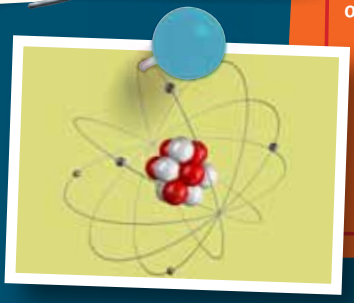
WHO INVENTED THE BATTERY?

The first working battery, a so-called **voltaic pile**, was built around 1800 by the Italian scientist **Alessandro Volta**. This highly significant invention in turn made it possible to conduct research into electricity.

THE MOST IMPORTANT PARTS OF YOUR BATTERY

The metal sheets immersed in the lemonade are the so-called **electrodes** of the lemonade battery. It is crucial that they are made of different materials. The electrodes in this kit are made of copper and zinc.

The lemonade is the battery's conductive liquid, also known as an **electrolyte**. It has to contain a little acid for the battery to work. Most soft drinks contain some citric acid.



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 farther, 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**.

TIP! The electrons react with the positive zinc particles in the conductive liquid. That gradually creates a layer of zinc on the copper electrode. 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 lemonade.**