

# ELECTROCHEM CLOCK

**WARNING** — Chemistry Set. This set contains chemicals and 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.

## Contents

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- > Digital clock
  - > 2 Copper sheets
  - > 2 Zinc sheets
  - > Cup for liquids
  - > Cup lid
  - > Assembly board with battery compartment
  - > 2 Contact springs
- You will also need:*
- > Lemonade or lemon soda
  - > Paper towels
  - > Various liquids
  - > 2 x AA Batteries (1.5-Volt, type AA / LR6 / Mignon)

## Dear Parents!

Before beginning the experiments, read through the instruction manual with your child and discuss the safety notes. Check that the lemonade clock has been properly assembled before use, and assist your child with the experiments. Have fun with the experiments!

## Safety Notes

**NOTE!** Not suitable for children under 3 years of age. There is a danger of choking due to small parts that may be swallowed or inhaled. Individual parts of this kit have sharp or pointed edges or corners. Do not injure yourself! Do not drink any of the liquids used for powering the lemonade clock.

**NOTE!** Only for use by children 8 years and older. Instructions are included for parents or other supervising individuals, and they must be followed.

Save the packaging and instructions, as they contain important information.

- > Two AA batteries (1.5-volt, type AA / LR6 / penlight) are required. They are not included in the kit due to their limited storage life.
- > Avoid short-circuiting the batteries. A short circuit can cause the wires to overheat and the batteries to explode.
- > 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.
- > Do not recharge non-rechargeable batteries. They could explode!
- > Rechargeable batteries should only be charged under adult supervision.
- > Rechargeable batteries are to be removed from the toy before being charged
- > Exhausted batteries must be removed from the toy.
- > 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.
- > The wires are not to be inserted into socket-outlets.

## Information about Environmental Protection



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.

## How to Assemble Your Clock

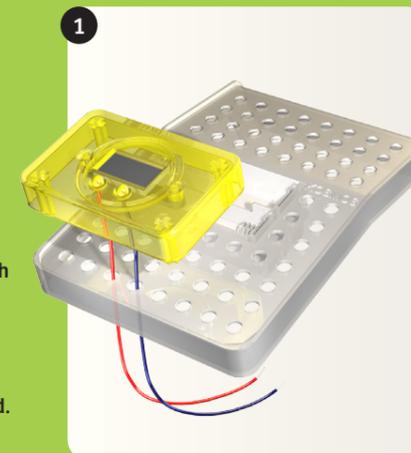
### YOU WILL NEED:

- > 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.



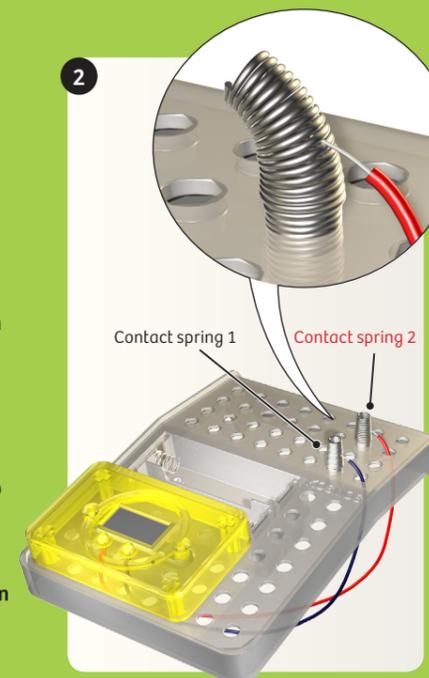
### STEP 2

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** into **contact spring 1** and the **red wire** into **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.

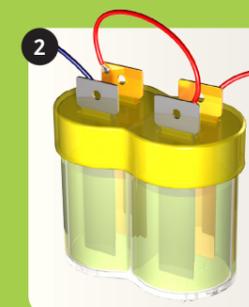
**WHY?** As soon as the **electrodes** are immersed into the liquid, they release positively-charged **metal ions** from the sheets due to the action of the acids in the lemonade, getting back negatively-charged electrons in return.

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!



## What Does the Display Show?

Under the display, you will see two buttons:

**A** and **B**.

Your clock has two display modes:

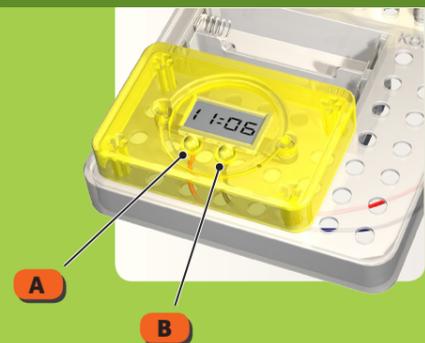
### Time Display

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.



## Does It Have to Be Lemonade?

### EXPERIMENT 2

#### YOU WILL NEED:

› Assembled board with digital clock, water, paper towel, various liquids (for example, diluted vinegar, cola, fruit juice)

1. Start by disconnecting the two metal sheet wires from the contact springs. Remove the metal sheets from the liquid cup and rinse them off. Take the cup off the assembly board and pour the lemonade down the drain. Rinse out the cup and clean the sink to avoid any stains.
2. Then fill the two chambers of the cup with some other liquid, up to about 1 cm beneath the rim.
3. Close the cup with the lid and insert the metal sheets through the slits as described in Experiment 1.
4. Re-mount the cup on the assembly board and clamp the wires into their proper contact springs.

Dry all the pieces with the paper towel.

2. Then fill the two chambers of the cup with some other liquid, up to about 1 cm beneath the rim.

Which liquids work to make your clock run? Write them down here!



## 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.

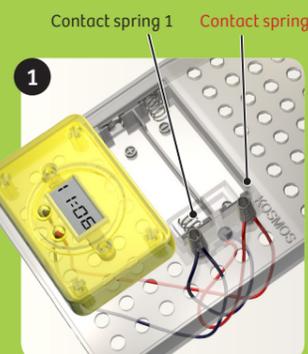
Connect the **black wire** from the battery compartment and the **black wire** from the digital clock to **contact spring 1** and the **red wire** from the battery compartment and the **red wire** from the digital clock to **contact spring 2**.

**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.

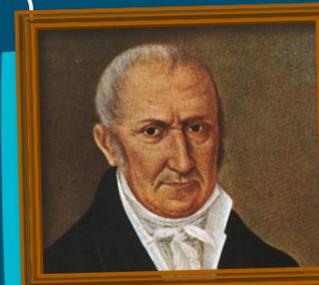
**WHY** The clock runs because you have now replaced the lemonade battery with ordinary batteries. The ordinary batteries supply electricity to the clock just like the lemonade battery did.



## 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.

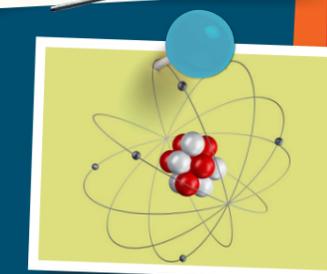
The lemonade is the battery's **conductive liquid**, also known as an **electrolyte**. It has to contain a little acid for the battery to work. Most soft drinks contain some citric acid.

### ? 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.

## How to Set Your Clock

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

Press **A** This takes you to the **month setting mode**.

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 to 1 (January) after 12 (December).

Press **A** This takes you to the **day setting mode**.

Then press **B** to get the correct day. The displayed number increases by 1 with every push, and switches back to 1 after 31.

Press **A** This takes you to the **hour setting mode**.

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.

Press **A** This takes you to the **minute setting mode**.

Press **B** again in order to set the minutes. The displayed number increases by 1 with every push, and switches back to 00 after 60.

Press **A** Now the correct time is shown on the display.