

**ZEPHYR**

*More Than Just Play*



**HIGH SPEED  
MOTOR**



**SAFE AND  
INTUITIVE**



**SUPER  
CAPACITOR**

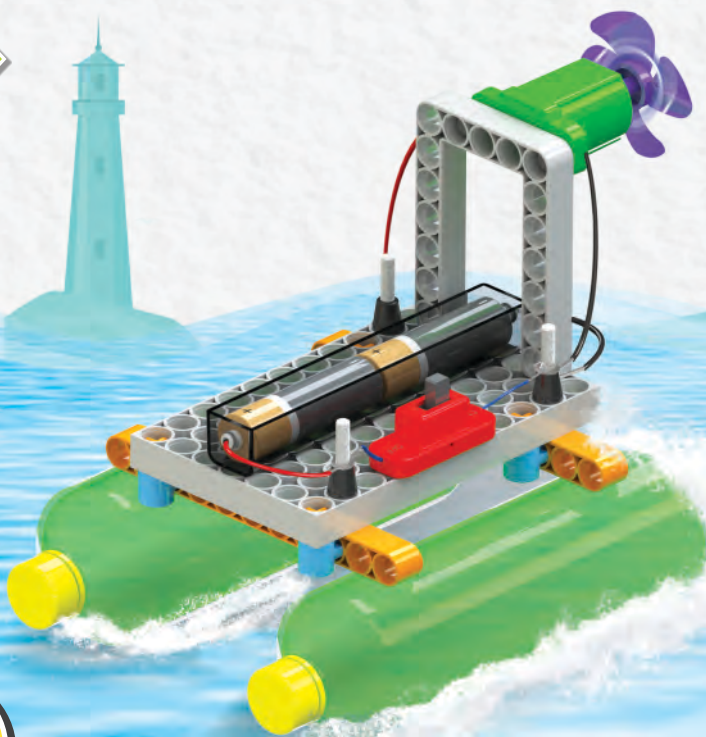


**EASY  
CONNECT**

**Blix**<sup>TM</sup>

**E - CIRCUITS**

**MOTION**



**AGE  
6-14**

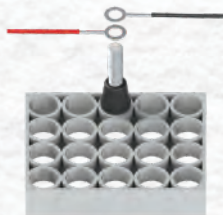
**10  
EXPERIMENTS**

**31  
COMPONENTS**

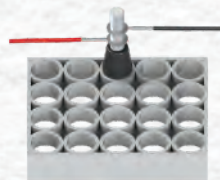
## How To Connect



Fix connecting tower  
on the baseboard



Slide loops of wires you  
want to connect



Connection  
completed!

## Useful Tips

- Most circuit problems are due to incorrect assembly, so always double check that your circuit exactly matches the diagram.
- Always connect the battery in the end, after you have connected all the other components properly and check all the connections before turning on a circuit. This ensures that no component is damaged if the circuit is accidentally connected in a wrong manner.
- Be sure that parts with positive/negative markings are positioned as per the drawing.
- Insert the batteries with correct polarity.
- Use only two, 1.5V AA type batteries.

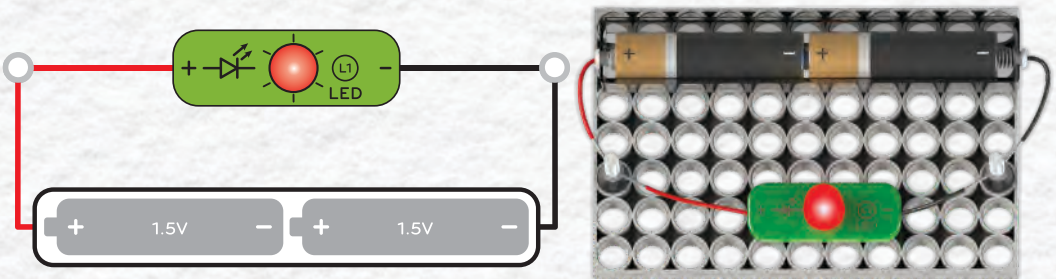
## WARNINGS!!!

- Never leave a circuit unattended while batteries are installed.
- Never connect additional batteries or any other power sources to your circuits.
- Do not short circuit the battery terminals.
- Do not touch the motor when it is spinning at high speed.



## Let's Make Our First Circuit!

- Attach the LED, Battery Box (WITHOUT batteries) & Connecting Towers to the Base Board.
- Connect the Red wire of the battery to the Red wire of the LED with the help of the Connecting Towers. Do the same for the Black wire.
- Double check with this image and connect EXACTLY as shown:



- Now insert the Batteries in the Box as indicated in the image. See the LED light up?
- Congratulations! You have just made your first circuit!

### Did not work?

- Don't worry, it is common in electronics for things not to work because of tiny errors. Just check if all the wires are firmly connected & are connected as per the directions above. Also make sure the batteries are new and are inserted correctly in the box. Your circuit should work now!

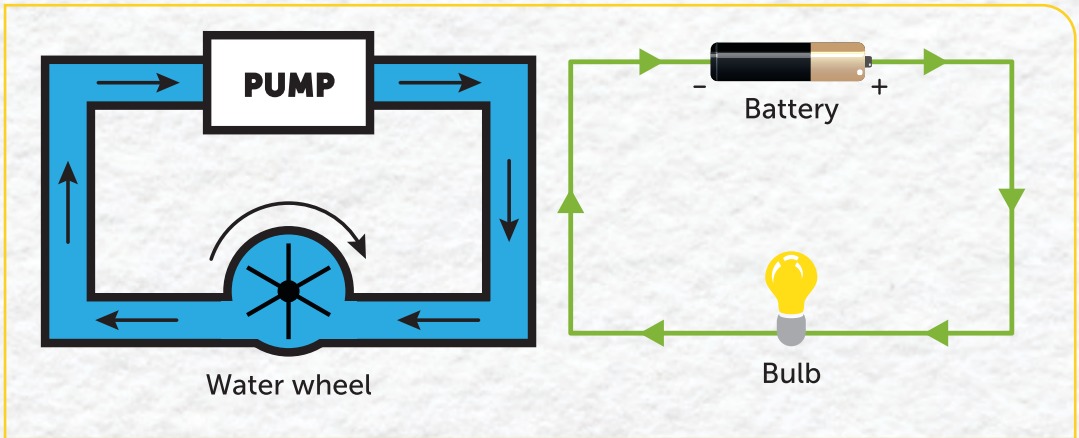
### Keep in mind!

- Remember all the steps that we followed here to make and check the circuit. These will be very helpful in making the other circuits in this book work quickly!
- Once you are confident and are able to make connections properly in the first go, you can connect the battery box with batteries from the start. But for the first few circuits, follow above steps to ensure no component gets damaged.

## What Is An Electric Circuit?

An electric circuit is like a path for electricity. A circuit is completed when two terminals ("+" & "-") of a battery are connected through a wire or any other conducting material. When this happens, the electricity starts flowing from "+" to "-" terminal of the battery.

You can think of the battery as a water pump and the wire like a water pipe. The battery pumps electricity into the wire from one terminal to the other.



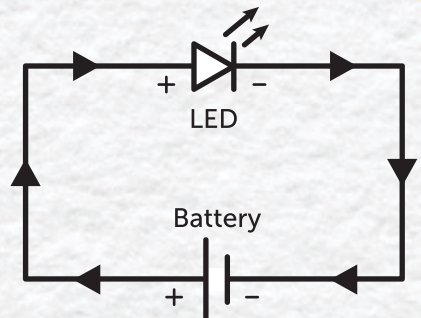
Thus battery is the "power source" that is required in every electric circuit. The components connected in the circuit make use of this power. For example a bulb glows by using power from the battery just in the same way as a water wheel will rotate by using the power of a water pump!

### Just remember this!

- If you want to check whether a circuit is complete or not, look for a continuous path from the '+' to the '-' terminal of a battery!

### Circuit Diagrams!

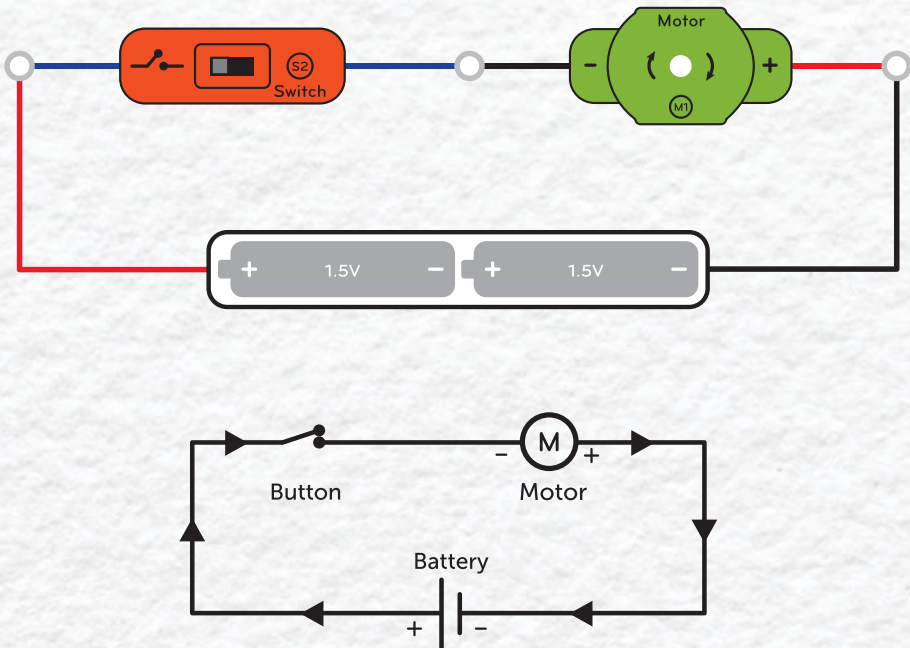
- Engineers use "Circuit Symbols" to represent circuits in a concise way. The diagrams made using these symbols are called "Circuit Diagrams".
- Can you identify the components from this diagram?
- Can you now relate the previous circuit to the water diagram and this circuit diagram?





## Motor In Reverse!

- Connect the Motor & Battery Box as shown here. Notice that the Motor is connected in an opposite way this time, with its black wire connected to battery's red wire and red wire connected to black!
- Then insert the batteries in the box.



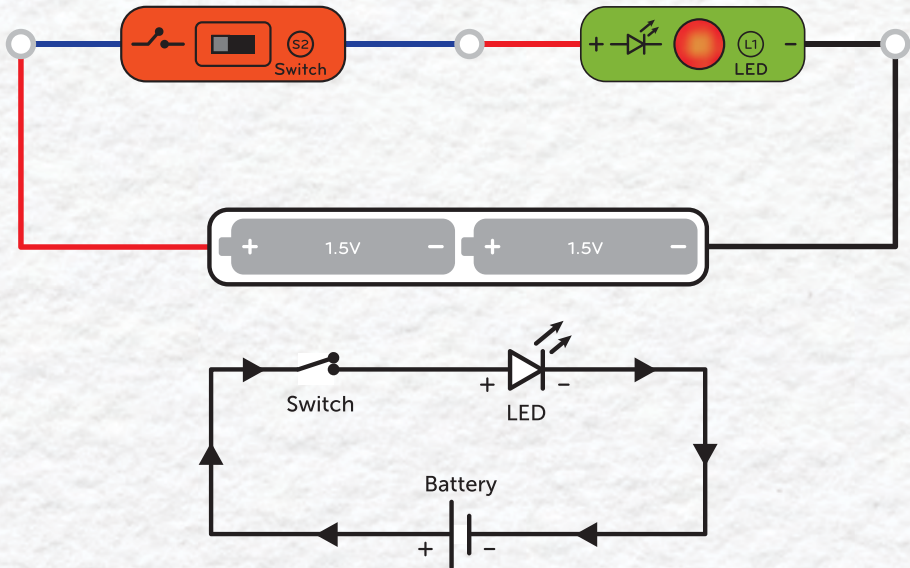
- The motor still works but now it spins Anti-Clockwise! That's because Motor is a "polar" component!

## Red, Black & Blue!

- The + & - signs on the components (denoted by red & black wires) are actually referred to as "Polarities". This means that the component is not uniform and will behave differently when connected in one way & differently in the other!
- So, when we connected the Motor in reverse, it spun Anti-Clockwise, because it is polar and the direction of spinning depends on the way it is connected! The components with blue wires are non-polar and can work in any direction!

## Light Switch

- Connect the Slide Switch & LED as shown. Set the Switch to OFF position.
- Then connect the battery.



- Now turn ON the switch to light up!
- Did you figure out how the connections worked here to complete the circuit? How did the Switch magically make & break the circuit?

## Open & closed circuits

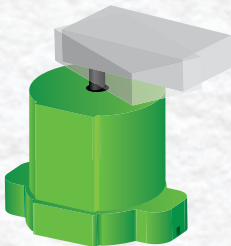
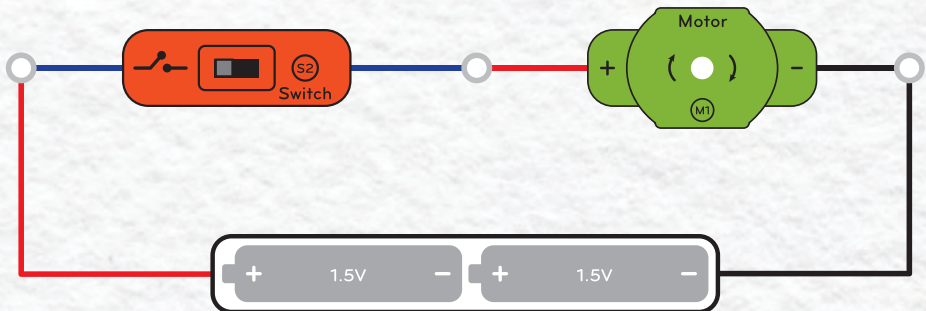
For a circuit to be complete there should be a continuous path for electricity from one battery terminal to the other. Even if one terminal is disconnected, the circuit will be incomplete and called an "Open Circuit". A completed circuit is called a "Closed Circuit".

A Switch helps you open & close circuits with ease by connecting & disconnecting the terminals. Think of it just like a water tap!



## The Vibrator

- Connect the Switch, Motor and Battery as shown.
- Mount an eraser on the motor shaft as shown.
- Now switch ON the motor.



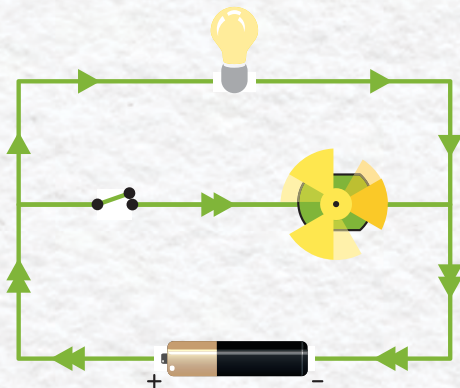
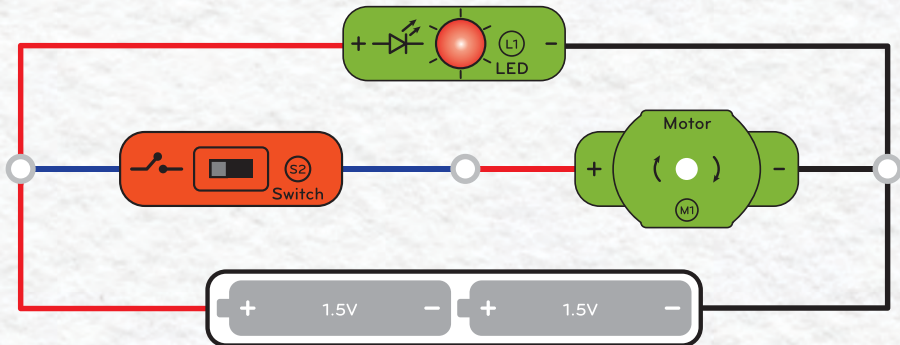
Mount the eraser on the motor shaft as shown  
It should be slightly off centered,  
with one side longer than the other

- Can you feel the vibrations?
- This is because we are applying an "Unbalanced Force" on the Motor shaft.
- When you put the eraser on the motor shaft, this increased the weight only on one side of the Motor which created this unstable force and vibration.
- That's why a fan has 3 same sized blades for stability where as the tiny phone vibrator motors use a weight only on one side of the shaft like we did, in order to produce vibrations!

## Big Bully The Small!

Blix

- Connect the LED, Switch, Motor and Battery as shown.
- Now turn the Switch ON.



As the motor draws more current on starting up, the LED connected in parallel gets less current

- Did you notice that the LED got dimmed for a while when you switched the Motor ON?
- This happened because the Motor needs lot of electricity to start. So when it tries to draw this large amount of electricity from the Battery, the LED gets less amount of electricity and goes dim!
- You would have seen the exact same thing happen in your home when you turn on a heavy appliance such as washing machine, fridge, AC, oven etc.



## Aero-boat!

### Step - 1



CT2  
4 pcs.



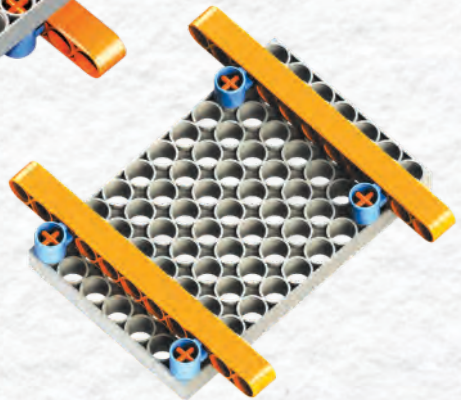
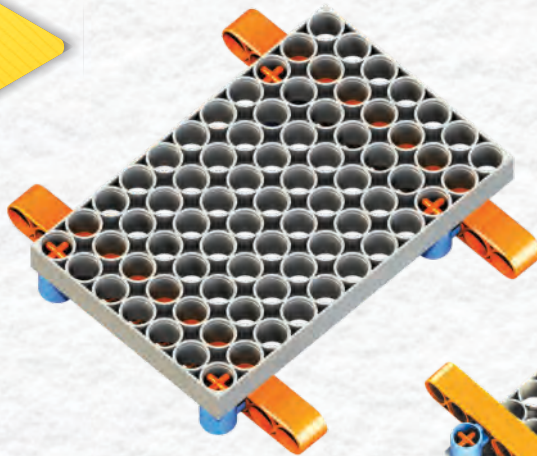
CH2  
4 pcs.



P11  
2 pcs.



P7 X 11  
1 pc.



Backside View

### Step - 2



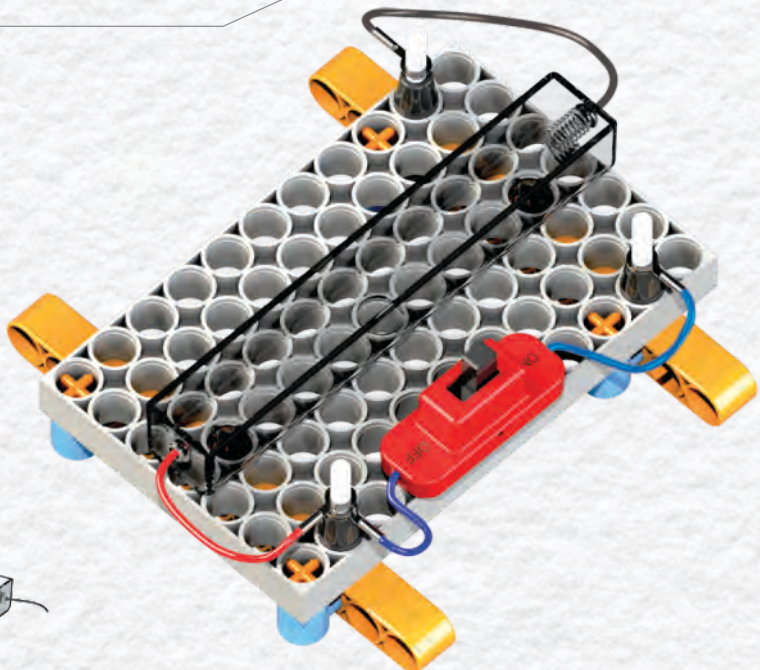
Slide Switch  
1 pc.



Connecting  
Tower 3 pcs.



Battery Box  
1 pc.





## Step - 3



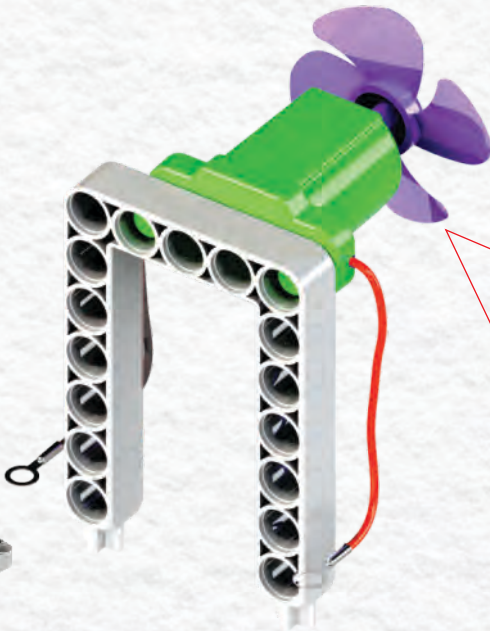
Fan Blade  
1 pc.



Motor  
1 pc.

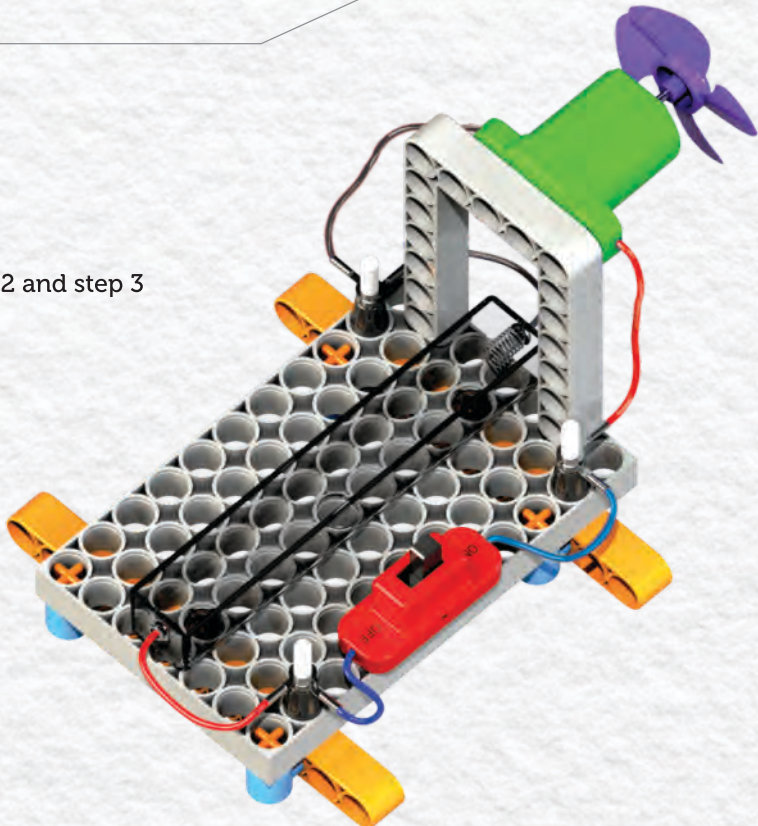


PU5 X 7  
1 pc.



## Step - 4

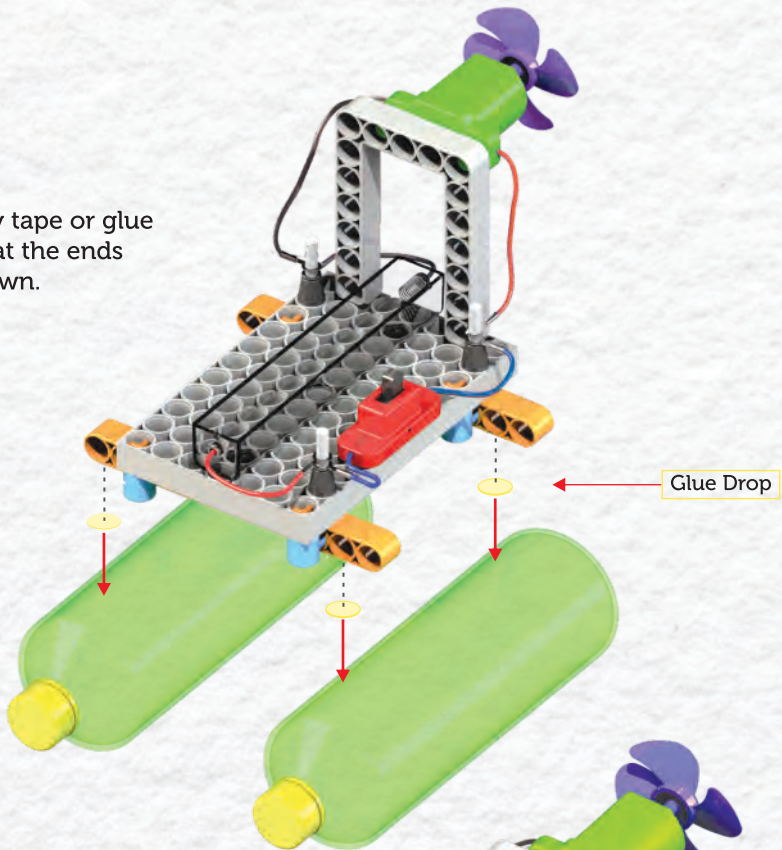
Assembly of step 2 and step 3





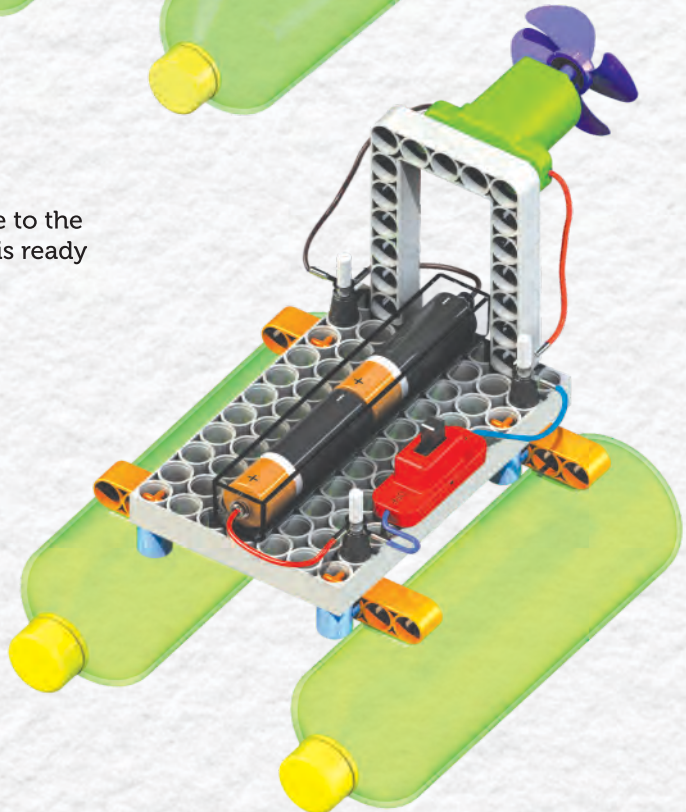
## Step - 5

- Affix two way tape or glue drop sticker at the ends of P11 as shown.



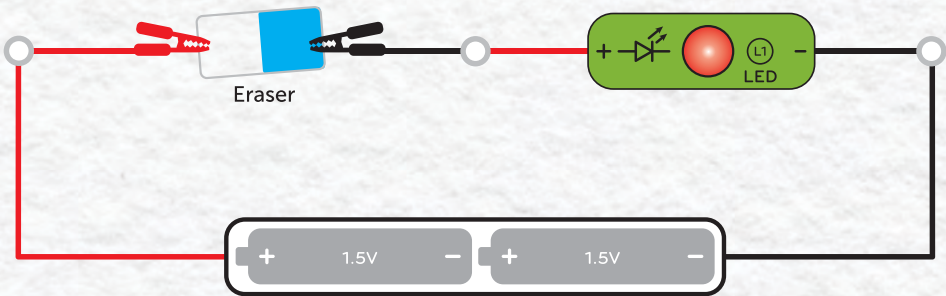
## Step - 6

- Stick two empty bottle to the model and your boat is ready to sail in water.

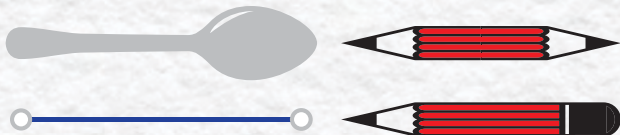


## Conductor Tester

- Connect the Clip Wire and LED as shown.
- Then connect the battery.
- Try connecting different things like spoons, erasers, pencils, pencil sharpened from both ends, wire, wire's outer covering etc. between the 2 clips.



Also try connecting these objects between the clips



- What did you observe? Did the LED glow for all the materials?

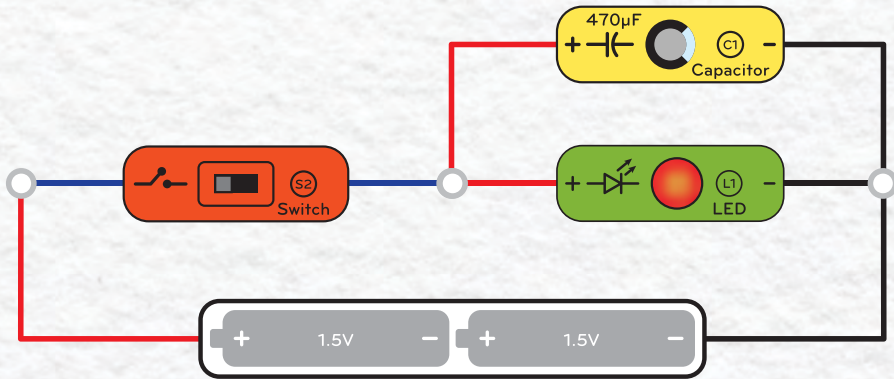
## Conductors & Insulators

- Conductors are materials that allow electricity to pass easily whereas Insulators don't. So, when you connected a conductor between the clips, the circuit got completed but for an insulator it remained open and so, the LED didn't glow!
- In general, metals like iron, copper, gold etc. are conductors where as non-metals like wood, rubber, plastic etc. are insulators.



## On & Faaaaaaaade!

- Connect the Switch, Capacitor, LED & Battery as shown.
- Mind the polarity of the Capacitor and connect EXACTLY as shown!



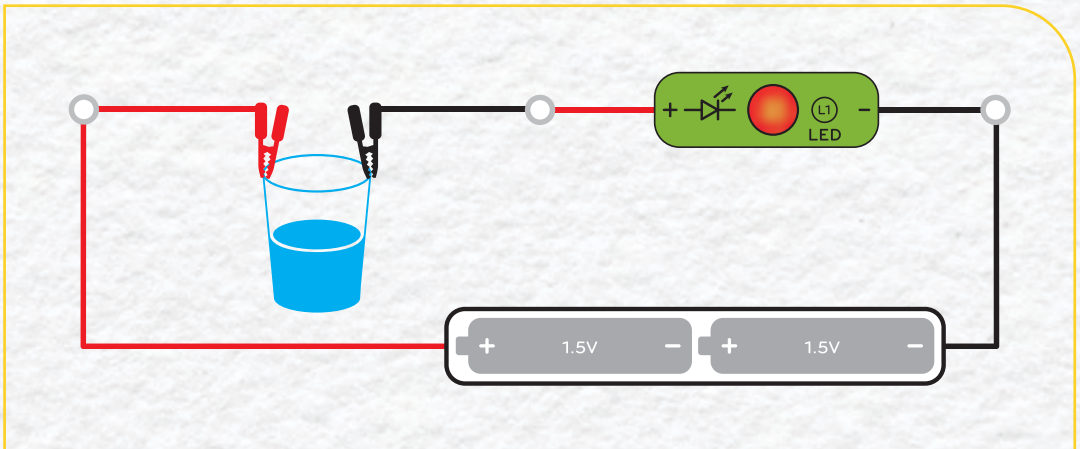
- Now turn ON the Switch for some time and then turn it OFF.
- Did you see something cool? The lights didn't go off instantly but instead they slowly faded! All thanks to the Capacitor for this!

## Capacitor

- Capacitors are very fundamental electronic components like Resistors. They are like small & temporary electric storage tanks which store electricity inside them for some time and give it back to the circuit when electricity is cut-off.
- So, when the Switch was ON the, not only did the LED glow but the Capacitor also got charged and when it went OFF, the capacitor discharged slowly and provided electricity to the LED for some time!
- You would have seen such fading LEDs many times when you turn off your TV, mobile charger, LED lights etc. You guessed it right. This is because the mighty Capacitor is used in all of these circuits!

## Water Overflow Indicator

- Connect the Clip Wire and LED as shown.
- Use a dark room for this experiment.
- Now connect the clips to a NON-METALLIC glass as shown.
- Slowly start pouring TAP WATER into the glass.
- As soon as water reaches the top, the LED will glow, alerting that the glass is full!



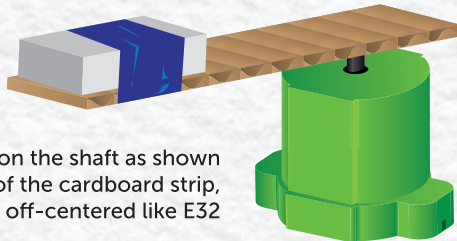
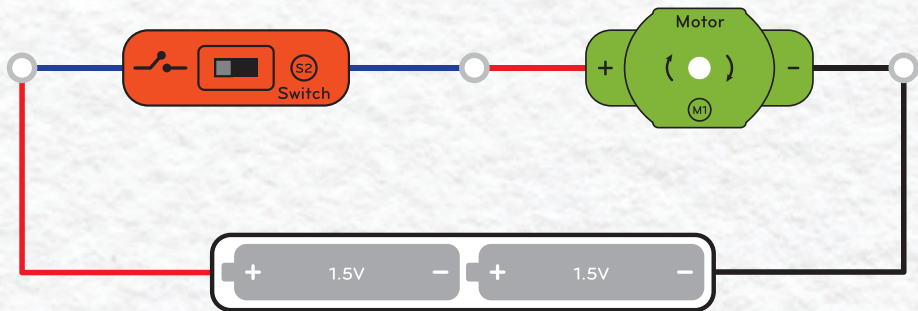
Can you tell why this happens? Well, because tap water generally contains minerals which make it a fairly decent conductor of electricity! When the water reached the top, it touched both the clips and completed the circuit! Thus we made use of the simple concept of conductors & open-close circuits to make such an important circuit. Saving water is now easy!

This is also why you should not touch electric appliances or switches with wet hands, else you can get a shock!



## Super Vibrator

- Connect the Switch, Motor and Battery as shown.
- Take a cardboard strip and tape an eraser on to it as shown.
- Mount it on the Motor & Switch ON.



Mount the eraser and cardboard on the shaft as shown  
The eraser should be at the end of the cardboard strip,  
and the strip should be off-centered like E32

- Do you feel more extreme vibrations than before!
- This is because, using this arrangement of the strip & eraser, we have increased the "Torque"!

## What is Torque?

Torque is a kind of rotational force that causes an object to rotate about an axis.

The longer the distance from the centre of a rotating shaft, more will be the torque. Have you felt that pulling a door from the handle is easier compared to pulling it from near the hinge?

Here we have increased the torque on the motor by increasing the distance of the eraser from the Motor shaft by using a long cardboard strip!



**E - CIRCUITS**  
**MOTION**



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