SNAP CIRCUITS

GREEN ENERGY LAB

BUILD 44 PROJECTS

Discover *Green Energy*

Build *A Wind Turbine*

Produce *Solar Power*

Simply Snap together

44 TOTAL PROJECTS

FULL ONLINE MANUAL

Snap Circuits® *uses building blocks with snaps to assemble real electronic circuits. Each block has a function: switch, light, battery, different length wire blocks, and more! With easy-to-follow project manual,* ***simply snap together to create working circuits!***

Table of Content

What is electricity? *Everything in the world around us is made of particles called protons, neutrons and electrons. These three tiny particles are found in everything around us. When the electrons move, they create electricity.*

For Additional Projects:

Go to:
www.elenco.com/scgrneng-manuals/
to download projects 19 - 44

Download projects 19-44, more information about your parts and how circuits work, and our Think Green – Learn About Energy book.

Important Safety Notes for Parents and Kids

- **Adult Supervision:** Because children's abilities vary so much, even with age groups, adults should exercise discretion as to which experiments are suitable and safe. Make sure your child reads and follows all of the relevant instructions and safety procedures, and keeps them at hand for reference.
- This product is intended for use by adults and children who have attained sufficient maturity to read and follow directions and warnings.
- Save the packaging and instructions. They contain important information.
- ⚠**Warning: Choking Hazard**- Small parts. Not for children under 3 years of age.
- ⚠**Warning:** This product produces flashes that may trigger epilepsy in sensitized individuals.
- ⚠**Warning: Shock Hazard** - Never connect Snap Circuits® to the electrical outlets in your home in any way!
- ⚠**Warning:** Always check your wiring before turning on a circuit. Never leave a circuit unattended while the batteries are installed. Never connect additional batteries or any other power sources to your circuits.
- Never modify your parts, as doing so may disable important safety features in them, and could put your child at risk of injury
- Save the packaging and instructions. They contain important information.

Helpful Symbols:

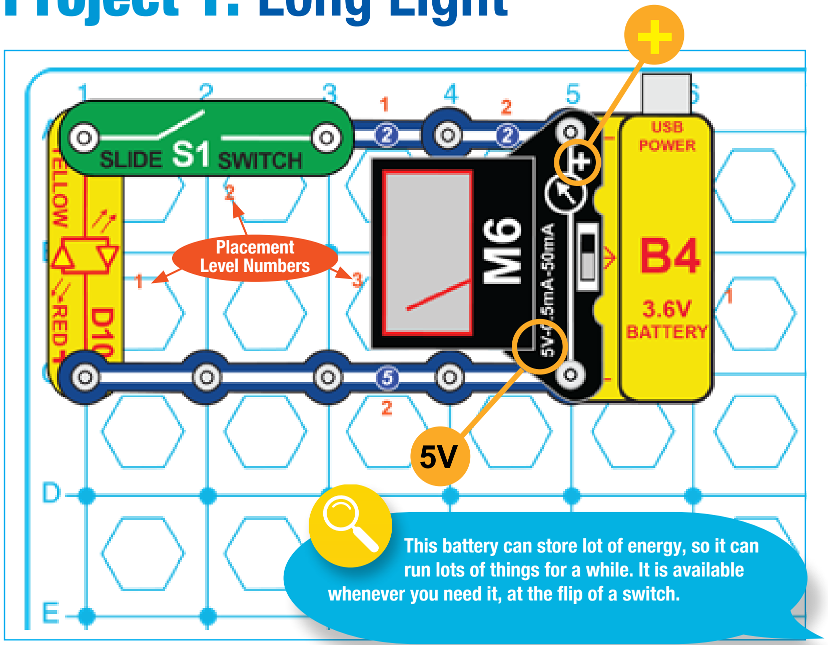
Look for these symbols throughout the manual.

GENERAL INFORMATION
·Definitions
·"How it works?"

SNAP CIRCUITS
Technical information using your parts.

ADULT ASSISTANCE REQUIRED
Get an adult to help with your build

Project 1: Long Light



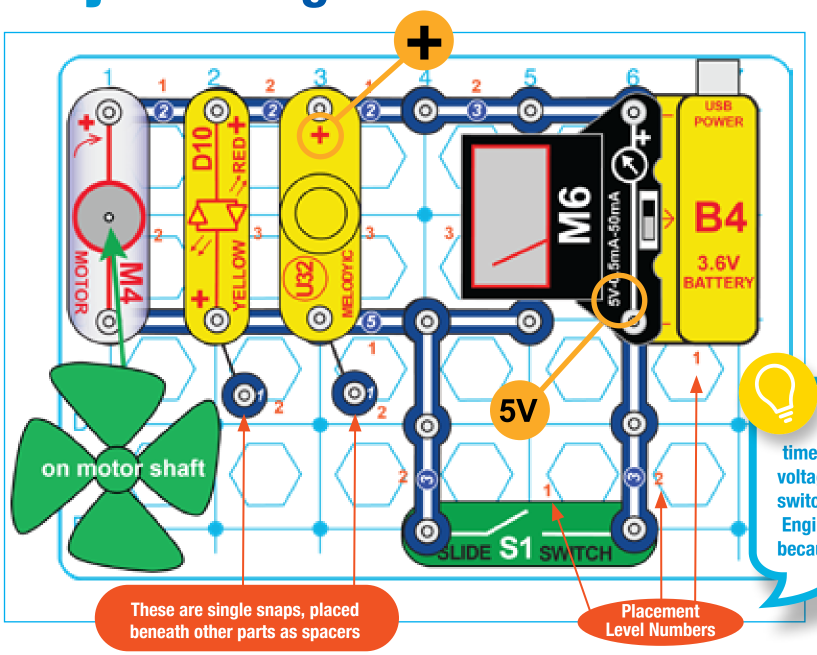
•Build the circuit shown by placing all the parts with a black 1 next to them on the clear plastic base grid first. Then, place parts marked with a 2. Then place the part marked with a 3. Set the **Meter (M6)** to the 5V setting and turn on the **Slide switch (S1)**. The red/yellow **LED (D10)** lights, and the meter measures the battery (B4) voltage.

•Watch the voltage on the meter for a while as the battery runs the red/yellow **LED (D10)**. How quickly does the voltage drop?

•If your battery was recently recharged then you probably found the voltage drops very, very slowly, and thought this was boring. That was the idea - batteries can run things for a long time and (unlike solar or wind power sources) are hardly affected by changing weather conditions. Batteries can provide power whenever you need it - but, eventually, they do run out.

See project 3 if you need to recharge the battery (B4).

Project 2: Lights



•Build the circuit and set the **Meter (M6)** to the 5V setting. Turn off the **Slide Switch (S1)** and read the **Battery (B4)** voltage when it is not running anything.

•Now turn on the slide switch and see what happens to the voltage when everything turns on. If the battery is already weak, some modules may not work. If you watch the voltage for a while, you will see it slowly drop as the battery is discharged. If the battery was already weak, the voltage will drop faster.

•If you remove some of the devices the battery is running (the melody IC, motor, and LED), then the voltage will not drop as much when the switch is turned on. See which device has the biggest effect.

The battery makes electricity using a chemical reaction, but has a limited amount of chemicals and not all of it can react at the same time. When a battery cannot supply as much current as a circuit needs, the voltage (electrical pressure) drops. That is why the voltage drops when the switch connects the battery to the rest of this circuit.
Engineers refer to all the devices a power source is running as the load, because they are the burden the power source is carrying.

See project 3 if you need to recharge the battery (B4).

GREEN ENERGY LAB

Model SC-GMPLY

PARTS LIST

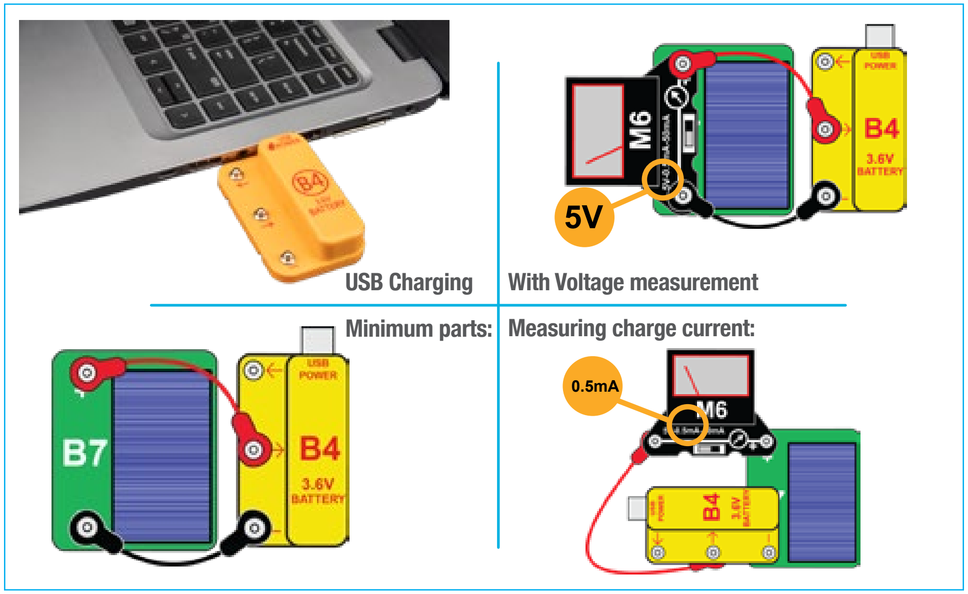
QTY.	ID	NAME	Part #
❐ 1		Base Grid	6SCBGMGR
❐ 2	1	1-snap wire	6SC01
❐ 3	2	2-snap wire	6SC02
❐ 3	3	3-snap wire	6SC03
❐ 1	5	5-snap wire	6SC05
❐ 1	B4	Rechargeable Battery	6SCB4
❐ 1	B7	Solar Cell	6SCB7
❐ 1	D10	Red/Yellow LED	6SCD10
❐ 1		Jumper Wire Black 8”	6SCJ1
❐ 1		Jumper Wire Red 8”	SCCJ2
❐ 1	M4	Motor	6SCM4
❐ 1		Wind Fan	6SCSM4B
❐ 1		Water Wheel	6SCM4C
❐ 1	M6	Meter	6SCM6
❐ 1	S1	Slide Switch	6SCS1
❐ 1	U32	Melody IC	6SCU32

IMPORTANT:
If any parts are missing or damaged,
DO NOT RETURN TO RETAILER.

e-mail us at:
support@elenco.com

You may order additional/ replacement parts:
elenco.com/replacement-parts

Project 3: Best Charging Circuits



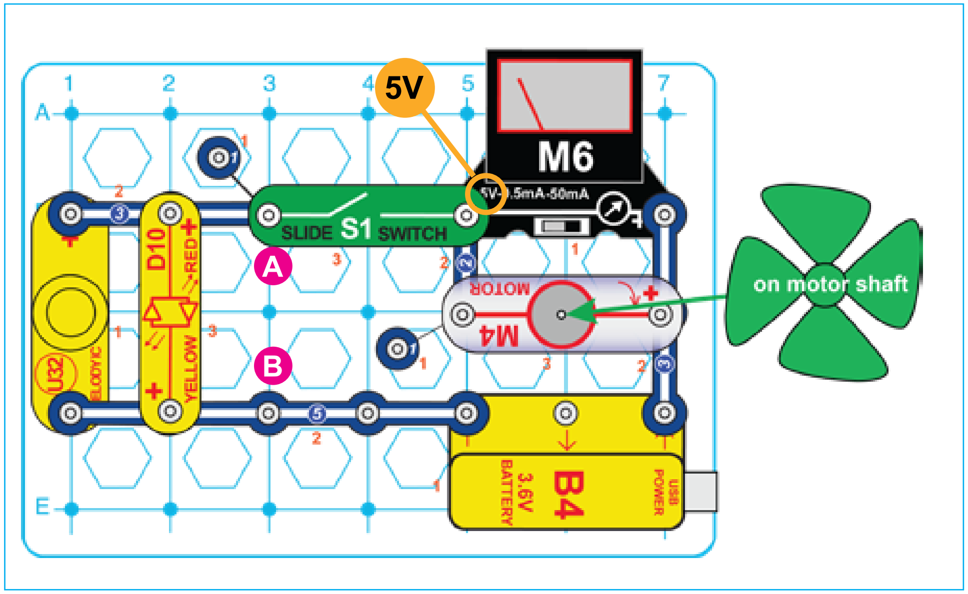
•Your **Rechargeable Battery (B4)** will need to be recharged often; it can be charged with a USB connection or with solar light using any of these circuits. The USB POWER light on B4 comes on when it is charging through the USB.

•For solar charging, place the solar cell in sunlight or about 12 inches from an incandescent light bulb of 60W or more. It takes a few hours to charge the battery. LED, CFL, and fluorescent lights do not work well with solar cells. When measuring charge current, the current will often be too high to measure on the 0.5mA setting but too low to measure on the 50mA setting (you can use either). The current will get lower as the battery approaches full charge.

You can't hurt the battery by overcharging.

Although the battery is rated as 3.6V, it may charge to as high as 4.0V. If you are monitoring the voltage using the meter, you may see the voltage quickly reach 3.6V, but this does not mean that the battery is fully charged. When the battery is discharging to power something, the voltage is nearly steady for a long while then drops off quickly. The same thing occurs when it is charging. Recharging the battery will quickly reach around 3.6V but it needs much more charging to avoid a quick drop-off when discharging. Recharge the battery for several hours.

Project 4: Moving Voltage

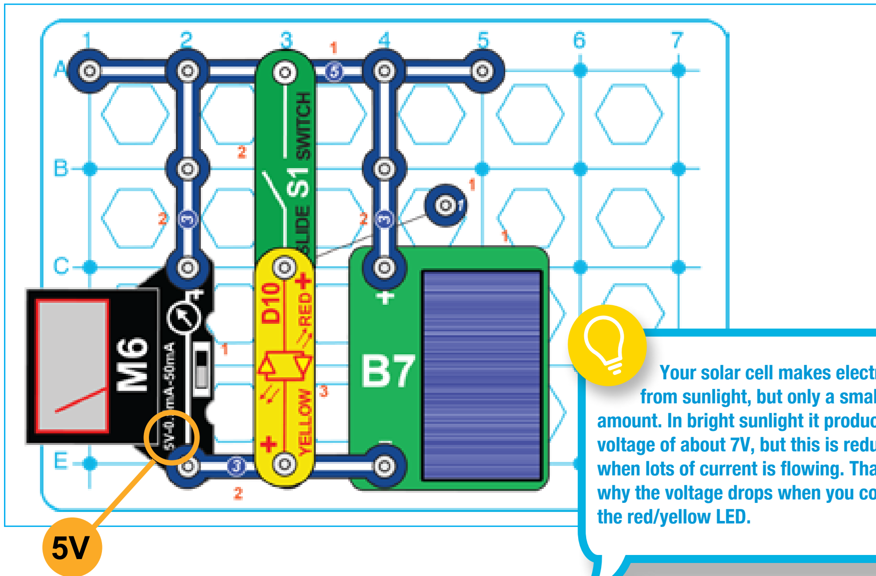


•Build the circuit and set the **Meter (M6)** to the 5V setting. Place the wind fan on the **Motor (M4)**. Turn on the **Switch (S1)**. The **LED (D10)** lights, the **Melody IC (U32)** makes a distorted sound, the fan spins, and the meter shows the voltage across the motor. You may need to give the fan a push to get it started. The voltage produced by the battery is split between the motor and the LEDs and melody IC.

•Connect the red jumper wire across points labeled A & B. The LED and melody IC turn off, the motor speeds up, and the meter shows a higher voltage across the motor. With the jumper wire connected, the full voltage from the battery is available at the motor because the LEDs and **Melody IC** are bypassed.

See project 3 if you need to recharge the battery (B4).

Project 5: Solar Power



Your solar cell makes electricity from sunlight, but only a small amount. In bright sunlight it produces a voltage of about 7V, but this is reduced when lots of current is flowing. That is why the voltage drops when you connect the red/yellow LED.

•Place all the parts with a black 1 next to them on the green plastic base grid first, then parts marked with a 2, then the part marked with a 3. The red/yellow **LED (D10)** may be connected in either direction.

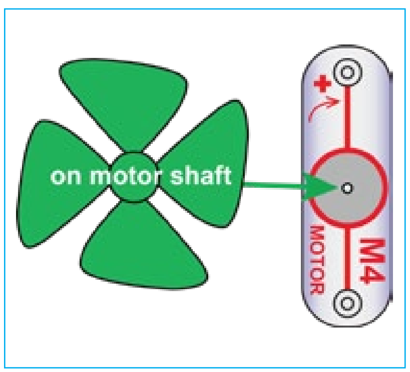
•Place the circuit so the solar cell is in bright sunlight or close to an incandescent light bulb. Set the **Meter (M6)** to the 5V setting.

•The meter is measuring the voltage produced by the solar cell. Adjust the position of the solar cell to see how the voltage produced changes depending on the angle to the light source and the brightness.

•Position the solar cell to make the highest voltage you can. Now turn on the slide switch to run the red/yellow LED with the solar cell. Notice how the voltage produced drops when the LED is connected.

•Compare the voltage and LED brightness when using different light sources (sunlight, incandescent bulbs, LED bulbs, fluorescent bulbs) to see which work best with solar cells.

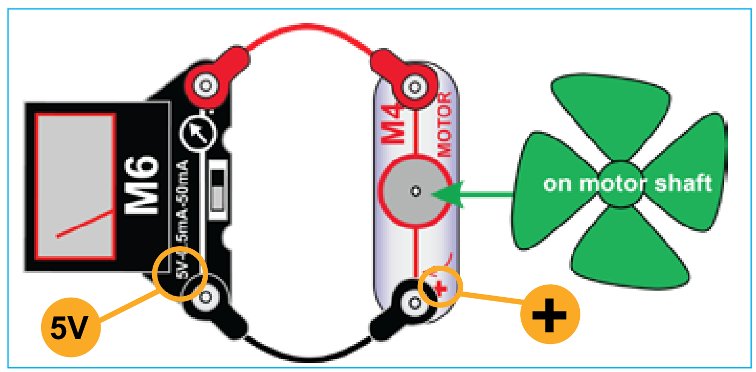
Project 6: Solar Motor



In the preceding circuit, replace the **Red/Yellow LED (D10)** with the **Motor (M4)**, in either direction) and place the wind fan on it. Now turn on the switch and watch how the voltage changes as the solar cell runs the fan. Depending on your light source, the fan may need a push to get started or may not work at all.

The motor needs less electricity from the solar cell as it speeds up, so the solar cell voltage is higher as the motor gets faster.

Project 7: Windmill

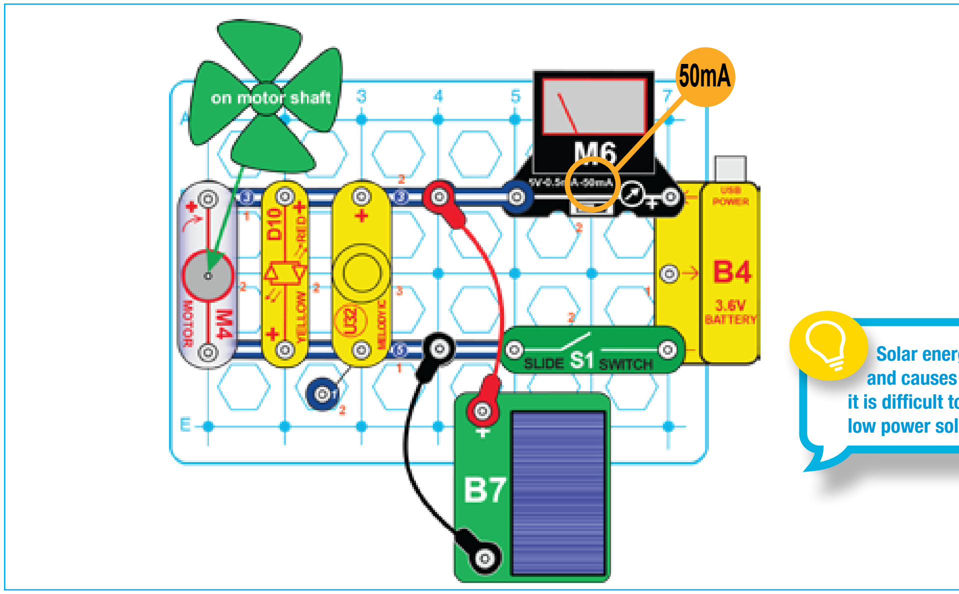


•Mount the **Wind Fan** on the **Motor (M4)** and connect it to the **Meter (M6)** using the red and black jumper wires. Set the meter to the 5V setting.

•Blow on the fan or place it in a strong wind (either outside or near an electric fan). You may need to give the fan a push to get it started. The meter measures how much voltage your “windmill” produces. See how the voltage produced changes with the angle to the wind.

The windmill uses magnetism to change the mechanical energy of the spinning shaft into electricity. The voltage it produces is usually lower than the solar cell, but the current is higher.

Project 8: Solar & Battery



•Build the circuit, set the **Meter (M6)** to the 50mA setting, and turn on the slide **Switch (S1)**. The **Motor (M4)** and fan spin, the **Red/Yellow LED (D10)** lights, the **Melody IC (U32)** plays a tune, and the meter measures the current from the **Battery (B4)**.

•Place the **Solar Cell (B7)**, which is connected using the **Red & Black jumper wires** in direct sunlight or a few inches from an incandescent light bulb. If the sunlight on the solar cell is very bright then the solar cell helps to power the **Motor, LED, and Melody IC**, and the meter shows lower current because less current is being drawn from the battery. Cover the solar cell with your hand and see how much the current measured on the meter changes.

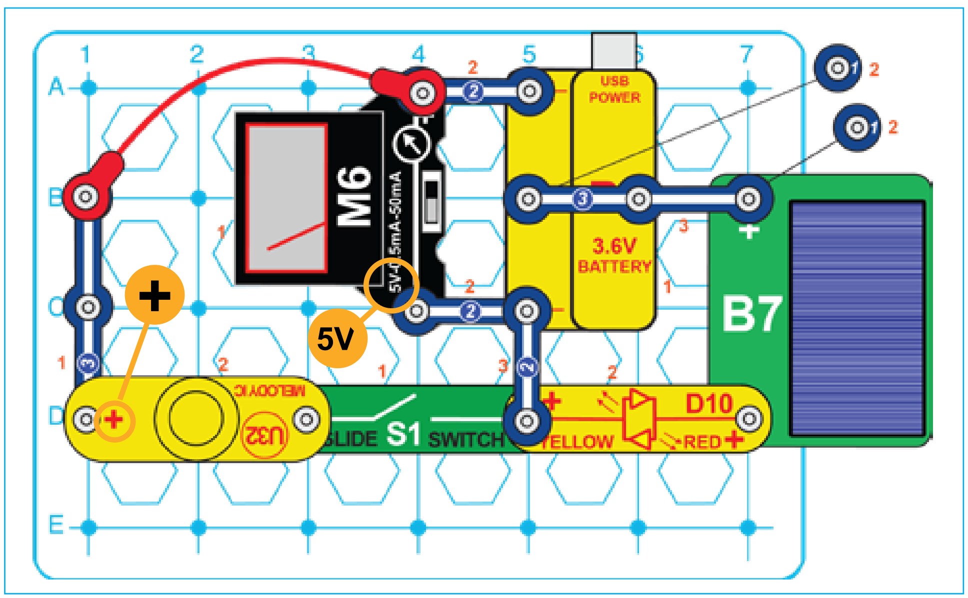
Solar energy is free, abundant and causes no pollution. However it is difficult to harvest because even low power solar cells are expensive.

Part B: You can make the battery last longer if you turn off some things. Remove the **Melody IC, LED, or Motor** from the circuit, and see how much the current drops. Then remove another. Some devices use more current than others, so it helps most if you disconnect the highest current device - find out which one it is.

See project 3 if you need to recharge the battery (B4).

Reducing how much energy we use is just as important as finding new sources of clean energy.

Project 9: Charge & Play



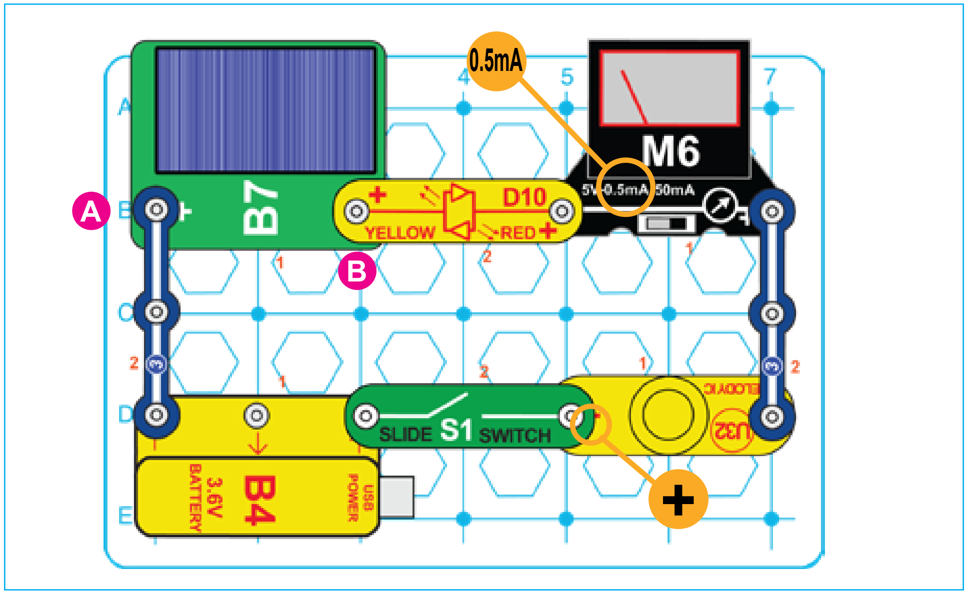
•Build the circuit shown here, set the **Meter (M6)** to the 5V setting, and leave the **Slide Switch (S1)** off. The meter will measure about 3.6V if the **Battery (B4)** is charged up.

•Place the **Solar Cell (B7)** in sunlight or a few inches from an incandescent light bulb to charge the battery. The **Red/Yellow LED (D10)** lights if the battery is being charged.

•Turn on the switch to play music on the **Melody IC (U32)**. The voltage measured may drop a little as the **Melody IC** slowly drains the battery.

See project 3 if you need to recharge the battery (B4).

Project 10: Voltage Adder



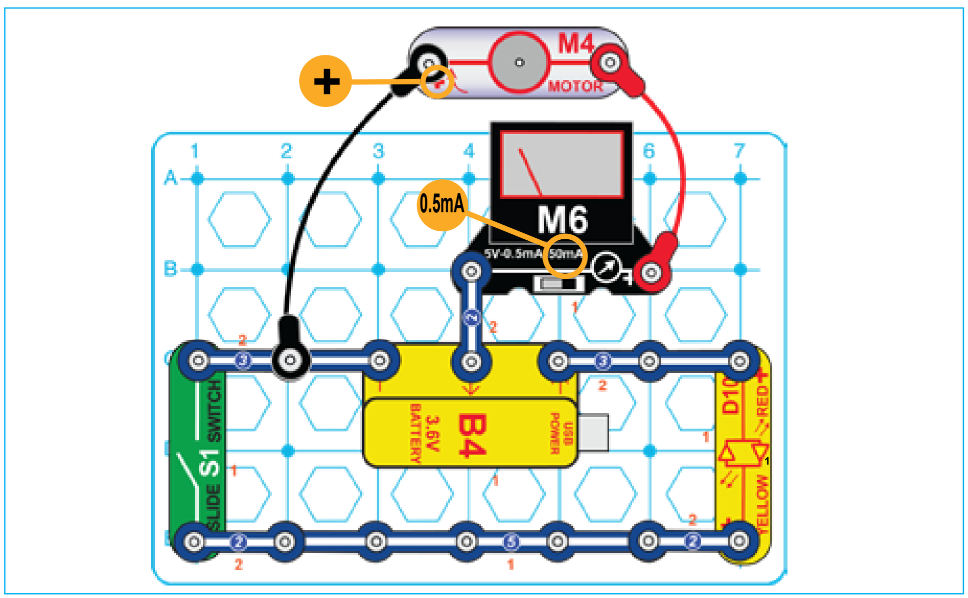
•Set the **meter (M6)** to the 0.5mA or 50mA setting and turn on the **Switch (S1)**. Place the **Solar Cell (B7)** in bright sunlight or near an incandescent lamp. If the light is bright enough, the **Red/Yellow LED (D10)** will be bright and the **Melody IC (U32)** will play a tune. If the current is too high to measure then change the meter to the 50mA scale.

•Now place a 3-snap wire across points A & B, to bypass the solar cell. Now the LED is dimmer and the melody IC makes no sound or very distorted sound,

When the solar cell is in the circuit its voltage combines with the battery voltage to make both the LED and melody IC work.

See project 3 if you need to recharge the battery (B4).

Project 11: Wind Charger with Light



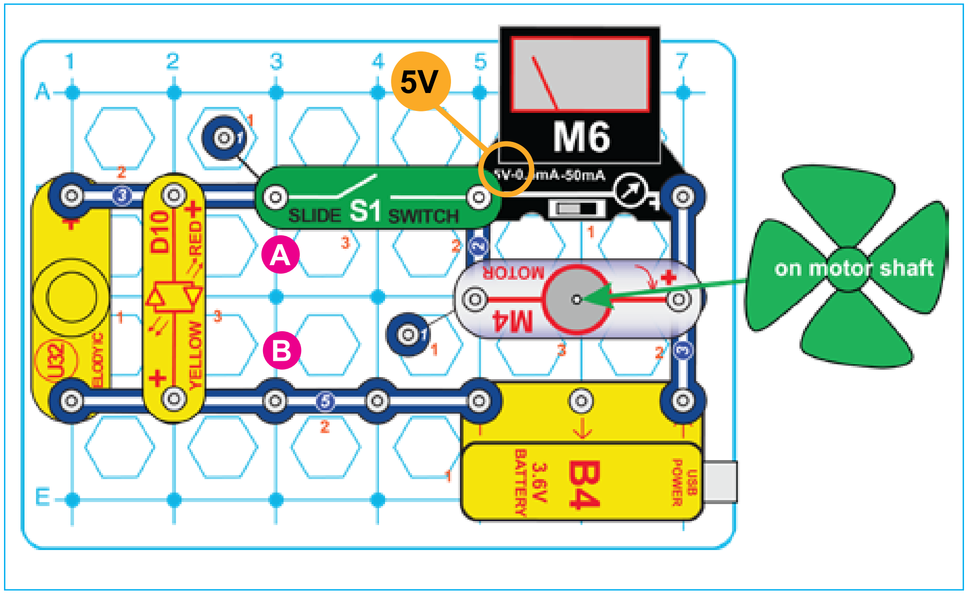
•Build the circuit shown. Set the **Meter (M6)** to the 0.5mA setting. Blow hard on the fan or place it in a very strong wind (either outside or near an electric fan). The “windmill” charges the **Battery (B4)** when the wind is blowing hard, and the meter measures the charging current. Turn on the **Switch (S1)** to turn on the **LED (D10)**.

•Part B: Replace the **Red/Yellow LED (D10)** with the **Melody IC** (U32, “+” on top). The circuit works the same except turning on the switch makes sound. Here the **Melody IC** is run using wind power, by using the battery for storage.

A problem with using wind to power a light is that the wind isn’t always blowing when you need the light on. On the other hand, the wind is often blowing when you don’t need the light on. So here you use the battery to store energy from the windmill when the wind is blowing, and then run the LED when you need the light on. This way light is always available from clean, free wind power.

See project 3 if you need to recharge the battery (B4).

Project 12: Moving Voltage

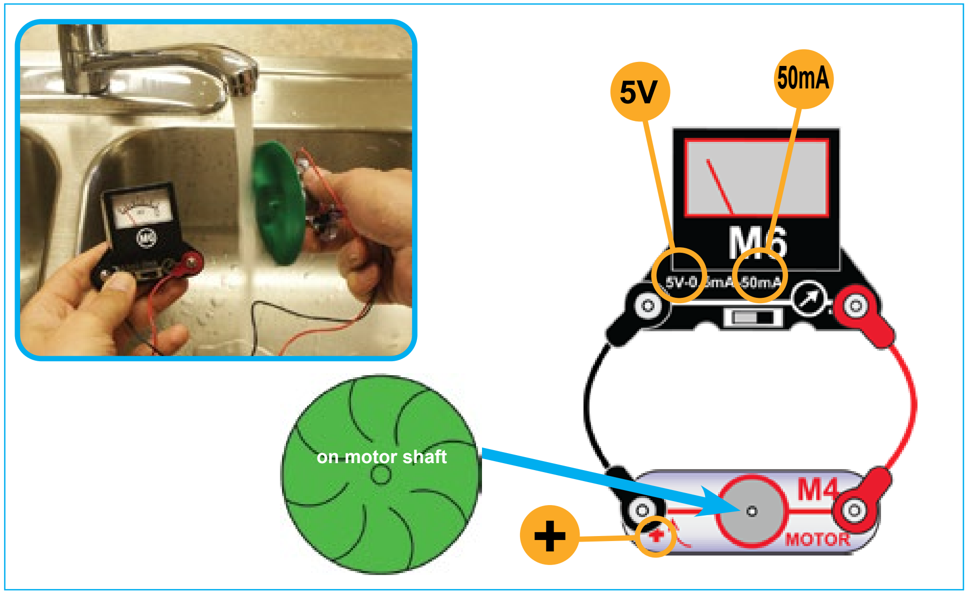


•Build the circuit and set the **Meter (M6)** to the 5V setting. Place the wind fan on the **Motor (M4)**. Turn on the **Switch (S1)**. The **LED (D10)** lights, the **Melody IC (U32)** makes a distorted sound, the fan spins, and the meter shows the voltage across the motor. You may need to give the fan a push to get it started. The voltage produced by the battery is split between the motor and the **LEDs and Melody IC**.

•Connect the **Red Jumper Wire** across points labeled A & B. The **LED** and **Melody IC** turn off, the motor speeds up, and the meter shows a higher voltage across the motor. With the jumper wire connected, the full voltage from the battery is available at the motor because the LEDs and melody IC are bypassed.

See project 3 if you need to recharge the battery (B4).

Project 13: Changing Water Pressure to Electrical Pressure



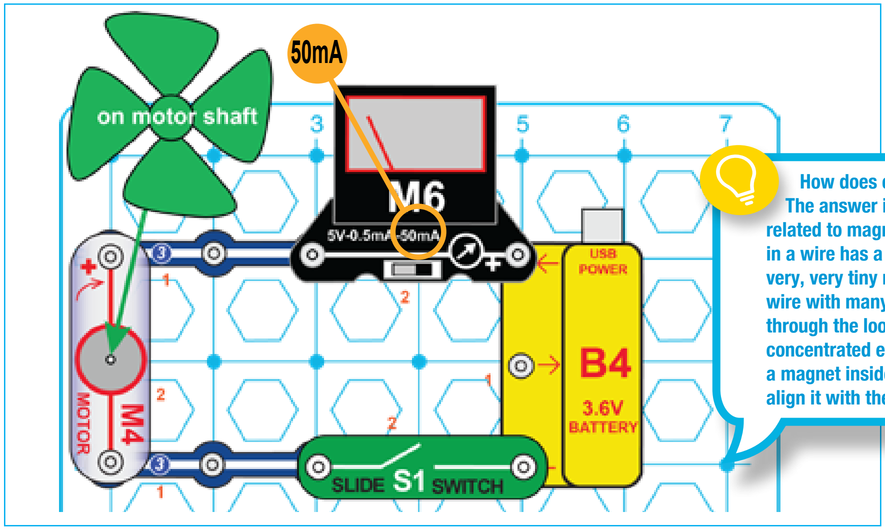
•Place the water wheel on the **Motor (M4)** and connect it to the **Meter (M6)**, as shown. Set the meter to the 5V or 50mA setting. Hold the motor under a water faucet so the water wheel will “catch” the water as it falls. See how much voltage and current you can produce.

•Using the water pressure from your faucet to make electricity using the motor (used as a generator here) is just like using water pressure from a lake to run an electric generator in a dam.

•Your parts might stop working if water gets inside them. Let them dry out and they should be fine.

Hoover Dam has a lake that is 500 feet deep on one side to provide great pressure to turn the generators that make our electricity.

Project 14: Motor



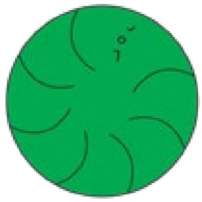
•Build the circuit shown. Set the **Meter (M6)** to the 50mA setting and place the wind fan on the **Motor (M4)**. Turn on the **slide switch (S1)** and watch the current on the meter as the motor speeds up.

•Do you know why the current drops as the fan speeds up?

How does electricity turn the shaft in the motor? The answer is magnetism. Electricity is closely related to magnetism and an electric current flowing in a wire has a magnetic field similar to that of a very, very tiny magnet. Inside the motor is a coil of wire with many loops. If a large electric current flows through the loops, the magnetic effects become concentrated enough to move the coil. The motor has a magnet inside, so as the electricity moves the coil to align it with the permanent magnet, the shaft spins.

See project 3 if you need to recharge the battery (B4).

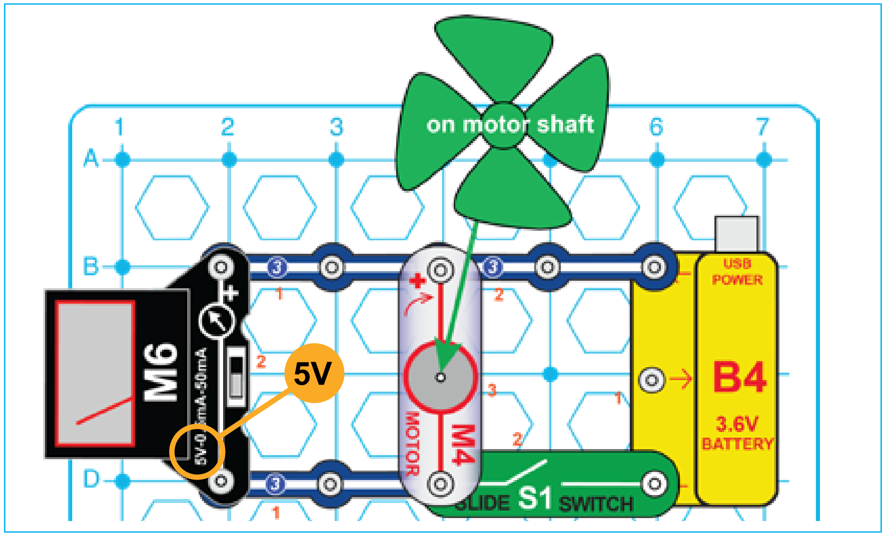
Project 15: Water Wheel



•Remove the wind fan from the motor shaft and replace it with the **Water Wheel**. Watch how the current is different with the larger water wheel.

•The water wheel is heavier, so it takes more current to spin it, and doesn't get as fast. Try laying something on the water wheel to give it even more weight.

Project 16: Motor Voltage



•Modify the preceding circuit into this one. Set the **Meter (M6)** to the 5V setting and place the wind fan on the **Motor (M4)**. Turn the **Slide Switch (S1)** on and off and watch the voltage on the meter as the motor speeds up and slows down.

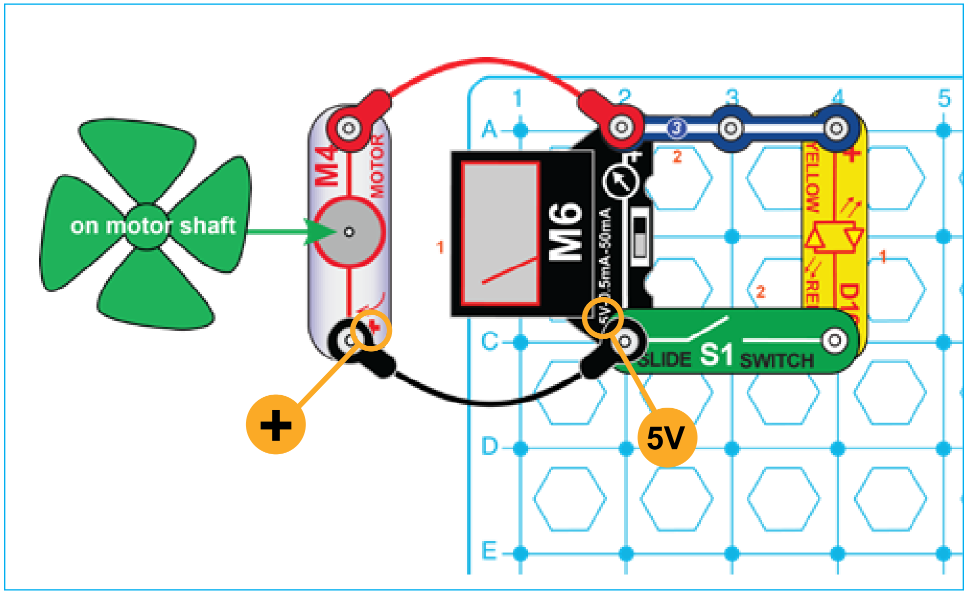
•Without pressing the switch, spin the fan clockwise with your finger and watch the voltage. In the preceding project, the current dropped as the fan sped up - now you see why. The spinning fan produces a voltage in the motor; this voltage opposes the voltage from the battery, reducing the current as the motor speeds up.

•How will the voltage and current change if you replace the wind fan with the water wheel? Try it.

Electricity is generated when you spin the motor shaft. A coil of wire is on the shaft and as it spins past the permanent magnet an electric current is created in the wire.

See project 3 if you need to recharge the battery (B4).

Project 17: Windy Lights

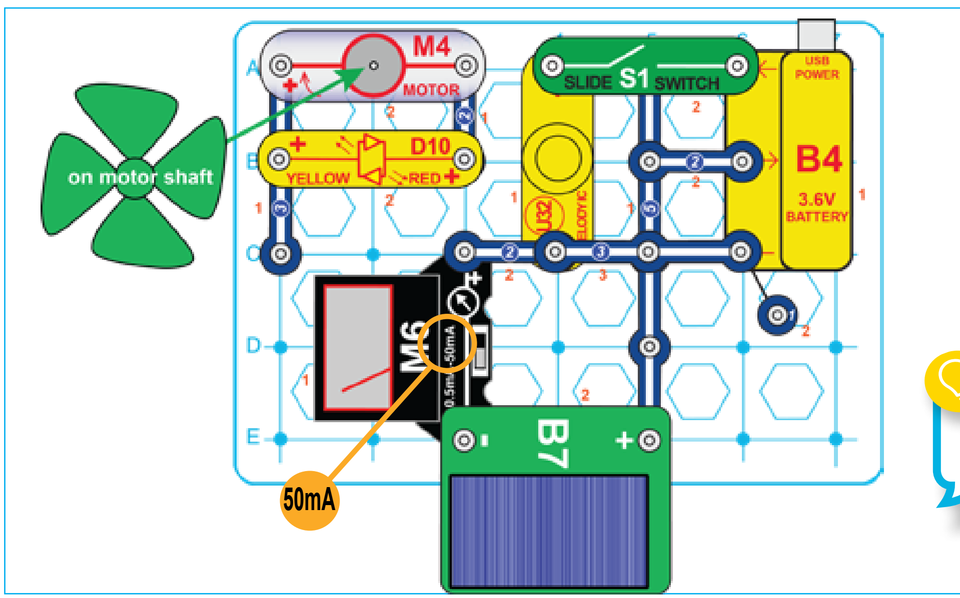


•Build the circuit shown. Set the **Meter** to the 5V setting, and keep the **Slide Switch (S1)** off. Blow on the fan or place it in a strong wind (either outside or near an electric fan). The meter measures how much voltage your "windmill" produces. You may need to give the fan a push to get it started.

•Now turn on the **Slide Switch (S1)** to connect the **Red/Yellow LED (D10)** to the **Windmill**. The voltage produced drops a little, but not as much as for the solar cell circuits. Compare the brightness of the LED at different wind speeds.

•If the wind reverses direction then the meter will measure less than zero voltage, and the **Red/Yellow LED** will light red. You can see this by spinning the fan in both directions using your finger.

Project 18: Box Cover Circuit



•This project combines several circuits to demonstrate what you can do with **Snap Circuits® Green Energy Lab**. This circuit may be shown on your box or manual cover.

•Assemble the circuits shown. Set the **Meter (M6)** to the 50mA setting. Turn on the **Slide Switch (S1)**. The **Battery (B4)** runs the **Melody IC (U32)**.

•Place the **solar cell (B7)** in sunlight or near an incandescent light bulb to charge the battery. The meter measures the changing current.

•Blow on the fan or spin it with your finger to light the **Red/Yellow LED (D10)**. The **Motor (M4)** acts as a generator, producing electricity to light the LED.

There are many ways to generate electricity, and many more ways to use it!

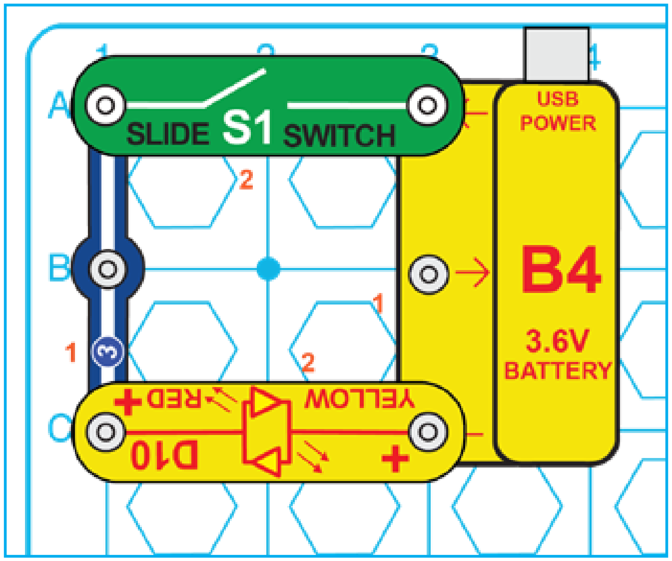
See project 3 if you need to recharge the battery (B4).

For Additional Projects:

Go to: www.elenco.com/scgrneng-manuals/ to download the full web manual

Download projects 1-44, more information about your parts and how circuits work, and our Think Green – Learn About Energy book.

Project 18: Electrical Circuit

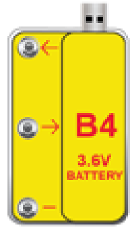


See project 3 if you need to recharge the battery (B4).

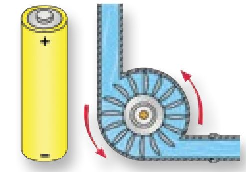
•Build the circuit shown. Turn on the slide switch **(S1)** to turn on the red/yellow LED **(D10)**.

EDUCATIONAL CORNER

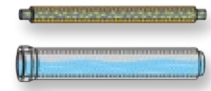
What's really happening here?



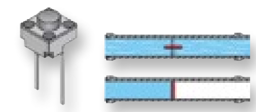
1. The battery (**B4**, containing a 3.6V rechargeable battery with protection circuitry) converts chemical energy into electrical energy and "pushes" it through the circuit, just like the electricity from your power company. A battery pushes electricity through a circuit just like a pump pushes water through a pipe.



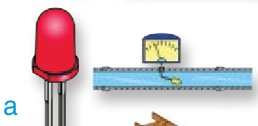
2. The snap wires (the blue pieces) carry the electricity around the circuit, just like wires carry electricity around your home. Wires carry electricity just like pipes carry water.

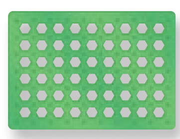


3. The slide switch (S1) controls the electricity by turning it on or off, just like a light switch on the wall of your home. A switch controls electricity like a faucet controls water.



4. The red/yellow LED (D10, a "light emitting diode") converts electrical energy into light; it is similar to lights in your home. An LED shows how much electricity is flowing in a circuit like a water meter shows how fast water flows in a pipe.

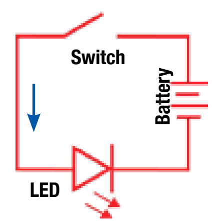


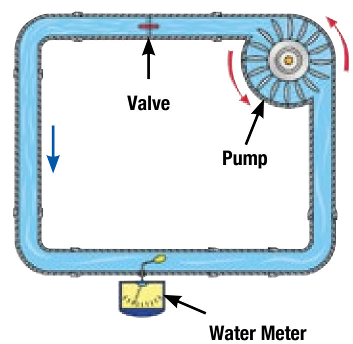


5. The base grid is a platform for mounting the circuit, just like how wires are mounted in the walls of your home to control the lights.

Comparing Electric Flow to Water Flow:

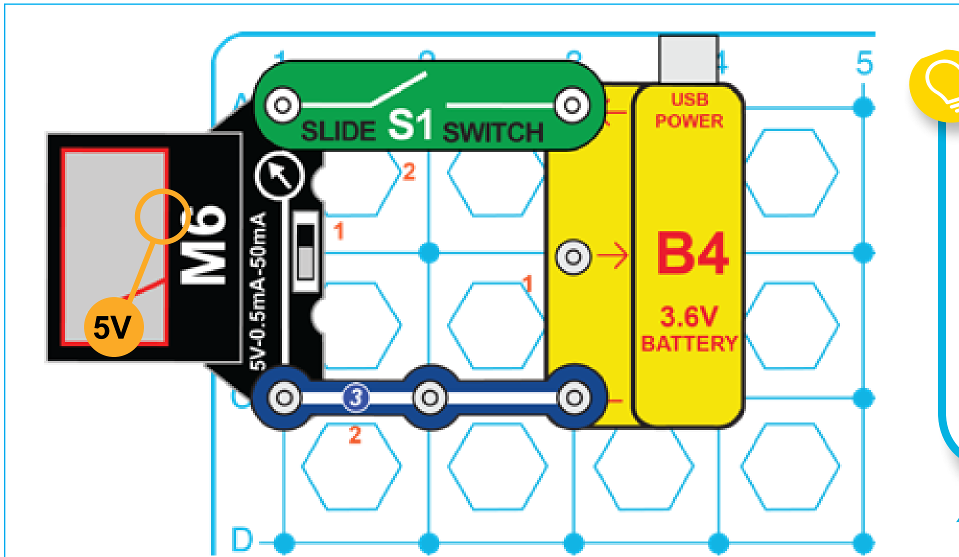
Electric Paths





Project 20: Voltage

•Build the circuit shown. Set the meter (M6) to the 5V setting. Turn on the slide switch (S1) to connect the meter to the battery and measure its voltage.



See project 3 if you need to recharge the battery (B4).

Electricity is the movement of sub-atomic charged particles (called electrons) through a material due to electrical pressure across the material, such as from a battery.

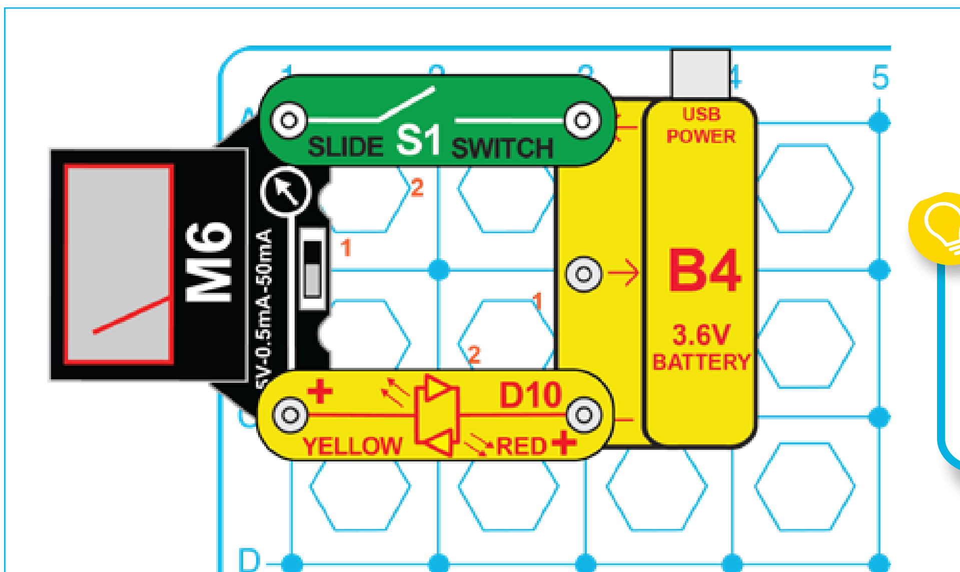
The electrical pressure exerted by a battery or other power source is called voltage and is measured in volts (V). Notice the "+" and "–" signs on the battery. These indicate which direction the battery will "pump" the electricity.

Circuits need the right voltage to work properly. For example, if the voltage to a light bulb is too low then the bulb won't turn on; if too high then the bulb will overheat and burn out.

The electric current is a measure of how fast electricity is flowing in a wire, just as the water current describes how fast water is flowing in a pipe. It is expressed in amperes (A) or milliamps (mA, 1/1000 of an ampere).

The "power" of electricity is a measure of how fast energy is moving through a wire. It is a combination of the voltage and current (Power = Voltage x Current). It is expressed in watts (W).

Project 21: Light Emitting Diode



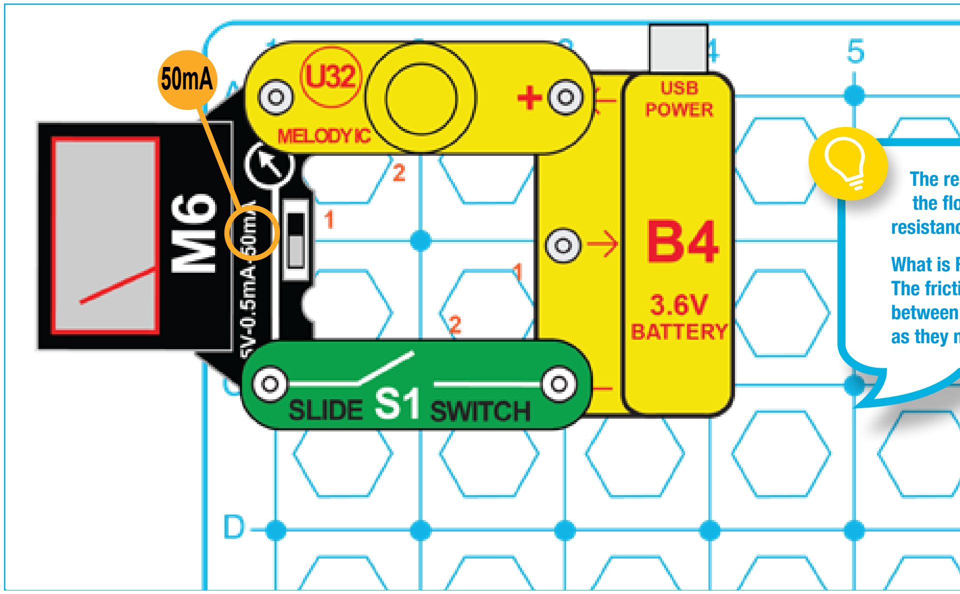
See project 3 if you need to recharge the battery (B4).

•Build the circuit shown. Set the meter (M6) to the 50mA setting. Turn on the slide switch (S1) to measure the current through the red/yellow LED (D10). You can connect the LED in either direction (for yellow or red).

Light emitting diodes (LEDs) are one-way lights with a turn-on voltage threshold. If the voltage is high enough (about 1.5V for red or yellow), they will light. Once an LED is activated, current must be limited by other components in the circuit or the LED can be damaged; your D10 LED has an internal resistor added to protect it.

When electric current flows through an LED, energy is released as light; the color depends on the material. LEDs are much more energy efficient and last longer than ordinary incandescent light bulbs but originally were only used in low-power applications due to power limits, cost, and limited colors. LEDs have since been improved and are now widely used in home lighting.

Project 22: Play a Tune



See project 3 if you need to recharge the battery (B4).

•Build the circuit, set the meter (M6) to the 50mA setting. Turn on the switch (S1) to play a tune on the melody IC (U32), while the meter measures the current through it.

•Compare the current with the melody IC to the current using the LED in project 20.

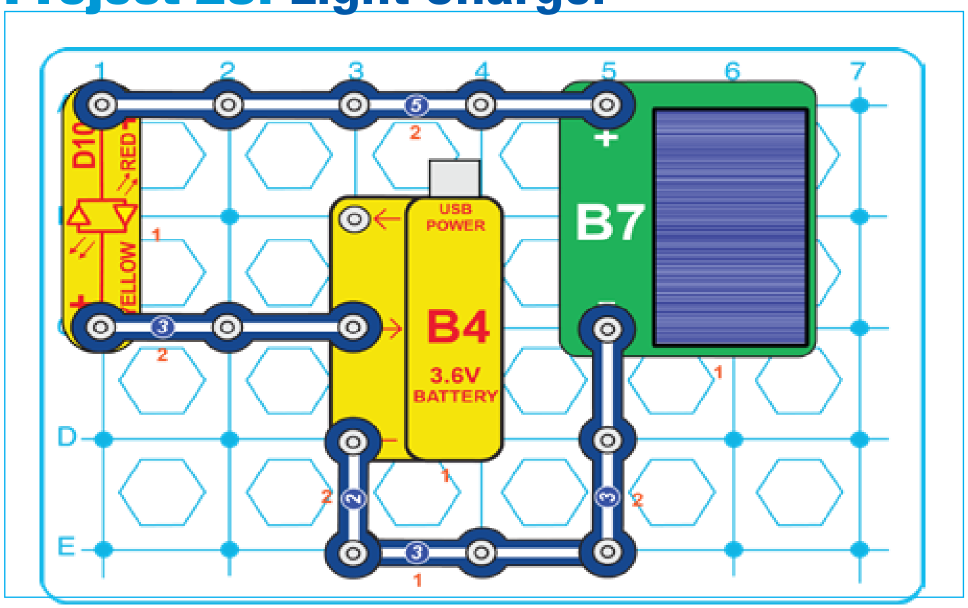
The resistance of a circuit represents how much it resists the electrical pressure (voltage) and limits the flow of electric current. The relationship is Voltage = Current x Resistance. When there is more resistance, less current will flow unless you increase the voltage. Resistance is measured in ohms (Ω).

What is Resistance? Take your hands and rub them together very fast. Your hands should feel warm. The friction between your hands converts your effort into heat. Resistance is the electrical friction between an electric current and the material it is flowing through; it is the loss of energy from electrons as they move through the material.

The melody IC converts electricity into sound energy by making mechanical vibrations. These vibrations create variations in air pressure, which travel across the room. You "hear" sound when your ears feel these air pressure variations.

The current is higher when the sound is louder, because it takes more electrical energy to produce more sound.

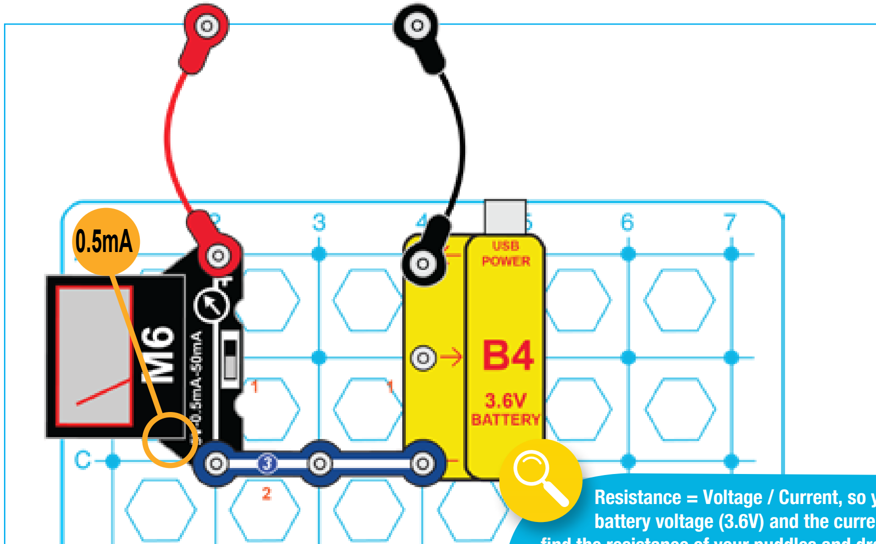
Project 23: Light Charger



See project 3 if you need to recharge the battery (B4).

•This circuit uses the solar cell (B7) to charge the rechargeable battery (B4). Place the solar cell in sunlight or near an incandescent light bulb. The red/yellow LED (D10) lights red when the battery is being charged. The brighter the LED, the faster it is charging.

Project 24: Make Your Own Parts



See project 3 if you need to recharge the battery (B4).

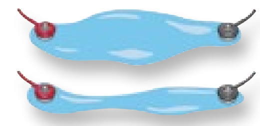
Resistance = Voltage / Current, so you can use the battery voltage (3.6V) and the current you measure to find the resistance of your puddles and drawings.

Long narrow shapes have more resistance than short wide ones. The black core of pencils is graphite, the same material used in the resistors in the pivot stand.

•Build the circuit, set the meter (M6) to the 0.5mA setting & set the switcher (S6) to the right position.

•Make your parts using either the water puddles method (A), the drawn parts method (B), or the pencil parts method (C). Touch the metal in the jumper wires to your parts and read the current.

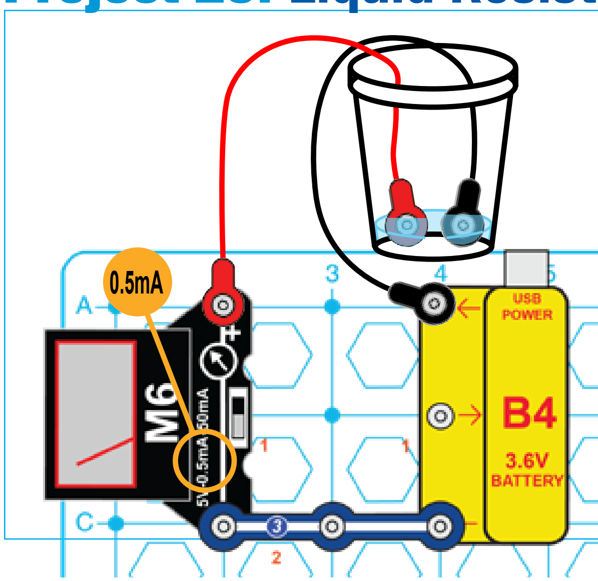
Method A (easy): Spread some water on the table into puddles of different shapes, perhaps like the ones shown here. Touch the jumper wires to points at the ends of the puddles.



Method B (challenging): Use a SHARP pencil (No. 2 lead is best) and draw shapes, such as the ones here. Draw them on a hard, flat surface. Press hard and fill in several times until you have a thick, even layer of pencil lead. Touch the jumper wires to points at the ends of the drawings. You may get better electrical contact if you wet the metal with a few drops of water. Wash your hands when finished.

Method C (adult supervision and permission required): Change the setting on the meter to the 50mA scale. Use some double-sided pencils if available, or VERY CAREFULLY break a pencil in half. Touch the jumper wires to the black core of the pencil at both ends.

Project 25: Liquid Resistors



•Build the cuit as shown and place the loose ends in the water, make sure the metal parts aren't touching each other. Measure the current through the water.

•Add salt to the water and stir to dissolve it. The current should be higher now, since salt water has less resistance than plain water. If the current is too high to measure on the 0.5mA scale, switch to the 50mA scale.

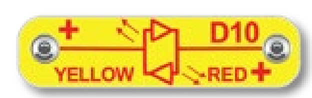
•Now add more water to the cup and watch the current.

•If you have some distilled water, place the jumper wires in it and measure the current. You should measure close to zero current, since distilled (pure) water has very high resistance. Normal water has impurities, which lower its resistance. Now add salt to the distilled water and watch the current increase as the salt dissolves!

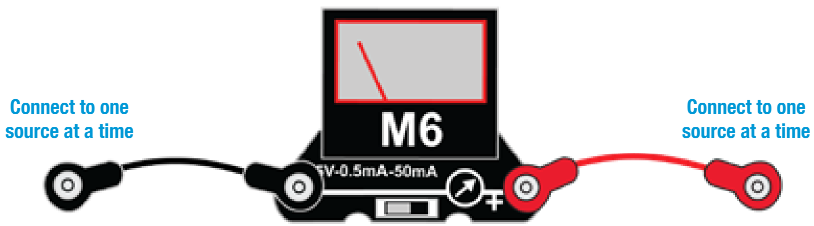
You can also measure the current through other liquids. ***Don't drink any water or liquids used here.***

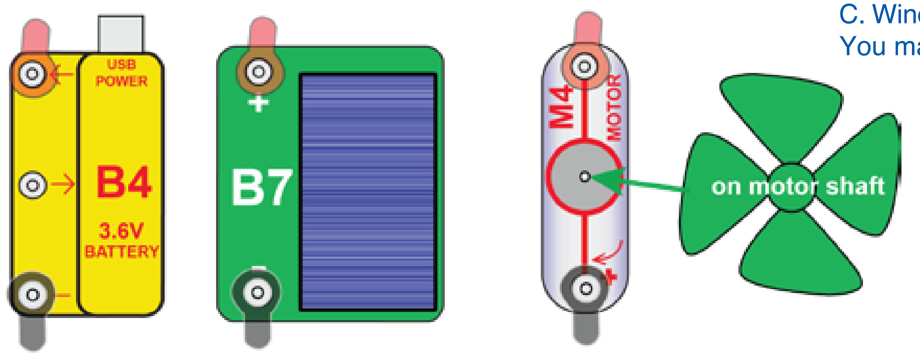
Project 26: Liquid Lights

•Replace the meter with the red/yellowLED (D10, positioned in either direction). Place the jumper wires back into water, into salt water, or on the shapes you drew.



Project 27: Power Sources





Power Source	Highest Meter Voltage	Highest Meter Current
Battery		
Solar Cell		
Windmill		

Snap Circuits® Green Energy Lab has 4 electrical power sources: battery, solar cell, windmill, and watermill. Let's compare them. The watermill is similar to the windmill and its messy, so we'll skip it.

•Connect the red & black jumper wires to the meter and to one of the power sources at a time, as shown. Measure the voltage produced using the **5V** meter setting; then look at the current produced using either the **0.5mA** or the **50mA** meter settings. Some times the meter reading will be more than the **5V** or **50mA** scales. Take some notes in the table below.

A. Battery.

B. Solar cell: Place it in sunlight or near an incandescent lamp.

C. Windmill: Place the wind fan on the motor, and blow on it or place it in a strong wind. You may need to give it a push to get it started.

The most powerful power source is the one which produces the best balance of voltage and current. Different types of circuits need different levels of voltage and current.

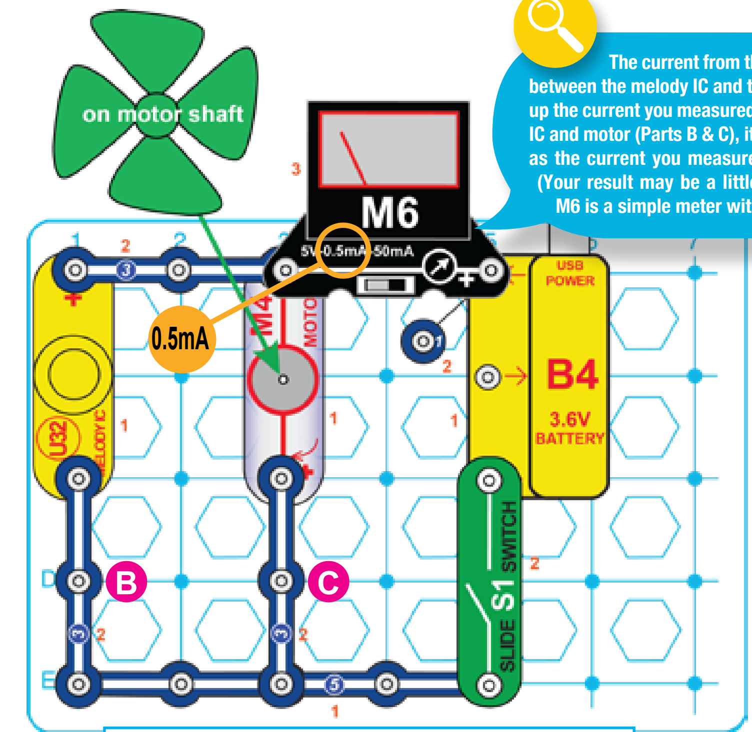
For each power source, the balance between voltage and current produced can be adjusted by changing its construction or with how groups of them are arranged.

Each power source has advantages and limitations:

A. Batteries have lots of power but they only store energy, they don't actually produce it.
B. The solar cell has limited power, and only while it has light.
C. The windmill makes good power but only in a strong wind.

See project 3 if you need to recharge the battery (B4).

Project 28: Splitting Current



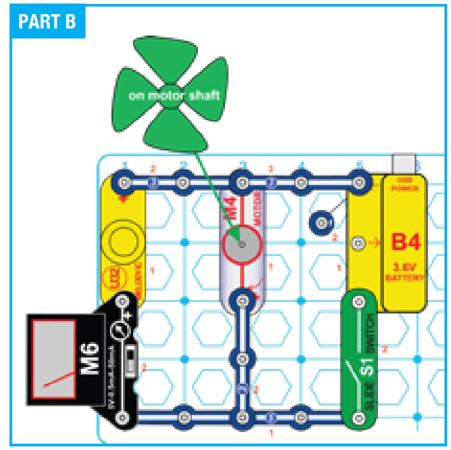
The current from the battery splits up between the melody IC and the motor. If you add up the current you measured through the melody IC and motor (Parts B & C), it should be the same as the current you measured from the battery. (Your result may be a little different, because M6 is a simple meter with low accuracy.)

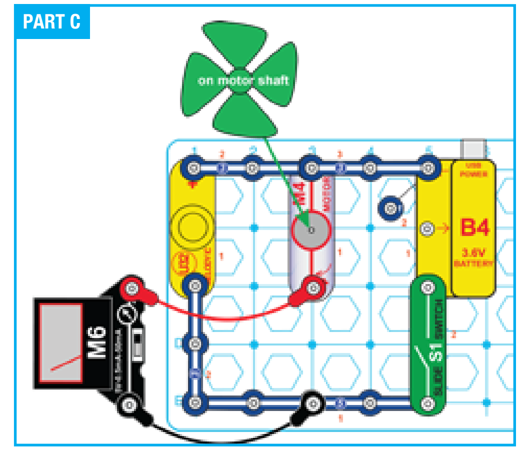
See project 3 if you need to recharge the battery (B4).

•Build the circuit and set the meter **(M6)** to the **50mA** setting. Turn on the switch **(S1)**; the meter measures the current from the battery **(B4)**. Let the fan get to full speed.

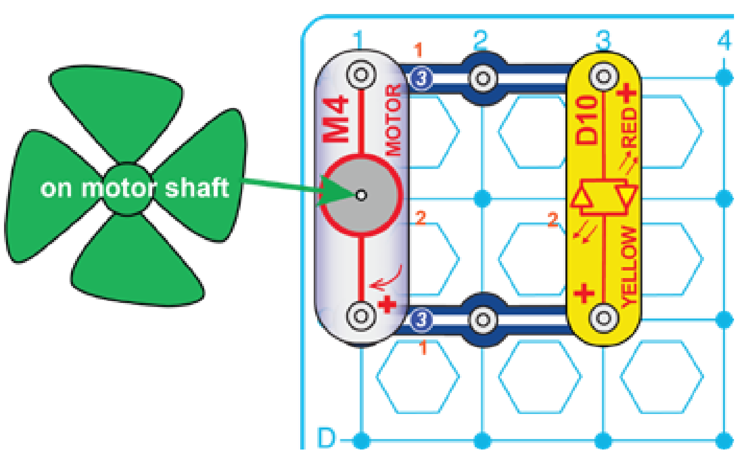
•Part B: swap the location of the meter with the 3-snap wire marked “B” (“+” side towards the melody IC **(U32)**). Turn on the switch to measure the current through the LED **(D10)**.

•Part C: swap the “B” location of the meter with the “C” 3-snap, connect the meter using the red & black jumper wires. Turn on the switch to measure the current through the motor **(M4)**.





Project 29: Wind Direction

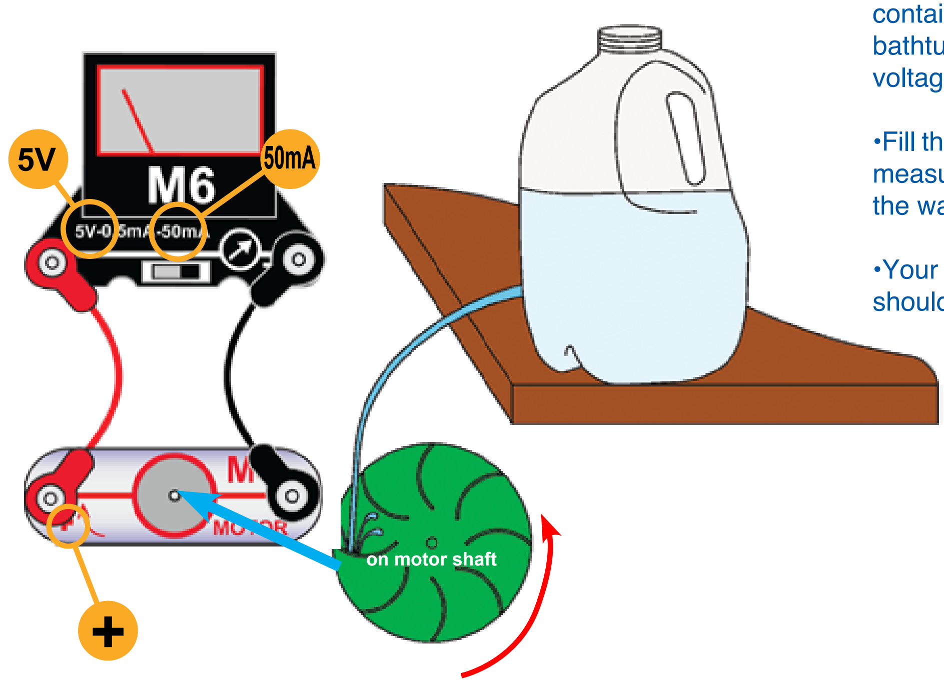


•Blow on the fan or spin it with your fingers. The rotating shaft on the motor **(M4)** generates a current and the LED **(D10)** lights.

•Spin the fan in the other direction (or reverse the position of the motor and blow on it), so it generates a current in the opposite direction. The LED (which is bi-color) now lights in a different color than before.

•As the fan spins faster, the LED lights brighter. You can use this circuit as a wind direction and speed indicator.

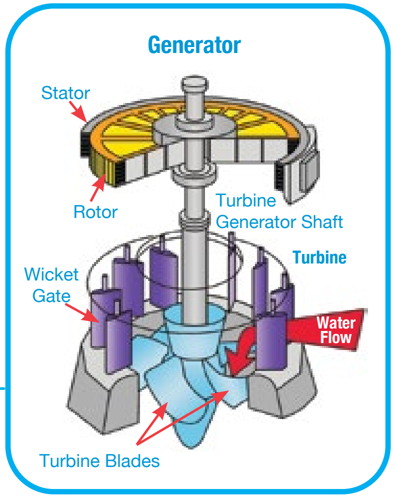
Project 30: Using Stored Water

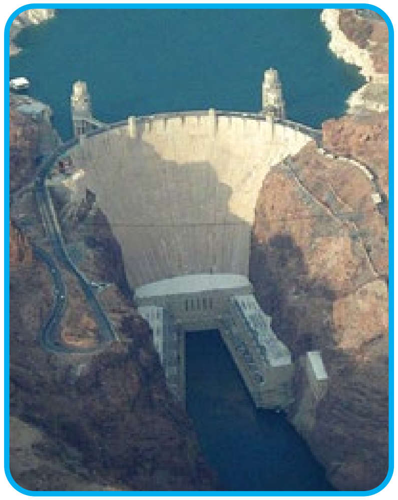


•Place the water wheel on the motor **(M4)** and connect it to the meter **(M6)**, as shown. Set the meter **(M6)** to the **5V** or **50mA** setting. Take an empty plastic water or milk container, make a hole about 3 inches from the bottom, place the bottle in a sink or bathtub, fill it with water, and then hold the water wheel next to it and measure the voltage or current produced.

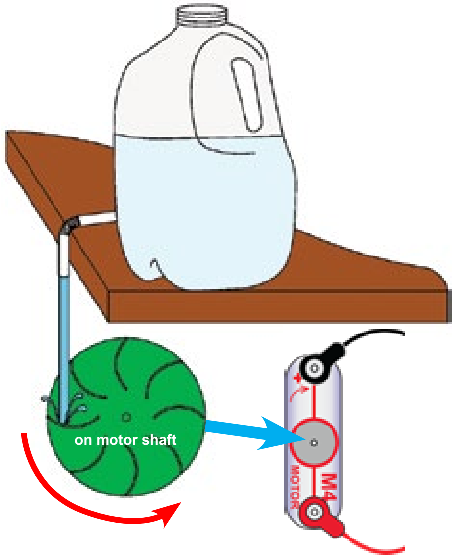
•Fill the container to different heights and see how the water pressure affects the meter measurement. Plug the hole with your finger while you fill the container, and try to keep the water wheel in the same position each time.

•Your parts might stop working if water gets inside them. Let them dry out and they should be fine.





Project 31: Water Redirection



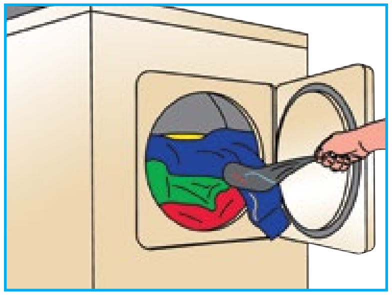
•In dam generators, the water to the turbine blades is directed by a series of wicket gates.

•Attach a straw (flexible ones work best) from your home to redirect the flow to the Water fan. Try and seal the area around the straw with putty, play dough, scotch tape or other such material. Repeat the meter readings from the previous project and see how much the power has increased.

Raising the water level in the container is just like storing water in a lake next to a dam. A higher water level means more water pressure, which spins the shaft faster, which produces more electricity.

A dam converts the potential energy of the high water into kinetic energy of fast moving water, which is reduced when the water is used to spin the turbine in a generator. The water in Hoover Dam is 500 feet deep at its base and reaches speeds of 85 mph going into the turbine.

Project 32: One of the Most Powerful Forces in the Universe



•Find some clothes that cling together in the dryer, and try to uncling them.

•The crackling noise you hear when taking off a sweater is static electricity. You may see sparks when taking one off in a dark room.

•Rub a sweater (wool is best) and see how it clings to other clothes.

These effects are caused by electricity. We call this static electricity because the electrical charges are not moving, although pulling clothes apart sounds like static on a radio. When electricity is moving (usually through wires) to do something in another place, we call it an electric current.

Electricity exists everywhere but is so well balanced that you seldom notice it. But sometimes, electrical charges get separated and build up a difference between materials, and sparks can fly. Lightning is the same effect as the sparks between clothes, but on a much greater scale. A cloud holds static electricity just like a sweater.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

The static electricity around us is extremely powerful. If we could learn to move and control it, we might have all the energy we need. Maybe someday you will find a way.

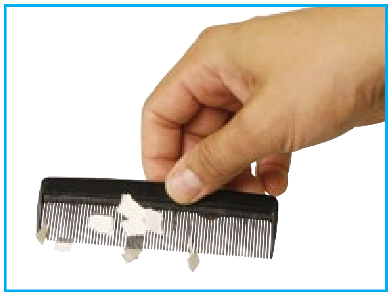
Project 33: Electricity Against Water

You need a comb (or plastic ruler) and a water faucet for this project. Run the comb through your hair several times then hold it next to a slow, thin stream of water from a faucet; the water will bend towards it. You can also use a plastic ruler. Rub it on your clothes (wool works best).

Rubbing the comb through your hair builds up a static electrical charge on it, which attracts the water.

Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

Project 34: Harnessing Static Electricity



Note: This project works best on a cold dry day. If the weather is humid, the water vapor in the air allows the static electric charge to dissipate, and this project may not work.

Notice how your hair can "stand up" or be attracted to the comb when the air is dry. Wetting your hair dissipates the static charge.

You need a comb (or a plastic ruler) and some paper for this project. Rip up the paper into small pieces. Run the comb through your hair several times then hold it near the paper pieces to pick them up. You can also use a plastic ruler, rub it on your clothes (wool works best).

Rubbing the comb through your hair pulls extremely tiny charged particles from your hair onto the comb. These give the comb a static electrical charge, which attracts the paper pieces.

Electricity is immensely more powerful than gravity (gravity is what causes things to fall to the ground when you drop them). However electrical attraction is so completely balanced out that you don't notice it, while gravity effects are always apparent because they are not balanced out.

Gravity is actually the attraction between objects due to their weight (or technically, their mass). This effect is extremely small and can be ignored unless one of the objects is as big as a planet (like the earth). Gravity attraction never goes away and is seen every time you drop something. Electrical charge, though usually balanced out perfectly, can move around and change quickly.

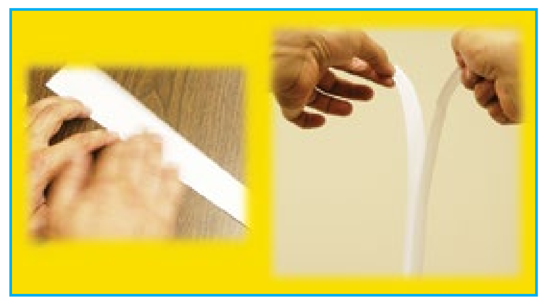
For example, you have seen how clothes can cling together in the dryer due to static electricity. There is also a gravity attraction between the sweaters, but it is always extremely small.

Some electricity is produced in dams, by harnessing the power of gravity to move water to spin a generator. If instead we could harness the static electricity contained in the water, we would have all the electricity we need.

Get a roll of plastic tape. Make some strips about a foot long. Hold their ends so they hang downwards, and slowly bring them close together. See if you can make them touch each other.

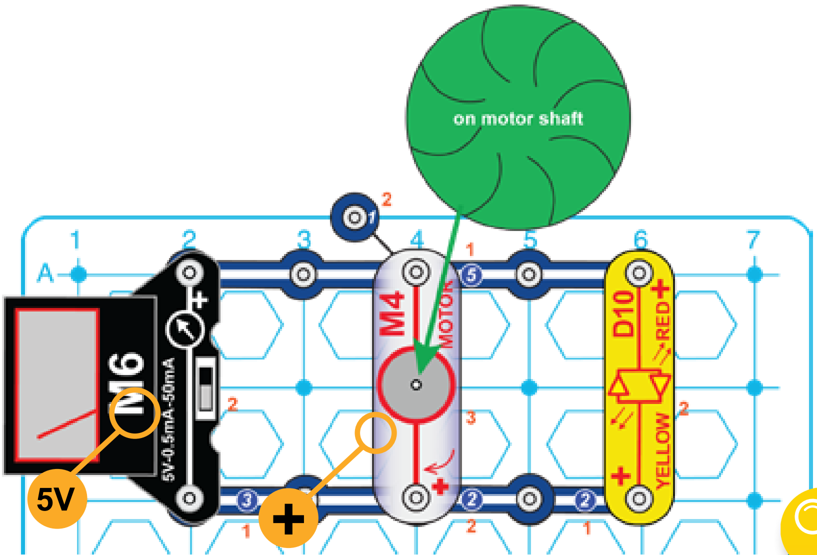
•If you have two balloons, rub them to a sweater and then hang the rubbed sides next to each other. They repel away. You could also use the balloons to pick up tiny pieces of paper.

•Take a piece of newspaper or other thin paper and rub it vigorously with a sweater or pencil. It will stick to a wall.



•Cut the paper into two long strips, rub them, then hang them next to each other. See if they attract or repel each other.

Project 35: Heavy Fan

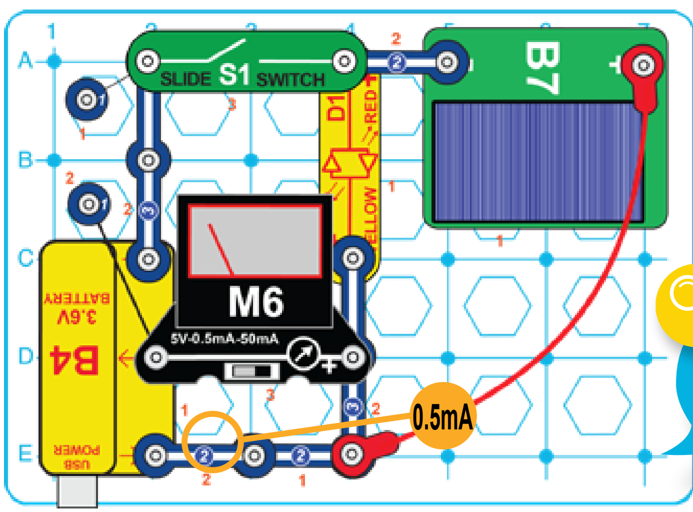


•Build the circuit as shown, with the water wheel on the motor. Set the meter **(M6)** to the **5V** setting. Blow on the water wheel, aiming the air into the "curves" on the fan. Watch the meter to see the voltage produced, and the red/yellow LED **(D10)** will light red.

•If you blow on the opposite side of the fan curves, the fan will not spin as easily. The LED will light yellow if you blow hard enough.

The water wheel was made to use with water, but wind can push it too.

Project 36: Solar Light Charger

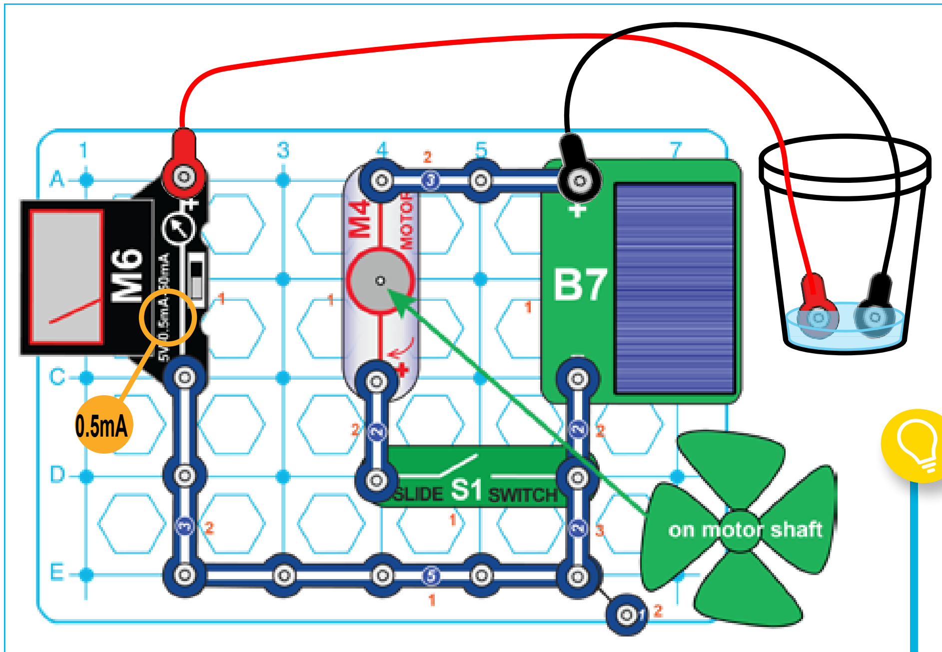


•Set the meter (M6) to the 0.5mA setting and turn off the slide switch (S1). Place the circuit in bright sunlight or 3-6 inches from an incandescent light bulb. Adjust the position of the solar cell to the light source to make the red/yellow LED (D10) brightest.

•Now turn on the switch, to add the rechargeable battery to the circuit. If your light source is strong enough then the solar cell will charge the battery, and the meter will measure the charging current. If your light source is weak then the battery will light the LED.

The solar cell only produces a small amount of electricity. The solar cell can only run the LED and charge the battery if the light source is very strong.

Project 37: Remote Water Heater



•Build the circuit, place the wind fan on the motor **(M4)**, and set the meter **(M6)** to the 0.5mA scale.

•Place the circuit so wind is blowing on the fan or sunlight is shining on the solar cell **(B7)**.

•Turn on the switch **(S1)** if you have wind or turn the switch off if you have sunlight.

•Connect the jumper wires to the circuit and place the other ends in a cup of water, make sure the metal parts aren't touching each other.

Your power source (wind or sun) is making an electric current flow through the water, and the meter measures the current. As the current flows through the water, the water is warmed.

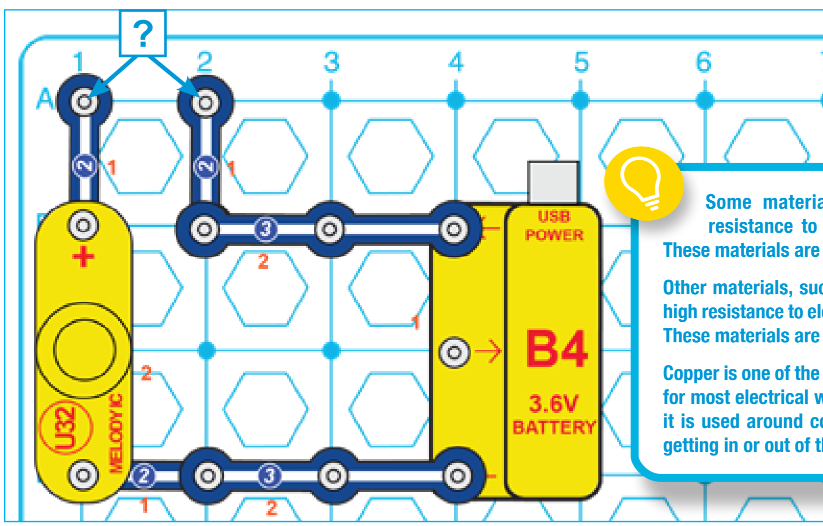
Don't drink any water or liquids used in this project.

These small wind and solar power sources may not produce enough heat for you to notice the water getting warmer, but you could use more powerful ones to heat up a lot of water. You could then pump the water around your house in pipes to use the wind or solar heated water to warm up your house.

How do you harness the wind to heat your house? It is easy when you use electricity to help.

Another way to harness sunlight to heat homes is by using sunlight to heat water, then pumping the water around the house.

Project 38: Electrical Material Checker



See project 3 if you need to recharge the battery (B4).

Build the circuit shown, and touch various materials between the snaps marked with ?.

The melody IC (U32) will signal for materials that are good at transporting electricity. Try string, the electrodes, a shirt, plastic, paper, wood, or anything in your home.

Some materials, such as metals, have very low resistance to electricity and will turn on the horn. These materials are called **conductors**.

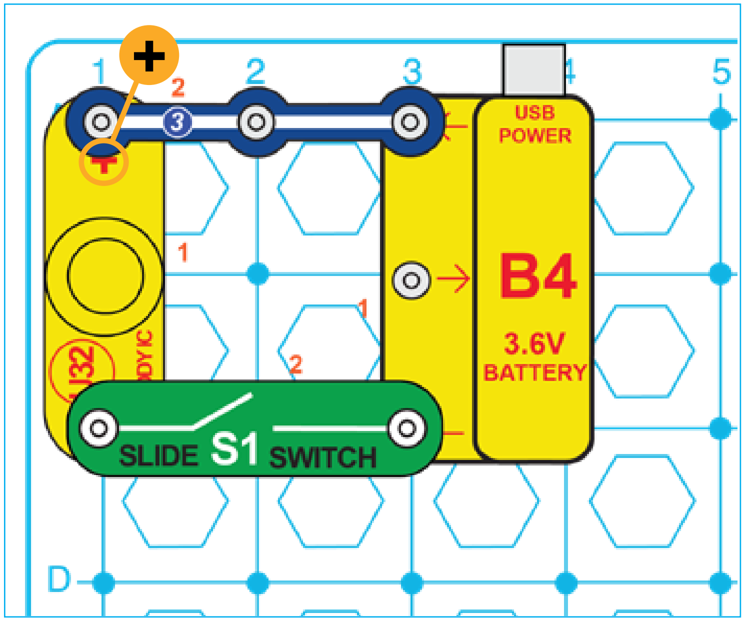
Other materials, such as paper, air, and plastic, have very high resistance to electricity. These will not turn on the horn. These materials are called **insulators**.

Copper is one of the best conductors ever found so it is used for most electrical wires. Plastic is a very good insulator so it is used around copper wires to prevent electricity from getting in or out of the wire.

Many electronic test instruments test wires and connections using probes and a sound device like you did here. A sound device is used so the user can focus his attention on where he puts the probes without looking at a display.

You can replace the melody IC with the meter (0.5mA setting) or the red/yellow LED (D10) to make a visual continuity checker.

Project 39: Morse Code



See project 3 if you need to recharge the battery (B4).

•Build the circuit and turn the switch **(S1)** on and off several times to send secret messages to your friends using Morse Code.

•If the melody IC **(U32)** was located 10 miles away and connected to the switch and battery **(B4)** using really long wires, then you could still use it to send messages.

Morse Code: The forerunner of today's telephone system was the telegraph, which was widely used in the latter half of the 19th century. It only had two states - on or off (that is, transmitting or not transmitting), and could not send the range of frequencies contained in human voices or music. A code was developed to send information over long distances using this system and a sequence of dots and dashes (short or long transmit bursts). It was named Morse Code after its inventor. It was also used extensively in the early days of radio communications, though it isn't in wide use today. It is sometimes referred to in Hollywood movies, especially Westerns.

MORSE CODE					
A	. _	N	_ .	Period	. _ . _ . _
B	_ . . .	O	_ _ _	Comma	_ _ . . _ _
C	_ . _ .	P	. _ _ .	Question	. . _ _ . .
D	_ . .	Q	_ _ . _	1	. _ _ _ _
E	.	R	. _ .	2	. . _ _ _
F	. . _ .	S	. . .	3	. . . _ _
G	_ _ .	T	_	4	. . . . _
H	. . . .	U	. . _	5	. . . . .
I	. .	V	. . . _	6	_ . . . .
J	. _ _ _	W	. _ _	7	_ _ . . .
K	_ . _	X	_ . . _	8	_ _ _ . .
L	. _ . .	Y	_ . _ _	9	_ _ _ _ .
M	_ _	Z	_ _ . .	0	_ _ _ _ _

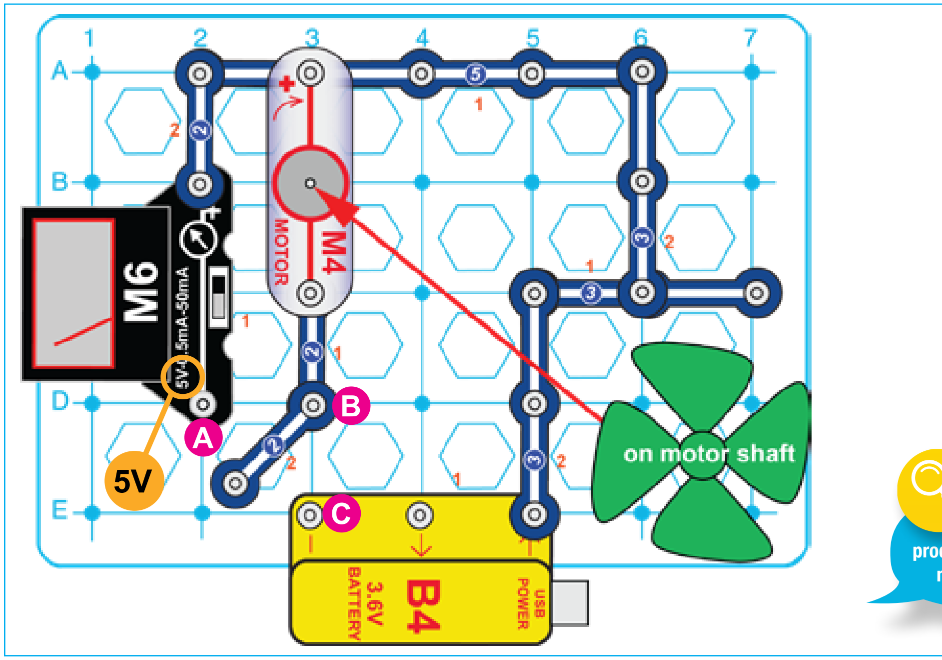
Project 40: Morse Light

•Use the preceding circuit but replace the melody IC **(U32)** with the red/yellow LED **(D10)**, oriented in either direction). Turn the switch **(S1)** on and off several times to send messages to your friends using Morse Code. You can connect the LED using the red & black jumper wires to make it more visible.

You could use this system to send messages during a noisy concert, or out in the wilderness where your cell phone won't work.

During World War II Navy ships sometimes communicated by flashing Morse Code messages between ships using searchlights (because radio transmissions might reveal their presence to the enemy). Years ago, Native Americans would send messages to other tribes using smoke signals and a special code.

Project 41: Generator



See project 3 if you need to recharge the battery (B4).

•Set meter **(M6)** to the **5V** setting. Touch the 2-snap wire at point **B** to point **C**. Some of the chemical energy in the battery becomes electricity, which is converted into mechanical energy of motion by the motor **(M4)**.

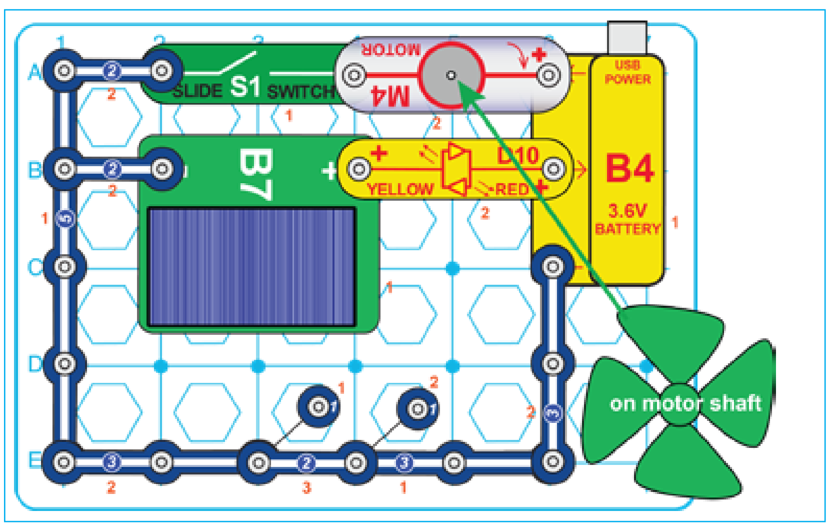
•Now swing the 2-snap wire from points **B** & **C** to points **A** & **B**. Some the mechanical energy in the spinning motor shaft and fan generates electricity, which is measured as voltage on the meter.

•Keep the 2-snap wire across points **A** & **B**, and spin the fan clockwise with your finger. The meter measures the voltage produced.

•**Part B**: Replace the meter **(M6)** with the red/yellow LED (**D10**, oriented in either direction). Swing the 2-snap wire to points B & C, then to points A & B to light the LED.

A motor uses electricity to produce mechanical motion. A generator uses mechanical motion to produce electricity.

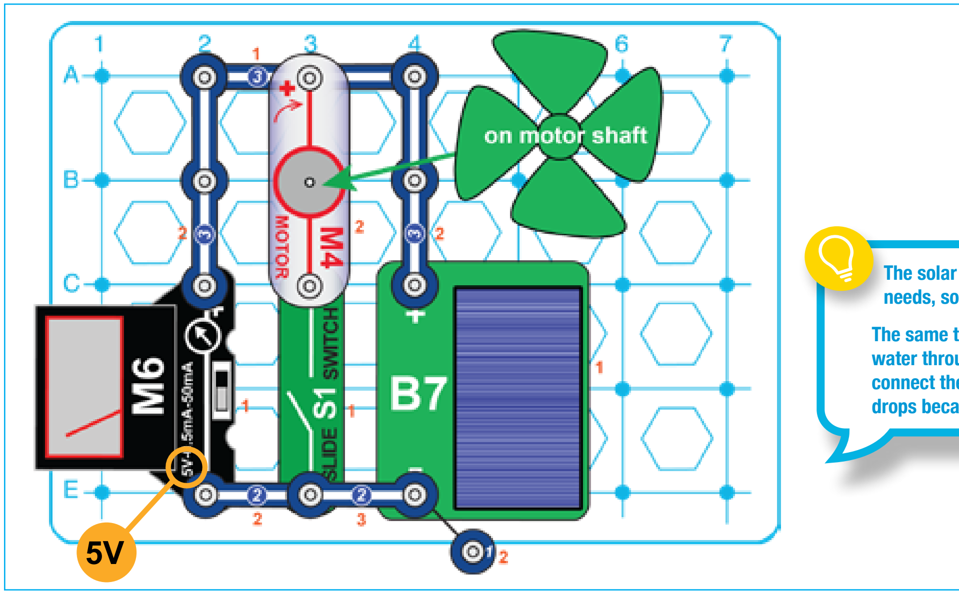
Project 42: Energy Converter



In this project you'll convert one form of energy to another. Place the solar cell in sunlight or about 12 inches from an incandescent light bulb of 60W or more. Adjust the light on the solar cell to make the red/yellow LED **(D10)** brightest. The solar cell converts light energy into electrical that lights the LED and charges the battery **(B4)**.

The electrical energy charges the battery, converting it into a chemical form. When you turn on the switch **(S1)**, chemical energy in the battery makes electrical energy, which runs the motor **(M4)** and fan. The spinning motor shaft and fan are another form of energy called motion.

Project 43: Solar Fun



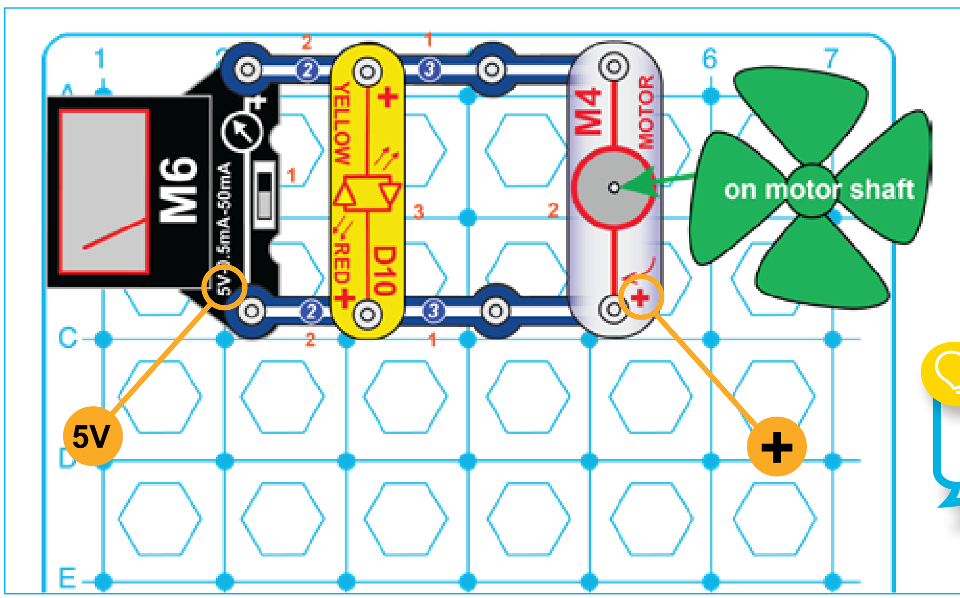
•Place the solar cell (B7) in sunlight or near an incandescent lamp. The meter (M6) measures the voltage produced.

•Turn on the switch (S1) to turn on the fan (the M4 motor), you may need to give it a push to get it started. The meter shows the voltage is much lower now with the solar cell running the fan.

The solar cell cannot produce as much current as the fan needs, so the voltage drops.

The same thing happens with water. A pump might push water through a narrow pipe at high pressure, but if you connect the same pump to a much larger pipe, the pressure drops because the pump can only push so much water.

Project 44: Anemometer



•The energy in the moving wind can be used to generate electricity. An anemometer is a device used for measuring wind speed, and is one instrument used in a weather station. The term comes from the Greek word anemos, meaning wind. Leon Battista Alberti invented the anemometer.

•Set the meter (M6) to the 5V setting. Slowly blow on the fan and notice the reading on the meter. The meter measures the voltage generated by the spinning shaft on the motor. The faster the shaft spins, the greater voltage generated. See how fast the fan must spin to light the LED.

Wind speed is important for wind energy. Wind turbines need a constant, average wind speed of about 14 miles per hour before the wind turbines can generate electricity.

Basic Troubleshooting

1. The battery (B4) will only work if it is charged. Project 3 shows how to recharge it.
2. Most circuit problems are due to incorrect assembly, always double-check that your circuit exactly matches the drawing for it.
3. Be sure that parts with positive/negative markings are positioned as per the drawing.
4. Be sure that all connections are securely snapped.

ADULT SUPERVISION RECOMMENDED

Advanced Troubleshooting

Elenco® is not responsible for parts damaged due to incorrect wiring.

If you suspect you have damaged parts, you can follow this procedure to systematically determine which ones need replacing:

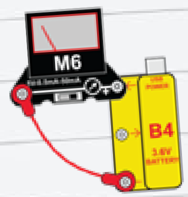
1. To Test:

Battery (B4)
Meter (M6)
Red/Yellow LED (D10)
Motor (M4):

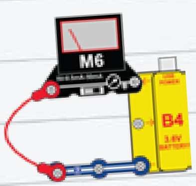
- Plug B4 into a powered USB port; the "USB POWER" light on B4 should come on, indicating that it is being charged by the USB. Next, set the meter to the 5V setting and touch it across B4; the meter pointer should move. If the meter measures 3V or less then recharge B4 using project 3. If B4 cannot be recharged then it is damaged. Set the meter to the 0.5mA and 50mA scales; the reading should be maximum. Touch the D10 directly across B4, it should light red or yellow (depending on which way you oriented it). Touch the motor across the snaps on B4, it should spin.
- If the meter, LED, and motor all do not work then B4 is damaged; if one of them did not work then that device is damaged.
- You should also confirm that B4 can be charged using the solar cell (B7). Confirm that B7 works, then use the "Measuring Charge Current" circuit of project 3. If the meter measures any current then B4 is fine.

2. **Solar cell (B7):** Place the meter directly across the solar cell and set it to the 5V setting. Place the solar cell in sunlight or near a bright light source (incandescent light bulbs are best); the meter pointer should move. Be sure you used a bright light source and removed any protective plastic wrap covering the solar cell.

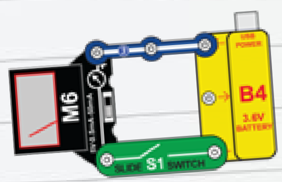
3. **Red & Black Jumper wires:** Set the meter to the 5V setting and use this circuit to test each jumper wire. The jumper wire is damaged if the meter pointer does not move.



4. **Snap wires:** Set the meter to the 5V setting and use this circuit to test each snap wire, one at a time. The snap does not move.



5. **Slide switch (S1):** Set the meter to the 5V setting and build this circuit. If the meter pointer does not move when you turn on the switch, the switch is damaged.



6. **Melody IC (U32):** Touch the melody IC directly across the snaps on the battery (B4), U32 "+" to battery "□". You should hear a tune. If the sound is distorted then recharge the battery.

IMPORTANT:

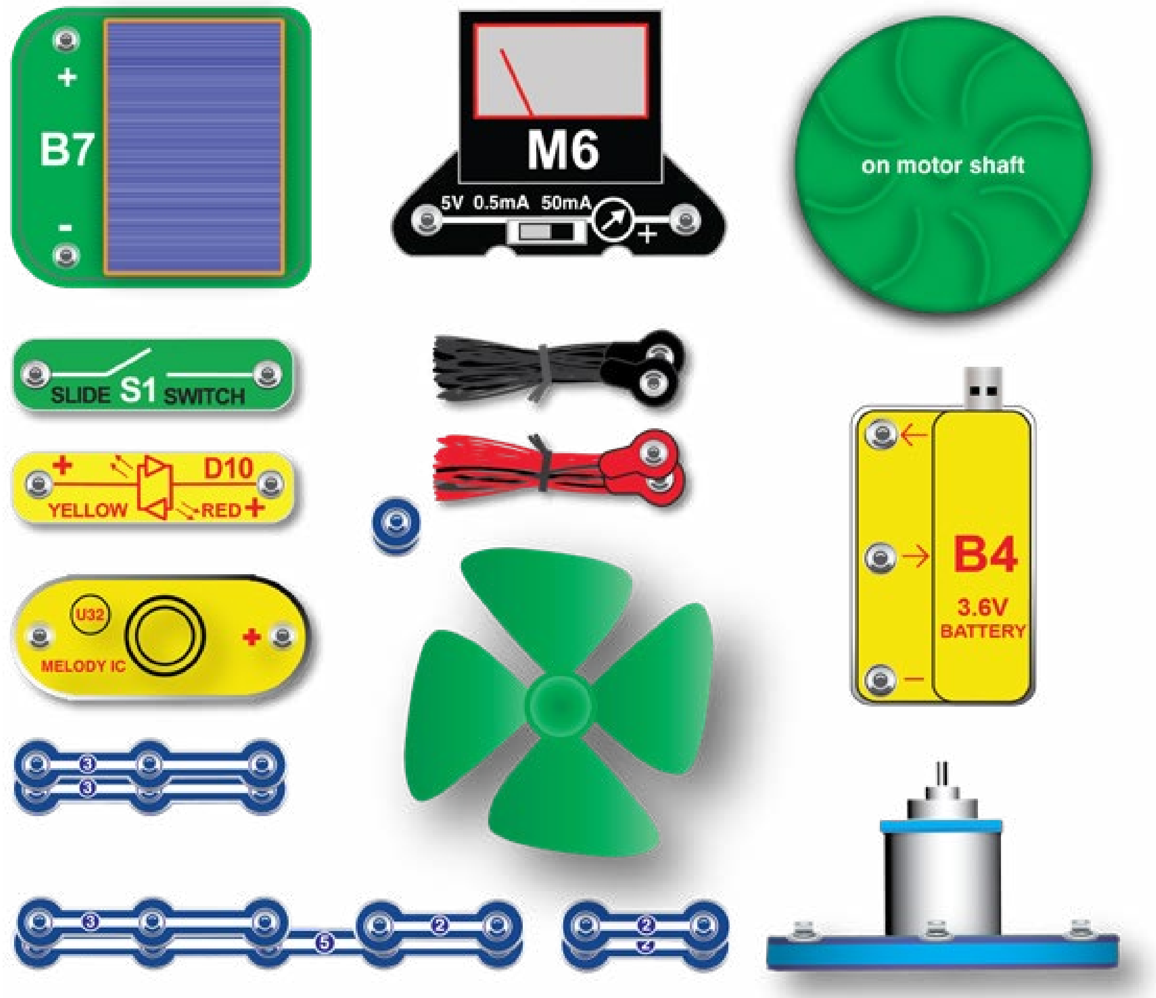
If any parts are missing or damaged,
DO NOT RETURN TO RETAILER.
Go to elenco.com/replacement-parts or e-mail us at support@elenco.com.
Note: A complete parts list is on page 2 in this manual.

If you have any problems, contact:

ELENCO® ELECTRONICS, LLC
150 Carpenter Ave. Wheeling, IL 60090 l (800) 533-2441
support@elenco.com l elenco.com

Snap Circuits® Green Energy Lab Parts Layout

IMPORTANT:
If any parts are missing or damaged, DO NOT RETURN TO RETAILER. Go to elenco.com/replacement-parts or e-mail us at support@elenco.com.
Note: A complete parts list is on page 2 in this manual.



Base Grid (7.7” x 5.5”) overlays some parts.

If you have any problems, contact: ELENCO® ELECTRONICS, LLC
150 Carpenter Ave. Wheeling, IL 60090 I (800) 533-2441 I support@elenco.com I elenco.com

Model: SC-GRNENKT | Part #753342 | Web Manual V1