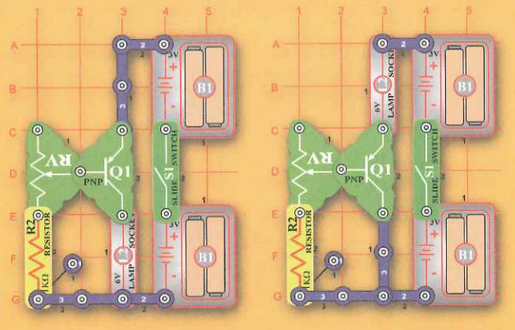
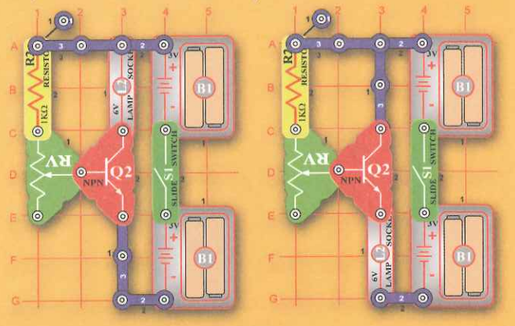
Experiments

Now compare lamp brightness in these two PNP circuits (which are projects 128 and 129):



The lamp is brighter when it is connected to the transistor's collector (project 128). When the lamp is connected to the emitter it reduces the emitter-base current, which sets the emitter-collector current.

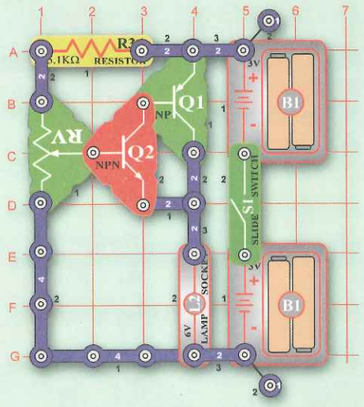
Now compare lamp brightness in the NPN-versions of the same circuits (which are projects 130 and 131, or variations of them):



The lamp is brighter when it is connected to the transistor's collector (left circuit), and these circuits are about as bright as the PNP-versions. This is because both transistors are made from the same material, silicon.

Experiments

Next, consider this circuit (which is project 253, or a variation of it):

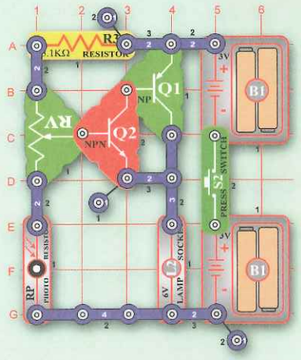


This circuit uses two transistors, and combines their amplifying power. As a result, the lamp is bright across more of the adjustable resistor's range than in the previous circuits. When the adjustable resistor is set for full brightness, the brightness is limited by the lamp itself (not by the transistors).

5-4 More Transistor Circuits

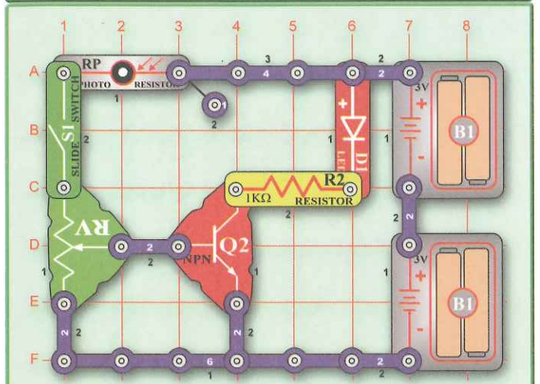
Experiments

Transistors are used in a wide range of applications. These are just some examples.



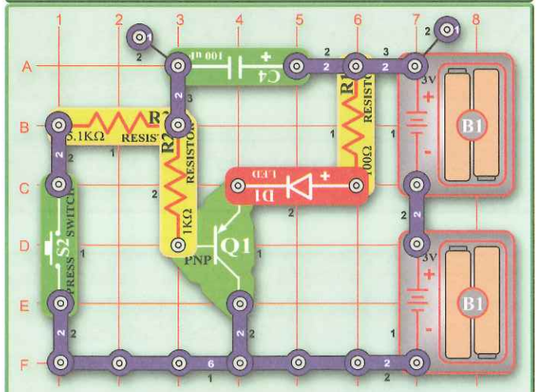
This circuit (which is project 107) uses light to control a lamp. If the adjustable resistor is initially set so the lamp just lights, then the lamp will be bright when the room gets dark. Light changes the resistance of the photoresistor, which controls the current to the transistors and lamp.

Experiments



This circuit (which is project 261) uses the photoresistor as a motion detector. If the adjustable resistor is set so the LED just lights, waving your hand over the circuit will cause the LED to flicker.

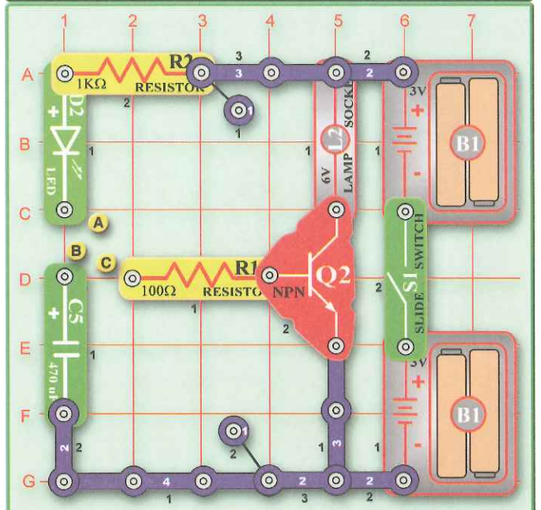
Experiments



This circuit (which is project 256) can be used as a light dimmer. When you turn off a light (by releasing the switch), this circuit keeps the light on for a few seconds to light your way as you leave the room. Electricity is stored in the capacitor, and released to the transistor when the switch is turned off.

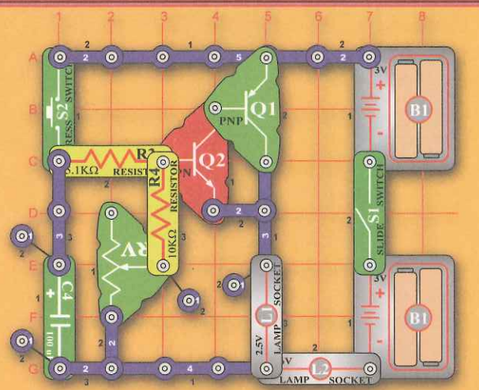
The same circuit could also be used in a wristwatch. When you press the button to read the time in the dark, a light comes on and automatically turns off after a few seconds to avoid draining the battery.

Experiments



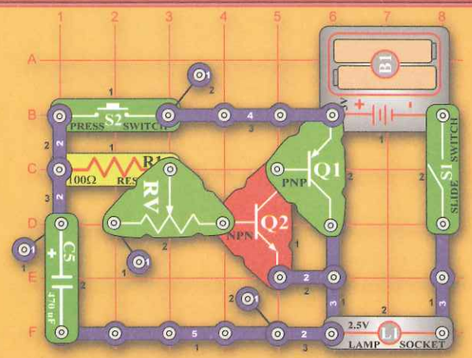
This circuit (which is project 252) is another example of how capacitors store electricity. If the green LED and capacitor are connected with a 2-snap wire (points A and B on the drawing), the LED will flash as the capacitor charges up. If the 100Ω resistor and capacitor are then connected (points B and C on the drawing), the lamp will flash as the capacitor turns on the transistor by discharging through it.

Experiments



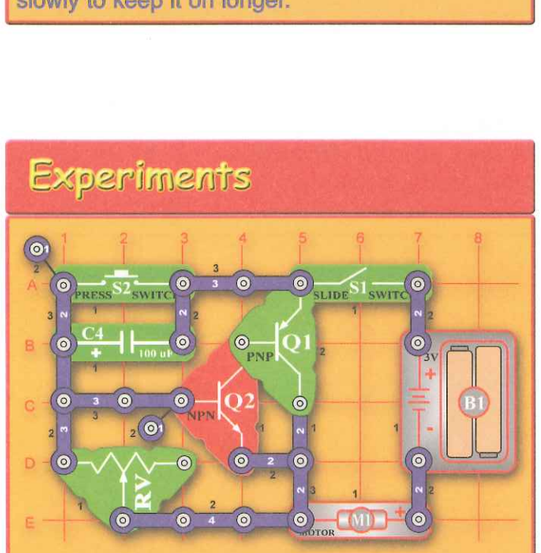
This circuit (which is project 300) is a light dimmer with an adjustable delay. The adjustable resistor controls how long the lamps stay on for after the press switch is released. If the 470µF capacitor were placed on top of the 100µF (so both are in parallel), the turn-off delay would be much longer.

Experiments



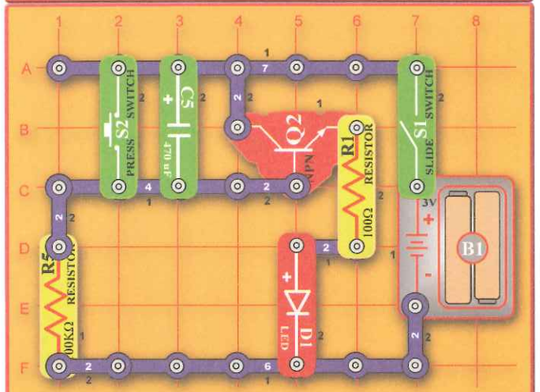
This circuit (which is project 302) is another light dimmer with adjustable delay. In this circuit all the electricity stored in the capacitor will discharge through the transistor, the adjustable resistor controls how quickly it is discharged. It can be released quickly to make the lamp brighter, or slowly to keep it on longer.

Experiments



This circuit (which is project 263) uses transistors and a capacitor to control a motor (use the fan) instead of a lamp. It works the same way, with the adjustable resistor controlling how long it stays on. The fan speed slowly drops as the capacitor discharges.

Experiments



This circuit (which is project 225) has an important difference from the other ones. When the slide switch is turned on, the LED is on for a while and slowly gets dim. Resetting the slide switch can't turn it back on. Current flows while the 470µF capacitor charges up, once it is charged it blocks current to the transistor. Pressing the press switch instantly discharges the capacitor and the LED can light again.

The fastest way to discharge a capacitor is to place a wire across it. Capacitor discharge time is controlled by the circuit resistance, and a wire has very little resistance.

As you have seen, transistors are useful in many different types of circuits.

Other snap circuits projects related to transistors: 105, 126, 127, 132, 133, 168, 169, 170, 171, 195, 196, 216, 222, 223, 224, 226, 227, 254, 257, 264, 280, 281, 282, 283, 291, 292, 301, 303, 304, and 305.

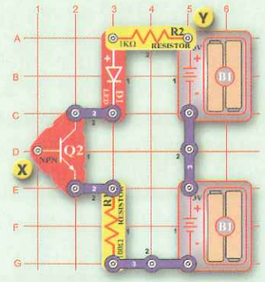
Quick Quiz

1. Draw/build a circuit that works the same as project 215 but uses a PNP transistor instead of an NPN transistor.

5-5 Human Transistor

Experiments

Now consider this circuit (which is project 246):

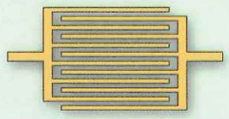


This circuit is missing a key component - you. If you place your fingers across the points marked X and Y, the LED will light. It will get brighter if you wet your fingers, since that will make a better connection.

You saw earlier that water conducts electricity. Since your body is made of water, it should not surprise you that your body can also conduct electricity. Although your body has high resistance (usually more than 100KΩ), this transistor circuit is sensitive enough to be activated by it.

This circuit is similar to touch-lamps sold in stores, but those lamps only need one finger to touch them. The circuit could be changed to put the touch points next to each other, so it could be turned on with one finger (this is project 247):

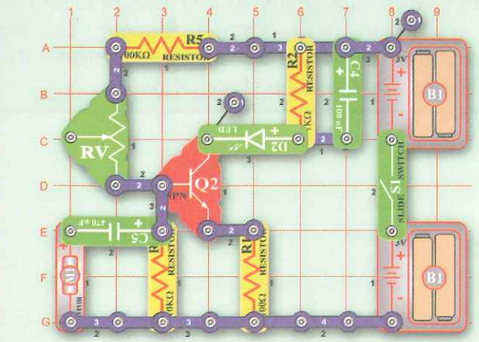
Actually, touch-activated products will usually interweave the contacts so that it is easy to touch both at the same time:



5-6 Motor as Generator

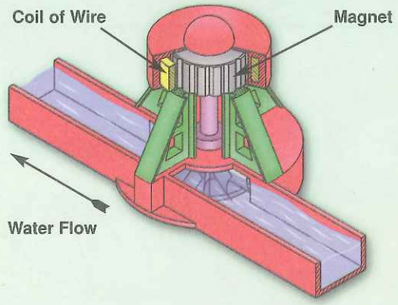
Experiments

Now consider this circuit (which is project 118):



This circuit is an example of using mechanical motion to create electricity, using a generator. If you spin the motor CLOCKWISE with your fingers, the green LED will flash. Give it a good, fast spin and leave the fan off.

The motor shaft you spin has a magnet on it, surrounded by a coil of wire. The spinning magnet has a magnetic field, which creates an electric current in the coil. Your fingers can't spin the motor very fast, so only a small current is created.



The resistors and capacitors in this circuit were chosen so that even a small motor current can light the LED. Since the middle connection on the adjustable resistor is not used, it acts as only a 50KΩ resistor and cannot be adjusted.