WHAT IS INCLUDED IN YOUR KIT

2x COINCELL BATTERY
This small battery can provide power and fit in tight places. You can connect this to your circuit for power—just make sure that the positive side connects to the positive end and the negative side (or ground) connects to the negative end.

1x COINCELL BATTERY HOLD-
You also have a sewable battery holder in your kit, with conductive holes marked as positive and negative. When inserting your battery in the holder make sure the side with the “+” is facing up and the unmarked side (sometimes perforated) is facing down.

1x PIECE OF CONDUCTIVE TAPE
This tape is made of a conductive material meaning it lets electricity pass through it. It can be used to carry power and signals through a circuit.
WHAT IS INCLUDED IN YOUR KIT

**4x ALLIGATOR CLIPS**

Alligator clips are also made of conductive material meaning they let electrons pass through them. You can use the alligator clips to attach parts without making a permanent connection. Just squeeze the ends to open the claws and clip them on.

**2x LEDS**

LEDs are the most popular way to test a circuit. When electricity is flowing through them they turn “on” and produce light. They have a positive end (longer leg) and negative end (shorter leg).

**1x BUZZER**

The buzzer in your kit contains a piezo element. When you put a voltage across a piezo, it vibrates and creates a tone. If you vary the power to your piezo you will hear this as a range of different tones.
WHAT IS INCLUDED IN YOUR KIT

1x MAGNETIC REED SWITCH

This is a switch that is activated by a magnet. When exposed to a magnetic field, the metal reeds inside the switch pulls together and the switch closes. When the magnetic field is removed, the reeds separate and the switch opens. The reed switch in your kit is covered with a black insulated box so that it won’t break easily. You also have a small ceramic disc magnet in your set.

1x TILT SWITCH

Vibration tilt switches contain a small ball of mercury that can roll back and forth in a capsule. When the mercury ball is at the bottom of the capsule the switch closes and when its at the top, it opens. The tilt switch in your kit is gold or black.
WHAT IS INCLUDED IN YOUR KIT

1x LEVER SWITCH
The lever switch has a lever on the top that can be pushed down. It will spring back to an open position when there is no pressure applied. Is it also a “momentary switch.” To turn “on” push down on the lever, to turn “off” release. OR push down to turn off and release to leave on, depending on how you have the circuit connected.

1x TOGGLE SWITCH
The toggle switch will hold the state (on or off) when toggled and won’t change until it is toggled again.

1x PUSH SWITCH
These are the classic switches you can find on most electronics. The most basic states are on and off. The push button switch will spring back to an open position when there is no pressure applied, it is technically in a class of switches called “momentary switches.”
Here is a list of tools and supplies that complement your set. We also encourage you to combine this set with other Teknikio sets, particularly the Activating Origami Set.

**MATERIALS AND TOOLS**
- Paper
- Cardboard
- Scissors
- Glue/hot glue

**OPTIONAL MATERIALS**
- Velcro
- Scrap metal and plastic
- Beads and sequins
- Fabric and Thread
- Snaps

**OPTIONAL TOOLS**
- Wire cutters/strippers
- Sewing needle/machine
- Multimeter
Basic Circuits
You probably use switches every day to turn things on and off, and that’s basically what they do. Switches and buttons have a latch inside of them that can open, close, or change position of a connection in a circuit.

In a closed position they allow electricity to flow through them and in an open position they cause a break in the connection and electricity can pass.
A sensor is something that senses an external pressure or force and sends a signal. Switches are really basic sensors. Some of them have unique properties for sensing a specific change. Here are a few interesting facts about the switches in your kit and where they are used as sensors:

**Tilt switches** are used to sense motion or a change in direction. They are sometimes used in construction machinery to warn workers in case the machine is tipping over; they are also used for dangerous jobs where the worker isn’t visible to others to set off alarms if he or she falls over.

**Reed switches** are used to sense distance. They are used on a lot of door alarms to sense when the door is closed or open.

**Lever switches** are used to sense pressure and can open or close a circuit rapidly. They are used in a lot of vending machine type of devices to sense when the claw has reached the top and stop the track from sending the claw too far up or down.
The next section will provide a review of basic electronics and how a circuit works.

Electricity will always take the path of least resistance. For example, if you are trying to build a light circuit and you connect the components like in the drawing below, the light will not turn on!

Things to remember:

**A CIRCUIT IS ALWAYS A LOOP.**

**ELECTRICITY FLOWS FROM POSITIVE TO NEGATIVE AROUND THE LOOP.**

**EVERYTHING IN THE CIRCUIT MUST BE ORIENTED IN THE SAME DIRECTION FOR THE CIRCUIT TO WORK.**

**ANYTIME A COMPONENT IS PUT INTO THE CIRCUIT BACKWARDS, IT CAUSES A BREAK IN THE CIRCUIT, MEANING IT BREAKS THE LOOP.**

**ELECTRICITY WILL ALWAYS TAKE THE PATH OF LEAST RESISTANCE.**
CIRCUIT
The flow of electrons across the circuit, carried by conductive materials. Measured in amps.

OUTPUT
The output, or part that is powered in a circuit. The LEDs and buzzer are loads in your kit.

RESISTANCE
Restricts the rate at which electrons flow through the circuit. Conductive materials have different resistances.

POWER SOURCE
Provides power to the circuit. Yours is the coin cell battery.

SWITCH
Closes and opens a break in the circuit.

BASIC CIRCUITS
If you were to connect the circuit line in the diagram to the left, the current will flow through the shorter (yellow) path and skip the path that connects to the LED.

This will result in a **short circuit**—a short circuit is basically equivalent to connecting from the positive end of the power source to the negative, without putting anything in between.

This will drain or “burn out” your battery very quickly. You should always make sure there are no short circuits in your design.
This guidebook is about how to incorporate circuits and switches into your own creation.

Project Guide

Want to make something else? Find more ideas and tutorials @ www.teknikio.com/learn
GETTING STARTED

1. Trace the house template at the end of this guide to make a house out of cardboard or foamcore.

   If using a hobby knife, have an adult help you with this part!

2. Next you will prepare to fold the house:

   Score the front of the house along the red dotted lines.
   Score the back of the house along the pink dotted lines.
   Cut along the blue solid lines.

3. Time to build the circuit! Start by finding your lever switch in your Sparking Sense Set.

   Let’s go over how this switch works:

   We need to use the terminals that are Common (COM) and Normally Open (N.O.).
   In this drawing, those terminals are in the middle and on the right.
   The Normally Closed (N.C.) terminal is not used in this design.
Flip your house over. You will be working from the inside of the house from here on out.

Put the switch near the middle on the right side of the doorway and orient it so the lever pushes down on the left-hand side.

Push the switch through the cardboard.

Remove the switch so you can see the holes that were made. The circuit will only be using the middle hole and on the right.
Place a strip of conductive tape parallel to the doorway. This tape must cover the middle hole that we made with the switch. Be certain that the conductive tape does not cover the left or right holes.

Now, place a small strip of conductive tape to the right of the first piece of conductive tape as shown, forming an “L” Be sure that the conductive tape covers the hole on the right and that there is a small gap between the two pieces of tape!

Now push the switch back through the conductive tape into the holes.
Now for the interesting part! We are going to make it so that the door activates the lever switch.
Cut a small rubber band in half and trim it to be about 3 inches in length.
Without stretching the rubber band, tape the rubber band to the lever on the switch and tape the other end of the rubber band onto the door like in the diagram below.
Now let's check the door switch. When the door is closed, the switch should be off, and when the door is open the switch should turn on.

If you hear a click coming from the switch as you open the door, that means that it is working! If it not working, make sure the rubber band is secure and that it is being stretched when you open the door.
7. Place the battery on top of the first piece of conductive tape as shown. Be sure that the positive side (plus sign) of the battery is facing up. Tape the battery down tightly onto the house, using a regular tape.

Be sure to leave some exposed space on the top of the battery as you will be making another connection to it.

8. Add another piece of conductive tape that leaves from the top of the battery make sure it makes contact with the exposed part of the battery.

This piece should be shorter than the piece that is connected to the switch.
Now you will add two more pieces of conductive tape.

First, add a long vertical strip, perpendicular to piece x.

Next, add another piece parallel to the previous one, that starts from the piece x and continues vertical into the roof, a little bit taller than the stripe beside it.

You are going to add two more strips of conductive tape across the inside of the roof as shown. The top strip is our positive side and the bottom strip is our negative side. They will tape your LEDs lamps to the house ceiling. For now just tape them down half way.
Time for the lights! LEDs have one short leg and one long leg. The short leg is the cathode (negative) and the long leg is the anode (positive). Bend the legs of the LED’s as shown.

Place the LEDs onto the last two strips of conductive tape such that the positive legs are attached to the top strip and the negative leads are attached to the bottom strip.

Now you can tape down the other half of the conductive strips from step 10. Your final design should look like the diagram below.
Test your circuit by opening up the door. When opening up the door, your LED’s should light up! If your LED’s are not lighting up, be sure to check that all of your conductive tape connections are tight and secure. Also be sure to check that the LEDs are wired correctly and that your battery is oriented with positive side up.

Now you are ready to fold the house! Tape or glue the sides of the house together!

Yay! Party!
Troubleshooting
TROUBLESHOOTING
To make a corner pinch the tape at a 45 degree angle and turn the other side of the tape perpendicular like in the diagram above.

**Do not tear or cut the tape!**

1. To "patch" 2 paths of tape you can take another piece of copper tape and place the non-sticky side across the gap you want to patch and then stick another piece over the top of it.
WHAT IS INCLUDED IN YOUR KIT

**1x LEVER SWITCH**

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