

FUNDAMENTALS OF TINKERING

Below are activity guides and a list of materials you'll need to do each of the hands-on activities on your own. You can buy material bundles from the Exploratorium store at artoftinkering.com or buy/gather everything individually using the list below.

Circuit Boards

Activity Guide (PDF)



Collect these things:

- 2x AA Battery Packs (3 volts total each) [Radio Shack Part # 270-408](#) OR [Jameco Part #216120](#) OR [Jameco Part #216081](#)
- AA batteries
- E-10 Lamp base [Radio Shack Part #272-357](#)
- Mini light bulbs [McMaster-Carr Part # 1505K355](#)
- 1.3 – 3.0 Volts DC motors [Kelvin.com Part # 851230](#) – NB: these types of motors are commonly found in mechanical toys and other household devices, so you might harvest them from old or thrift store toys instead of buying them
- Buzzers [Jameco Part # 1956741](#)
- Knife switch [Arbor Scientific Part # P6-7105](#)
- DPDT switches [Radio Shack Part # 275-1537](#)
- Potentiometers [Jameco Part # 255477](#)
- Alligator clip wires [Jameco Part # 10444](#)

Recommended parts and tools for constructing circuit board blocks:

- Hand crank generator [Arbor Scientific Part # P6-2560](#) – This is a more expensive part and not essential for building a Circuit Board set, however it allows for some interesting experimentation and discoveries.
- Stainless steel or copper nails
- Philips head screws
- Flat head screws

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- Coated wire
- Zip ties
- Soldering irons
- Solder
- Power drill screwdriver
- Hammer
- Saw
- Sand paper
- Wire cutter
- Wire stripper

Other interesting materials to experiment with:

Reused inputs, outputs and switches; micro switches; light sensors; larger battery packs*; LEDs; computer fans; mechanical moving toy parts; doorbells or sound makers

**For safety, we recommend only using direct current (DC) battery packs, that are 6 volts or less.*

Scribbling Machines

Activity Guide (PDF)



Collect these things:

- 1.5-3.0 volt motor Kelvin.com Part # 851230 – NB: these types of motors are commonly found in mechanical toys and other household devices, so you might harvest them from old or thrift store toys instead of buying them
- AA battery
- Markers
- A piece of hot melt glue stick
- Broccoli band
- Recyclable container such as a strawberry basket or yogurt cup
- Tape
- Paper for testing

Other helpful materials:

Clothespins; popsicle sticks; skewer sticks; pipe cleaners; wire; nuts, washers, or other small weights; wire stripper; scissors; small screwdriver; googly eyes.

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Sewn Circuits

Activity Guide (PDF)



Collect these things:

- Conductive thread. Lamé lifesaver <http://members.shaw.ca/ubik/thread/order.html> – This is just like regular thread but has metal wound into it so it acts like a wire. Electricity will flow anywhere where two pieces are touching.
- LEDs (tip: unlike an incandescent bulb, LEDs have a positive and negative orientation. When you attach them to the battery the positive leg needs to touch the positive side of the battery, and vice versa.) <http://evilmadscience.com/productsmenu/partsmenu/383>
- Sew on battery holder <http://search.digikey.com/us/en/products/BA2032SM/BA2032SM-ND/257743>
- Coin cell battery (CR-2032) SparkFun part # PRT-00338
- Round nose pliers <http://amzn.com/B002QKE6ZW>
- Felt
- Needle

Other helpful materials:

Needle nose pliers; other non-fraying fabrics like vinyl, pleather, etc.; thread; buttons; pincushion; needle threader; scissors; fabric glue; sharpies; pens/pencils; stuffing. Conductive tape (<http://www.lessemf.com/fabric.html> "Ni/Cu/Co FABRIC TAPE").

Paper Circuits

Activity Guide (PDF)



Collect these things:

- Cardstock or construction paper
- Copper tape [Tip: You can get 5mm copper tape, ready for use, from sparkfun.com (part #PRT-1-561). It is also often sold in hardware stores under the name of Slug Tape – it is taped to the lip of planters to prevent slugs and snails from climbing in! In that case, you might want to cut it into thinner strips before using it on your paper circuit.]
- Surface mount LEDs www.sparkfun.com Part numbers:
 - Blue #12620 <https://www.sparkfun.com/products/12620>
 - White #12621 <https://www.sparkfun.com/products/12621>
 - Red #12619 <https://www.sparkfun.com/products/12619>
 - Green #12622 <https://www.sparkfun.com/products/12622>
 - Yellow: unfortunately sparkfun doesn't stock yellow. If you really want it, you can buy it from digikey.com: Digikey part # 754-1144-1-ND)
- Coin cell battery (CR-2032) [SparkFun](http://SparkFun.com) part # PRT-00338

Other helpful materials:

Soldering iron, safety glasses, multimeter, tweezers, binder clips, scotch tape, scissors, x-acto knife, pencil and pens, small hole punch, glue stick, bone folder (or popsicle stick).

Toy Take Apart

Activity Guide (PDF)



Collect these things:

- Old or broken mechanical toys (think mechanical plush animals, dancing Santas, remote control cars, and more) NOTE: thrift stores are a great resource for finding interesting toys to take apart; give them a good clean when you get home.
- Screwdrivers in various sizes
- Scissors or x-acto knife
- Small saw (such as a utility saw) and vice to hold whatever you're cutting
- Wire stripper
- Safety glasses
- Plastic gloves

Other helpful materials:

Extra batteries, cafeteria tray (great as a work surface and to stop small parts from rolling away), soldering iron/solder/fume extractor, hot glue gun, snips, thread, needles, alligator clips or extra wire, hand wipes (for you and for de-greasing parts).

MaKey MaKey

MaKey MaKey creator Jay Silver has put together a great **SketchIt PlayIt Activity Guide** that we recommend you download and try out.

Collect these things:

- **MaKey MaKey kit**
- Computer with USB port

Other helpful materials:

A variety of conductive and non-conductive materials for building and experimenting with, such as: aluminum foil, pencil (graphite is conductive) and paper, clothes pins, brads, paper clips, hook up wire, craft foam, metal ball bearings, springs, cardboard, pipe cleaners, straws, play-doh, the possibilities are endless!