Activity description: **SOFT CIRCUITS**

- plan your design
- test the components (LED, resistor, battery)
- attach components
- wiring

Age level: 9+

Time frame: medium to long

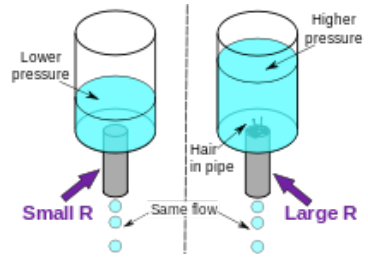
Equipment needed:

BASICS

- felt for bracelets (thicker is better)
- buttons or other decorations
- LEDs, resistors, 3V batteries
- paperclips & safety pins(or something for connectors)
- beading wire or conductive thread
- black thread (or thread to match your bracelets)
- scissors, pliers

OPTIONAL CUSTOMIZATIONS

- soldering iron and solder



The hydraulic analogy compares electric current flowing through circuits to water flowing through pipes. When a pipe (left) is filled with hair (right), it takes a larger pressure to achieve the same flow of water. Pushing electric current through a large resistance is like pushing water through a pipe clogged with hair: It requires a larger push (voltage drop) to drive the same flow (electric current) (courtesy of wikipedia).

1. **design your bracelet.**
   - Get one piece of felt and make sure it is long enough to go around your wrist, with a bit of overlap. You will get one LED. Pick decorations and plan how you wish them to look on your bracelet with the LED.

2. **test the components**
   - get a LED, a battery and a resistor. Connect the long end of the LED to the + side of the battery, and short end of the LED to the – side. Does it light up? Now put the resistor in between the battery and the LED – on either side, it doesn't matter which. Does it still light up?
   - *Why do we need a resistor?* The LEDs only require around 1.7V, but you are using a 3V battery. This will burn out the LED eventually, so we resist the pressure (see explanation above) to allow the LED to use the current supplied by the 3V battery without burning out.
   - **What did we learn?** (explain about positive and negative terminals of the battery, and how when we create the circuit with the wires the electrons flow through the circuit. Nice explanation here: http://www.edinformatics.com/math_science/how_does_a_battery_work.htm)

3. **attach your components**
   - attach your decorations by sewing them on.

- poke the LED legs through the felt and use pliers to twist them around kind of like this:

- do the same with ONE LEG of your resistor, then sew it to the inside of the bracelet near to one end. poke the other leg up through the felt, then curl it over.
- at the other end of your bracelet sew a safety pin to the inside. Have about half of the pin stick out beyond the edge of the fabric.

4. wiring

- Use the wire to connect the resistor to the LED, then the LED to the safety pin. Did you keep track of which is the positive end and which is the negative end? Try to get your connections as tight as possible without breaking the wire. This is where soldering would be good.

5. attach the battery

- put the battery on top of where your resistor leg pokes out, then wrap the bracelet around to touch the safety pin to the top of the battery. If the LED doesn't light up try flipping your battery over. If it still doesn't light up check to make sure all your wiring connections are good (that is, that they connect tightly to everything they are supposed to connect to, and that there are no short circuits).
- take a square of felt and cut it to around the size of your battery. Get one of the paperclips that has been cut for you, and poke the ends through the square so you have a loop sticking out the other side. Sew it on tightly – this will be your hook for doing up your bracelet.
- sew your square on top of where your resistor leg sticks out, so that the loop is on the outside. This is your battery holder – make it tight enough that the battery won't fall out, but loose enough that you can slide the battery in. The felt will stretch, so better to make it too tight than too loose.
- put in the battery and try on the bracelet – DOES THE LED LIGHT UP?

6. reinforce the connections

- if you haven't got a soldering iron use some extra thread to sew your connections together more tightly
- tack down the wire. Just loop your thread around the wire and stitch it more firmly to the bracelet so it doesn't get caught on anything.
- YOU'RE DONE!

Resources

- this idea was copied from the high-low tech website: http://hlt.media.mit.edu/?p=1003
- the soft circuit activity guide from high-low tech provides additional resources: http://web.media.mit.edu/~emme/guide.pdf
- other sites to check out:
  - http://hlt.media.mit.edu/?cat=20 (more stuff from high-low tech)
  - http://www.fashioningtech.com/page/soft-circuit-tutorials
  - https://learn.sparkfun.com/ (supplier, as well as lots of neat ideas)
  - CUTEST PROJECT IN THE WORLD: http://soft-circuit.com/wp-content/uploads/2010/05/Tutorial_Peanut.pdf