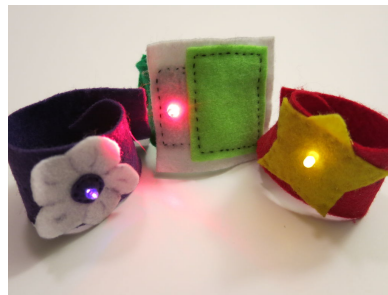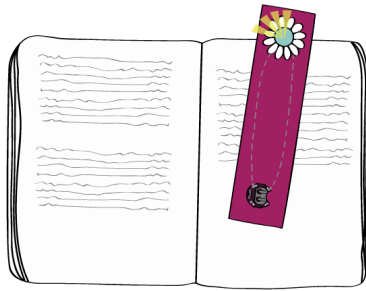# An Electronic Textiles / Soft Circuits Project for Beginners

Make a light-up bookmark, wristband, pin, or similar item*

Materials: Felt, conductive thread, LED(s), coin cell battery (CR2032), battery holder

More materials, optional: Metal snap, safety pin, regular thread, embroidery thread, fabric paint
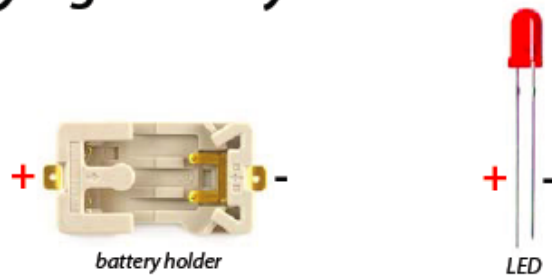
Tools and supplies: Sewing needles, craft glue / hot glue, clear nail polish, sharp scissors, needle nose pliers, tweezers
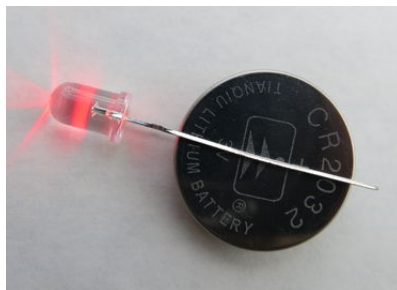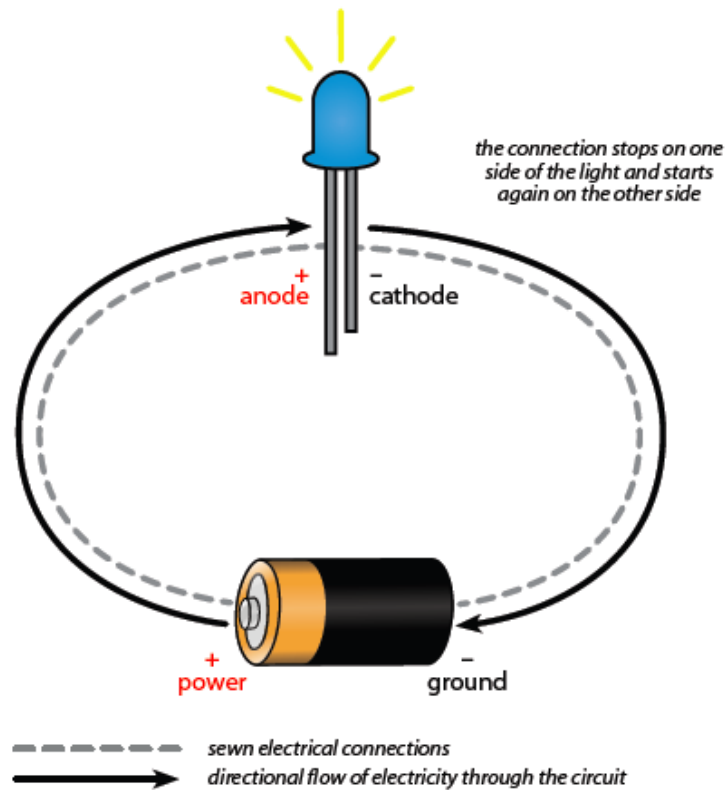
Overview of steps

1) Understand your materials — learn how to light up an LED using a coin cell battery
   → See the simple circuits on pages 2–3

2) Sketch your design — what does it look like? Where do the LED(s) and battery holder go?
   If you're using snaps to make a switch, where will they be placed?
   → See the examples and tips on page 4

3) Cut a long rectangle or other shape(s) out of felt — or use your own fabric / hat / t-shirt…

4) Glue your battery holder in place if you like — use just a dab of glue to keep it still while you sew

5) Sew the circuit that connects the battery holder to the LED(s) and snaps
   → See the sewing advice on pages 5–6

6) Embellish your design — use more felt pieces, fabric paint, embroidery thread…

7) Insert the battery into the battery holder (+ side up) and close the switch, if needed

8) Enjoy!

* Based on the tutorials listed on page 6

Identifying Polarity

battery holder

LED

A Simple Circuit Schematic

the connection stops on one
side of the light and starts
again on the other side

anode + − cathode

+ power ground −

- - - - - - sewn electrical connections
————→ directional flow of electricity through the circuit

Testing: Insert the battery between the legs of the LED. The longer leg (positive) should touch the side of the battery with the writing on it (also positive). If you have the battery turned around, it won't work (and it won't hurt the LED).

Simple Circuit Schematic for Lights in Parallel

+ –

+ –

+
power

–
ground

– – – – – – – *sewn electrical connections*
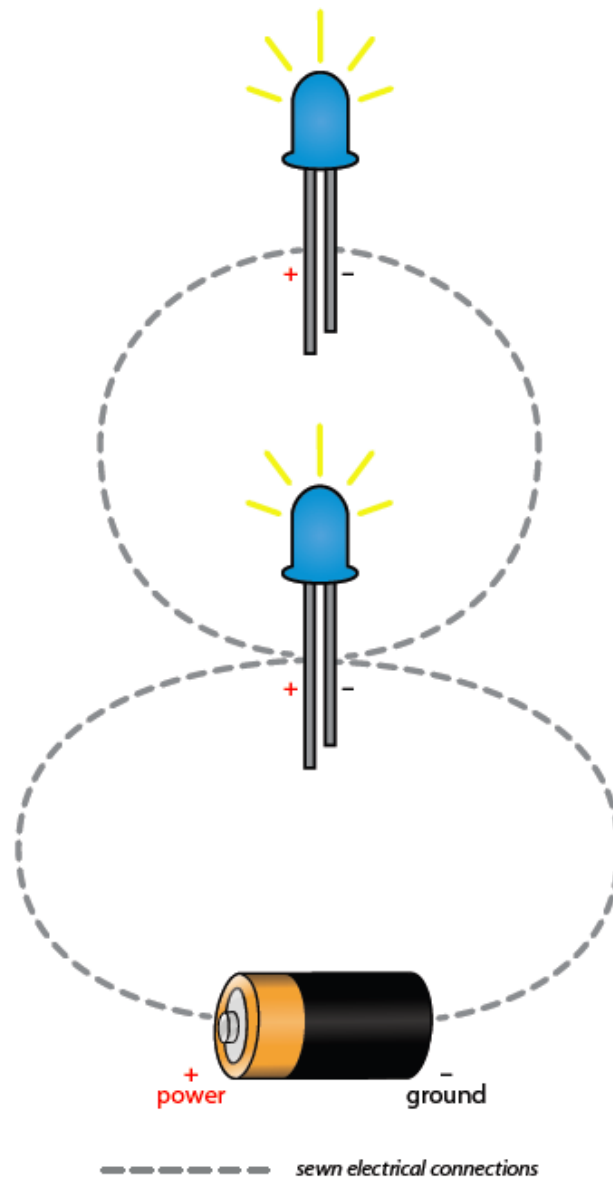
Recap: What's a circuit?

A circuit is an uninterrupted path made from conductive elements (such as metal wire or conductive thread, lights, motors, and sensors) that lets electricity flow between the power and ground sides of a power source. A switch creates an opening in the path, which interrupts the flow. The positive trace consists of the wire or thread that connects the positive side of the power source to the positive side of each component; similarly, the negative trace connects components to ground.

A short circuit occurs when there is a direct path, without components, from power to ground. The battery will drain instantly (and larger power sources can cause shocks and start fires). Avoid loose threads (such as long tails on knots), touching or crossing traces, and unintended folds.

Design examples and tips

These bookmarks show an alternate style of battery holder. Use snaps to create switches.
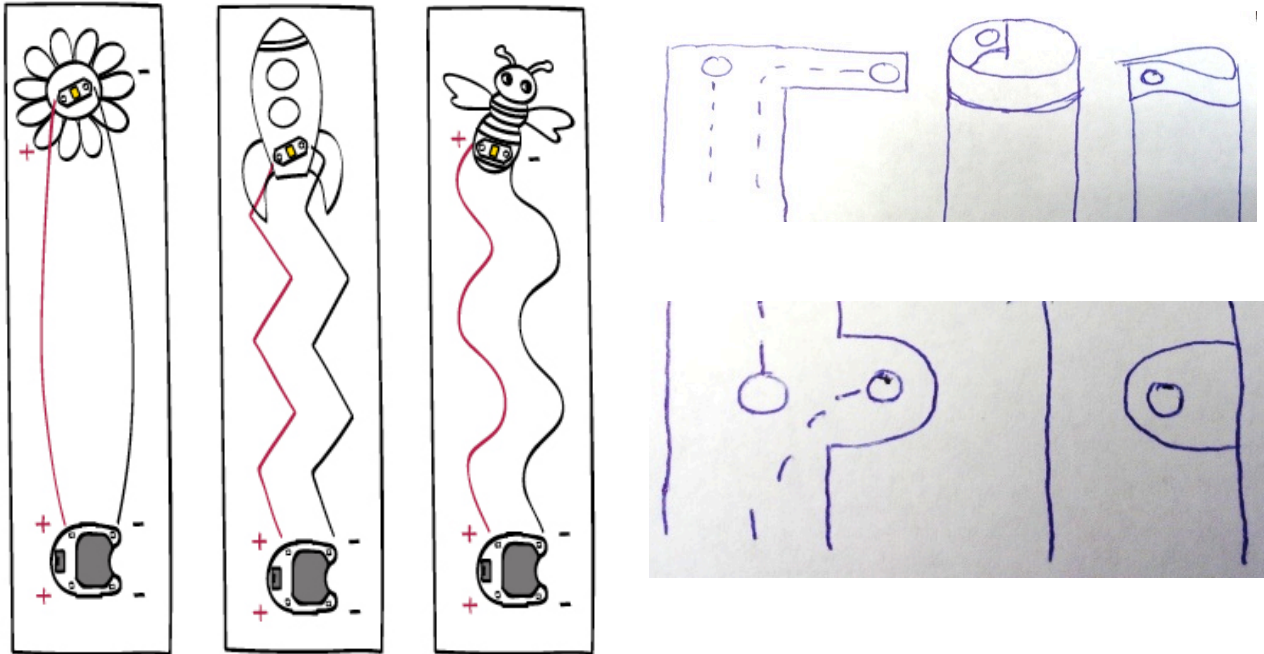
For wristbands, the snap halves go on different sides of the fabric—check fit before sewing in place.
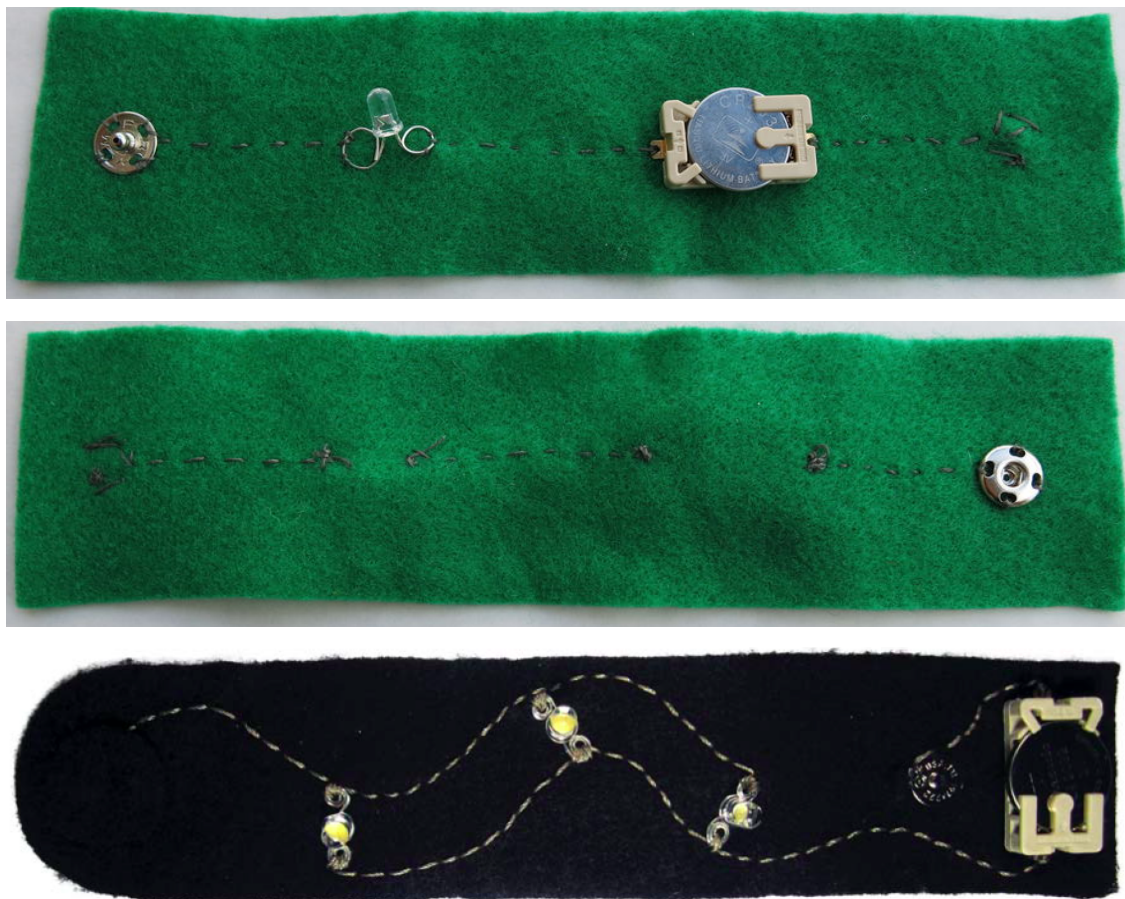
Sewing tips

<u>Preparing needles and thread</u>

For e-textile projects, your needle should have a large eye (easier to thread) but be narrow enough to pass through attachment holes in components (such as battery holders).

Use about two feet of thread to start. Cut through the thread at an angle (makes threading easier).

Avoid cutting conductive thread over your work, because doing so creates mini-fibers that can cause shorts later. A small piece of tape is helpful for removing such fibers, but some will likely be left behind.

To thread the needle, use a needle threader or pull the end between damp fingertips before pushing it through the needle's eye. Tweezers can help you pull it through.

One tail should be short (a few inches) and the other should be long. Make a knot at the end of the long tail.

<u>Sewing traces</u>

Traces can be part of the design, or you can cover them up with other materials. Any shape is OK, as long as you avoid creating short circuits. Lightly mark traces on the fabric before sewing.

Hold the eye of the needle while you sew so that the thread doesn't slip out.

Start by pulling the thread all the way through the fabric from the side that won't be seen, so that the knot in the long tail is up against the fabric.

Use a running stich (looks like a dotted line) with short (1/4"), flat stiches, continuing to pull the thread all the way through. Avoid puckering the fabric.

Remember, connect positive to positive, and negative to negative. Carefully secure any thread-to-thread connections (as when adding more thread to an existing trace).

Put all knots on the side of the fabric that won't be seen, cut the knot tails short (1/4"), and use a bit of nail polish or glue to keep them from unraveling.

<u>Attaching components</u>
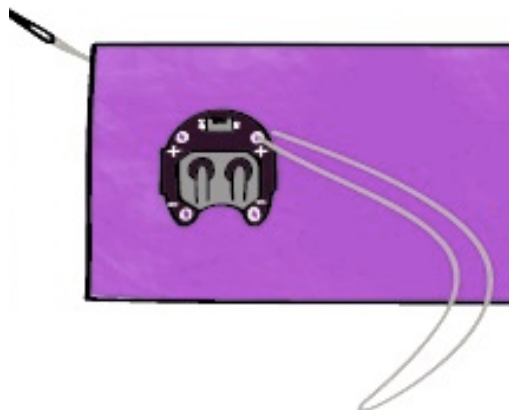
For good connections, make at least three loops of thread through every attachment point, pulling the thread snug. You'll push the needle down (or up) through the hole in the component and back up (or down) through the fabric next to the component several times so that the edge of the component is surrounded by the loops of thread.

Snaps have multiple attachment points, and you can use regular thread (which is less expensive than conductive thread) for the holes that don't have traces attached.

To make LEDs sewable, curl their ends using needle nose pliers. Keep track of which side is positive by marking it or by curling the two ends differently. If you like, you can poke the legs though the fabric before curling the ends. You can even make pilot holes with your needle first!
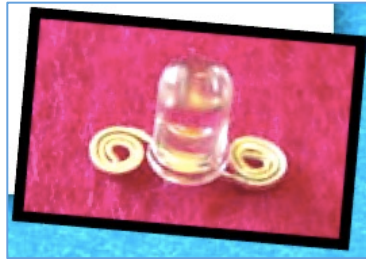
Pages 3 and 4 show how to add extra LEDs.

Touching / overlapping traces

Avoid short circuits by preventing positive and negative traces from touching or overlapping.

If your design requires an overlap, insulate traces from each other with extra fabric.

Also avoid direct connections between the positive and negative sides of any component.

Double-check for loose threads and other possible causes of short circuits before putting in the battery. It goes into the holder with the positive (+) side up.

Tutorial sources
http://sewelectric.org/diy-projects/bookmark-book-light/
http://sewelectric.org/diy-projects/bookmark-book-light/design-your-bookmark/
http://sewelectric.org/diy-projects/bookmark-book-light/build-your-bookmark/
http://alumni.media.mit.edu/~emme/guide.pdf
http://www.instructables.com/id/LED-Cuff-Bracelet/?ALLSTEPS
http://www.atxdiy.com/2010/07/05/tutorial-sew-a-simple-circuit/
https://learn.sparkfun.com/tutorials/sewing-with-conductive-thread/all
Book: Fashioning Technology
http://www.youtube.com/watch?v=04fbilyg36Y

Image sources
http://sewelectric.org/diy-projects/bookmark-book-light/
http://www.instructables.com/id/LED-Cuff-Bracelet/?ALLSTEPS
http://www.pinterest.com/pin/286330488779404569/
http://alumni.media.mit.edu/~emme/guide.pdf
http://sewelectric.org/diy-projects/bookmark-book-light/design-your-bookmark/
https://learn.sparkfun.com/blog/1361