

# 1/What You'll Need

The great thing about the FLORA platform, and wearable electronics in general, is how accessible it is to all types of people. Basic projects require very little knowledge about electronics and only a few inexpensive tools. For more complex projects, you will need more specialized tools and a few basic skills.

## Tools

The following tools are used throughout this book and your FLORA projects. Making is more fun with good quality tools, so invest a little extra when you can.

## Sewing Needle

Needles (Figure 1-1) carry your thread (conductive or otherwise) through fabric by piercing it with the sharp tip, while the hole at the other end holds the thread. When you push/pull a needle through, the thread comes with it, making a stitch.



**Figure 1-2.** Sewing needles

Needles come in different sizes and sharpness, based on their use: blunt big-eyed ones for tapestry and cross-stitch, extra

sharps for embroidery, and multipurpose in between. You can purchase a needle assortment for building wearable electronics; just make sure that the eye (the fattest part) of the needle you choose fits easily through the holes on the components of your circuit. See [Chapter 4](#) for a primer on stitching.

## Scissors

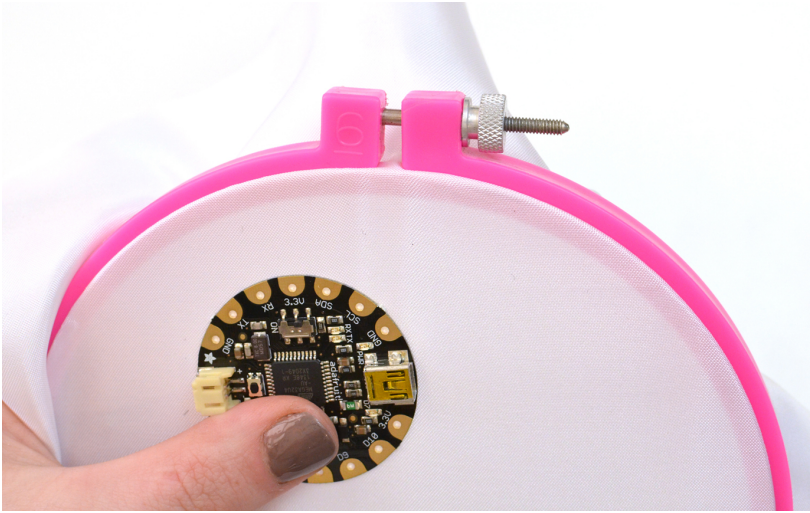
Keeping your scissors ([Figure 1-2](#)) sharp is very important! Conductive thread and fabrics dull your scissors quickly because they are made of metal. Large, heavy scissors can be great for cutting out large pattern pieces or heavyweight materials, and you'll also want a small, pointy pair for snipping loose threads. Metal textiles can be tough on the blades; to keep them sharp the longest, avoid using your good craft scissors to cut paper. Get them professionally sharpened when their performance starts to decline.



**Figure 1-3.** *Various scissors*

## Embroidery Hoop

For many wearable projects, stretching the fabric circuit substrate taut during sewing can make the whole process much easier and results in a more refined final project with clean, unbunched lines. An embroidery hoop ([Figure 1-3](#)) is composed of two nesting rings that sandwich the fabric between, and the outer ring tightens to pinch the fabric, holding it taut. They are available in many sizes. Our favorites are the plastic style with a “grip lip” for added staying power. [Chapter 4](#) also covers embroidery basics.

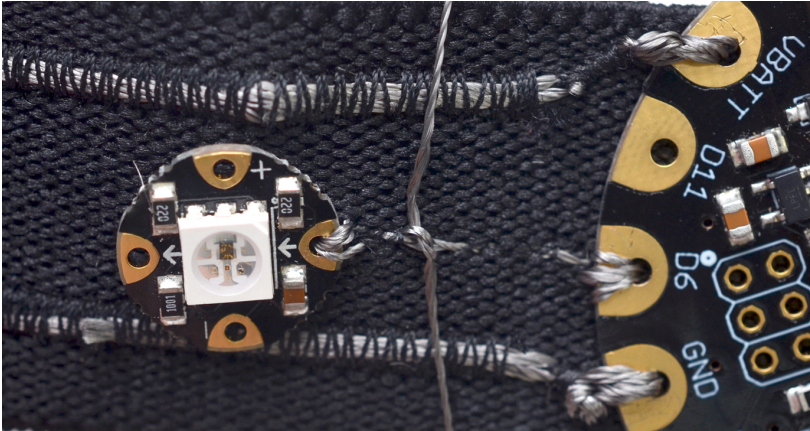


**Figure 1-4.** *Fabric in an embroidery hoop*

## Conductive Thread

Conductive thread is a flexible, sewable fiber made (in part or whole) of metal, and is used to conduct power and digital signals in many wearable electronics. There are two main types: silver plated nylon, which tarnishes over time and loses conductivity, and stainless steel fiber, which is entirely metal throughout and does not oxidize nearly as easily as silver. All conductive thread has resistance greater than wire, which means that across long distances it loses power. So, depending on your project and circuit, you may wish to double or triple up the thread to increase its power delivery to your components ([Figure 1-4](#)).

Keep your stitches small and snug throughout your circuit to prevent unintentional shorts. Keep power and ground lines far apart from each other. A short between power and ground will prevent your project from working and may even cause your battery to heat up. Check your circuit for shorts after finishing each path in your circuit. This way, if you do discover a problem, you will know the likely location of the stray thread/short circuit.



**Figure 1-5.** Multistrand power and ground lines, double-strand signal line

## Clear Nail Polish or Fray Check

Because of its metal content, most conductive thread won't stay tied in knots by itself—it's too springy. Dabbing a spot of adhesive on the knot and allowing it to dry while pulling the knot tight keeps thread in place. Try clear nail polish (Figure 1-5) or Fray Check (a commercial product for the prevention of fabric fraying) for this purpose. They are both flexible and insoluble in water, and offer more precision than a clunky glue gun.



**Figure 1-6.** Nail polish

## Sewing Machine

A sewing machine is not required for any project, but it sure makes things easier sometimes! Any standard sewing machine can make straight and zigzag stitches. Thin 2-ply conductive thread can be used in the bobbin of the machine, or plain thread can be used to affix many strands of conductive thread to fabric with a zigzag stitch ([Figure 1-6](#)).



**Figure 1-7.** Use a sewing machine to zigzag over conductive threads

## Disappearing Marking Pen

Sold at craft stores in the embroidery section, a disappearing marking pen ([Figure 1-7](#)) can be handy for planning out your circuits—just dab with a moist towel and the blue ink turns clear! On dark fabrics, you might try tailor's chalk instead, which is shaped in a wedge for easy markmaking. Regular chalk is a valid substitute.