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**Make:**

# Make It Glow



**LED PROJECTS FOR THE WHOLE FAMILY**

EMILY COKER

KELLI TOWNLEY

# Make It Glow

**LED PROJECTS FOR  
THE WHOLE FAMILY**

In the daytime, the world is a colorful place.  
At night, darkness may steal those colors away.  
But with the activities in this book—along with  
a little creativity and inspiration—  
you can light up your world, and make it glow.



# Make:

## **Make It Glow**

LED Projects for the Whole Family

Emily Coker and Kelli Townley

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# INTRODUCTION

Many of the most amazing devices around us today—from microwave ovens that can sense when your potato is done to the videogame systems that can respond to your spoken commands—get their smarts from the electronics inside.

Electronics (see the word “electron” in there?) is essentially the science of manipulating electrical energy. And that’s where this book begins. These activities have been crafted to give everyone—from the tech-savvy to the tech-wary—a way to start exploring the skills and materials that are at the heart of the world of electronics.

The projects in this book introduce you to some simple, fun ways to brighten your life. With these activities, you can light up the night with LED balloons, make a glow-in-the-dark fashion statement (for you and your pet!), and create lightning in your living room. Try making soda-bottle ghosts with glowing eyes, crafting light-up holiday cards, and bringing a well-loved stuffie to life.

## **It’s Not Just Cool... It’s Science**

Everything in the world—  
including you—is  
made from  
zillions of  
tiny

particles called atoms. No matter how nearsighted you are, you can’t actually see them, so don’t bother trying. But by using special microscopes, scientists can see that they’re there.

Moreover, each atom is made up of even tinier bits and pieces called protons, neutrons, and electrons. Put those pieces together in different ways, and you get all the different elements in the universe—from the carbon in your pencil lead to the calcium in your bones. They’re all made out of atoms.

You can think of an atom as a little clump of protons and neutrons surrounded by a swarm of electrons madly zipping around it. The way those electrons behave is what we’ll be exploring in this book. By manipulating them with magnets and batteries, and moving them through wires, threads, and tapes, we’re going to make the world glow.

This is not a technical treatise. You don’t have to know anything about electricity to create these projects. You don’t need to be an electronics wiz or a computer geek. In fact, you don’t even need a computer. You just need to be willing to play around with stuff you may never have explored before.



Be sure to gather the tools and materials for each project before you begin. You should be able to find everything you need online or at stores that sell crafts and party supplies, hardware, and electronics. We've tried to help out by including photos of some of the most important materials in each activity so you can identify components, even if they're unfamiliar.

You can do the activities in any order, but we recommend beginning with chapter 1, which introduces some basic ideas and techniques. Some projects are more challenging than others, so we've also included a handy skill-level guide, which you can find on page 133.

**That said, these projects do require a few basic skills and techniques:**

Chapters 1 and 2 introduce easy activities for lighting things up by using LEDs and batteries, and you'll make simple switches. No special skills are needed, though parental guidance may be a good idea for children who have not had practice with hot-glue guns or craft knives.

Chapters 3 and 4 introduce new tools and more-advanced techniques. Household tools such as wire strippers, needle-nose pliers, and screwdrivers are occasionally needed. Several activities require sewing and soldering. If you've never used a needle and thread or handled a soldering iron, be sure to have an experienced Maker with you who can show you the ropes—or do your homework to learn how to use these tools yourself, so you don't get hurt!



**For your convenience, skill levels for each activity are identified so you know what you're getting into. For activities sorted by skill level, see the list on page 133.**

**SKILL LEVEL 1**

**FOR THE FUN OF IT**

No special skills or experience are required for these projects, though hot-glue guns, craft knives, and other common tools and materials may be needed.

**SKILL LEVEL 2**

**FOR YOUR INNER SCIENTIST**

These intermediate-level projects introduce new materials, tools, and techniques—from paper folding (origami) to simple sewing skills—and they may require participants to follow more precise instructions. Adult supervision suggested.

**SKILL LEVEL 3**

**FOR THE ADVENTUROUS MAKER**

These more challenging projects may take longer or require more complex skills, including sewing and soldering. Some introduce new components, such as resistors. Adult supervision highly recommended.



# A PRACTICAL PRIMER: CIRCUITS, BATTERIES, LEDS, AND MORE

**T**he materials needed to explore the world of electronics may not be familiar to work with, but you've seen them, and used them, all your life. Whenever you use your cellphone, printer, or computer, flip on a fan or light switch, or play a videogame, there are electronics at work, making things go.

Most of us never get to see how the circuits, batteries, bulbs, motors, LEDs, and wiring inside our electronic devices actually work, but those are exactly the kinds of things we're going to play with here. This primer will give you a simple, nontechnical foundation that will help you start making discoveries on your own.

## Tips for Creating the Circuits Used in This Book

- + Your job in these projects is to connect batteries to LEDs via one-way, circular pathways, called circuits. The batteries provide electrical current; the LEDs use it.
- + The metal wires, threads, and tapes you use to connect your batteries and LEDs are known as “conductive” materials: they “conduct” the flow of electrons through circuits. Once electrons are flowing through a circuit, they make LEDs light up. (Like flowing water, flowing electrons are also called a current!)
- + Always make sure you've created a clear and complete path for current to flow through your LEDs. If the electrons in your circuit flow directly from one side of your battery to the other (without going through an LED or other electrical

component in between), they cause a problem called a “short circuit”—or sometimes just “a short” ... for short. Without something to power (such as an LED), too much current will flow, causing damage to your circuit. Short circuits can happen if the current isn't doing anything but circulating back to the battery, or if parts of your circuit cross over one another. Check your battery—if it's heating up, it's a sure sign of impending problems.



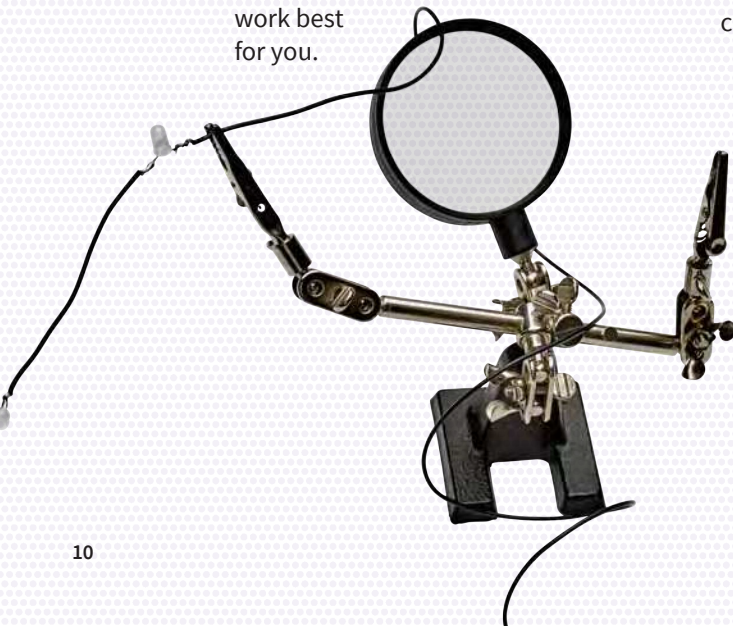


## Tips for Using Batteries & Resistors for the Projects in This Book

- ✦ All but one of the projects in this book use small, button-sized, 3-volt, lithium coin-cell batteries, identified commonly as CR2032. (The Light-up Tote Bag uses a 9-volt battery instead.) You can buy packs of coin-cell batteries just about anywhere; get them a few at a time or in bulk. But don't jumble them together. Regular batteries have their positive and negative terminals on the ends, so it's easier to keep them apart. A coin-cell battery's terminals are exposed. If they touch, they can short each other out. Either keep coin-cell batteries in the package or tape them individually to pieces of cardboard so they stay fresh.
- ✦ Batteries generate voltage. LEDs use it up. In any circuit, the two must balance. To make sure each project works as intended, we've figured out which batteries work best with which LEDs, so be sure to use the ones recommended! If you double up on batteries to make an LED shine brighter, you're just likely to burn it out instead.
- ✦ You need to “feed” your LEDs just the right amount of electrical current for them to be at their best. Not enough, and they won't glow. Too much, and they'll burn out. In a few projects, we've added resistors to control the amount of current getting to the LEDs. They'll help the batteries last longer, protecting your circuit from any electrical overloads and letting each LED shine its brightest. The 3-volt coin-cell batteries that power most of these projects create low levels of electricity, so can be safely used without resistors.
- ✦ Coin-cell batteries are great for projects, but the chemicals inside are highly corrosive, and their small size makes them attractive to toddlers and young children. Be sure to store and dispose of your batteries responsibly. Keep them far away from small children, and don't just throw them in the trash when you're done with them! Many hardware and crafts stores will recycle them for you, or check with your local refuse company to find out if they will take spent batteries.

## Tips for Using LEDs for the Projects in This Book

- ✦ All of the projects in this book glow by using LEDs, or “light-emitting diodes.” LEDs come in lots of sizes and colors. Some LEDs blink, some pulse, some cycle through a rainbow of colors. Some LEDs are blindingly bright, and others glow softly, with diffused light. There are flat “surface mount” LEDs, bulky “gumdrop” LEDs, adhesive “circuit sticker” LEDs, sew-on “sequin” LEDs, and even long strips of “ribbon” LEDs. Specific sizes (3mm, 5mm, 10mm, for instance) refer to the diameter of the LED. The variety is endless, and different kinds are available online and at craft stores.
- ✦ We’ve recommended specific LEDs for some of these projects, but you can pick your favorites for most projects. As you work, though, note that different LEDs use different amounts of current, so some colors or sizes may end up being brighter than others. Experiment to find the ones that work best for you.



## Tips for Using Conductive Materials for the Projects in This Book

- ✦ Where wire is used in these projects, look for stranded wire in the 18–22 gauge range. And while you might think that electrical current can only flow through wires, that’s not the case! These days, there are lots of cleverly made conductive materials you can use in circuits. In addition to wire, we’ve used copper tape and conductive thread, but you might want to experiment with conductive paints, glues, and inks, too.
- ✦ Note that there are lots of different types of copper tape on the market. Some are stickier than others; some are more conductive than others. They also come in different widths, but you can cut copper tape lengthwise if it’s too fat to fit neatly in your projects. A few tear too easily to be useful for electronics projects, and some have coatings that need to be scraped off at their terminal ends. Watch for products made for crafts and Maker usage.
- ✦ Conductive thread, in general, can be knotty stuff to use—after all, it’s made of metal. But the better the quality, the easier it is to work with. Other than that, you can just sew with it like you would any thread. You don’t need to double it, like you would in some sewing tasks; single threads will work best.

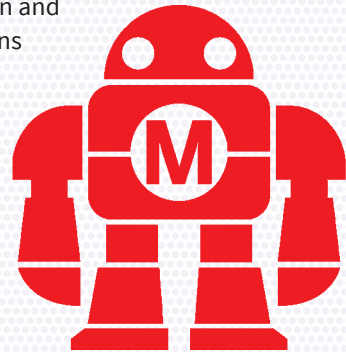
## ABOUT BEING A MAKER

We're all Makers, of course—creators of personal, imaginative, unexpected stuff that may come out of a classroom, kitchen, office, playroom, sewing room, or just about anywhere. But the community of Makers who experiment with electronics take their creative juices one step further, playing with the very nature of, well, nature itself.

The team that worked on this book brainstormed and experimented at every step and ended up taking some unexpected paths. Now it's your turn.

If you think something would work better upside down and inside out, give it a try! If you want to see what happens when you use old Christmas lights instead of flashing LEDs, use them! If you think sticky-back Velcro will work better than glue, Velcro away!

Let your curiosity drive your creativity, and you'll find that one discovery will naturally lead to another. And if you find yourself suddenly inventing your own projects, then you've joined the ranks of Makers around the world, and our job here is done.



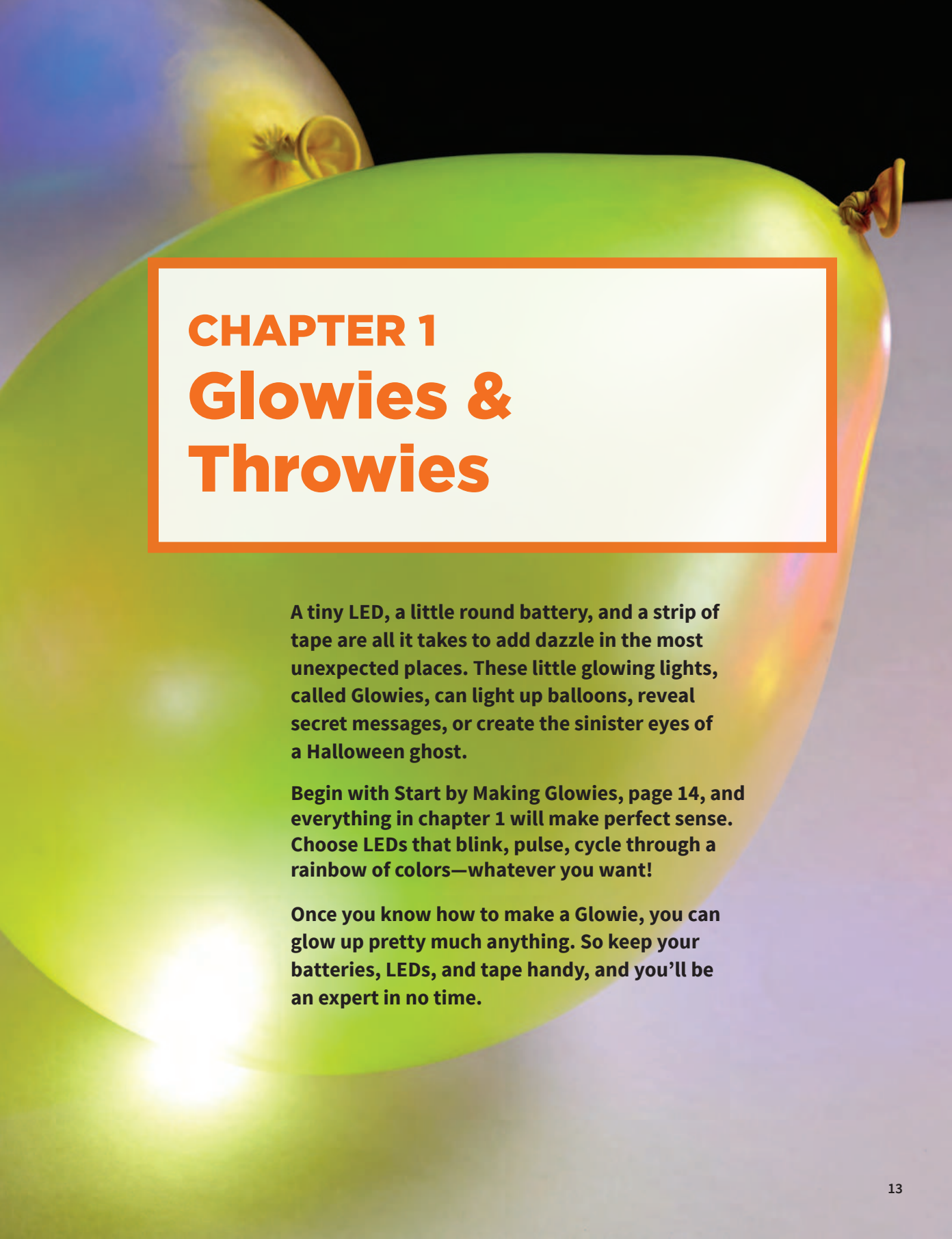
### AN IMPORTANT NOTE ABOUT SAFETY

Children working on the activities in this book will often need adult supervision. Depending on the project, participants may be asked to use craft knives, hot-glue guns, needles, soldering irons, and other tools and materials that will require oversight. Please keep safety in mind as you experiment and explore.

Maker Media connects Makers with one another, creating ideas and products that let curious inventors push the boundaries of their own knowledge and skills.

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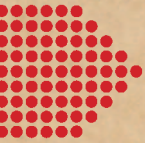
# CHAPTER 1

## Glowies & Throwies

A tiny LED, a little round battery, and a strip of tape are all it takes to add dazzle in the most unexpected places. These little glowing lights, called Glowies, can light up balloons, reveal secret messages, or create the sinister eyes of a Halloween ghost.

Begin with *Start by Making Glowies*, page 14, and everything in chapter 1 will make perfect sense. Choose LEDs that blink, pulse, cycle through a rainbow of colors—whatever you want!

Once you know how to make a Glowie, you can glow up pretty much anything. So keep your batteries, LEDs, and tape handy, and you'll be an expert in no time.



# Start by Making Glowies

## SKILL LEVEL 1

Tape an LED to a battery and you've made a "Glowie." This simple circuit is the secret ingredient for all the activities in this chapter. In fact, it's the basis for lots of different ways to make your world glow.



## Get your tools & materials...

### TOOLS

- » Scissors

### MATERIALS

- » One LED (any type)
- » One 3V coin-cell battery (CR2032)
- » Tape (any type)

## ...and MAKE it!

**1.** Sandwich a battery between the legs of an LED. Make sure the LED's longer, positive (+) leg is on the smooth, positive (+) side of the battery, and its shorter, negative (-) leg is on the bumpy, negative (-) side of the battery. The LED should light right up. If it doesn't, flip the battery and try again.



**2.** Use scissors to cut a piece of tape, and tape the LED legs and battery tightly together.

