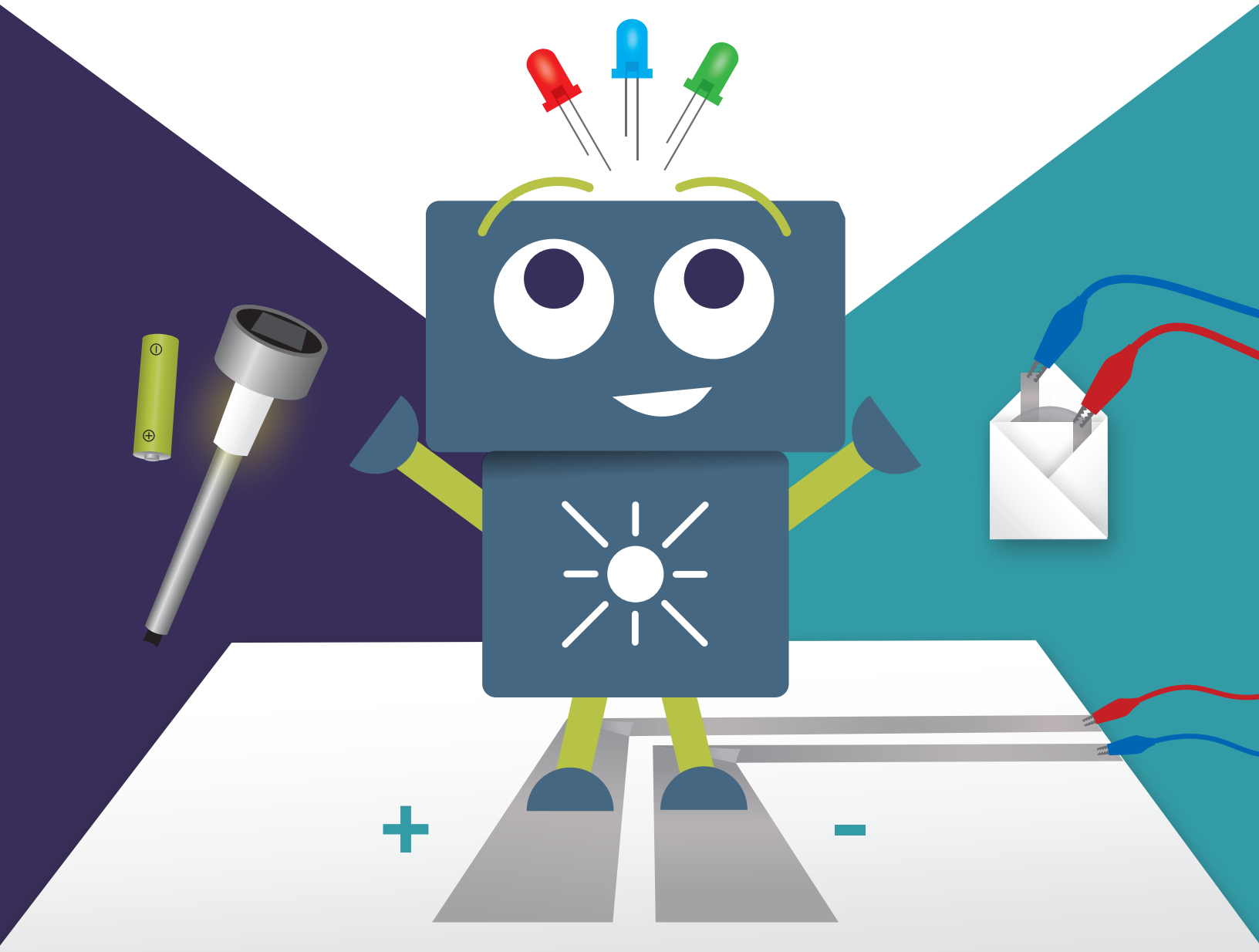
A creative and innovative way for young engineers to explore circuitry

NATIONAL PEER REVIEWED

#1 EXPLORE A POWER PARK:

PAPER CIRCUITS



The activities in this book offer a hands-on introduction to electric circuits using LEDs and conductive tape. The pages are full of opportunities for exploration and challenge young designers to problem-solve and think creatively and critically. Power engineers spend their careers making electricity available to people all over the world and report a thrill every time the lights come on. We want this same thrill, literally and metaphorically, to inspire the next generation of scientists, engineers, and makers.

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ACKNOWLEDGEMENTS

We love to tinker. We thank all of the creative individuals and groups who have brought tinkering into homes and classrooms through more accessible materials, supplies, and activities. We have been inspired by the work done by educators and makers at Adafruit, SparkFun, the Exploratorium, the MIT Media Lab and High-Low Tech group, Chibitronics, the 21st Century Notebooking group, and by many teachers and students who are lighting things up.

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Learn More

FOR THE FACILITATOR

This circuity curriculum offers a hands-on introduction to electric circuits using LEDs and conductive tape. The pages are full of opportunities for exploration and challenge young designers to problem-solve and think creatively and critically. The activities are meant to ignite a young person's curiosity and imagination, opening the mind to new possibilities and moving him or her to play, tinker, and explore.

Short tutorials and background information accompany puzzles and challenges. The activities build on each other and are designed to allow youth to learn by doing. Each curriculum book becomes a completed workbook full of solved puzzles, met challenges, and creative light-up projects.

As a facilitator of these projects, encourage youth to use their troubleshooting and problem-solving skills and to learn from every situation. Even when there is a "power outage" there is something to be learned. The activities have been designed to promote creative design and encourage empowered learners. The materials offer opportunities for collaboration and encourage redesign.

This curriculum was written for youth in Grades 4-9, but may be used and adapted for younger and older audiences, based on experience.

Each book in the **Power Park** series was written using the International Society for Technology in Education (ISTE) Standards for Students, Next Generation Science Standards (NGSS), and Common Core State Standards (CCSS) for Mathematical Practice as guidance.

STANDARDS EXPLICITLY ADDRESSED:

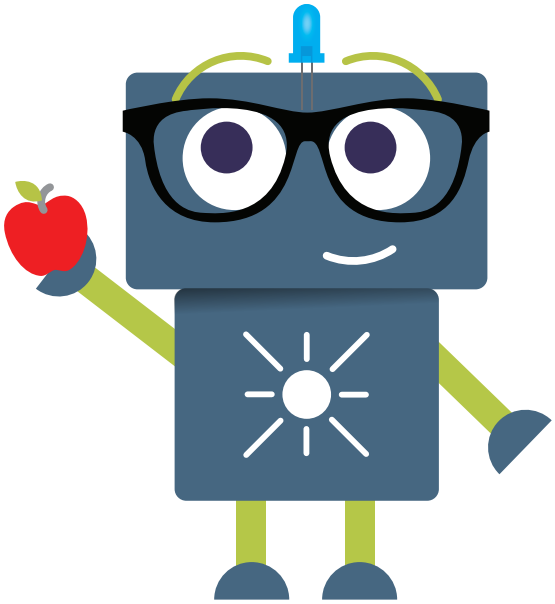
ISTE Standards For Students:

Innovative Designer

- Students develop, test and refine prototypes as part of a cyclical design process.
- Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

NGSS Science and Engineering Practices

- Asking questions *(for science)* and defining problems *(for engineering)*
- Planning and carrying out investigations
- Using mathematics and computational thinking
- Constructing explanations *(for science)* and designing solutions *(for engineering)*
- Obtaining, evaluating, and communicating information



CCSS for Mathematical Practices

- **MP1:** Make sense of problems and persevere in solving them.
- **MP2:** Reason abstractly and quantitatively
- **MP6:** Attend to precision

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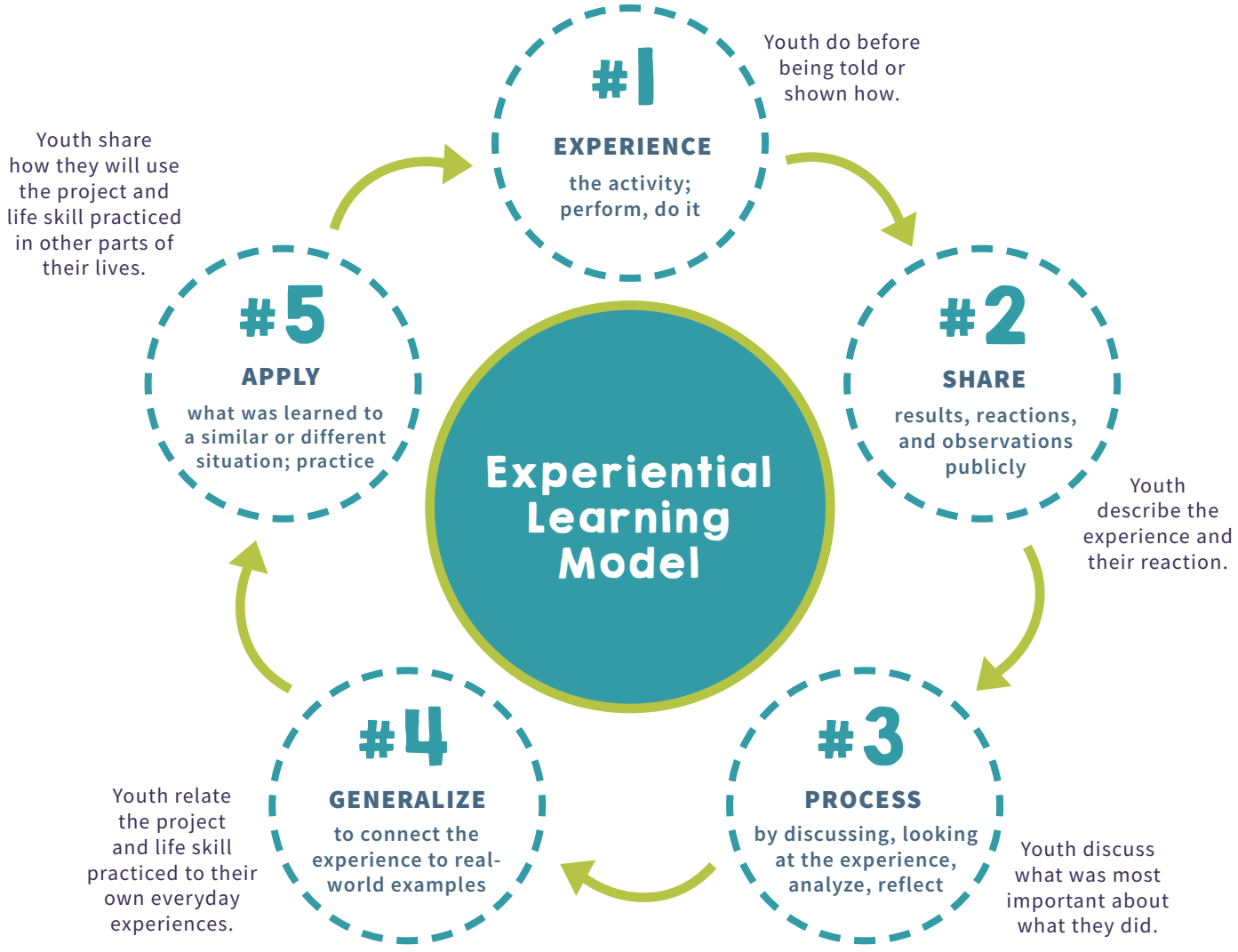
EXPERIENTIAL LEARNING

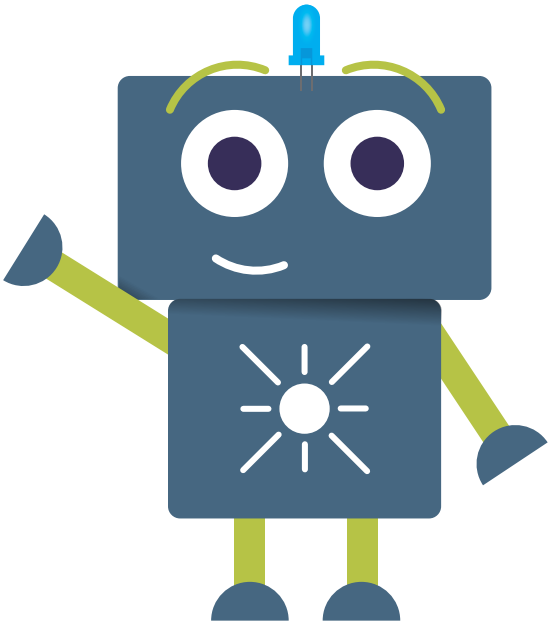
The **Experiential Learning Model of Instruction** provides learners an opportunity to become familiar with the content (Experience), explore a deeper meaning of the content (Share and Process), connect the learning to other examples or opportunities (Generalize), and apply it in real world situations.

The facilitator will guide youth through this process by helping them to focus on the activities, provide support and feedback for the learning, and debrief with them about their learning experience: what went well, what they could have done differently, what they could do next. This debriefing process fits hand-in-glove with the engineering design process used throughout the curriculum.



Pfeiffer, J.W., & Jones, J.E., "Reference Guide to Handbooks and Annuals"

WELCOME TO THE PARK



USING THIS BOOK

Welcome to the Power Park! I'm the friendly neighborhood robot.

This is an interactive workbook designed to give you a hands-on experience as you follow along. Use the pages of this book for writing, taping, cutting, drawing, creating, and more!

- Describe your explorations.
- Record your thinking.
- Jot down your questions.
- Challenge what you've learned.
- Create your own projects!

Create circuits in the blue dotted boxes.

Jot down notes and thoughts in the gray dotted boxes.

Pay attention to what the green boxes say!

Find interesting challenges in the blue boxes!

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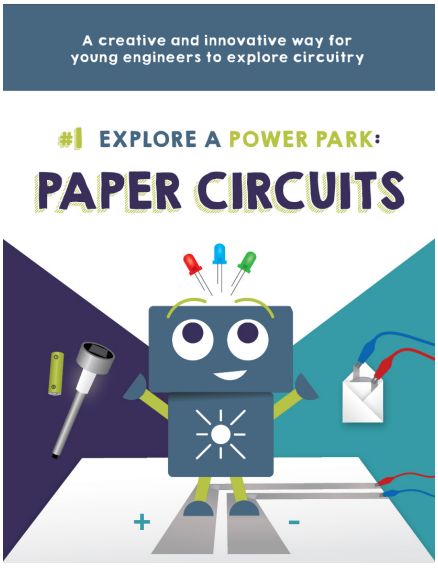
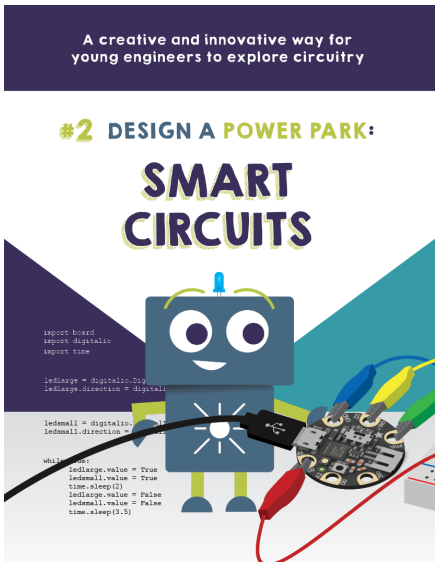
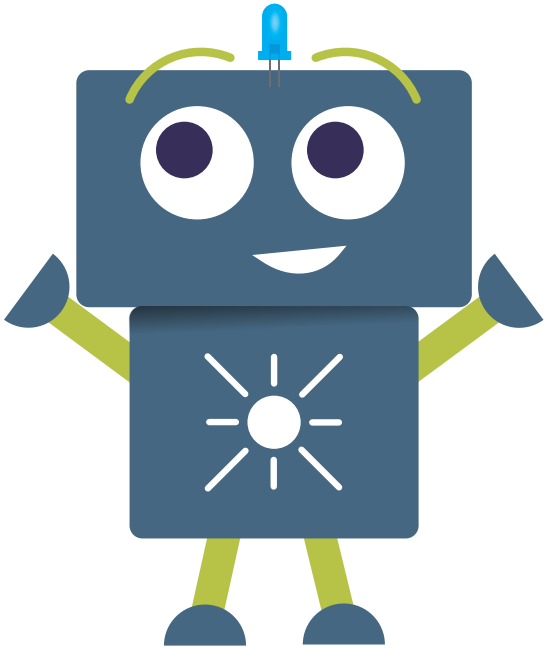
ABOUT THE POWER PARK SERIES

This series of three **Power Park** books provides opportunities to explore electrical circuits, power systems, sensors, coding, and microcontrollers. ***Explore a Power Park: Paper Circuits*** is an interactive notebook for investigating conductive tape circuits and alternative power sources. ***Design a Power Park: Smart Circuits*** introduces coding, microcontrollers, and sensors to circuitry projects. ***Build a Power Park: Lights On in the Neighborhood*** adds motors and controls to a three-dimensional neighborhood concluding with a carnival ride design challenge. These books invite you to create, explore, investigate, and tinker as you use science and engineering design to meet a series of challenges.

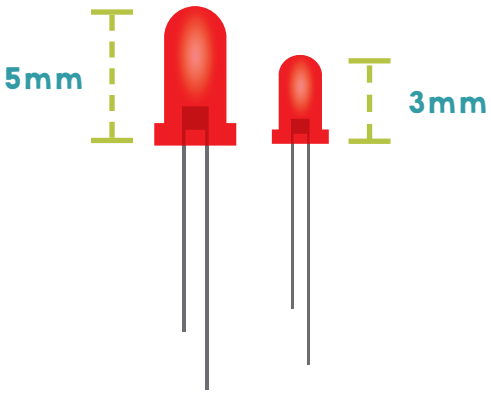






CHOOSING AN LED TYPE

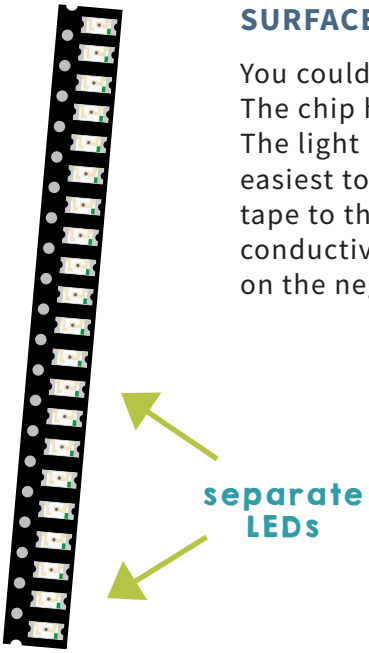
LEDs can be found in a variety of packages of varying shape and size. The part that emits light is very tiny and is enclosed in a case or lens. The case can be clear or colored. Through-hole LEDs have legs that can fit through holes in a breadboard or printed circuit board and come in different sizes. Surface mount LEDs are much smaller and have pads instead of legs.



through-hole LEDs

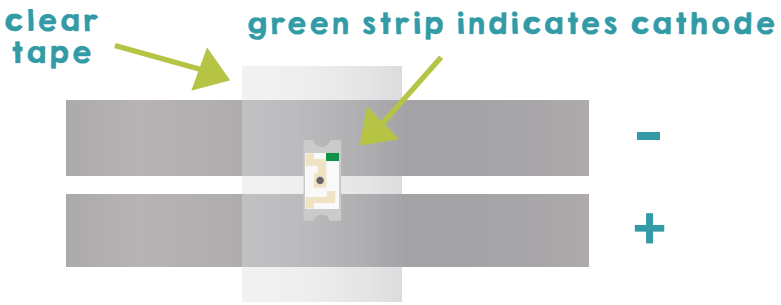
THROUGH-HOLE LEDS

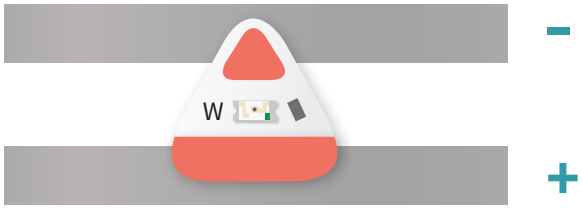
Most of the projects in this book show 3mm through-hole LEDs. This size is big enough so that you can place the LEDs in your projects with your fingers, but small enough so that the pages of your book won't be too lumpy after creating your projects.



SURFACE MOUNT LEDS

You could also use surface mount LEDs (SMD LEDs) in any or all of the projects. The chip holding the LED is a small rectangle with copper pads on the ends. The light is bright and they barely rise above the page in your book. It's easiest to place these in a project using tweezers. You can also stick clear tape to the top and hold the tape to place it. Just remember to place the conductive tape strips close together, but not touching, so one copper pad is on the negative trace and the other is on the positive trace.





CIRCUIT STICKERS

Circuit stickers are another option. These are SMD LED circuits pre-mounted on stickers with larger copper pads that you can place in a project with your fingers. These LED stickers are easy to use, but they are more expensive than the other options.