



# Power It Up

A High-Voltage Introduction  
to Circuitry and Soldering

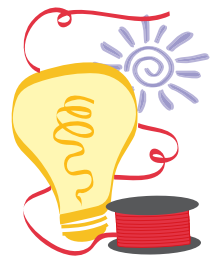






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The Techbridge staff demonstrated tireless creativity and flexibility while developing and testing these programs. Thanks to Maria Anaya, Megan Davis, Jennifer Diaz, Jennifer Joyce, Linda Kekelis, Molly Larkin, Lulu McCourt, Martha Pena, and Jennifer Wei, with the assistance of Eli Leonardo, Jennifer Tai and Vicki Tu.

Our friends at the Girl Scout councils of Northern California (especially troops 60021, 60656, and 60688), Central Texas, West Central Florida and Central Maryland, piloted early versions of the activities and offered suggestions that helped improve the program boxes.

Our partnership with Girl Scout councils embodies the best in collaboration. We have shared resources and learned so much from teaming up on this project. Together we worked to inspire girls to change the world through engineering and science.



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## About Techbridge

“Boring, nerdy, and only for boys.” Some girls may think of engineering in those terms, but not the girls participating in Techbridge. They say, “I learned that this science thing is very fun and educational at the same time. I LOVE IT!” and “I learned that engineering is not just for men.”

Techbridge is a leader in providing girls with firsthand experience working as engineers—from designing toys and building turbines, to meeting professional engineers who help make the world a better place.

Techbridge brings together best practices and lessons learned for partners and offers curriculum that builds on girls’ interests and expands their career options. We have seen first-hand the impact that role model visits and field trips can have. We offer training and resources to youth-serving adults to create positive experiences for girls.

The Techbridge program reaches out to girls in under-served communities and offers after-school and summer programs with hands-on projects and career exploration. Techbridge has served over 3,000 girls in elementary, middle, and high schools in Oakland, California and surrounding communities since its start in 2000. The program has been shown to increase girls’ confidence, build skills, and promote interest in careers in engineering, science, and technology.

In order to bring a Techbridge experience to girls across the country, we are partnering with Girl Scout councils. The Techbridge team has developed programs-in-a-box that include all the activities and materials you will need to introduce girls to the wonders of engineering and science. The Girls Go Techbridge program-in-a-box includes the leader guide you have in your hands, and the box of materials in front of you, ready for a group of ten girls to dive in and enjoy.

We invite you to partner with us to bring engineering and science to girls in your community. Together we can inspire a girl to change the world.

For more information, visit [www.techbridgegirls.org](http://www.techbridgegirls.org).

# Power It Up: Suggested Schedule

Time	Session 1	Session 2	Session 3	Session 4	Session 5	
:00	<b>Pre-Surveys</b> (if applicable)	<b>Icebreaker:</b> Conductors vs. Insulators	<b>Career Activity:</b> Gradvertisement	<b>Career Activity:</b> Your Career Card	<b>Activity:</b> Electric Game Board Part 2	
:10	<b>Icebreaker:</b> Break the Chain					
:20						
:30	<b>Activity:</b> Snap Circuits®	<b>Activity:</b> Tilt Lantern	<b>Activity:</b> Practice Soldering	<b>Activity:</b> Electric Game Board Part 1		
:40						
:50						
1:00						<b>Career Activity:</b> Career Step Up
1:10						
1:20						<b>Post-Surveys</b>
1:30						
1:40						

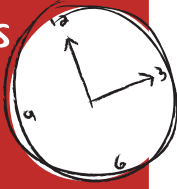
# Power It Up: Alternative Schedules

Time	6.5 Hours	4.5 Hours
:00		
:10	<b>Icebreaker:</b> Break the Chain	<b>Icebreaker:</b> Break the Chain
:20		
:30		
:40	<b>Activity:</b> Snap Circuits®	<b>Activity:</b> Snap Circuits®
:50		
1:00		
1:10		
1:20		
1:30		<b>Icebreaker:</b> Conductors vs. Insulators
1:40	<b>Career Activity:</b> Gradvertisement	
1:50		<b>Activity:</b> Practice Soldering
2:00	<b>Activity:</b> Tilt Lantern	
2:10		
2:20		
2:30		
2:40		
2:50	<b>Icebreaker:</b> Conductors vs. Insulators	<b>Activity:</b> Electric Game Board
3:00		
3:10		
3:20	<b>Lunch</b>	
3:30		
3:40	<b>Activity:</b> Electric Game Board Part 1	
3:50		
4:00		
4:10		
4:20		
4:30		
4:40		
4:50	<b>Career Activity:</b> Career Step Up	
5:00		
5:10	<b>Activity:</b> Electric Game Board Part 2	
5:20		
5:30		
5:40		
5:50		
6:00		
6:10		
6:20		
6:30		

# Power It Up: Introduction

## 4-5 Suggested Sessions

approximately 1 hour and 30 minutes each



### Skills:

- Designing circuits and soldering
- Problem solving

Circuitry and electronics are prevalent in everyday life but are tricky concepts for girls to understand. This project demystifies these topics for girls and allows them to develop confidence in their knowledge of electronics.

The Power It Up program-in-a-box will help educate girls on the concept of electricity, the different electrical components used in circuits, and the process of creating their own electronic circuit. The hands-on activities are designed to be instructive as well as provide the girls with new soldering skills.

### ☀ **Snap Circuits®:**

Girls use a fun kit to build and explore circuits, polarity, and electricity.

### ☀ **Tilt Lantern:**

The girls use their understanding of circuits to create a lantern that turns on when it is tipped upside down.

### ☀ **Practice Soldering:**

Girls use soldering irons and practice safety skills.

### ☀ **Electric Game Board:**

The final project has the girls put all their knowledge to use to create an interactive game. Girls will solder components to a circuit board and design the game.

There are two parts in most of the five, ninety minute sessions:

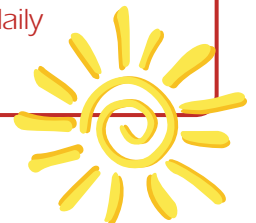
☀ **Icebreakers:** help the girls grasp the concepts behind circuitry, and expand their vocabulary with technical terminology. They will learn about energy flow, polarity, and the characteristics of electrical components. Each icebreaker lasts twenty to thirty minutes. Some of the Icebreakers are career exploration activities that give girls the opportunity to explore careers in **Electrical Engineering**.

☀ **Activities:** provide the girls hands-on experience building circuits and soldering.

We also encourage you to take the girls on field trips and have role models visit your program. These can enhance your girls' interest and curiosity in careers they may never have considered before. Information on how to plan a role model visit can be found on page thirteen.

### **Recommendations:**

Throughout this project emphasize safety and the importance electricity plays in our daily lives.



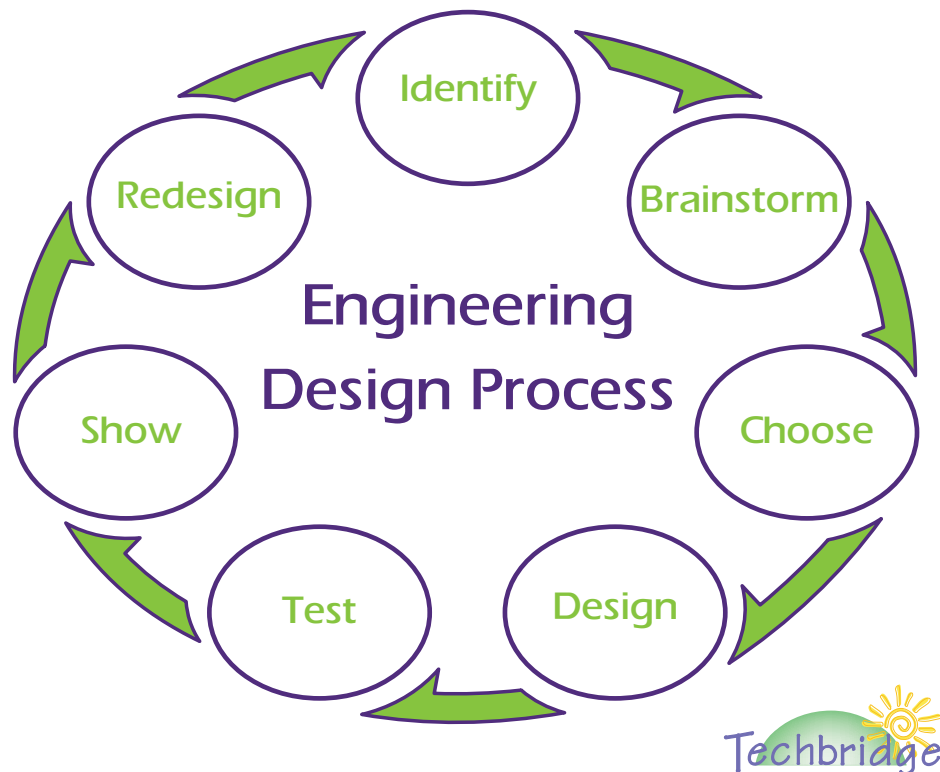
# Power It Up: Introduction

## Engineering Design Process

The Techbridge **Engineering Design Process** is a never-ending cycle of creativity. With each of the hands-on activities in this guide, we encourage you to lead girls to identify and talk about where they are in the design cycle. Growing awareness of the design process helps girls strengthen their outcomes, whether it be a hand-made product or a presentation in front of a group.

The design process encourages girls to both “try, try again” and recognize that “two heads are better than one.” Engineers, and everyone from kids to professionals, use these steps to reach their desired result. We knew this was an effective tool when one Girl Scout remarked that she used the **Engineering Design Process** when writing and revising a paper for English class, and to persuade her parents to get a later curfew!

As the leader, you’ll have to know when it’s time to stop, but the more opportunities you allow girls to reflect, redesign, and repeat the design process steps, the better the experience for all. We recommend you display the supplied **Engineering Design Process** poster throughout these activities for easy reference.



# Background Information

## Introduction:

This program-in-a-box will explore various concepts relating to electricity and circuits. The most basic circuit, a simple circuit, is created with a power source (a battery), a component (an LED or a motor) and sometimes a switch. The power source supplies electrons, tiny charged particles which travel through the circuit and excite any components they pass through. Electrons flow through a circuit continuously until it is "off." Electrons are negatively charged, and they travel from the negative side of the battery, through the circuit, and back to the positive side. All the concepts described here will be introduced to the girls with the Snap Circuits® activity.

## Closed vs. Open Circuits:

The circuit must make a closed circle in order to be "on." If the circle is broken, the electrons cannot flow through it and it will be "off." Switches, like the light switches on your wall, are really opening and closing circuits.

## Polarity:

Some components have polarity, meaning they have a positive and negative side. Batteries, LEDs and motors are a few examples. LEDs will only turn on if the electrons flow through them from negative to positive. Other polar components, like certain motors, will turn a different direction depending on which way they are installed.

## Series vs. Parallel Circuits:

Circuits with more than one component can be built either in series or in parallel. A series circuit means that each component is connected to the circuit one after another. They are all on the same "circle." A circuit in parallel means that each component has its own path to the battery; there are actually two or more circuits being built from the same power source.

A series circuit means that the components must share the power supplied by the battery, and there might not be enough power for each component. In a parallel circuit, each component has its own path to the battery and receives the full amount of power. This also means that the battery will die faster.

## Resistors and Capacitors:

These are two components commonly found in electric circuits. A resistor limits the amount of power going through a circuit. This is useful if the power source provides too much power for a component, like an LED. Resistors come in different strengths indicated by the colored stripes on them. Capacitors store power to be used later. For example, they can be used in solar-powered products, where they store the power generated from the solar panel for later use even if the sun is no longer shining.