Techbridge

Power it Up!

A fun introduction to circuitry and soldering

chabot space & science center

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We would like to express our gratitude to those who helped make this project possible.

We thank the Noyce Foundation and the Gordon and Betty Moore Foundation for their generous support of this project, the Girl Scouts of Northern California and the Girl Scouts of Central Texas for their wonderful feedback on the curriculum and materials. We would also like to thank the outside advisors and reviewers: Cary Sneider, Maryann Stimmer, and Pam Garza. We appreciate their generosity and thank them for improving the quality of this project.

About Techbridge

Techbridge, a program of Chabot Space & Science Center in Oakland, California, has been a leader in providing informal girls' science education since 2000. Since its founding, Techbridge has served nearly 2,500 girls in grades 5-12 primarily in socioeconomically disadvantaged communities in Northern California. Techbridge offers free after-school and summer programs with hands-on projects, career exploration opportunities, and academic and career guidance to expand girls' interests and options. The program creates a spark that excites every girl about technology, science, and engineering and expands her options. Recognizing the importance of building a strong network of support for girls, Techbridge supports educators, role models, families, and partners through professional development, trainings, publications and other outreach activities across the country.

With nationally-recognized curriculum and proven evaluation results, Techbridge is embarking on a major national partnership with the Girl Scouts and other partners through dissemination of curriculum and career resources, enabling us to reach many more girls across the U.S. Our projects are offered in boxes and include all the activities and materials you will need for introducing girls to the wonders of science and engineering. For more information, visit www.techbridgegirls.org.

	Program Box 1		Program Box 2		
Time	Session 1	Session 2	Session 3	Session 4	Session 5
:00	**Activity**: Snap Circuits® (p. 8)	**Icebreaker**: Career Charades (p. 11)	**Icebreaker**: Electronic Component Concentration (p. 18)	**Icebreaker**: Conductors vs. Insulators (p. 25)	**Icebreaker**: Career Mock Interview (p. 36)
:10					
:20					
:30			**Activity**: Practice Soldering (p. 20)	**Activity**: Blinky Robots (p. 27)	**Activity**: Blinky Robots (p. 27)
:40					
:50		**Activity**: LED Butterflies (p. 14)			
1:00					
1:10					
1:20					

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	6 Hours	4.5 Hours
:00	**Icebreaker:** Career Charades (p. 11) - 20 minutes	**Icebreaker:** Career Charades (p. 11) - 20 minutes
:10		
:20	**Activity:** Snap Circuits® (p. 8) - 70 minutes	**Activity:** Snap Circuits® (p. 8) - 70 minutes
:30		
:40		
:50		
1:00		
1:10		
1:20		
1:30	**Icebreaker:** Conductors vs. Insulators (p. 25) - 30 minutes	**Icebreaker:** Conductors vs. Insulators (p. 25) - 30 minutes
1:40		
1:50		
2:00	**Activity:** LED Butterflies (p. 14) - 60 minutes	**Activity:** LED Butterflies (p. 14) - 60 minutes
2:10		
2:20		
2:30		
2:40		
2:50		
3:00	**Icebreaker:** Career Mock Interview (p. 36) - 20 minutes	**Icebreaker:** Career Mock Interview (p. 36) - 20 minutes
3:10		
3:20	**Activity:** Practice Soldering (p. 20) - 30 minutes *Solder only 3 components	**Activity:** Practice Soldering (p. 20) - 60 minutes
3:30		
3:40		
3:50	**Activity:** Blinky Robot (p. 27) - 120 minutes	
4:00		
4:10		
4:20		
4:30		
4:40		
4:50		
5:00		
5:10		
5:20		
5:30		
5:40		
5:50		

Power it Up!: Introduction

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Time:
5 Sessions, each lasting 1 hour and 30 minutes

Skills:
Designing circuits and soldering
Problem solving

Recommendations:
Throughout this unit emphasize safety and the importance electricity plays in our daily lives.

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

The Power it Up! unit will help educate girls on the concept of electricity, the different electrical components used in circuits, and how to create their own electronic circuit. The hands-on activities are designed to be instructive as well as provide the girls with a new skill – soldering.

- Snap Circuits®—Girls use a fun kit to build and explore circuits, polarity, and putting electricity to work.
- LED Butterflies—The girls use their understanding of circuits and polarity to make a butterfly.
- Practice Soldering—Girls use soldering irons to create a piece of art.
- Blinky Robots—In the final two sessions, girls put all their new knowledge to work soldering a flashing circuit board.

There are two parts in most of the five 90 minute sessions:

- **Icebreaker**—helps the girls grasp the concepts behind circuitry, as well as expand their vocabulary with technical terminology. They will learn about energy flow, polarity, and the characteristics of electrical components. Each icebreaker lasts about 20-30 minutes. Some of the Icebreakers are career exploration activities that give girls the opportunity to explore unfamiliar careers in electrical engineering.
- **Activity**—allows girls to experience building circuits and soldering.

We also encourage you to take the girls on field trips or have role models visit your program. These can enhance your girls' interest and curiosity in careers they may never have thought of before. Information on how to plan a role model visit can be found on page 6.

Sessions 1 and 2 are found in Box 1, and Sessions 3, 4, and 5 are in Box 2. Box 2 activities should not be done before completing all Box 1 activities.

This handout is designed to give parents some tips on how to support and encourage their daughters outside of the Girl Scout program boxes. Copies of this Parent Resource Handout are included in Program Box 1 and can be given out anytime you see fit.

Encouraging Girls in Technology, Science, and Engineering

You can make a difference in a girl's future! If you're looking for an activity to do with your daughter, try one that encourages the skills needed in technology, science, and engineering careers. Here are some ideas that build upon the activities in Power it Up! They'll give you a chance to have fun and may also help spark her interest in becoming an engineer or computer scientist.

1. Snap Circuits™ are a simple and safe introduction to how circuits work. You can build simple circuits to make a motor spin or more advanced circuits that make a doorbell ring. This kit, which is girl-tested, includes everything you need: speakers, snap wires, LEDs, lamp sockets, and motors. Snap Circuit kits are available from www.elenco.com.

2. Learn about the appliances in your home. We all know that a fridge keeps your food cold but can your daughter explain why? Identify five different appliances in your home and discuss how you think electricity plays a role in how each of them work. Then, visit www.howstuffworks.com to learn more about out how your appliances works. (Warning: Do not attempt to take apart old appliances, certain electrical components can cause a fatal shock.)

3. Solder something new. Soldering kits come in a variety of shapes, sizes, and skill levels. Once a girl masters the technique of soldering she will enjoy putting together a variety of kits. A good soldering iron and stand and safety goggles are required for all soldering activities. Check out Chaney Electronics for electronic kits and robots at www.chaneyelectronics.com.

4. Make your own mechanical animal! You bet. With step-by-step picture directions, your daughter will be able to make a robotic animal that walks, runs, or jumps. This kit is available from Tamiya at www.tamiya.com.

5. Conserve electricity. Think about all the ways that you used electricity today. Come up with ways that your family can conserve electricity from line drying laundry to unplugging chargers to not preheating the oven. There are lots of things that you can do to save resources and money.

6. Building projects and science kits aren't just for boys. Look for projects that your daughter can work on at home and best yet, work on them with her. For example, you can make your own flashlight and learn about circuits. PBS's ZOOM has lots of fun and easy projects. Invite your daughter's friends over to work on a science experiment or plan a slumber party that includes time to tinker. Check out pbskids.org/zoom/activities/

7. Give a girl a biography of a female role model in engineering or technology. ***Check out Totally Amazing Careers in Engineering*** in the Sally Ride Science career series. You can read about NASA Jet Propulsion Lab engineer, Ayanna Howard, who builds robots to cooperate with people. www.SallyRideScience.com

8. Plan a family visit to a science or technology museum. With their hands-on activities, science and technology museums are a great resource for family fun. Look for an exhibit that features electronics and new technologies and their applications. Be mindful of giving your daughter her fair share of attention when you offer explanations of exhibits. Research finds that parents are much more likely to explain science to boys than to girls while using interactive science exhibits in a museum.

9. Check out Design Squad on your local PBS TV station. After your daughter sees their interesting projects she'll want to design some of her own. Design Squad's website provides lots of ideas to learn about science like building a hidden alarm. With batteries, tin foil, electric wires and other simple supplies she'll be able to make an alarm that's certain to surprise your family. She'll also learn about switching circuits on and off. For more information visit http://pbskids.org/designsquad.

10. Help your daughter explore her dream job. You might not be able to find an electrical engineer or computer scientist to introduce to your daughter but she can meet engineers who love what they do at Engineer Your Life and Engineer Girl. These websites were designed with girls in mind and offers information and practical tips about exciting jobs in engineering. www.engineeryourlife.org and www.engineergirl.org.

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Planning a Role Model Visit

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Hands-on projects can spark an interest in science, technology, or engineering but on their own they may not lead to a career interest in these fields. Role models can inspire girls and help them make informed decisions about their future.

Interactions with role models require the right combination of career guidance and social engagement. The key is for role models to be personal and passionate while communicating how their work matters. A hands-on activity that offers a snapshot of their work will engage and inspire your girls.

Tips for a successful role model visit:

1. Share our role model resource guide ***Get Involved…Make a Difference*** and toolkit with suggested activities, questions, and other resources. http://www.techbridgegirls.org/role_models.asp
2. Help your role model start with an icebreaker. We recommend using Imagine Your Workplace so the role model can introduce it and then complete the worksheet using her current workspace.
3. Encourage role models to start with a personal story to help them connect with your girls.
4. Invite role models to share their passion for what they do. When they get excited, your girls will, too.
5. Encourage role models to explain why their work is important and how it helps the world.
6. Encourage role models to talk about more than just their job. Invite them to talk about hobbies, family, and friends which will help dispel stereotypes.
7. Role models can help by offering guidance such as the importance of taking advanced math and science classes, finding summer classes or internships, and getting good grades.
8. Make sure your girls send thank-you notes to role models.

Here is a sample schedule for a role model visit to your program.

15 minutes	Welcome and icebreaker
10 minutes	Introduction by role model
45 minutes	Hands-on activity
15 minutes	Wrap up and Q&A

Tips for finding role models:

- Contact your local Girl Scouts STEM (Science, Technology, Engineering and Math) coordinator for role model contacts. They may have contacts at organizations such as Society of Women Engineers who can provide role models in your area.
- Ask your friends and contacts for leads.
- Check with science teachers who may have contacts.
- Is there an Expanding Your Horizons program in your community? Your girls will find great role models there.
- Recruit role models from local businesses or universities.
- Recruit a diverse group of role models (especially individuals that reflect the diversity of your girls).
- Be creative!

Suggested activities for a role model:

- Snap Circuits® are a great way for role models to work with the girls to explain basic parts of a simple circuit. The Snap Circuits® kit provides many different activities that a role model can choose from when presenting to girls.
- LED Butterflies can be a good way for role models to engage in a hands-on activity with the girls. They can lead a step by step instruction of how to create the circuit needed to light up the butterfly eyes and then interact with the girls as they decorate.
- Practice Soldering is a great activity for role models to teach girls a new skill. Girls will be able to use this skill when soldering their own Blinky Robot Kit.

Sessions		Quantity	Non-Consumable Items (must be returned)
1	2	1	Power it Up! Leader's Guide
1	2	1	Power it Up! Instructional DVD
1		5	Snap Circuits®
1		10	AA batteries
	2	2	Career Cards, set of 5
	2	5	Glue guns
	2	2	Extension cords
	2	3	Pliers
	2	3	Electrical tape, roll
	2	5	LED Butterfly Reference Sheet
	2	5	Scissors
	2	100	Glue gun sticks

Sessions		Quantity	Consumable Items (return any unused materials)
1	2	10	Parent Resources Take Home Sheet
1	2	1	Get Involved Make a Difference Guide
	2	10	3V coin batteries
	2	10	3V coin battery holders
	2	20	Red LEDs
	2	10	Bare wire, 6 inches
	2	2	Foam sheets

The following additional materials are not provided in the box but are required.

Sessions		Quantity	Consumable Items (return any unused materials)
	2	1	Pencil
	2	10	Scratch paper

Safety Reminder

The activities in the Power it Up! box are designed to spark girls' interest in circuitry and soldering. While we want them to be excited to learn more about electricity, it is important that girls understand that electrical current and components need to be treated with caution. The electrical current used in this kit, low voltage direct current (DC), may cause wires to get hot or burn, but will not cause harm to the girls.

However, the electrical current in household plugs, alternating current (AC), can be much more dangerous. Girls should be reminded not to explore electrical circuits or tinker with appliances (even if they are unplugged or broken) without adult supervision. Make sure they understand NEVER to work on any electrical component that is attached to a wall plug; this could cause serious injury.

Activity Time:
90 minutes

Grouping:
Pairs

Introduction: In this activity, girls will build a variety of electrical circuits using a Snap Circuits® kit.

Objective: As a result of this activity, the girls will be able to:
- Identify how a resistor, switch, and motor work
- Create circuits in series and in parallel
- Understand polarity

Materials:
- 5 Elenco Electronic Snap Circuits® kits
- 10 AA batteries

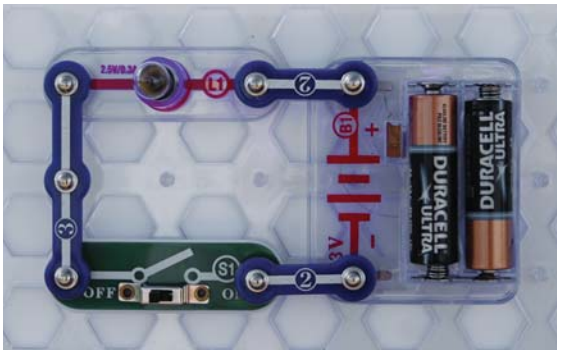
Directions:

1. Hand out one Electronic Snap Circuits® kit to each pair.
2. Review all warning labels and parts list. Read out loud the "How To Use It" section on page 3 of the Snap Circuits® Brochure. Ensure that each girl understands how to use this kit.
3. Each page consists of two projects that highlight a specific electrical component. Have the group go through each project. Stop after each activity and discuss what they learned. A recommended project order and suggested discussion questions are provided on the following pages.
4. If one group completes their projects early have them assist other girls who might be having problems.

Project Breakdown and Leader Notes

CONCEPT: Electrical vs. Mechanical Energy

Project #1 shows how charge flows from the battery, through the switch, to the light bulb, and back through the battery to complete a simple circuit.
Project #2 replaces the light bulb with a fan to illustrate how the same circuit can change electrical energy into mechanical energy. Make sure girls observe the polarity of the motor (the positive side of the motor is noted in the picture).
Project #11 shows that when you reverse the polarity of a motor, the motor spins in the opposite direction. The orientation of the fan blades causes the fan to catch the air and lift off the motor when it spins in one direction but not the other.

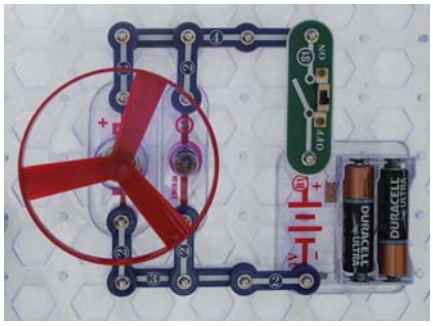


Discussion Questions:

1. How does the switch turn the light on and off in Project #1? *(When the switch is "on," the circuit is complete. When the switch is "off" the circuit is broken and the electrical energy cannot flow around the circuit.)*
2. Why did the fan fly in Project #11? *(Project #11 has you change the polarity of the motor which affects the way the fan spins.)*
3. Which other component have you used that has polarity? *(The battery.)*
4. Which components do not have polarity? *(Wires and light bulb.)*

CONCEPT: Series and Parallel Circuits

Project #5 arranges the lamp and the motor in a series circuit. The 3 volts are divided between the bulb and the motor. The motor may need a little push to get going because it is receiving so little voltage. Have the girls note the brightness of the light.
Project #6 illustrates the lamp and the motor in a parallel circuit. The motor and lamp are both receiving the full 3 volts from the battery. Have girls note the speed of the fan and the brightness of the lamp. This is an important concept that will come up in later circuitry activities.



Discussion Questions:
1. Was the fan spinning at the same speed both times? *(The fan spun faster in Project #6. (Note: Sometimes the fan won't spin at all in Project #5.))*
2. Why did the fan spin faster in Project #6? *(In Project #6, the fan and light bulb are in a parallel circuit so they each receive 3V of energy. In Project #5, the fan and light bulb are wired in series so they share the 3 volts of energy.)*

CONCEPT: Sound Switch and Resistor

Project #3 shows girls how other electrical components such as a sound sensor can be used to close a circuit. The whistle chip is used to show how air vibrations can cause a switch to activate. It has two thin metal plates that can detect noise (like blowing into the chip or clapping) which will make the song play again once it has already finished. Have the girls note how loud the sound is.
Project #4 shows girls how a resistor limits the amount of current that travels through the circuit. As a result, the volume of the sound decreases.

Discussion Questions:

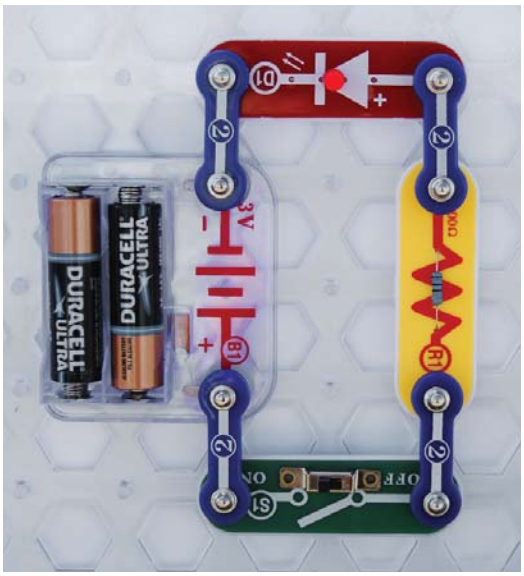
1. In the previous projects we used the switch to open and close the circuit. What electrical component in Project #3 is used to open and close the circuit? *(the whistle chip)*

2. How is the whistle chip able to work as a "switch" to turn on the circuit? *(When you clap you create air vibrations. These vibrations cause the switch to activate.)*

3. In Project #4 what happens to the volume of the sound when you add the resistor in the circuit? *(The volume decreases.)*

4. How does the resistor change the level of the sound? *(The speaker's volume decreases because the resistor limits the amount of current in the circuit.)*

CONCEPT: Polarity



Project #7 illustrates how a resistor and an LED are wired to emit light. Make sure girls notice the polarity of the LED (it has a positive sign on one side).
Project #8 illustrates the polarity of the circuit they have been working with. It is important that electrical components with polarity are placed correctly in the circuit in order for it to work.

Discussion Questions:

1. Does an LED have polarity? *(Yes.)*

2. What happens when the LED polarity is switched? *(The LED will not light up because the polarity is wrong.)*

Session 2: Icebreaker - Career Charades

Activity Time:
20 minutes

Grouping:
Pairs for reading cards
Two teams for charades

Recommendations:
If there are fewer than six girls, do not play with teams. Instead, have each girl perform her charade with the whole group guessing.

Introduction: In this activity, girls will learn about different careers by animating them with their bodies.

Objective: As a result of this activity, the girls will be able to:
- Learn about careers in science and engineering
- Increase their knowledge of different types of careers

Materials:
- 2 sets of 5 Career Cards
- 1 Pencil (not included)
- 10 pieces Scratch paper (not included)

Directions:

1. Distribute the career cards and have girls read about various science and engineering careers in pairs.
2. After the girls are familiar with all five careers, divide the group into two teams, Team A and Team B. Collect the career cards. On the scratch paper, write the five careers from the cards plus five additional careers of your choice such as doctor, teacher, photographer, dentist, and librarian.
3. Have Team A go first. They will send one girl to the front to pick a career.
4. Give her about 30 seconds to act out the career for her team (Team A). The team must collectively come up with one career that they think she is acting out. If they guess correctly, then Team A gets a point. If they guess the wrong career, Team B gets a chance to guess.
5. If Team B guesses correctly, they get a point. If they guess incorrectly, then the first team gets to guess again. This can go back and forth until a team guesses the correct career. If they are completely stumped, the Leader can give them the correct answer and no points will be awarded.
6. The turn now goes to Team B, even if they guessed Team A's career correctly. The turns will go back and forth like this until the career cards run out. The team with the most points wins.

Materials Science Engineer

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Material Science Engineers design new and improved materials. They might design materials that are very strong and lightweight or they might design materials that don't harm the environment when they are disposed of.

As a materials engineer, your job might be to create disposable utensils that dissolve in water, or produce a sun block that protects against skin cancer. You might also design materials to make computers run faster.

Joanna Bettinger
University of California
Berkeley, California

Joanna's Biography:

I always loved math and science as I was growing up. The first time I heard of Materials Science was at college at Brown University. I like it because we used physics to engineer new and creative uses for materials. Now I am in graduate school at UC Berkeley working towards my Ph.D. in Materials Science. I study magnetic materials that might be in your computer in about 10 years!

Joanna's Hobbies:

One of my favorite hobbies is hiking. I love hiking because it gives me a good chance to think about things and reflect back. I also love playing with my cats, Bonsai and Jasper. I adopted them from the SPCA three years ago and I can't remember life without them. I try to bring my camera wherever I go so I always have the memories. I think I have about a million pictures of my cats!

Aerospace Engineer

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Aerospace Engineers design and develop all parts involved in flight vehicles and satellites. They also play a role in creating directions on how to operate these vehicles, and figuring out solutions when things don't go as planned.

As an aerospace engineer, you participate in the design process, including the planning, manufacturing and testing. You might be part of a team that designs new airplanes or you might design TV satellites.

Amy Connors
Stellar Solutions
Palo Alto, California

Amy's Biography:

Amy's interest in space started when she read about the space program and astronauts in a children's magazine in elementary school. She was introduced to engineering in high school when she attended Space Camp. Amy received an Aerospace Engineering degree from the University of Notre Dame. She worked on space hardware for the International Space Station as well as two TV satellites.

Amy's Hobbies:

Amy enjoys spending time with friends, traveling, and teaching children about space and science. She also enjoys taking walks, swimming, and cake decorating.

Amy was a Girl Scout for 12 years, and now volunteers as a role model for Girl Scout events.

Electrical Engineer

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Electrical Engineers design parts for anything that uses electricity. They think about how to power everything from very small to large products.

As an electrical engineer, you might design parts for the next digital camera or MP3 player. Or you could design on a large scale, developing batteries for an electric car or designing power grids for cities.

Maria Alvarado
University of California
Davis, California

Maria's Biography:

I lived most of my life in Oakland and I recently completed my first year of college at UC Davis where I am majoring in electrical engineering. I chose electrical engineering because I want to make smaller and better radio collars for endangered species and create green electronics.

Maria's Hobbies:

I like hobbies where I can relax and be creative.

My hobbies include reading, listening to music, hanging out, and taking pictures with my camera.

Also, I'm a flute player in the Cal Aggie Marching Band-uh!

User Interface Designer

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User Interface Designers design computers, appliances, and software programs with a focus on how it is used by people. They think about how to make products easier to use.

As a user interface designer, you will think about who is using the product and design for the needs of many people, such as children, the elderly or those with disabilities. You might design how the settings are displayed on a digital camera or design the look of MySpace.

Gerelee Howard
Mindjet
San Francisco, California

Gerelee's Biography:

In high school I loved technology but thought I should be a writer. After planning to major in English I found the Cognitive Science department at UC Berkeley and fell in love with the classes. After graduating I was hired as a Junior Product Designer at a company called Autodesk and later went on to work at Mindjet.

Gerelee's Hobbies:

I love to jog and do yoga, go dancing, go shopping and write artides on a volunteer basis for magazines.

Computer Scientist

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Computer Scientists, sometimes called Computer Engineers, develop the software programs for products we use at home, school, and play. They design software that can save lives, improve our planet, and help us learn, play, and stay in touch.

As a computer scientist, you might design a laptop computer that kids in villages around the world can use. Or you might create software for computers or cell phones such as the program that allows you to instant message with your friends or take pictures with your cell phone.

Patty Legaspi
Google
Mountain View,
California

Patty's Biography:

My interest for computers was sparked in elementary school when I was introduced to the computer game, Oregon Trail. I began to wonder how it had been created and what was inside the computer that made it work. I enjoyed taking old computers apart and loved the challenge of math. I went on to study computer science at Mills College and now I am an engineer at Google.

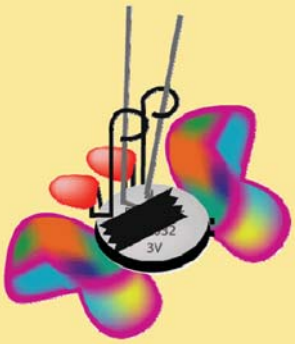
Patty's Hobbies:

My favorite hobby is spending time with my one-year-old daughter, Sofia. We play with stuffed animals, read books, and chase each other on our hands and knees. We also play on the computer together. She likes to hear music on it. Besides playing with my daughter, I also enjoy reading, biking, playing with my dog (Cookie), and spending time with the rest of my family.

Activity Time:
70 minutes

Grouping:
Pairs

Recommendations:
This activity can use an extra set of hands so have the girls help each other.



Introduction: In this activity, girls will be constructing an LED (Light Emitting Diode) Butterfly using two simple circuits.

Objective: As a result of this activity, the girls will be able to:
- Make their own working simple circuit

Materials for each girl:
- 1 3V coin battery
- 1 3V coin battery holder
- 1 6 inch piece of wire
- 2 red LEDs

Materials to be shared:
- 2 Foam sheets
- 5 Scissors
- 3 rolls Electrical tape
- 3 Pliers
- 5 Glue guns
- Glue gun sticks
- 2 Extension cords
- 5 LED Butterflies Reference Sheets

Directions:

1. Although each girl gets to work on her own butterfly, have the girls work in pairs and encourage them to help each other.

2. Distribute the materials to each girl and provide each pair a LED Butterflies Reference Sheet. Follow each step as a group.

Discussion Questions:

1. Can you follow the circuit? *(The energy from the negative side of the battery flows to the negative legs of the LEDs, through the LEDs to the positive legs, through the wire, then to the positive side of the battery and then through the battery to complete the circuit.)*

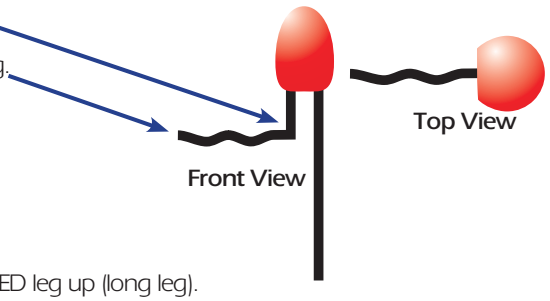
Remind the girls that glue guns can get very hot and burn them if they are not careful. You might want to have a piece of scratch paper underneath the glue guns in case they drip.

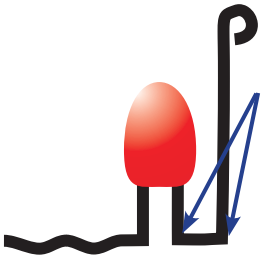
2. Are the LEDs in series or parallel? *(The LEDs are in parallel.)*

3. How can you make the LEDs blink? *(When you shake the butterfly, the LEDs will blink on and off as the wire touches the LED loops.)*

LED Butterflies

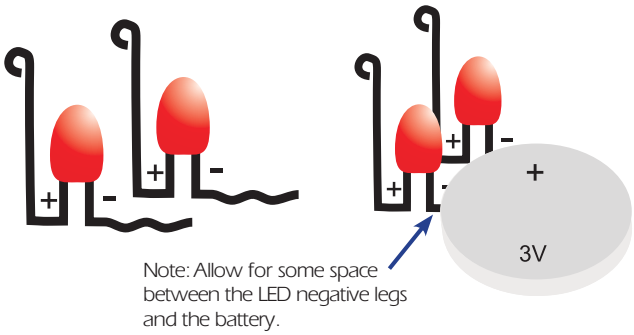
1. Bend each negative LED leg 90° (short leg).
2. Add a crimp to the end of the negative LED leg.



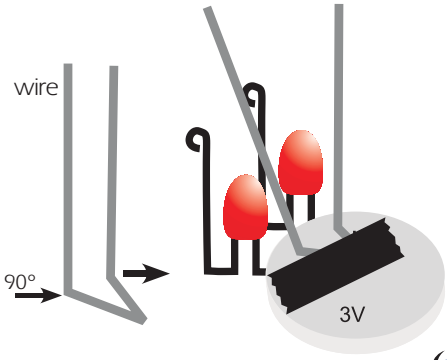


3. Bend each positive LED leg up (long leg).
4. Add a loop to the end of the positive LED leg.

5. Use electrical tape to connect both negative LED legs to the negative side of the battery.



6. Bend a piece of wire into a V shape. Bend the bottom of the V shape 90°.
7. Use electrical tape to connect the wire to the positive side of the battery.



Power it Up! - Session 2 - Reference Sheet

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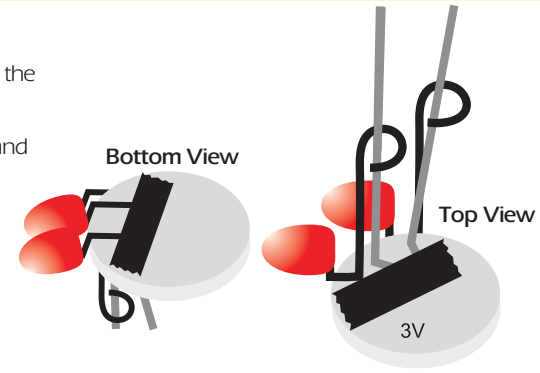
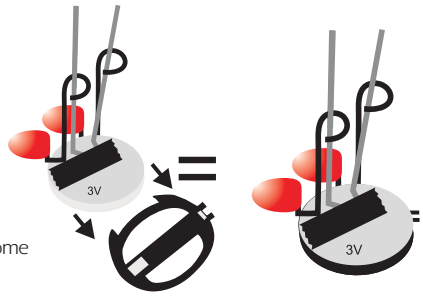
LED Butterflies

8. Adjust the positive LED legs so they're on top of the battery and the LED lights are facing forward.
9. Insert the wire between the LED's positive legs and through the loops.



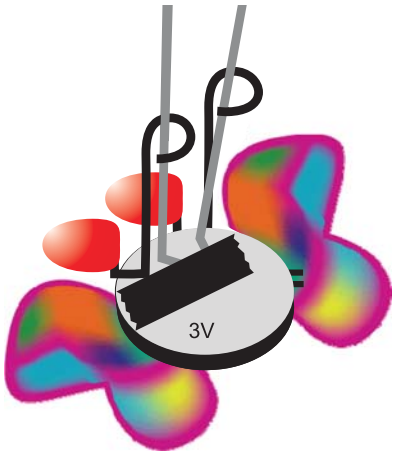
10. Insert the battery bug into the battery case.



Note: Make sure the LED's come out the battery case gap.

Note: Using pliers move or bend sharp metal studs located at the bottom of the battery case.

11. Create the wings with a foam sheet and glue them onto the battery case.



Power it Up! - Session 2 - Reference Sheet

Session			Quantity	Non-Consumable Items (must be returned)
3	4	5	1	Power it Up! Leader's Guide
3	4	5	1	Power it Up! Instructional DVD
3			5	Electronic Component Concentration Game, set of 10 cards
3			5	Practice Soldering Reference Sheet
3	4	5	5	Soldering irons
3	4	5	5	Soldering iron stands
3	4	5	5	Sponges
3	4	5	11	Goggles
3	4	5	5	Side cutters
3	4	5	5	Extension cords
3	4	5	2	Masking tape, roll
	4		5	Circuit tester (D cell and holder, bulb and holder, 3 wires)
	4		5	Circuit Testing Materials: wood cube rubber piece wire penny foam piece paper clip marble
	4		20	Salt packets
	4		10	Cups
	4	5	1	Battery, 9 volt, for testing
	4	5	10	Blinky Robot Component Reference Sheet
	4	5	5	Blinky Robot Instructions Reference Sheet
	4	5	1	Blinky Robot Troubleshooting Reference Sheet
	4	5	1	Definition of Electrical Components Reference Sheet
		5	1	Career cards, set of 5
		5	5	Sample Questions Reference Cards

Session			Quantity	Consumable Items (return any unused portion)
3	4	5	3	Solder, roll
3	4	5	2	Desoldering braid
3			1	Electronic Surprise Box
3			10	Circuit Boards
	4	5	10	Blinky Robot Kits

Session 3: Icebreaker - Electronic Component Concentration

Activity Time:
30 minutes

Grouping:
Pairs

Recommendations:
Use as a review of components before starting circuitry projects.

Introduction: In this activity, girls will learn the names of electrical components and soldering materials by playing a matching game.

Objective: As a result of this activity, the girls will be able to:
- Name different electrical components
- Identify different materials they will use when soldering

Materials:
- 5 sets Electronic Component Concentration Cards

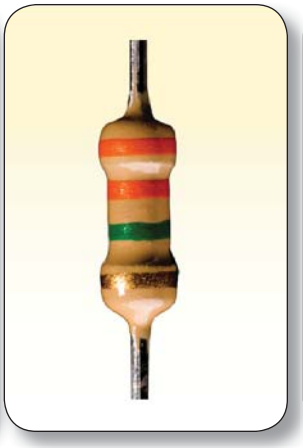
Directions:

1. Give each group of girls a set of matching cards.
2. Have the girls lay the cards face down on a table.
3. One girl turns over two cards.
4. If the picture and the name match, then the girl may collect the two cards and take another turn.
5. If the cards do not match, then both of the cards are turned face down again and the next girl takes a turn.
6. When all cards have been matched, the game ends and the girl who has collected the most matches wins the game.

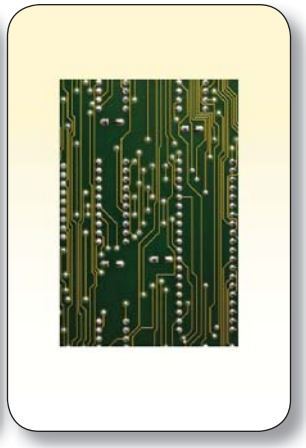
LED

Light Emitting Diode

Switch



Resistor



Circuit Board

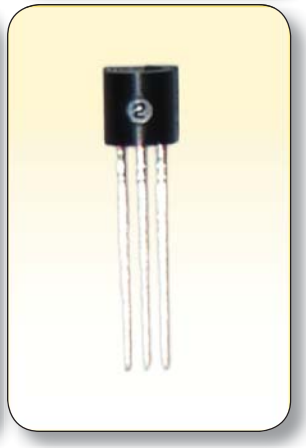
Wire

Power Source

Capacitor

Soldering Iron

Solder



Transistor

Session 3: Activity - Practice Soldering

Activity Time:
1 hour

Preparation Time:
20 minutes

Grouping:
Whole group

Recommendations:
Carefully review soldering safety tips before you begin soldering.

Introduction: In this activity, girls practice soldering by making a piece of art using a circuit board and different electronic components.

Objective: As a result of this activity, the girls will be able to:
- Safely hold and use a soldering iron
- Solder components onto a circuit board

Materials:
- 5 Soldering irons
- 5 Stands for soldering irons
- 5 Sponges to clean the soldering iron
- Solder
- 5 Side cutters
- Desoldering braid
- 5 Extension cords
- 11 Goggles (1 for each girl and Leader)
- 10 Circuit boards
- Electronic Surprise Box
- 2 Masking tape, roll
- 5 Practice Soldering Reference Sheets

Preparation:
- Do "safety check" on Leader Reference Sheet.

Directions:

1. Review the Soldering Safety information on page 22 with the girls.
2. Soldering is a skill that takes practice. We recommend soldering three electrical components as a group to help your girls learn and practice how to solder.
3. Give each pair of girls a Practice Soldering handout.
4. Give each girl one circuit board and 3 electrical components from the grab bag.
5. As a class, practice soldering the 3 components on their circuit board. The leader should lead the class with step by step instructions on how to solder. Remember that the components must be soldered onto the copper side of the circuit board. No girl should move on until the entire group feels comfortable soldering.
6. Go around the room and check to make sure each girl is soldering correctly. Look at their joints to make sure they are not using too little or too much solder.
7. Next, tell the girls they can use their new soldering skills to create a fun piece of art.

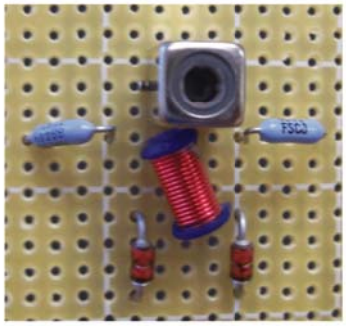
8. Allow each girl to pick 5 more electrical components from the Electronic Surprise Box to design and create a unique and fun piece of art. Let their creativity shine!

Discussion Questions:

1. How did it feel to solder for the first time? Was it scary? *(Encourage the girls to talk about overcoming their fears and feeling confident as they learn this new skill.)*

2. Were you able to make good solder connections between your board and the components? How did you make good solder connections? *(To make a good solder joint, touch the soldering iron to the component lead and the pad of the circuit board. Then touch the solder to the soldering iron until the solder covers the pad and the component lead. Once it is covered, remove the solder then the soldering iron.)*

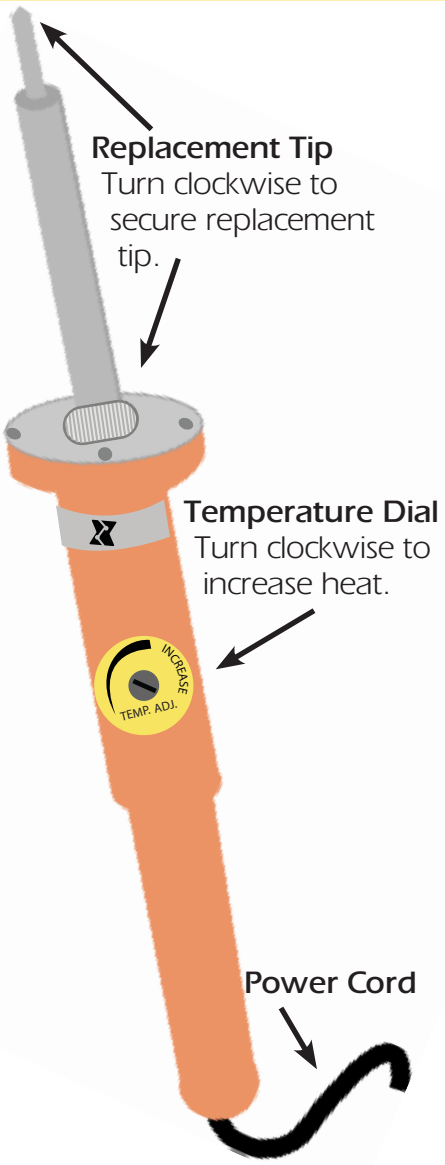
3. Were you able to recognize or identify any of the components that you soldered onto the board? *(There is no right or wrong answer to this question. Many of the components may be new to the girls but this can be a question to help them review the components they have already learned about.)*



Leader Reference Sheet: Soldering Safety

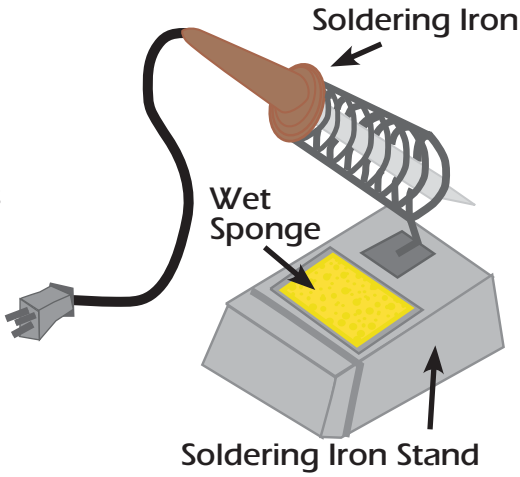
Complete each safety check before you begin any soldering activity:

1. Check each soldering iron to ensure that the iron's replaceable tip is securely fastened before plugging it in.
2. Check the power cord for any melted spots or exposed wire. If you see any melted spots or exposed wires, tag soldering iron and do not use it, use a new one. Let the Girl Scout headquarters know so they can replace it with a new one.
3. Make sure you have one soldering stand for every soldering iron.
4. Moisten each sponge and place it near the soldering stand.
5. Tape extension cords to each table top. Plug in 2 soldering irons per extension cord.
6. Make sure you have enough safety goggles for each student.
7. Be careful soldering on a paper table cloth. If girls accidently set their soldering iron down, a fire can quickly start.



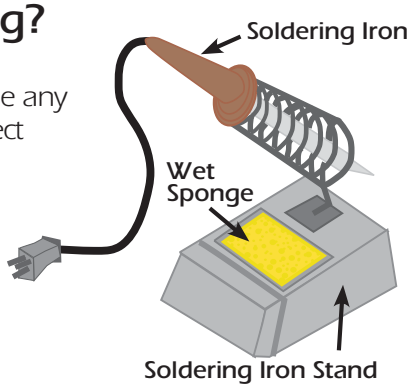
Safety tips while soldering:

1. Soldering irons are hot (typically 626°F to 662°F)! This also means that any part of the wire your soldering iron touches (that is not insulated) will be the same temperature!
2. Make sure that girls don't melt the power cord and expose the inner wires.
3. Girls should never hand each other their soldering irons; make sure it is returned to the stand before the next girl uses it.
4. Girls must wear safety goggles and tie their hair back.
5. Rosin solder releases fumes. These fumes are smelly and contact with eyes should be avoided.
6. Never eat or drink while soldering.
7. Wash hands after soldering.
8. Remind girls to ask for a new piece of solder when theirs gets too small.



Practice Soldering Reference Sheet

What is soldering?

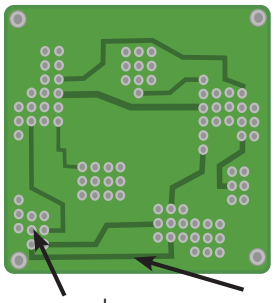


Soldering is the most fundamental skill needed to assemble any electronic project. It takes some practice to make the perfect solder joint, but once learned it is never forgotten.

The idea is simple: to join electrical parts together to form an electrical connection by melting a tin mixture called solder on the joint of two metal components. To do this you use what is called a soldering iron.

Most soldering takes place on a "circuit board."

Circuit Board

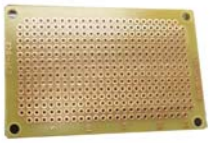


On some circuit boards you can see small copper strips (which act like wire) and solder pads with holes in the middle. The legs of components (like LEDs) are stuck through the hole so that they stick out on the copper side. The base of the leg is soldered to the copper pad which connects the component to the circuit.

For this activity you will be using a circuit board without copper strips but plenty of copper pads. These circuit boards are used to test circuits.

Activity 1: Read the back of this sheet to learn how to solder. Practice with three different components. They can be inserted into any copper pads since this is only for practice. Note: components are inserted from the top so their legs come out the copper side of a circuit board.

Front Side 

Back Side 

Activity 2: Once you feel comfortable soldering, add five more components to your circuit board to create a fun and unique piece or art. This is your time to shine so be creative and have fun.

Practice Soldering Reference Sheet

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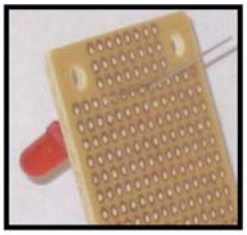
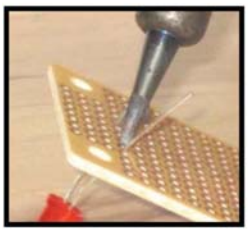
Circuit Board Soldering

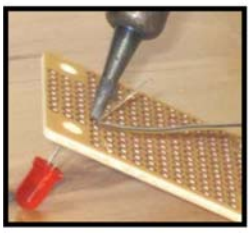
Step #1 - Pick up and hold the soldering iron like it was a pencil. Clean the soldering iron tip using a wet sponge. Apply a very small amount of solder to the tip of the iron, and then wipe off the excess on the sponge.



Step #2 - Make sure your component and circuit board are clean. Insert the component through the proper holes on the top of the circuit board so the legs are sticking out on the back side of the circuit board (copper side).



Step #3 - Lay the iron tip so that it rests against both the component lead and the pad of your board. Normally, it takes about three seconds to heat the component/board enough to solder.



Step #4 - Once the component lead and copper pad are heated up, apply solder. Touch the tip of the strand of solder to the component lead and copper pad. The solder should flow freely around the lead and pad. Once the surface of the pad is completely coated, stop adding solder. It should take no more than a few seconds.

Step #5 - Remove the solder, then the iron. Place the soldering iron back in the stand. Don't move the joint for a few seconds to allow the solder to cool.

Step #6 - Examine your joint. A well-soldered joint should look shiny and shaped like a Hershey's Kiss. Snip the excess wire with wire-cutters.

Activity Time:
30 minutes

Preparation Time:
10 minutes

Grouping:
Pairs

Introduction: In this activity, girls will figure out what materials are conductors (allow electricity to pass through) and what materials are insulators (do not allow electricity to pass through). They will then test their predictions using a simple circuit.

Objective: As a result of this activity, the girls will be able to:
- Explain the difference between a conductor and an insulator
- Identify materials that are good conductors and materials that are good insulators

Materials:
- 5 Circuit testers (D cell and holder, bulb and holder, 3 wires)
- 5 sets Testing Materials:
  - Aluminum foil
  - Wood cube
  - Rubber piece
  - Wire
  - Penny
  - Foam piece
  - Paper clip
  - Marble (glass)
  - Cup for water
  - Cup for salt water
  - Salt

Preparation:
- Mix salt and water.
- Set up stations with testing materials.

Directions:

1. Hand each pair of girls a Circuit tester. Have them test the circuit so they can observe how the bulb turns on when the circuit is closed.

2. Present the girls with the testing materials provided. Explain to the girls that you will now have them insert this material into the circuit. Have them make two lists – one for materials that they think will allow the electricity to pass through and light up the bulb, and another for the materials that they think will not allow electricity to pass through.

3. Once the girls have created their piles, have them actually test the materials to see if their guess was correct. Have them adjust their piles accordingly or keep a record of the results of their test.

4. Allow girls to test the electrical conductivity of different materials in the classroom. They might want to try objects such as their desk, chair, stapler, whiteboard, etc.

Discussion Questions:

1. Why is wire commonly used to create a circuit? *(Wires are commonly used to create circuits because they are made of metals that conduct electricity.)*
2. What are the qualities that make materials conductive or insulating? *(Metal materials make good conductors.)*
3. Why do you think wire has a coating? *(Wires have a plastic coating to insulate the metal so that it only touches (conducts) on the stripped ends.)*

Answer Key:

Conductors	Insulators
aluminum foil	wood
wire	rubber
penny	polystyrene foam
paper dips	glass (marble)
salt water	water

Session 4: Activity - Blinky Robot

Activity Time:
2 hours

Preparation Time:
10 minutes

Grouping:
Individually

Recommendations:
This kit should only be attempted after girls have completed every activity in this unit.

Begin constructing the kit in Session 4. Finish the kit during Session 5.

Introduction: In this activity, girls will be soldering a Blinky Robot.

Objective: As a result of this activity, the girls will be able to:
- Correctly solder different components to a circuit board
- Create a working circuit

Materials:
- 10 Blinky Robot kits
  - 1 circuit board
  - 4 LEDs
  - 2 Capacitors
  - 2 Transistors
  - 2 10 kΩ Resistors (brown-black-orange strips)
  - 2 330 Ω Resistors (orange-orange-brown strips)
  - 1 Battery snap
  - 1 On/off switch
- 5 Soldering irons
- 5 Extension cords
- 5 Soldering stands
- Solder
- 11 Goggles
- 5 Side cutters
- Desoldering Braid
- 1 9V Battery (for testing)
- 10 Blinky Robot Components Reference Sheets
- 5 Blinky Robot Reference Sheets
- 1 Blinky Robot Troubleshooting Reference Sheet

Preparation:
- Set up soldering stations.
- Review Leader Reference Sheet: Soldering Safety

Directions:

1. Have each girl separate out the parts using the Blinky Robot Components Handout.

2. Give each girl a Blinky Robot Instruction Handout and lead the girls, step by step. No girl should move on until the entire group has completed the step.

Discussion Questions:

1. How did you feel soldering a complete circuit? *(Encourage the girls to talk about overcoming their fears and feeling confident as they learn this new skill.)*

2. Did you have any problems with your circuit board? What did you do to fix it? *(Encourage girls to talk about what they learned. The goal of this activity is to understand the components and where they belong on the circuit board.*

Sometimes a girl will solder a component in the wrong position or the component will be reversed. If it cannot be fixed, the girl is successful if she understands why it is not working.)

3. Name all of the components and what they do.
Light-emitting diode (LED) is a semiconductor diode that emits light when an electrical current is applied. LEDs use little voltage and are very bright. LEDs have polarity which means electricity can flow through them in one direction.

A Capacitor is an electrical component that can store electrical voltage. Think of it as a mini battery that can store a certain amount of power for a certain amount of time. Capacitors have polarity.

A Transistor is an electronic device that controls the current. Transistors are commonly used to amplify or switch electronic signals. Transistors have polarity.

Resistors are components used to control the flow of electricity in a circuit. Resistors are characterized primarily by their resistance and the power they can dissipate. Resistors have no polarity.

A Circuit Board is used to connect electronic components using conductive pathways made of copper sheets laminated onto a non-conductive material.

A Switch connects and disconnects electrical circuits.

Definitions of Electrical Components

Techbridge

Light-emitting diode (LED) is a semiconductor diode that emits light when an electrical current is applied. LEDs use little voltage and are very bright. LEDs have polarity which means electricity can only flow through them in one direction.

A Capacitor is an electrical component that can store electrical voltage. Think of it as a mini battery that can only store a certain amount of power for a certain amount of time. Capacitors have polarity.

A Transistor is an electronic device that controls the flow of the current. Transistors are commonly used to amplify or switch electronic signals. Transistors have polarity.

Resistors are components used to control the flow of electricity in a circuit. Resistors are characterized primarily by their resistance and the power they can dissipate. Resistors have no polarity.

An electric motor uses electrical energy to produce mechanical energy.

A Circuit Board is used to connect electronic components using conductive pathways made of copper sheets laminated onto a non-conductive material.

Solder is a soft metal with a low melting point. Solder is used in a process called soldering where it is melted to make a permanent connection between two joints.

A Battery is a device which uses a chemical reaction to create an electric charge.

A Switch connects and disconnects electrical circuits.

Power it Up! - Session 4 - Reference Sheet

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Blinky Robot Components

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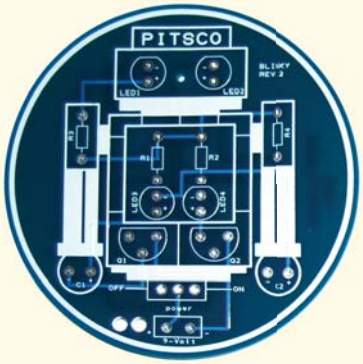
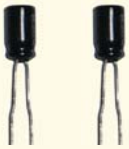
Separate the different parts of your Blinky Robot Kit into the correct spaces below.



1 Circuit Board

4 LEDs

2 100kΩ resistors
brown-black-orange stripes



2 Capacitors

2 Transistors

2 330kΩ resistors
orange-orange-brown stripes

1 Battery Snap

1 Switch

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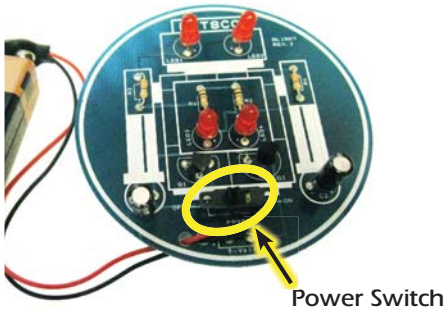
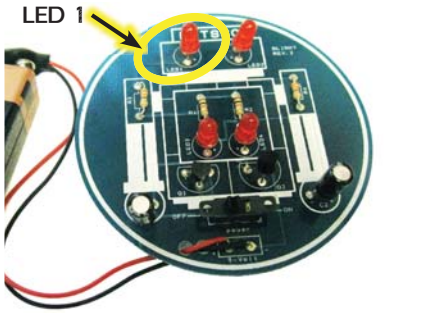
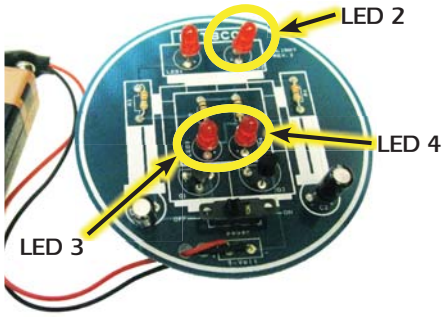
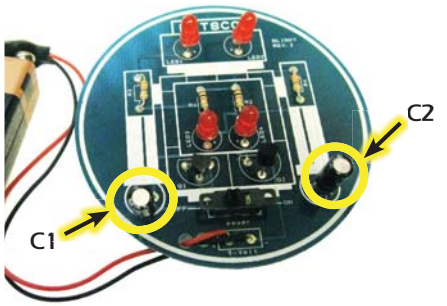
Blinky Robot Reference Sheet

	1. Place the switch in the area labeled "power" on the circuit board. The direction of the switch does not matter.
	2. Turn the circuit board over and solder the switch in, making sure not to let any of the solder overlap between the three legs of the switch.
	3. Place the first LED in the LED1 position. Remember to orient the LED so that the long positive leg and the short negative leg are in the correct holes. Push the LED in as far as you want, but make sure not to break the legs.
	4. Flip the circuit board over and bend the legs of the LED against the board so the LED stays in place. Solder so that you have a small dot of solder over the hole.
	5. Bend the legs of the LED back up and clip them off with side cutters. You should now have two Hershey Kiss shaped dots.
	6. Repeat steps 3, 4, and 5 for the LEDs in the LED2, LED3, and LED4 positions.
	7. Place your capacitors in the C1 and C2 positions. The longer leg is the positive end and the shorter leg is the negative end.
	8. Flip the circuit board over and bend the legs of the capacitor against the board.
	9. Solder the capacitor into place and clip the legs with your side cutters.

Power it Up! - Session 4 - Reference Sheet

Blinky Robot Reference Sheet

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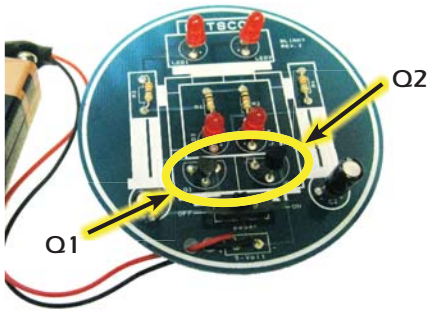
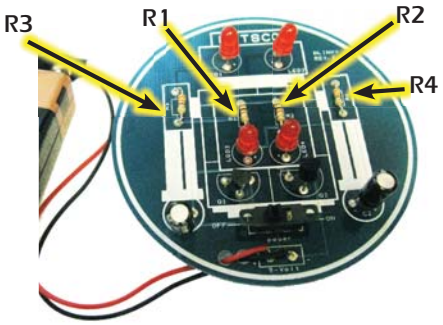


10. Find your transistor and notice that there is a rounded side and a flat side. Now, look at the Q1 and Q2 location and notice that the board also indicates a rounded side and a flat side.

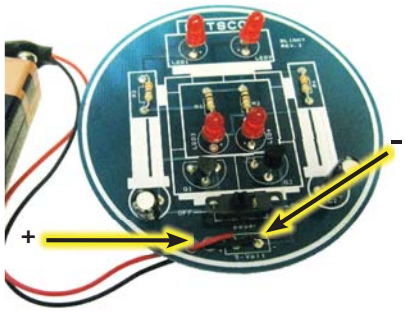
11. Bend the 3 legs of the transistor so that they fit through the holes of Q1 and Q2. Position your transistor, but don't push too hard. The legs may break.

12. Flip the circuit board over and solder and clip.



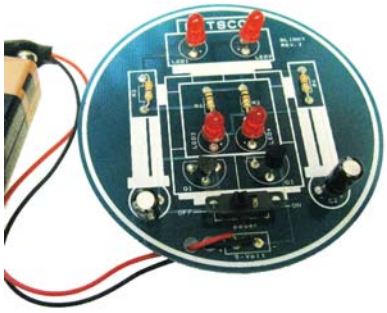
13. Find your brown-black-orange resistors. Place them in the R1 and R2 positions. Direction does not matter. Solder and clip.

14. Find your orange-orange-brown resistors. Place them in the R3 and R4 positions. Direction does not matter. Solder and clip.



15. Put the leads of your battery snap through the two big holes at the bottom left of your circuit board. Thread them back to front.

16. Take the exposed wire of the red positive lead and put it through the hole labeled (+) in the 9-volt battery location.



17. Put the black negative lead through the hole labeled (-).

18. Flip and solder.

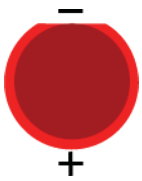
19. Snap your battery in and flip the switch to "on" and see your robot blink!

Power it Up! - Session 4 - Reference Sheet

chabot

Blinky Robot Troubleshooting

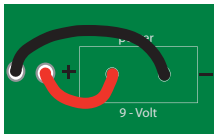
If your robot does not light up, make sure your connections are complete. You must have a complete circuit for it to work. Also check to see if your parts are going in the right direction by referencing the pictures below.



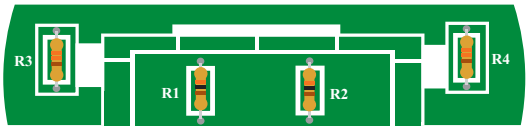
When looking straight down at the LED you should see the flat part of the LED on the negative side.

When looking straight down at the capacitor you should see a gray strip on the negative side.

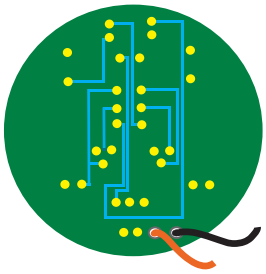
The top of the transistor should have the same half circle orientation as the outline on the circuit board.



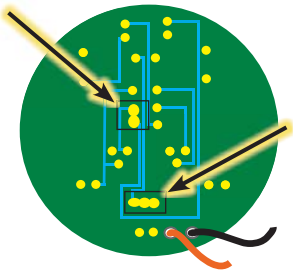
Check that the black wire is coming from the far "negative" hole and the red wire is coming from the "positive" hole.



Your robot has four different resistors. Remember that resistors do not have polarity so it does not matter which direction you place the resisters as long as they are in the correct position. You can tell the different resistors by their different colored bands. The R1 and R2 positions should have the orange-black-brown resistors and the R3 and R4 positions should have the orange-orange-brown resistors as shown to the left.



Correct Solder Joints



Incorrect Solder Joints

If the pieces are in the correct orientation and your robot still will not light up, make sure your solder does not overlap. Notice where the solder overlaps in the picture on the right. If this happens, use de-soldering braid to fix the connections.

Check to make sure that there is enough solder on each joint. If you can see through the hole where the solder was applied the student probably did not put enough. Add some additional solder to any questionable solder joints.

Other tips:

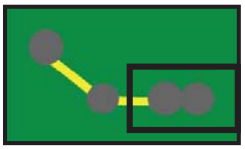
- When soldering, you don't need big globs of solder to make your connections. Just a little drop will do.
- If you are having trouble positioning your solder, try melting the solder on the tip of the iron first and then touch the iron to the place you want to solder. This will allow you more accuracy in directing the solder where you want it to go.

Desoldering Instructions

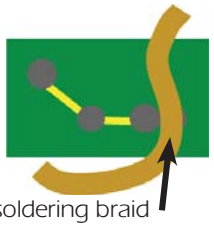
Techbridge

There are occasions when a girl will need to remove solder (for example, if solder joints overlap or if a component was put in incorrectly). Please follow the instructions below for using the desoldering copper braid.

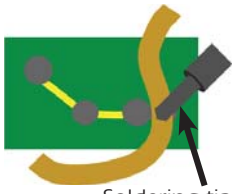
Step #1 Identify which solder joint needs to be removed. In the picture to the right, there are two overlapping joints so the solder will be removed from the solder joint on the right.

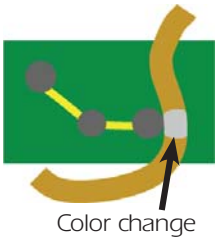


Step #2 Place the desoldering braid on top of the joint you wish to remove as illustrated in the picture.



Step #3 Place the soldering tip on top of the desoldering braid and hold it there until the braid absorbs the solder. You will notice the color of the copper braid changes from orange to gray where the solder was removed.





Step #4 Remove the desoldering braid and you should have a clean area to resolder your component.

IMPORTANT: The desoldering braid is made out of copper so heat will travel quickly through it. Make sure you are holding it far away from the point where the soldering iron touches it!

Soldering Iron Tips

Techbridge

The girls will be using lead-free solder which has a higher melting point. Make sure that the soldering irons are turned up as high as possible by turning the temperature knob clockwise as far as you can.

To help keep the soldering irons working properly please instruct your girls to clean the soldering tips with the sponge only BEFORE soldering. After soldering, the iron should be returned to the stand without being wiped on the wet sponge. Leaving a small amount of solder on the tip helps protect the metal from oxidizing which can cause corrosion and make it hard to transfer heat.

REMEMBER:

Remove soldering iron →
Wipe on sponge →
Solder →
Return to stand

If the tip of your soldering iron gets burned and is no longer working well please return to the Girl Scouts Coordinator who will fix it. Do NOT attempt to fix it on your own by using sandpaper or file as this could cause damage to the tip if done improperly.

Session 5: Icebreaker - Mock Interviews

Activity Time:
20 minutes

Grouping:
Pairs

Recommendations:
This activity is a great way for girls to start thinking of themselves as engineers.

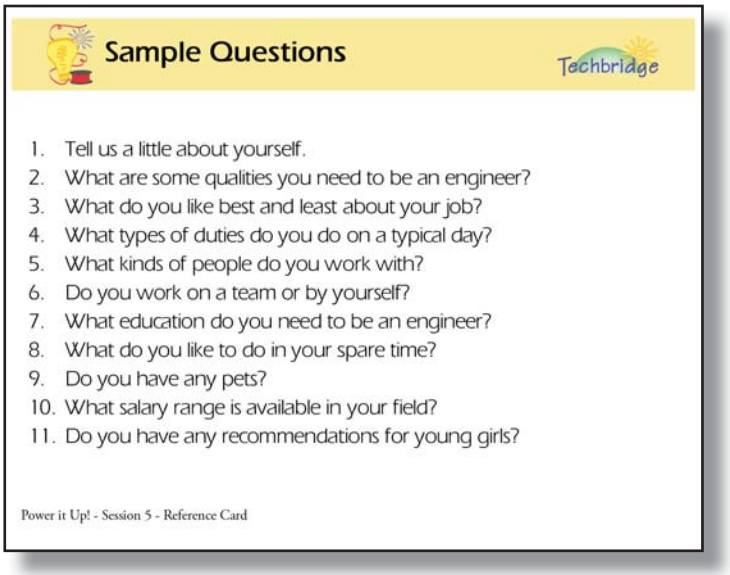
Introduction: In this activity, girls will conduct mock interviews with one another based on role model biography cards.

Objective: As a result of this activity, the girls will be able to:
- See themselves in a variety of professional careers
- Practice interviewing skills

Materials:
- 1 set of 5 Career cards
- 5 Sample Questions Reference Cards
- 2 Chairs

Directions:

1. Have the girls work in groups of two. Hand each group one role model card and a copy of the interview questions.
2. Give each group five minutes to read the role model's biography and the role model questions.
3. Assign each group member the role of the engineer or the reporter.
4. Have each team come up with a mock interview based on the role model's bio and the questions provided. Reporters can come up with their own questions.
5. Have each group perform their interview in front of the class.
6. After each interview allow for some time for questions from the audience.
7. Encourage the girls to be creative and have fun during their interviews.



Electrical Engineer

Techbridge

Electrical Engineers design parts for anything that uses electricity. They think about how to power everything from very small to large products.

As an electrical engineer, you might design parts for the next digital camera or MP3 player. Or you could design on a large scale, developing batteries for an electric car or designing power grids for cities.

Maria Alvarado
University of California

Maria's Biography:

I lived most of my life in Oakland and I recently completed my first year of college at UC Davis where I am majoring in electrical engineering. I chose electrical engineering because I want to make smaller and better radio collars for endangered species and create green electronics.

Maria's Hobbies:

I like hobbies where I can relax and be creative.

My hobbies include reading, listening to music, hanging out, and taking pictures with my camera.

Also, I'm a flute player in the Cal Aggie Marching Band-uh!

User Interface Designer

Techbridge

User Interface Designers design computers, appliances, and software programs with a focus on how it is used by people. They think about how to make products easier to use.

As a user interface designer, you will think about who is using the product and design for the needs of many people, such as children, the elderly or those with disabilities. You might design how the settings are displayed on a digital camera or design the look of MySpace.

Gerelee Howard
Mindjet
San Francisco, California

Gerelee's Biography:

In high school I loved technology but thought I should be a writer. After planning to major in English I found the Cognitive Science department at UC Berkeley and fell in love with the classes. After graduating I was hired as a Junior Product Designer at a company called Autodesk and later went on to work at Mindjet.

Gerelee's Hobbies:

I love to jog and do yoga, go dancing, go shopping and write artides on a volunteer basis for magazines.

Materials Science Engineer

Techbridge

Material Science Engineers design new and improved materials. They might design materials that are very strong and lightweight or they might design materials that don't harm the environment when they are disposed of.

As a materials engineer, your job might be to create disposable utensils that dissolve in water, or produce a sun block that protects against skin cancer. You might also design materials to make computers run faster.

Joanna Bettinger
University of California
Berkeley, California

Joanna's Biography:

I always loved math and science as I was growing up. The first time I heard of Materials Science was at college at Brown University. I like it because we used physics to engineer new and creative uses for materials. Now I am in graduate school at UC Berkeley working towards my Ph.D. in Materials Science. I study magnetic materials that might be in your computer in about 10 years!

Joanna's Hobbies:

One of my favorite hobbies is hiking. I love hiking because it gives me a good chance to think about things and reflect back. I also love playing with my cats, Bonsai and Jasper. I adopted them from the SPCA three years ago and I can't remember life without them. I try to bring my camera wherever I go so I always have the memories. I think I have about a million pictures of my cats!

Aerospace Engineer

Techbridge

Aerospace Engineers design and develop all parts involved in flight vehicles and satellites. They also play a role in creating directions on how to operate these vehicles, and figuring out solutions when things don't go as planned.

As an aerospace engineer, you participate in the design process, including the planning, manufacturing and testing. You might be part of a team that designs new airplanes or you might design TV satellites.

Amy Connors
Stellar Solutions
Palo Alto, California

Amy's Biography:

Amy's interest in space started when she read about the space program and astronauts in a children's magazine in elementary school. She was introduced to engineering in high school when she attended Space Camp. Amy received an Aerospace Engineering degree from the University of Notre Dame. She worked on space hardware for the International Space Station as well as two TV satellites.

Amy's Hobbies:

Amy enjoys spending time with friends, traveling, and teaching children about space and science. She also enjoys taking walks, swimming, and cake decorating.

Amy was a Girl Scout for 12 years, and now volunteers as a role model for Girl Scout events.

Computer Scientist

Techbridge

Computer Scientists, sometimes called Computer Engineers, develop the software programs for products we use at home, school, and play. They design software that can save lives, improve our planet, and help us learn, play, and stay in touch.

As a computer scientist, you might design a laptop computer that kids in villages around the world can use. Or you might create software for computers or cell phones such as the program that allows you to instant message with your friends or take pictures with your cell phone.

Patty Legaspi
Google
Mountain View,
California

Patty's Biography:

My interest for computers was sparked in elementary school when I was introduced to the computer game, Oregon Trail. I began to wonder how it had been created and what was inside the computer that made it work. I enjoyed taking old computers apart and loved the challenge of math. I went on to study computer science at Mills College and now I am an engineer at Google.

Patty's Hobbies:

My favorite hobby is spending time with my one-year-old daughter, Sofia. We play with stuffed animals, read books, and chase each other on our hands and knees. We also play on the computer together. She likes to hear music on it. Besides playing with my daughter, I also enjoy reading, biking, playing with my dog (Cookie), and spending time with the rest of my family.