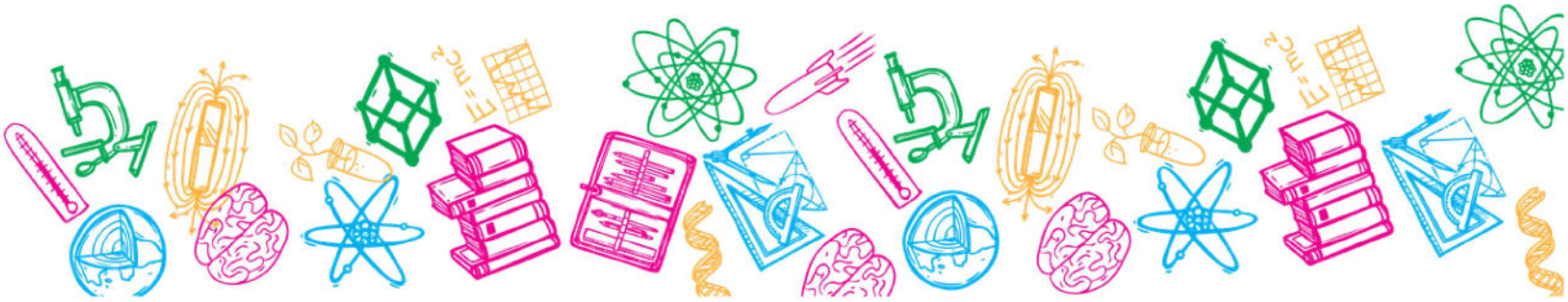
ABB Girls in STEM

Fun Patch

girl scouts of san jacinto



girl scouts of san jacinto

ABB SUPPORTS GIRLS IN STEM
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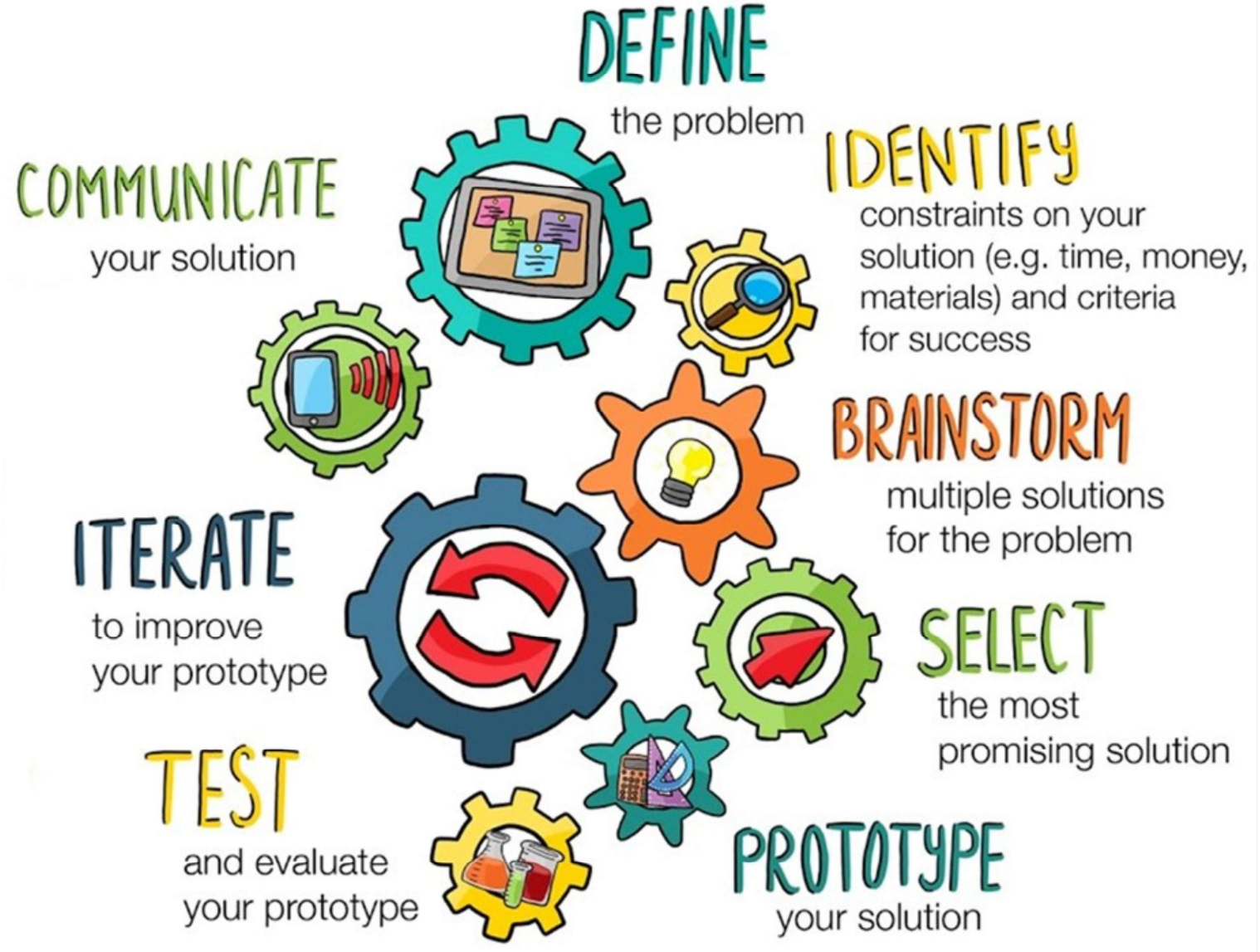
DESIGN THINKING PROCESS



ABB, a global technology leader, is teaming up with Girl Scouts of San Jacinto Council to help spark girls' interest in STEM!

Girls are natural-born scientists! They look at the world around them with inquisitive eyes as they experiment, push boundaries, and learn as they go. Throughout our 100-year-plus history, Girl Scouts have learned by doing. And because our program is girl-led, girls decide what they do together, often choosing to explore science, technology, engineering, and math (STEM). In fact, Girl Scouts are more likely to participate in STEM activities than non–Girl Scouts—and in the process, they become better problem-solvers and critical thinkers, and more effective leaders.

Patch Requirements: To earn the ABB Girls in STEM patch from Girl Scouts of San Jacinto Council, Girl Scouts will complete at least one of the STEM challenges, either on their own or with their troop or group.

Tips and Tricks for Leaders: These challenges are designed to help Girl Scouts think like scientists by using the Design Thinking Process. This process is used in many STEM disciplines and encourages thoughtful exploration, problem solving, and critical thinking. This process embodies the Girl Scout Processes!

- Girl-Led: Girls are in charge of their experience! Let them lead the way!
- Learning by Doing: This process is incredibly hands-on. They will be building and testing every step of the way.
- Cooperative Learning: Your troop can work together on projects or give feedback on individual projects.

This process is built into the program, but it can be challenging! Use the tips below to help your Girl Scouts work through these projects.

- A critical part of STEM is learning how to problem solve, and that often involves hard work and failure! Don't be afraid to let your Girl Scouts try an activity a few different times. Encourage them not to give up!
- Learning to think like a scientist rarely involves step-by-step directions. Let your Girl Scouts develop their own approaches to these challenges to help support this learning. Their final project does not have to look like the samples in our pictures!
- Let girls ask for what they need! We all want to be helpful, but let your Girl Scouts take the lead on working through challenging parts of these projects. They will feel empowered, and it helps them practice perseverance (another critical STEM skill).
- Ask questions! Asking girls about what they are doing and why will help them shape their own thoughts. A conversation with one girl might inspire another too!
- Lend a hand when needed. Some of these projects may require an extra hand to finish a tricky part of construction. Just recognize when your part is finished and keep it girl-led!

Ordering the Patch: Upon completion of the ABB Girls in STEM patch requirements, submit your information on this form to receive your ABB Girls in STEM patch!
https://gssjc.jotform.com/232856255835061

CHALLENGE ONE – EMERGENCY LIGHT

Oh no, the power has gone out! Can you design an emergency light?

Challenge Length: 1.5 hours

Great For: All Levels

Time	**Activity**	**Materials Needed**
15 minutes	Warm Up	
30 minutes	Learn a Skill	Copper tape (two 10-inch lengths for each girl) Button battery (one or two for each girl) Diode light (one for each girl) Paper circuit template (one for each girl) Binder clips (one for each girl) Scotch tape
45 minutes	Design a Solution	Notebook and pencil Copper tape Button battery Diode light Prototype-building materials (this is a sample list feel free to customize based on what you have on hand) • Recycled objects (boxes, egg cartons, paper towel rolls, etc.) • Masking tape • Construction paper • Scissors • Markers/crayons/colored pencils • Craft sticks

Challenge 1 Warm Up - 15 minutes

Materials Needed:

- none

Process:

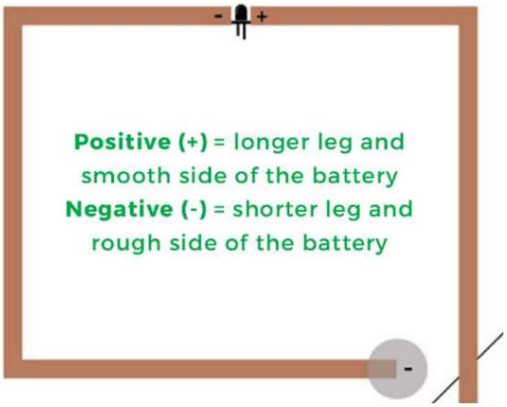
- Start by introducing this real-world problem. Encourage your Girl Scouts to think about a time when they lost power. What was happening- was there a storm? What kinds of lights did they use during the emergency?
- Talk about what made these emergency lights useful. Start to identify the criteria your troop will use when building their own emergency lights.
    - → Do they want a light that has a focused beam, or one that lights the whole room?
    - → Should it be portable, or can it stay in one place?
    - → What size should it be, large or small?
    - → What else should we consider?
- Watch this short video about circuits and electricity to get excited about this project!
https://www.youtube.com/watch?v=HOFp8bHTN30

Challenge 1 Learn a Skill - 30 minutes

Create a Simple Paper Circuit

Materials Needed:

- Copper tape (two 10-inch lengths for each girl)
- Button battery (one or two for each girl)
- Diode light (one for each girl)
- Paper circuit template (one for each girl)
- Binder clips (one for each girl)
- Scotch tape



Process:

- Explain that we are going to create a simple circuit to light up a small diode light!

  → Relate this circuit to lights we use daily. Instead of wires we'll be using copper tape. Instead of a lamp we'll be using this diode light. Our small battery will provide electricity.

- Discuss basic concepts of a circuit

  → A circuit needs to be a *complete circle.*

  → Electricity will leave one side of our battery. It will flow through the copper tape/wire, through the diode light (causing it to light up), then needs to flow back to the other side of the battery.

  → Electricity flows from the positive side of the battery to the negative. Find the plus and minus symbols on your battery.

- Instruct the Girl Scouts to create a copper tape circuit

  → Test your battery and diode by creating a mini circuit!

  → Note that one of the diode's legs is shorter than the other. This is the negative side.

  → Find the negative side of the battery. Touch the shorter leg to this side of the battery.

  → At the same time, touch the longer leg to the positive side of the battery. The diode should light up!

  → If not, try switching your diode legs. Try a different battery and a different diode.

  → The diode legs are like mini wires. The electricity is going out of the battery, along the leg, through the diode, along the other leg, then back into the battery.

- Start with the copper tape. This will be our wires.

→ This copper tape is a sticker with a backing. We recommend not pulling it all off at once! Pull the backing from one end, stick it on the paper template, then pull the rest as you go.

→ The sticky side of the tape is less conductive than the top side. When you make corners, fold the tape to create a connection.

→ Any breaks or tears in the tape can prevent the electricity from flowing. We recommend starting over if you break the tape.

→ Use the copper tape to trace the lines on the template.

→ Use caution at the corners.

→ Make sure there is a break at the diode bulb symbol.

→ Install the diode light at the symbol

→ Note that one of the legs of the diode light is shorter than the other. The shorter leg will go on the negative symbol side of the template.

→ Bend the diode legs to "do the splits." Then tape each leg to each side of the copper tape. Be sure to tape it tightly to have a firm connection!

→ Note that the electricity must flow *through* the diode bulb. There must be a break in the copper tape to make this happen.

→ Install the battery

→ Place the negative side of the battery on the circle on the paper template.

→ Fold the corner of the template up, so the second copper tape wire touches the top of the battery.

→ Use the binder clip to hold in place.

→ See if the battery lights up!

- Troubleshoot!

→ Persistence is a critical STEM skill to practice! Projects often don't work the first time- but don't give up! Let's troubleshoot and make it work.

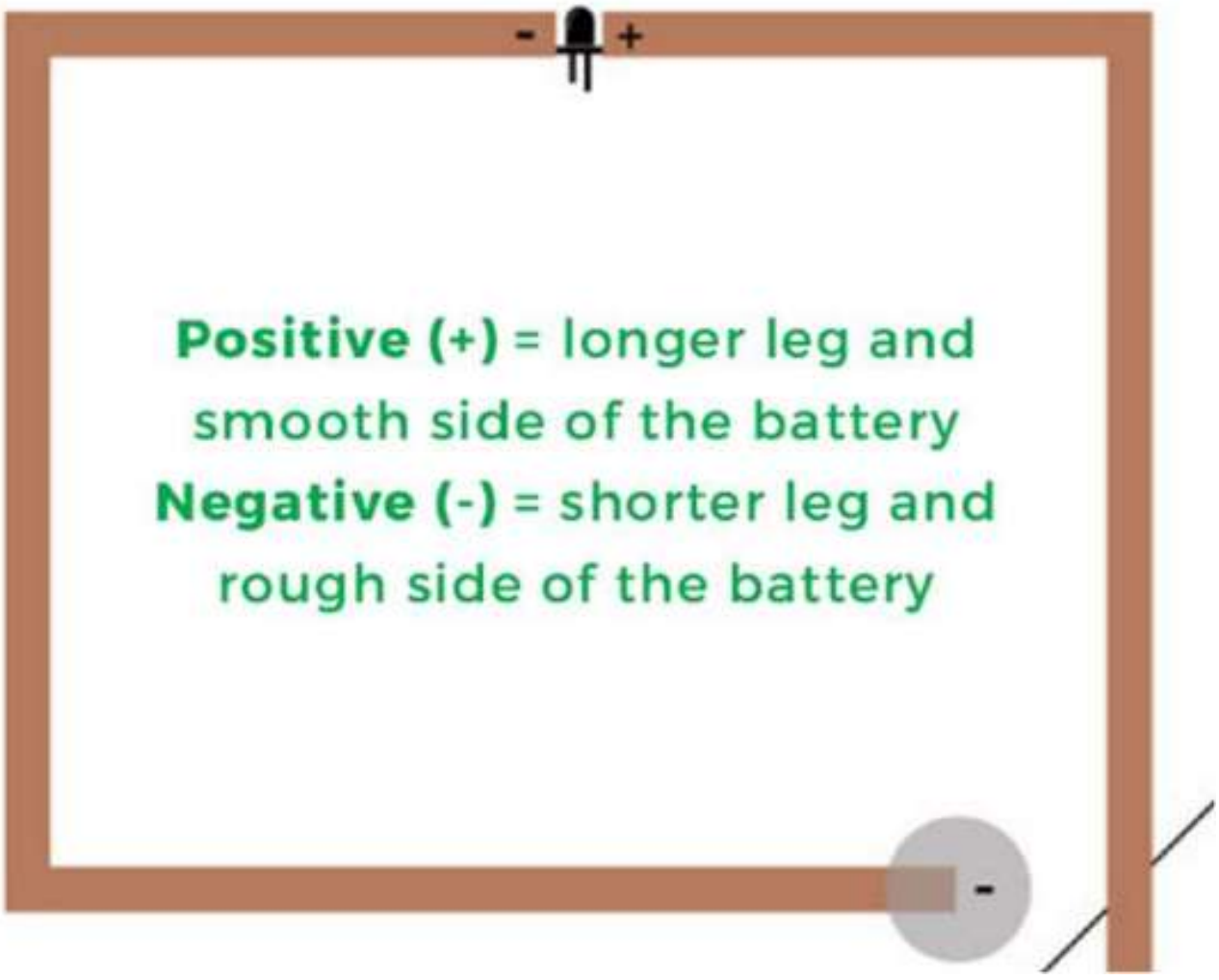
→ Check your connections. Push down on the circuit (with the battery attached) to see if anything is loose. Are the corners folded tightly? Are the diode wires well-connected? Are there any breaks or rips in the copper tape?

→ Check your battery. Are both sides of the battery connected? Flip it over to see if that helps.

Template

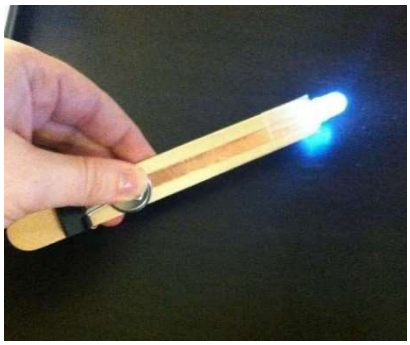
PAPER CIRCUIT

SIMPLE



Challenge 1 Design a Solution - 45 minutes

Create an Emergency Light



Materials Needed:

- Notebook and pencil
- Copper tape
- Button battery
- Diode light
- Prototype-building materials (feel free to customize based on what you have)
    - → Recycled objects (boxes, egg cartons, paper towel rolls, etc.)
    - → Masking tape
    - → Construction paper
    - → Scissors
    - → Markers/crayons/colored pencils

Process:

- Review the Design Thinking Process. We'll be using that process to design a solution to our problem!
    - → Before beginning, decide on how your troop will best work. Girls can work as individuals or in small groups. Your troop can also work as a whole group if that is best.
- First, we need to **define the problem**. We'll do that for our Girl Scouts in this challenge: the power went out and we need an emergency light!
- Next, we'll **identify constraints and criteria**. Think back to our original brainstorming and help the Girl Scouts define this for themselves. Record their responses to look back on later.
    - → Ask questions like: What does a good emergency light have? What does it not have? What materials can you use? Which can you NOT use?
- Let's **brainstorm solutions**! Start as a large group, then have girls refine their individual ideas. Encourage conversation and collaboration. Remember, there are no "bad" ideas in brainstorming!
    - → Encourage girls to sketch out their ideas. They will likely want to start building first, but planning is an important STEM skill!
    - → Think about the materials needed, construction ideas, etc.
- Use the criteria to evaluate the different ideas and **select the best idea** to build!

- **Build a prototype** of the proposed solution!

  → Girls can use their recycled materials to build their own prototype of their solution!
  → Coach through process, especially when it comes to adding the light

    ♣ Encourage girls to draw their circuit first in pencil, then trace it with the copper tape and bulb.

    ♣ Check the troubleshooting points from above if needed.

    ♣ Encourage girls to keep working and trying! This process might be frustrating but the outcome will be worth it!

- **Test and evaluate** the prototype.

  → Have girls present to the whole troop midway through their build. Focus on what is working and what they modified.

  → Give girls feedback on their inventions. Evaluate based on the stated criteria and functionality.

- **Iterate and improve** the prototype

  → Girls continue to make improvements to their inventions after feedback. Continue to coach and encourage their work!

  → This might take a few rounds of discussion and iteration. Feel free to do this informally through ongoing conversations.

- **Communicate your solution**.

  → Have girls present and discuss their inventions. Coach them through providing constructive criticism if needed. (We suggest the “oreo” or “sandwich” methods.)

CHALLENGE TWO –ROBOTS

The local factory needs a new robot! Design a robot that can lift or push.

Challenge Length: 1 hour, 15 minutes

Great For: Juniors & Up

Time	**Activity**	**Materials Needed**
15 minutes	Warm Up	
15 minutes	Learn a Skill	Oral syringes (2 per girl) Plastic tubing (8-inch length per girl) Cup of water
45 minutes	Design a Solution	Notebook and pencil Zip ties Cardboard Scissors Masking tape Construction paper Craft sticks Markers/crayons/colored pencils Recycled objects (boxes, egg cartons, paper towel rolls, etc.)

Challenge 2 Warm Up - 15 minutes

Materials Needed:

- none

Process:

- Start by introducing this real-world problem. Encourage your Girl Scouts to think about factory.
- Do a robot dance together! Have your Girl Scouts try and move like one of the robots in the video. Play some fun music.
- Talk about what makes these robots useful. Start to identify the criteria your troop will use when building their own robots.
    - → Your robots should lift or push. What size object do they need to move?
    - → Should it be portable, or can it stay in one place?
    - → What size should it be, large or small?
    - → What else should we consider?
- Watch this video about robots at a factory to learn more about how they might move, and how ABB's experts create unique robots!
https://www.youtube.com/watch?v=0FqMe1i__uM
- Watch this video to better understand this project.
https://www.youtube.com/watch?v=gmVXGpnWaqo
    - → Please note that this video uses materials not provided in these kits, including hot glue. Hot glue should only be used in a way that aligns with the *Safety Activity Checkpoints*.

Challenge 2 Learn a Skill - 30 minutes

Creating Movement

Materials Needed:

- Oral syringes (2 per girl)
- Plastic tubing (8-inch length per girl)
- Cup of water

Process:

- Explain that we are going to create the movement for our robots. Demonstrate a completed system for the girls so they can see how it will push or lift.
- Start by attaching one end of the tubing to the end of one syringe. This can be tricky- it will be a snug fit.
- Put the open end of the tubing in the cup of water. Depress the plunger on the syringe and then pull it up. This should fill the tube and syringe with water.
    - → Be careful to keep the plunger inside the barrel of the syringe! It may come out easily (and leak water) so keep it away from any computers or electronics. If it comes out, it can easily be replaced.
    - → There will be an air bubble in this system. Older girls can play around and try and get it out! The system will still work with the air bubble.
- Attach the open end of the tubing to the second syringe. Be sure the plunger is fully depressed when you do.
    - → Again, this will be difficult. It should be a tight fit.
- Now test it out! Press down the open plunger and observe what happens to the closed plunger. The closed plunger should pop out!
    - → If not, check each of the connections. The closed plunger might be stuck, so try and loosen it up by pulling it out a little.
    - → Then pull out the closed plunger and see how the other one moves.

Challenge 2 Design a Solution - 45 minutes

Materials Needed:

- Notebook and pencil
- Zip ties
- Cardboard
- Scissors
- Masking tape
- Construction paper
- Markers/crayons/colored pencils
- Brads (for hinges)
- Recycled objects (boxes, egg cartons, paper towel rolls, etc.)

Process:

- Review the Design Thinking Process. We'll be using that process to design a solution to our problem!

  → Before beginning, decide on how your troop will best work. Girls can work as individuals or in small groups. Your troop can also work as a whole group if that is best.

- First, we need to **define the problem**. We'll do that for our Girl Scouts in this challenge: our factory needs new pushing or lifting robots!

- Next, we'll **identify constraints and criteria**. Think back to our original brainstorming and help the Girl Scouts define this for themselves. Record their responses to look back on later.

  → Ask questions like: What does a good robot have? What does it not have? What materials can you use? Which can you NOT use?

- Let's **brainstorm solutions**! Start as a large group, then have girls refine their individual ideas. Encourage conversation and collaboration. Remember, there are no "bad" ideas in brainstorming!

  → Encourage girls to sketch out their ideas. They will likely want to start building first, but planning is an important STEM skill!

  → Think about the materials needed, construction ideas, etc.

- Use the criteria to evaluate the different ideas and **select the best idea** to build!

- **Build a prototype** of the proposed solution!

  → Girls can use their recycled materials to build their own prototype of their solution!

→ Coach Girl Scouts through this process.

♣ Check the troubleshooting points from above if needed.

→ Encourage girls to keep working and trying! This process might be frustrating, but the outcome will be worth it!

→ Start by sketching out an idea. Think about how your piston system will move.

→ We recommend a simple “up and down” or “back and forth” movement. This is by far the least complicated solution.

→ Think about what will hold or push the object the robot is moving. Do you need a wide platform, a bucket, or a narrow poker? Customize accordingly.

→ What will anchor the stationary part of the piston? Does this need to be wide and heavy, or can it be lightweight and stuck to a surface with tape?

- **Test and evaluate** the prototype.

  → Have girls present to the whole troop midway through their build. Focus on what is working and what they modified from their original plan.

  → Give girls feedback on their inventions. Evaluate based on the stated criteria and functionality.

- **Iterate and improve** the prototype

  → Girls continue to make improvements to their inventions after feedback. Continue to coach and encourage their work!

  → This might take a few rounds of discussion and iteration. Feel free to do this informally through ongoing conversations.

- **Communicate your solution**.

  → Have girls present and discuss their inventions. Coach them through providing constructive criticism if needed. (We suggest the “oreo” or “sandwich” methods.)

CHALLENGE THREE – ELECTROMAGNETS

The recycling center needs help sorting the recycling! How can they pull out the magnetic material to recycle it appropriately?

Challenge Length: 1 hour, 15 minutes

Great For: Juniors & Up

Time	**Activity**	**Materials Needed**
15 minutes	Warm Up	
15 minutes	Learn a Skill	Kitchen magnet Assorted magnetic and non-magnetic materials. Iron nail Magnet wire (1 coil per girl) Sandpaper Battery Scotch tape
45 minutes	Design a Solution	Notebook and pencil Electromagnet Assorted recyclable materials (metal and plastic) Recycled materials for machine creation (this is a sample list- feel free to customize based on what you have on hand) • Recycled objects (boxes, egg cartons, paper towel rolls, etc.) • Masking tape • Construction paper • Scissors • Markers/crayons/colored pencils • Craft sticks

Challenge 3 - **Warm Up** - 15 minutes

Materials Needed:

- none

Process:

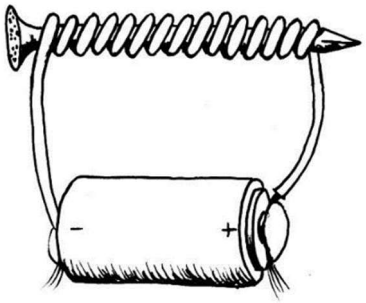
- Start by introducing this real-world problem. Show a video of a recycling center and talk about their experiences recycling at home and school.

  → Do recycled materials need to be separated, or do they go into one bin? How do you think materials are recycled? Why is it important to recycle?

- Talk about what happens to different materials, using the video as a reference: https://www.youtube.com/watch?v=BuBIDn9kkY8

Challenge 3 - **Learn a Skill** - 15 minutes

Materials Needed:



- Kitchen magnet
- Assorted magnetic and non-magnetic materials.
- Iron nail
- Magnet wire (1 coil per girl)
- Sandpaper
- Battery
- Scotch tape

Process:

- Explain that we are going to build our own electromagnets today!
- Watch these videos to learn more about electromagnets and how they work:

  https://www.youtube.com/watch?v=sFC7-WVNUP8
  https://www.youtube.com/watch?v=cxELqN7wjS0

  → Electromagnets are a type of magnet that can be turned on and off. Discuss places we see magnets often (fridge, some cabinets close with magnets, magnets stick to cars, are in toys, etc.).

  → Electromagnets use electricity to generate a magnetic field. This was discovered in the 1820's and has been used in many different things since!

Today, electromagnets are used in motors and generators, loudspeakers and headphones, MRI machines, and more!

• Do a magnet experiment! Spread out the magnetic and non-magnetic materials. Use the kitchen magnet and see what you can pick up!

• Sort these materials into two piles: magnetic and not magnetic. What do magnetic items have in common?

• Magnetic items have "ferromagnetic materials" in them, including iron, steel, nickel, and cobalt. They will all be metal, though not all metals are magnetic.

• Demonstrate an electromagnet. Turn it "on" by attaching the wires to the battery. Demonstrate how it picks up magnetic materials when it is "on" but won't when it is "off."

→ If your troop completed the "circuits" challenge, this might be a good opportunity to review what a circuit is!

• Coach girls as they make their own!

• Start with the coil of magnet wire. You will wrap this wire around the iron nail. Leave about 6 inches of wire loose before you start wrapping. We'll need this to attach the battery.

• The wire should be wrapped tightly around the nail. This process may take a while- the more coils around the nail, the more powerful the magnet is. We've measured out enough wire to allow our electromagnets to pick up paper clips easily.

• Leave another 6 inches of wire loose at the end.

• Girls can use scotch tape to secure the coils when they finish wrapping.

• Use sandpaper to remove the red coating on the wire at the ends.

• This coating is insulation, which prevents it from conducting electricity. It must be removed to attach it to the battery.

• Use scotch tape to secure the ends of the wires to the battery.

• This needs to be a tight connection. Press it down firmly to ensure it is connected.

• Test it out! It should pick up the magnetic items. If not, troubleshoot!

• Be sure the wires are firmly attached to the battery, and the red coating is completely removed.

• Did you use all the wire? The length of wire is measured to give enough coils around the nail. Shorter wire lengths might not have enough power.

• Is your battery dead? Try a different one!

• Note that sometimes the electromagnet will take a few minutes to fully lose its magnetism after being disconnected from the battery

Challenge 3 - **Design a Solution** - 45 minutes

Materials Needed:

- Notebook and pencil
- Electromagnet
- Assorted recyclable materials (metal and plastic)
- Recycled materials for machine creation (this is a sample list- feel free to customize based on what you have on hand)
    - → Recycled objects (boxes, egg cartons, paper towel rolls, etc.)
    - → Masking tape
    - → Construction paper
- Scissors
- Markers/crayons/colored pencils

Process:

- Review the Design Thinking Process. We'll be using that process to design a solution to our problem!
    - → Before beginning, decide on how your troop will best work. Girls can work as individuals or in small groups. Your troop can also work as a whole group if that is best.
- First, we need to **define the problem**. We'll do that for our Girl Scouts in this challenge: we need to sort magnetic items at our recycling factory!
- Next, we'll **identify constraints and criteria**. Record their responses to look back on them later.
    - → Ask questions like: What will make this a successful sorting machine? What will make it not successful? How will we test it out? What materials can you use? Which can you NOT use?

      Let's **brainstorm solutions**! Start as a large group, then have girls refine their individual ideas. Encourage conversation and collaboration. Remember, there are no "bad" ideas in brainstorming!
    - → Encourage girls to sketch out their ideas. They will likely want to start building first, but planning is an important STEM skill!
    - → Think about the materials needed, construction ideas, etc.
- Use the criteria to evaluate the different ideas and **select the best idea** to build!
- **Build a prototype** of the proposed solution!

→ Girls can use their recycled materials to build their own prototype of their solution!

→ Coach and encourage girls through this process.

♣ Check the troubleshooting points from above if needed.

♣ Encourage girls to keep working and trying! This process might be frustrating, but the outcome will be worth it!

→ You might suggest starting with a shoebox-sized "factory building." Using the inside of a box (diorama style) will give many points to attach different parts of this sorting apparatus.

→ Think about what will hold the electromagnet in this recycling sorting facility. Build a housing for it.

→ Think about how the electromagnet will interact with the materials. Will it move, or will the materials move past it? Build the appropriate mechanisms.

→ Where will the materials end up when they have been sorted? In a bin or designated area? Build that structure too!

- **Test and evaluate** the prototype.

  → Have girls present to the whole troop midway through their build. Focus on what is working and what they modified.

  → Give girls feedback on their inventions. Evaluate based on the stated criteria and functionality.

- **Iterate and improve** the prototype

  → Girls continue to make improvements to their inventions after feedback. Continue to coach and encourage their work!

  → This might take a few rounds of discussion and iteration. Feel free to do this informally through ongoing conversations.

- **Communicate your solution**.

  → Have girls present and discuss their inventions. Coach them through providing constructive criticism if needed. (We suggest the "oreo" or "sandwich" methods.)