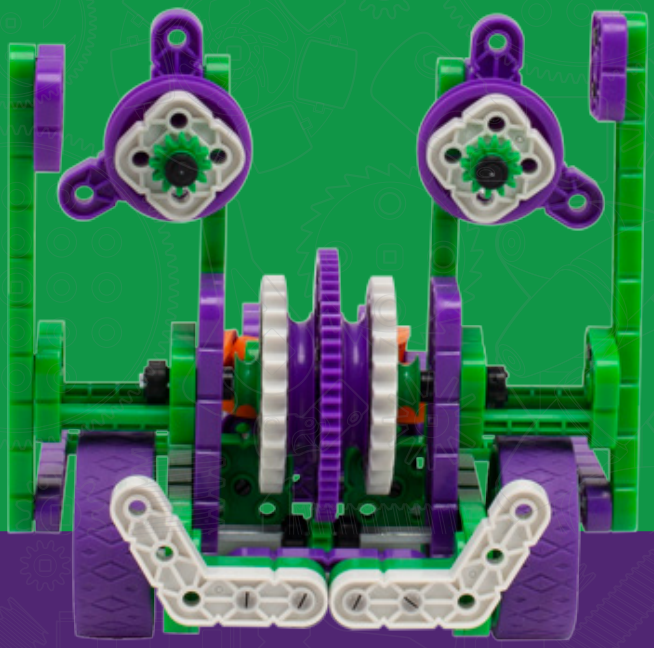
ROBOTICS EDUCATION & COMPETITION FOUNDATION

REC FOUNDATION

VEX IQ MIA KIT BUILDING EXCITEMENT

EXPLORE • LEARN • DEVELOP



BROWNIE

ROBOTICS BADGE CURRICULUM

$E=mc^2$

REC FOUNDATION

Girl Powered

Welcome

EXPLORE • LEARN • DEVELOP

Explore the world of robotics, science, technology, engineering and math with the Robotics Education & Competition Foundation, and put your knowledge to work with these hands-on engaging activities to earn robotics Girl Scouts badges!

Together, through these real-world concepts and activities, the REC Foundation and Girl Scouts want to empower you to reach for your dreams and redefine the face of STEM.

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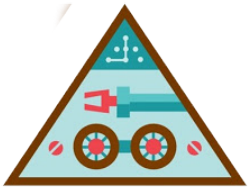

Robotics Badge 2: Designing Robots

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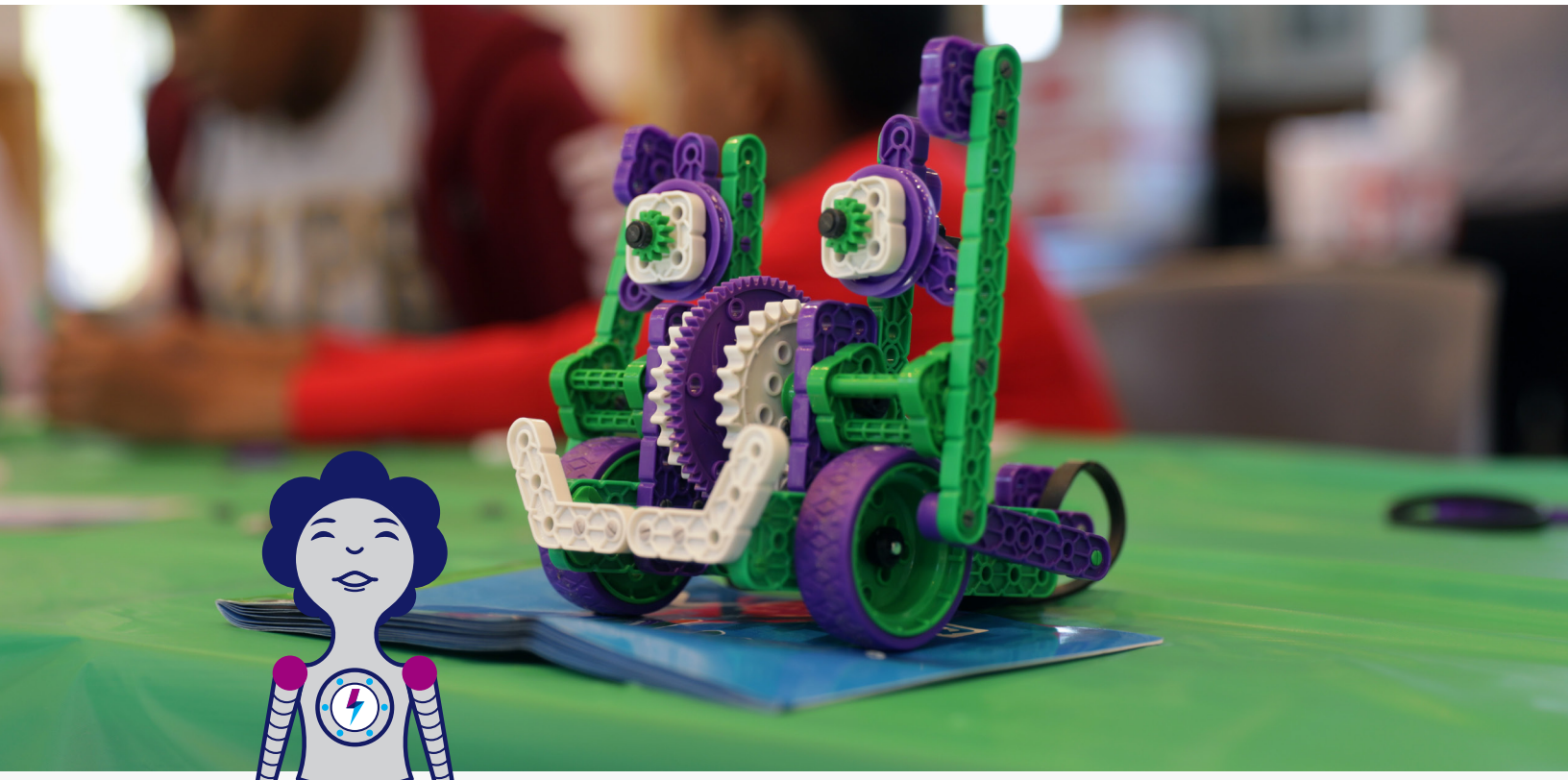
Badge 1
Programming Robots



Overview

When you've earned these three badges, you'll know how to build a robot, program a robot, and share what you've designed with others. Every day, a robotics engineer invents another robot that can do something new - like perform surgery, explore Pluto and even herd cattle! What will they do in the future? If you can't wait to find out, you might want to think about becoming a robotics engineer someday, so you can invent what the future looks like!

Vocabulary

Algorithm
A set of step-by-step instructions for how to do something. A recipe to bake a cake is an algorithm. So are directions to get from your house to your friend's house. Robots use algorithms to know how to move on their own.

Coding
Transforming algorithms into a language that computers understand.

Program
An algorithm that has been coded into a machine or robot to make it run.

Debugging
Finding and fixing issues in a robot's program.

Automatic
A machine that works with little or no human control.

Sensor
A device which detects or measures a physical property (like sight, sound, temperature).

Work
A force acting on an object to move it across a distance (like pushing, pulling and lifting).

Simple Machines
Tools used to make work easier that cannot move on their own (Inclined Plane, Wedge, Screw, Wheel and Axle, Lever, Pulley).

Inclined Plane
A flat surface (or plane) that is slanted, or inclined, so it can help move objects across distances. A common inclined plane is a ramp.

Wedge
A moveable inclined plane, but instead of using the flat smooth side to make work easier, you use the pointed edge to push things apart. An example is an ax blade.

Screw
A screw is an inclined plane wrapped around a cylinder with a pointed end and helps to do work by being easily turned to move itself through a solid space like a block of wood.

Wheel and Axle
Makes work easier by moving objects across distances. The wheel turns with the axle causing movement. Wheels and axles can be found on cars.

Lever
A stiff bar that rests on a support called a fulcrum. Levers move against the fulcrum to move heavy objects by putting the object on one end and applying pressure to the other end. A seesaw on the playground is an example of a lever.

Pulley
A cord that wraps around a wheel. The cord is used to raise and lower objects, and the wheel makes the objects lighter and easier to raise. A common pulley is a flagpole where a rope is attached to a pulley to raise and lower the flag.

Badge 1 • Step 1: Create a Simple Machine

Items Needed

- **Blank paper**
- **Pencils, markers**
- **Two Printed Copies of Simple Machines (Found on page 25-27)**
- **Brown bag (one for each girl)**
- **Variety of snack items (pretzel, candy, marshmallow, etc.)**
- **Computer or laptop with Internet connection (Recommended one per 2 girls)**

Ask

- **What is a robot?**

A robot is a machine that can follow instructions to do jobs that are too boring, dangerous or impossible for people to do

- **How do robots work?**

Robots are just simple machines, made of many different parts that can run automatically with a program.

Activity

1. **Say:** To understand how robots are built, we must first understand the parts of machines that cannot work automatically, called simple machines. Without a program, robots are just many different simple machines all together!
2. **Read and discuss:** The definition of Simple Machines and the six different types of simple machines. (Inclined Plane, Wedge, Screw, Wheel and Axle, Lever, Pulley)
3. **Cut out images:** From the Simple Machines document on the table and ask girls to categorize the images into the six groups of simple machines.

Discuss

1. Why have girls chosen to places images in each category and how is each image a simple machine?
2. Can you think of some reasons why a robot might have these simple machines in its design?
3. What do they help a robot do?

Badge 1 • Step 2: Test Your Robot

Ask

- **What 5 senses do humans have and how do they help us? (Sight, sound, smell, taste, touch)**

Activity

1. Have the girls seated with their eyes closed.

2. Place a different snack into each of the brown paper bags and place one bag in front of each girl. Give each girl a paper and pen to write down the data they collect from their sensors.

3. Ask girls to write down their observations after each round. Remind girls to keep their eyes closed!
    - **Round 1: Smell** - Tell girls to smell what is inside the bag and write down their notes.
    - **Round 2: Sound** - Tell girls to shake the bag and write down what they hear.
    - **Round 3: Touch** - Ask girls to put their hand into the bag to touch the snack, but do not pull the snack out.
    - **Round 4: Taste** - Ask girls to taste the snack with their eyes closed and write down notes.
    - **Round 5: Sight** - Allow girls to see what their snack is.

Discuss

Robots have sensors just like humans do to help us sense the world around us. A robot **sensor** is a device that detects or measures a physical property (like sight, sound, temperature). Robots use sensors to receive information and respond according to how they are **programmed**.

- What sensors may a robot have and how do they help?
- How are they similar or different from what humans have?

Badge 1 • Step 3: Learn About Programming

ASK

- **What do you do in your daily life that can be broken down into step by step instructions? (or an algorithm)?**
  Answers may include: brush teeth, make a sandwich, wash hands, etc.
- **Ask girls to give step by step instructions using 5 steps on how to _____ (use one of the answers provided)**
- **Ask girls to give step by step instructions using 10 steps on how to_____ (use one of the answers provided)**

Discuss

- Robots need step-by-step instructions known as **algorithms** to know what to do. A program is when an algorithm has been coded into a robot's brain so that it knows what to do.
- Robots run on **programs** created by computer engineers called programmers. When programmers make mistakes, they must find the errors known as "bugs" in the code and fix them. This is called **debugging.**

Follow-Up

- What you did was just create 2 different algorithms. Did one work better than the other? Why? (the 10 steps should have led to clearer instructions)
- More detailed instructions should lead to a better result when you are trying to tell someone how to do something. In robotics, the algorithm must be very detailed for the robot to function properly.
- Robots run on programs created by computer engineers called programmers. When programmers make mistakes, they must find the errors known as "bugs" in the code and fix them. This is called debugging.

Badge 1 • Step 4: Try Simple Programming

ASK

- **Did your program work perfectly the first time? Why not?**
- **How did you debug your program?**

ACTIVITY

1. Pair girls and give groups a paper and pen.
2. Ask one girl to be the 'programmer' and to write an algorithm for their partner, the 'robot', to act out. Example algorithms girls can write are how to get ready for school in the morning, brushing teeth, how to make a sandwich, etc.
3. Once the programmer finishes the program without the robot seeing it, have her read it to the robot and see if the robot can do the task perfectly.
4. Have the girls take turns being programmer and the robot.

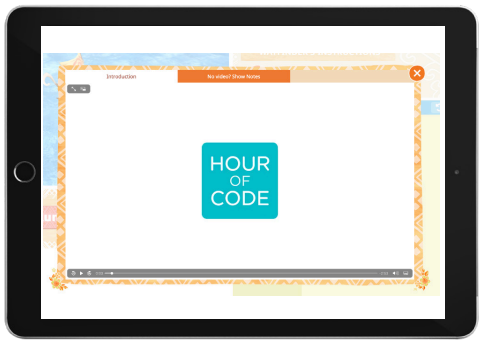
Badge 1 • Step 5: Code a Robot

ASK

1. **Why do we programmers include specific detailed algorithms to sail Moana's boat (her robot)?**
   Answer: The robot (Moana's boat) will not know what to do without algorithms. The robot cannot think for itself and only can do what the program says.

2. **How did you create your algorithm to tell Moana's boat what to do? How did you debug when creating your code?**

3. **Do you think you would be able to create a program like this for a robot in real life?**

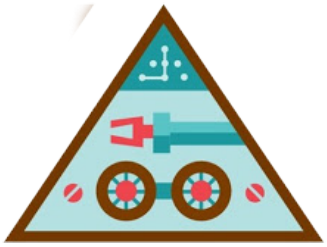


ACTIVITY

1. Have girls gather around laptops in small groups.
2. Go to http://partners.disney.com/hour-of-code/wayfinding-with-code
3. Watch the three-minute tutorial video that comes up.
   Have girls rotate and take turns for each of the different levels.
4. Allow girls to make mistakes and take a complete turn before letting the next girl go.

CONCLUSION

- Programmers can make creative programs to make their robots do jobs that are too boring, dangerous or impossible for people to do.
- What would you want to program a robot to do for you? What would you want to program a robot to do to help others?



Badge 2
Designing Robots

Overview

Robots are designed with many different parts, each with its own important job to help the robot. Sometimes, engineers design robots that are inspired by humans, animals, and nature. In this badge, the girls will identify problems and brainstorm different solutions that can be achieved with robots. They will explore biomimicry in design and create a working prototype and program for their robot design.

Vocabulary

Biomimicry

The design and creation of materials or systems that are modeled on humans and other parts of nature, like animals or plants.

Pollinate

To deposit pollen on a plant or flower to allow fertilization

Algorithm

A set of step-by-step instructions for how to do something

Program

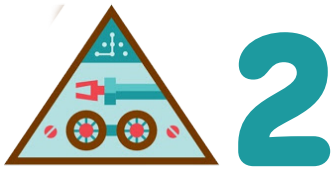
An algorithm that has been coded into something that can be run by a machine

Prototype

A quick way to show an idea to others or to try it out. It can be as simple as a drawing or it can be created with common materials such as cardboard, paper, string, rubber bands, etc.

Debugging

Finding and fixing issues in a program



Badge 2 • Step 1: Explore How Robots Imitate Nature

Items Needed

- **VEX IQ Mia Kit**
- **Computer or tablet with Internet connection to watch a video**

Ask

- What do robots look like?
- What does biomimicry mean? (**Biomimicry** is the design and creation of materials or systems that are modeled on humans and other parts of nature, like animals or plants)

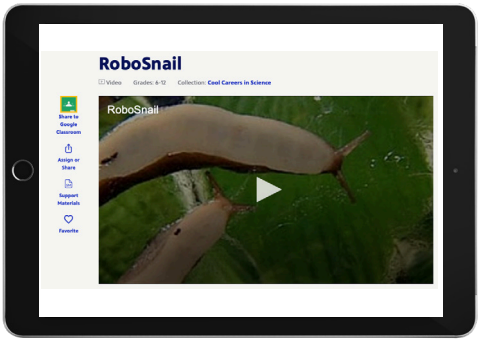
Engineers create and design robots to do things humans can1t do. They look at how humans and animals do certain actions when they're deciding what they want their robot to do. That helps engineers think of creative ways to design their robots.

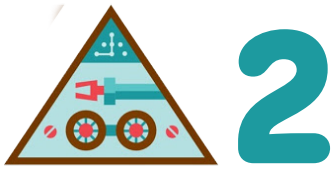
- If you wanted to make a machine that could fly, what would you need? (ex. wings like a bird)
- If you wanted to make a robot that can jump high, what would you need? (ex. strong legs like a kangaroo)

Activity

Watch these videos on how scientist use biomimicry

https://www.pbslearningmedia.org/resource/eng06.sci.engin.systems.robosnail/robosnail/





Step 1: Learn about the parts of a robot (continued)

Discuss

In groups, discuss how you would create a robot inspired by a bumblebee. Some questions you may ask:

- What do bumblebees do? *(Bumblebees help **pollinate**, meaning they help to move and deposit pollen on a plant or flower to allow fertilization.)*
- How would a robot bee help the environment? *(It would help pollinate plants so that they can continue to grow.)*
- What would a robot bee look like and do? What robot parts would it have? *(wings, antenna, stingers, stripes, legs, etc.)*

Badge 2 • Step 2: Learn About the Parts of a Robot

Just like us, robots have different parts of their bodies that help them to move, sense, and react. Compare how your body moves to that of a robot as you explore how a robot 1s parts can be inspired by humans. After, create a simple machine out of common materials that mimic a robotic arm to help extend your arm 1s reach!

Ask

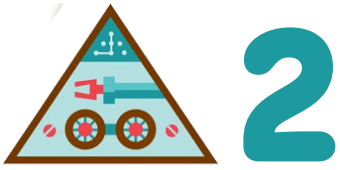
- **What body parts help us move?**
- **Robots have sensors to help them get around - what senses do we use to get around?**
- **Robots have pieces to keep them moving and together-what kind of parts do you have that help you move your hand? (joints, bones, and muscles)**

Activity

1. Use the VEX IQ Mia kit and explore the parts.
2. Let girls imagine how the parts could be used to build a robot. What parts might make up the wheels? What parts could make a moveable joint? What parts could make up the body?

Discuss

How are these VEX IQ Mia kit parts similar to parts of our body?



Badge 2 • Step 3: Begin Building Your VEX IQ MIA

Ask

- **Can you remind us of the things robots do?** ***(Robots do tasks that are often too hard, boring or dangerous for humans to do. Robots can also be created to help humans or animals.)***
- **What career could you have to create robots?** ***(Engineers)*** **Engineers often work in groups so that they have team members with different strengths.**
- **Today, we are going to begin building a robot in small groups. How can we make sure that everyone has a chance to participate?**

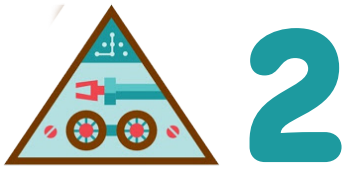
Activity

1. Divide the girls into engineering groups of 5.

2. Using the VEX IQ Mia Build Instructions booklet follow the directions for steps 1 -10. (This will not complete your Mia but will get you to a good place to stop for a break.)

Discuss

- What issues did your group face when working together?
- Is there anything we can change to work better as a team?
- How were you like engineers today?



Badge 2 • Step 4: Finish Building Your VEX IQ MIA

Engineers create prototypes, a quick way to show an idea to others or to try it out. It can be as simple as a drawing or created with common materials, such as cardboard, paper, and string. Now is your chance to finish building the prototype of your robot.

Remember, you're creating a robot, not a simple machine, so you'll also need to create a step-by-step program for your robot prototype to "run".

Ask

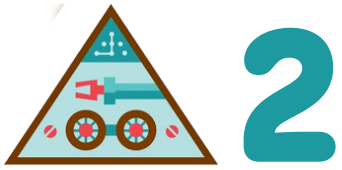
Studying the portion of the VEX IQ Mia that we have built, what do you think it will do when it runs?

Activity

Using the VEX IQ Mia Build kit instruction booklet complete the building steps 11 -27. (This will complete the building process. We will run it in the next step.)

Discuss

- What was difficult about building the VEX IQ Mia?
- How did your engineering team excel in working as a team to build the VEX IQ Mia?
- Now that the VEX IQ Mia is built, do you have a better idea of what it will do when it runs?



Badge 2 • Step 5: Run the VEX IQ MIA and Get Feedback

Once engineers create a prototype, they test it to find ways to improve and redesign their new products. Work with a fellow Brownie to test your robot prototype. Tell your partner how to move the prototype according to your program so you can debug or fix problems before you share your prototype with your Troop. After you share, gather feedback and ideas, like an engineer, on how to improve your robot's design and make it even better!

Ask

- **What does the word feedback? (meaning a person's reaction or opinion to a product)**
- **How could getting feedback from others be helpful when building robots?**

Activity

1. Using the photo on step 28 of the VEX IQ Mia Build Instruction Booklet, have the girls place the black rubber band to run the VEX IQ Mia.

2. Have each girl take a turn running the VEX IQ Mia. Let the girls give feedback on each group's robot. Could it be built better? Differently?

Discuss

- Earlier we talked about biomimicry. How does the VEX IQ Mia robot mimic something in nature?
- Would you enjoy being an engineer that designs robots?
- What kind of robot would you choose to create?

Badge 3
Showcasing Robots

Overview

After engineers build their robots, they show them to others and enter them into challenges and competitions. Now that you have built your robot prototype, it's time to present and share your design with others. After, learn about robotics teams and competitions and see a robot in action!

3

Badge 3 • Step 1: Create a Presentation to Share Your Robot

After an engineer creates a prototype, she shares it with others. This is important because it gives her a chance to share her work, get feedback, and teach others how to build their prototype. Choose a way to share your prototype and explain how you designed it.

Items Needed

Depending on method of presentation, materials will vary.

- **Paper**
- **Pencil**
- **VEX IQ Mia prototypes created in the 'Designing Robots' Badge**
- **Device for recording video**
- **Computer to edit video**
- **Craft materials - poster board, construction paper, scissors, markers, etc.**

Ask

- **Are you happy about what your robot looks like?**
- **Would you make any changes to your robot?**

Activity

1. Create a show-and-tell presentation
2. Share your VEX IQ Mia with others in your troop.
3. Prepare and practice a short presentation with your engineering team.
4. Explain how you built it and any problems that you encountered along the way. Include a demonstration of your robot.
5. Get feedback from your audience about the robot.

Discuss

- Did sharing your VEX IQ Mia give you constructive feedback?
- How could you take the feedback and improve your robot?
- Were you confident in sharing in front of your troop?

Badge 3 • Step 2: Tell Others How You Designed Your Robot

ASK

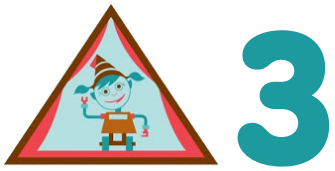
You are going to give the same show-and-tell presentation you gave to your troop to others - friends, family or classmates. How will you show the steps that were involved in building your VEX IQ Mia?

ACTIVITY

Share your VEX IQ Mia with friends, family or classmates using the same presentation as Step 2.

DISCUSS

- How did others react to the VEX IQ Mia?
- How did it feel to be a presenter?
- Was it difficult or easy for you? Why?



Badge 3 • Step 3: Learn About Robotics Competitions

Ask

- **Are you interested in competing in a robotics competition?**
- **Are you wanting to meet with other girls that are also interested in STEM?**

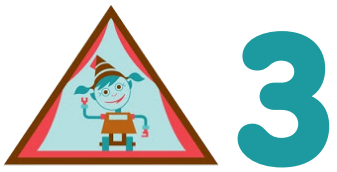
Activity

There are a lot of places where you can meet other people who design robots. At robotics competitions, teams of engineers build robots that can navigate mazes, lift heavy options, and solve other's problems. Teams are posed with challenges, then design prototypes to solve the problem using robotics kits. Competitions like these are held around the world!

1. Watch this video to learn more about VEX: https://www.youtube.com/watch?v=jrCb n l3tY.
2. Choose a way to learn about VEX IQ (grades 3-8) and VEX Robotics competitions (grades 6-12):
    - **Option A:** Go to a competition to see how they are showcased. Check out RobotEvents.com for local robotics competitions: https://www.robotevents.com/robot-competitions/all.
    - **Option B:** Interview someone who participated in a robotics competition
    - **Option C:** Learn about competitions online. Visit this link to learn more about this year's VEX IQ Challenge: https://www.vexrobotics.com/vexiq/competition/viqc-current-game. Watch the Game Video and think about how you could design a robot to play the game.

Discuss

- Did learning about competitions get you interested in competing?
- How did the competition make you feel?



Badge 3 • Step 4: Learn About Robotics Teams

Robotics teams are made up of dedicated members, each with their own talent or expertise to bring to the robot, from programming to driving to marketing the robot. Robotics teams work together, listen to each other, and make sure to be safe when creating their robots. Now that you1ve seen what teams do at robotics competitions, consider if you1d you like to join a robotics team.

If you are interested in starting your own team, visit RoboticsEducation.org to learn more. Team grants are available to help get you started.

Ask

Would you like to join a robotics team?

Activity

- See if any of your fellow brownies would be interested in joining or creating a robotics team.
- Research options for robotics competitions and challenges to figure out the next steps.
- Talk to an older Girl Scout who is involved in competitions, see how they like it and if it is something you could be interested in.
- Watch videos online to learn more about the competitions and all the involvements that come with it.

Discuss

- After research, are you interested in joining a team?
- Would you be willing to be a leader for this team?
- Who else would be a part of the team?

Badge 3 • Step 5: See Robots in Action

Robots exist all around our everyday world. See a robot in action and reflect on everything you've learned. What does the robot do? What sort of parts do you see in the robot? Discover how engineers bring robots to lite.

Ask

• **Where could we go to see robots in action?**

Activity

- Find a real robot at a nearby high school or college and visit their workspace. Explore the labs and learn more about how they do their jobs and what they achieve.
- Talk to an older Girl Scout and see if they have been involved in a robotics lab or have used a robot before.
- Search online, "Robotics Lab Virtual Tours", to find videos and virtual tours of robotics labs around the world.

Discuss

- Did the tours help you gain an interest in robotics?
- Could you see yourself making a career out of this?

Simple Machines

Brownies Badge 1
Activity

Welcome to the wonderful world of robotics and STEM. Today, you will discover the 6 different simple machines. Many of your use these simple machines every day, here are the 6 different simple machines you will learn about today!

Levers

A lever is just like a see-saw you play with on the playground. A lever is a stiff board or bar that rests on a base called a fulcrum. The fulcrum lifts and moves objects, just like a see-saw lifts you up when your friend bounce down.

Pulleys

A pulley has a rope and wheels. It can be used to pull things up. An old-fashioned well uses a pulley to pull up water.

Wedges

A wedge has a pointed end. It can be driven into something to separate it. An ax is a wedge. So is a nail.

Wheels

A wheel and an axle are a type of simple machine. A wheel has a rod, or axle running through it. Your bicycle wheel has a wheel and axle.

Inclined Planes

An inclined plane has a slope that takes you from a lower surface to a higher one. A sloped sidewalk is an inclined plane. A dump truck and a roller coaster also have inclined planes.

Screws

A screw is an inclined plane wrapped around a rod. It holds things together securely.

Simple Machines

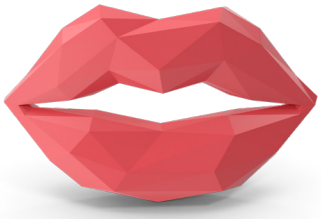
Brownies Badge 1: Activity

Instructions

1. Have the troop leader cut out all labels below.
2. Place all labels on a surface spread out.
3. Cut out all pictures on pages 25-27
4. Mix the pictures randomly into a pile
5. Have the troop place the pictures in the correct label category
6. When the troop is finished, check their work using the Troop Leader Key on page 27

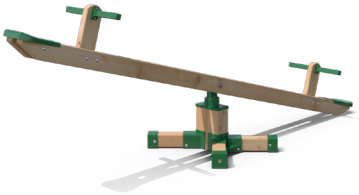
Levers	**Pulleys**
Wedges	**Wheels**
Inclines Planes	**Screws**

Cut out these pictures and rearrange them in a random order for the game.



Cut out these pictures and rearrange them in a random order for the game.

Cut out these pictures and rearrange them in a random order for the game.



This key is for the troop leader to have in order to check the troop's answers to the game. After the girls have finished their game, check their answers. A good idea is to give a prize out for correct answers.

Trooper Leader Key • Pictures of the following in each group:

Levers: wheelbarrow, scissors, light switch, tongs and seesaw. • **Pulleys**: flagpole, water well, elevator, crane, and fishing pole. **Wedges**: shovel, mouth, door stop, ax, and nail • **Wheels:** ship wheel, ferris wheel, roller-skates, door knob, and bike • **Inclined Planes**: ramp, stairs, slide, roller coaster and skateboard ramp • **Screws:** screw, vending machine, jar, water faucet and can opener