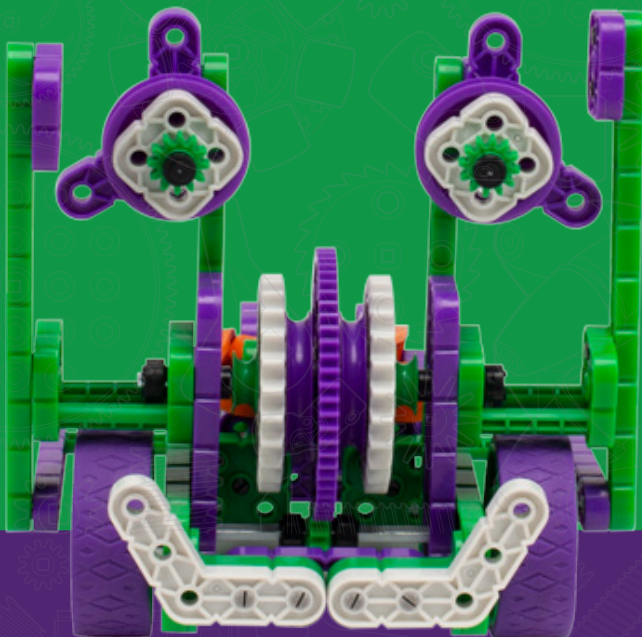


VEX IQ MIA KIT BUILDING EXCITEMENT

EXPLORE • LEARN • DEVELOP

JUNIOR

ROBOTICS BADGE CURRICULUM



Girl
Powered.

$$E=mc^2$$



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.

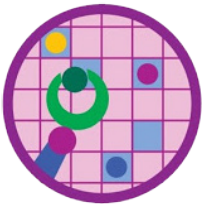


Junior Robotics Curriculum



Robotics Badge 1: Programming Robots

- 06 | Learn how robots work
- 07 | Discover the robot brain
- 08 | Learn about programming
- 09 | Try simple programming
- 10 | Code a robot



Robotics Badge 2: Designing Robots

- 12 | Discover the future of robots
- 14 | Determine your robot's experience
- 15 | Plan your robot
- 16 | Create a prototype & finish building your VEX IQ MIA
- 17 | Run the MIA & get feedback



Robotics Badge 3: Showcasing Robots

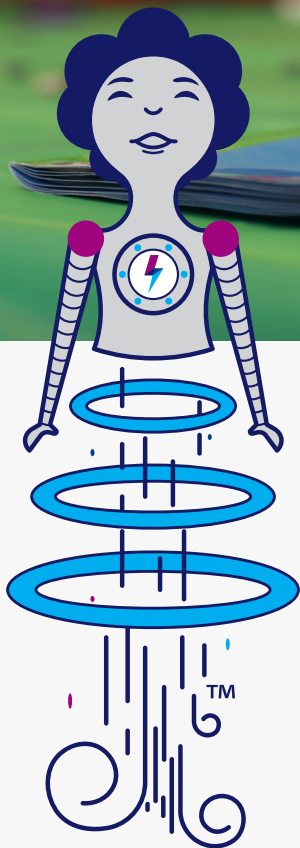
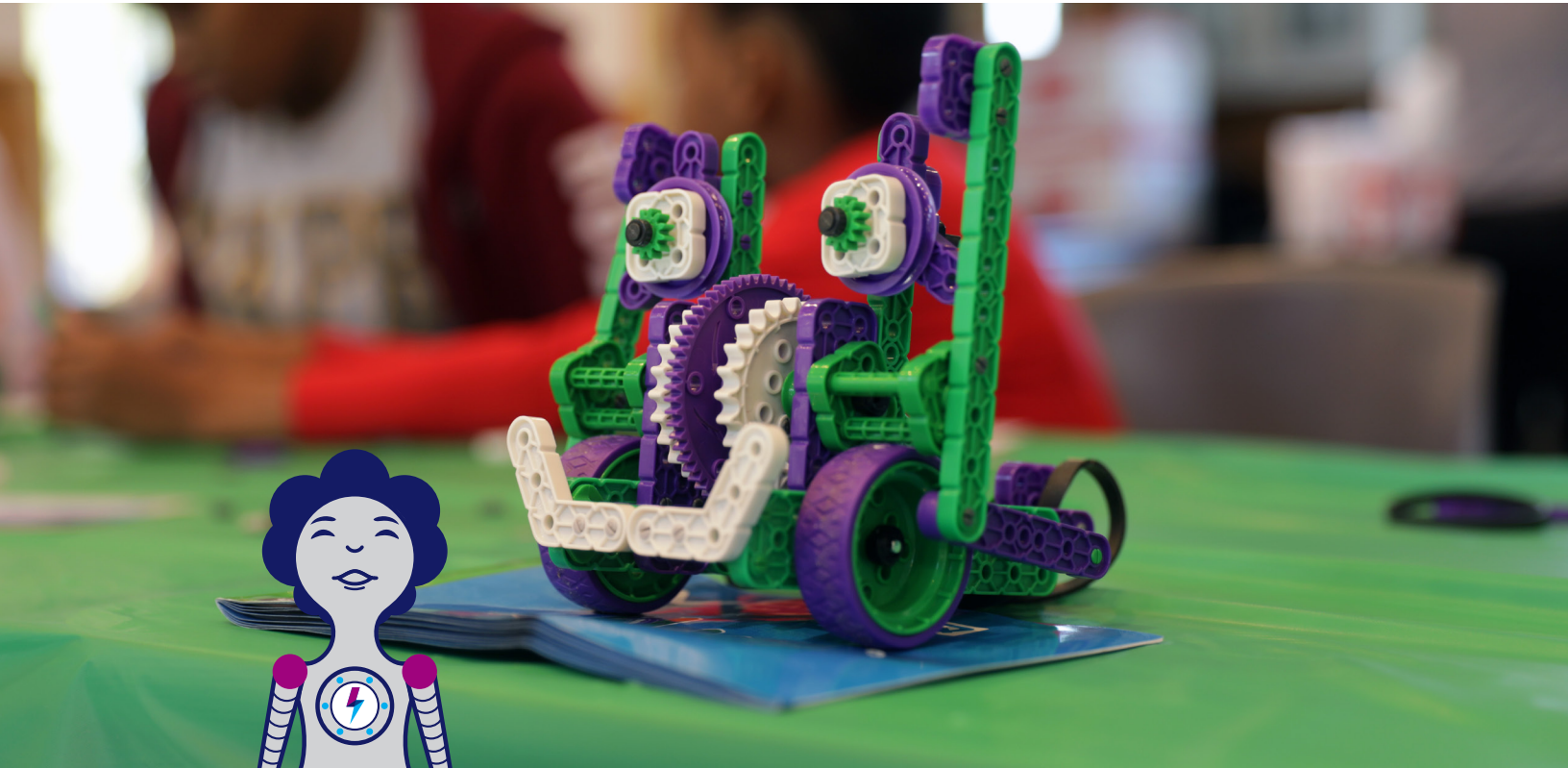
- 19 | Create a presentation to share your robot
- 20 | Tell others how you designed your robot
- 21 | Learn about robotics competitions
- 21 | Learn about robotics teams
- 22 | See robots in action

Conclusion





Badge 1 Programming Robots



Overview

Robots are simple machines programmed to run automatically. Programmers are the engineers that create step-by-step instructions, or algorithms, that tell robots how to understand and respond to their environment. Start by engineering a machine that helps a robot to land then learn about the robot brain. After, create programs to instruct your friends before coding on a device.



Vocabulary

Neuron

A special cell that carries impulses to and from the brain

Soma

The cell's body

Axon

The special appendages on a neuron that send and receive impulses

Algorithm

A set of step-by-step instructions for how to do something. For example, a recipe is an algorithm. It tells you the steps you need to take to bake a cake or cook some food. When your friend gives you directions to her house, those directions are an algorithm, too. She's telling you what you need to do to get to where she lives. Robots use algorithms to know how to move and perform tasks.

Coding

Transforming algorithms into a language that computers understand

Program

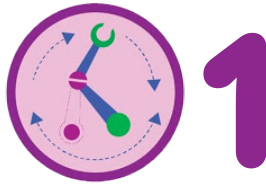
An algorithm that has been coded into a machine or robot to make it run.

Automatic

A machine that works with little or no human control

Debugging

Finding and fixing issues in an algorithm or code



Badge 1 • Step 1: Learn About Robots Work

ITEMS NEEDED

- Computer or laptop with internet access to watch videos
- Tangrams Algorithm Activity Sheet (page 24)
 - Copies of Algorithm Card Images, one per two girls (page 25 & 26)
 - One Tangram Set for each girl scout
- Printed copy of Cup Stacking Cards (page 27)
- Printed copies of Cup Stacking Symbol Key, one for each girl (page 29)
- One printed and cut out copy of Flashcards Document (for Step 2) (page 28)
- One Sandwich Ziploc bag for each Girl Scout
- Markers, pens, pencils, etc.
- Scissors
- Paper
- Plastic cups that can be used for stacking, about 5 cups per two girls

ASK

What is an example of a robot that you've seen either in the media or in real life?

How do you think those robots move and know what to do?

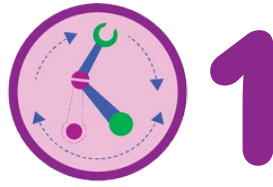
ACTIVITY

Have the girls watch the following video, which entails how robots work.

<https://www.youtube.com/watch?v=VtsFmxHDw9k> or <https://www.youtube.com/watch?v=d3MBTT10pxk>

DISCUSS

- How do robots work? (They are simple machines that are programmed to run automatically)
- What parts did you see in the robots? (Motors, Sensors, Gears, Wheels, Controllers, etc.)



Badge 1 • Step 2: Discover the Robot Brain

ASK

- How do robots know how to perform their tasks? (They are programmed by computer engineers known as programmers)
- Where do robots get their instructions from? (From programs which is an algorithm that has been coded into the robot's brain)

ACTIVITY

Juniors will learn how robots process and respond to information similarly to the human brain, through programming. Use the Flashcards Document to help girls act like the brain!

1. Review how the human brain works:

- The brain gives instructions to our body through cells called neurons, which can share messages to all different parts of your body.
- The brain receives information from the environment through our eyes, which are like sensors on a robot.

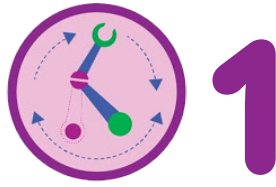
2. Now, the girls will have a chance to act like a neuron to send messages around the body.

3. Split up into groups of 3 or more. In each group, one girl should be the “Eyes” (Sensors), another should be the “Brain”, and the others can be the reactive “Body Part(s).”

4. Have the girls stand in order with the “Eyes” at the front, the “Brain” in the middle, and the “Body Part(s)” last. Go around and show the Flashcard images to the “Eyes” of each group and have the girls practice receiving and passing information.

DISCUSS

- How do our brains send and receive information? (*Receive information through sensors like “Eyes” and send information using neurons like “electronic wires” on robots.*)
- How does the robot's computer programming help make it move its arms, legs, and other parts? (*Robots move based off the information they receive from the environment and according to the program they are given.*)



Badge 1 • Step 3: Learn about Programming

ASK

- What is an algorithm? (a set of step-by-step instructions for how to do something)
- Is there more than one way to solve a problem? Why?

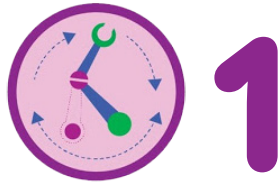
ACTIVITY

1. Watch this video: <https://www.youtube.com/watch?v=xZlKyTwQZv8>
2. Have each member cut out their own tangram pieces from the Tangrams Algorithm Activity Sheet.
3. One girl will select an Algorithm Card, and without showing it to anyone else, and try to explain this image to the other girls.
4. Each of the other girls will build their pictures based on the description given by the Card Holder.
5. When the Card Holder is done, everyone will show their tangrams to see if they end up with the same image. If any of the tangrams are different from each other, have the Card Holder try describing the image again with more detail.
6. If everyone's pictures look the same, have another girl scout choose a new Algorithm Card and repeat the activity until everyone has had a turn.



DISCUSS

What were some of the challenges you faced? If you had to repeat a card, was it easier hearing the instructions in a different way?



Badge 1 • Step 4: Try Simple Programming

ASK

What kind of instructions does your “robot” need to stack cups?

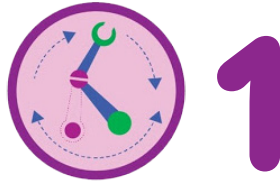
ACTIVITY

1. Watch this video as a group: <https://www.youtube.com/watch?v=7zXtn8CoJ-w>
2. Have one of the girls be a “robot” and the rest of the girls be “programmers.” Review the arrows and directions from the symbol key with the girls: arrow up = pick up cup, arrow down = put cup down, arrow right = move cup to the right half a cup width, arrow left = move cup to the left half a cup width, and rotating arrow = turn cup upside down.
3. Create an algorithm (a set of step-by-step instructions for how to do something) with the girls using the Cup Stacking Program. For example, first stack your cups on the table where everyone can see them.
4. Next, ask the girls to instruct you on the first thing to do “(pick up cup).” When you pick up each cup, remember that the cup should automatically rise above the highest cup that’s already in the stack.
You may have to remind the girls several times
5. Then, while your hands are still in the air, ask for the next move. After you’ve placed a single cup move back to your chart and encourage the girls to help write symbols on the paper/board, so you “run the program” later.
6. When the entire program has been written down for the girls to see, call a volunteer to “run” the program or you can do it yourself. Say the arrows out loud as you move the cups into place.

DISCUSS

What problems did you have writing the program to stack cups?

Why is it important for robots to have a “special code”?



Badge 1 • Step 5: Code A Robot

ASK

What are some things you already know about programming?

HOUR OF CODE

ACTIVITIES HOW-TO PROMOTE FAQ English

Learn computer science. Change the world.

Anyone, anywhere can organize an Hour of Code event. One-hour tutorials in over 45 languages. No experience needed.

Try it

ACTIVITY

1. Have each member practice programming with [Hour of Code](https://hourofcode.com/us). <https://hourofcode.com/us>. Take into account each member's previous experience with coding when choosing a game.
2. Remind them of the connection between robots, programs, and computers.

DISCUSS

What did your algorithm do? Was your program successful on the first try? If not, what are the steps you took to debug your program?

Conclusion

- What have you learned about the human and robot brain?
- What was your favorite part about learning to Program Robots?
- Did you find it easier to program with other people, or on your own?



Badge 2

Designing Robots & Building Your Mia

Overview

Robots are made of many different parts, each with its own important job. Sometimes, engineers use biomimicry to design robots that are inspired by humans, animals, and nature. Engineers can even create robots that continue to learn about their environment. Explore artificial intelligence (AI) and technology. After, plan, build, and share your own robot prototype to solve a global problem!

Vocabulary

Artificial Intelligence

Robots or other machines that are programmed by engineers to be able to learn and adapt over time

Biomimicry

When an engineer makes a machine that looks and acts like a human, animal, or plant

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

Innovation

A new or improved idea, device, product, etc.

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

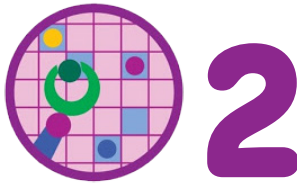
Finding and fixing issues in code.

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)



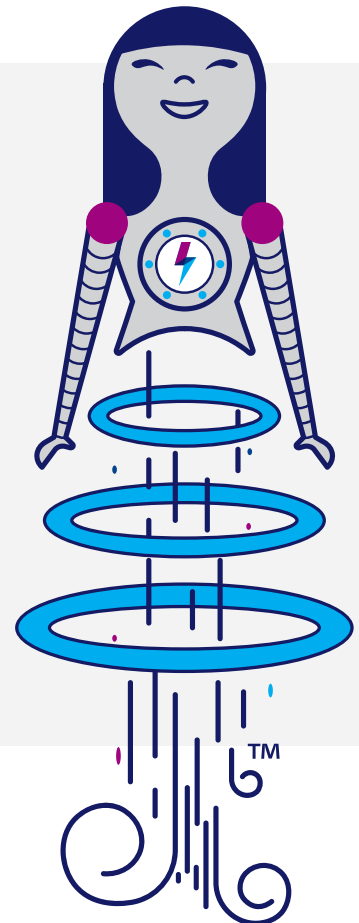
Badge 2 • Step 1: Discover the Future of Robots

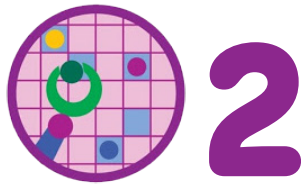
ITEMS NEEDED

- VEX IQ Mia Kit
- Blank paper
- Pencils and markers
- Prototype building materials, such as cardboard, string, aluminum foil, duct tape, etc.
- Printed copies of **Activity Guide - Personal Innovations**, one copy per girl (Page 30 & 31)
- Computer or laptop with internet connection and an Adobe Flash Player - for a game called Light Bot (simple programming), and to use for watching a video

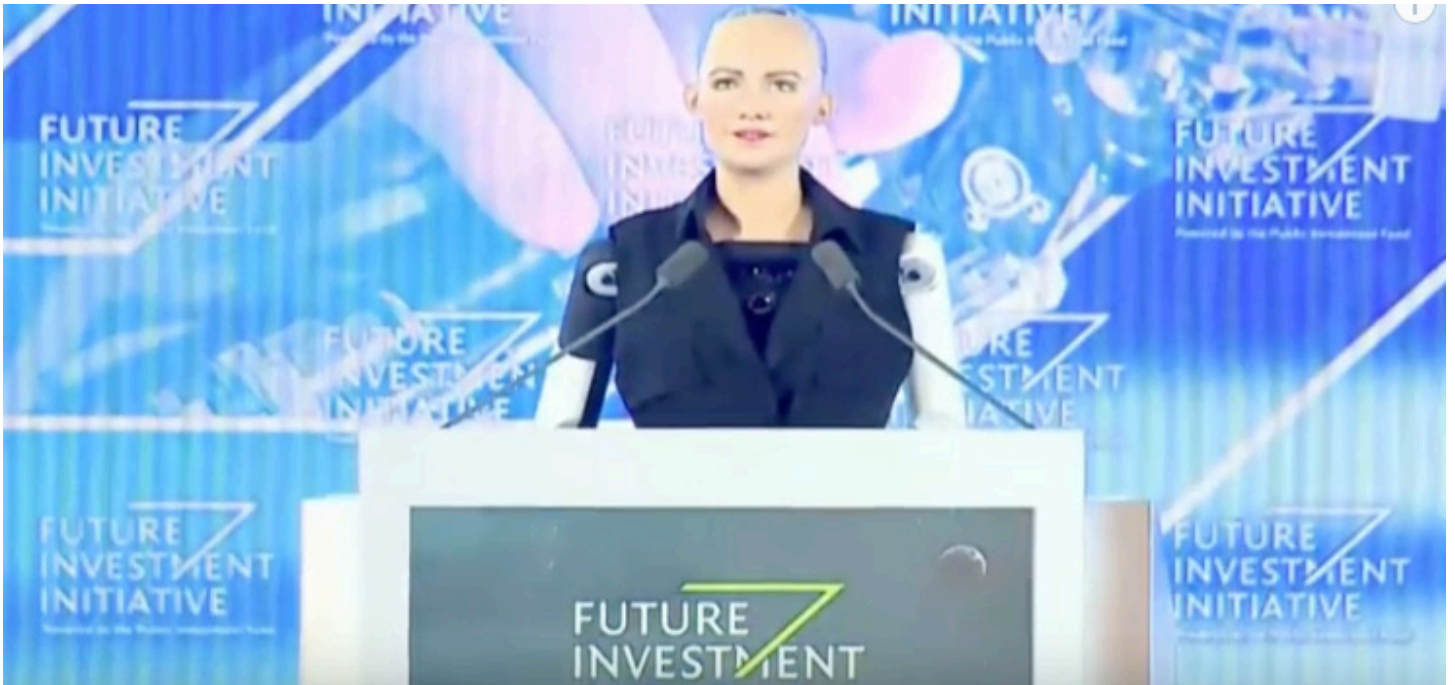
ASK

- What do robots typically look like?
- What is biomimicry?
(Biomimicry is when an engineer makes a machine that looks and acts like a human, animal, or plant.)
- What is artificial intelligence?
(Artificial intelligence is when robots or other machines are programmed to learn and adapt to their environments over time.)
- What makes something intelligent?





Step 1: Discover the Future of Robots (continued)

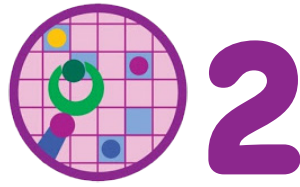


ACTIVITY

Watch this video about Sophia: <https://www.youtube.com/watch?v=S5t6K9iwcdw>

DISCUSS

- How did this video make you feel?
- What questions do you have about Sophia? What questions would you like to ask Sophia? Do you think Sophia is intelligent?
- Why do you think the engineers created a robot to look like a woman? What features did they give this robot to look like a human? (Physical features and also the ability to mimic many emotions)
- What types of businesses do robots work in? What are their jobs? Discuss how artificial intelligence can help to solve global problems.



Badge 2 • Step 2: Determine Your Robot's Expertise

ASK

- What are algorithms?

(Algorithms are step by step programs that are usually followed by a computer or a robot)

- Where do you see algorithms in everyday life outside of machines? *(recipes, giving directions, etc.)*

ACTIVITY

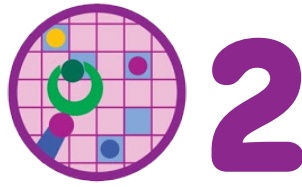
1. Give each girl a copy of the **Activity Guide - Personal Innovations. (Page 30 & 31)**
2. Read through the instructions on top and have girls work to fill in the first page of the activity.
3. Encourage girls to begin listing improvements that already exist, and list some improvements that are from their own ideas.

Example

- **Interest** - Soccer and The World Cup
- **Problem** - It is hard for everyone to watch the World Cup when they are in different parts of the world.
- **Improvement 1** -Television broadcasting, can watch game at home on television.
- **Improvement 2** - Jumbotron are available at the games so everyone in the stadium can watch better.
- **Improvement 3** - More access to watching games online or on mobile devices such as phones or tablets.
- **Improvement 4** - Can take a plane flight to see game in person.
- **Improvement 5** - Virtual Reality Seat: fans from home can watch a game from the front row on the field, using a VR headset at home. (New idea example)

DISCUSS

- How do technology and innovation already help people to solve problems in the real world right now?
- What are some things you would want your robot to be programmed to do?
- Talk about how engineers can use algorithms to complete tasks in their everyday jobs.



Badge 2 • Step 3: Plan Your Robot

ASK

- What are some global problems? (*natural disasters, lack of clean water, no electricity etc.*)
- If you could build a robot that solves a global problem, what would your robot do? (*a robot could detect when an earthquake is coming, a robot could clean water, etc.*)
- Engineers often work in teams to design and build robots to solve problems. You are going to work on an engineering team to build a robot. How can we make working as a team successful?

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 VEX IQ 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?
- Based on what you have built so far, how do you expect this robot will run?
- How were you like engineers today?



Badge 2 • Step 4: Create a Prototype & Finish Building Your VEX IQ Mia



ASK

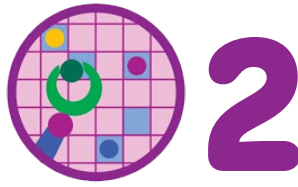
- Studying the portion of the Mia that we have built, what do you think it will do when it runs?

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 MIA & Get Feedback

ASK

- What does the word feedback mean? (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 Mia.
3. 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?

Conclusion

- What have you learned about artificial intelligence?
- How do engineers create programs and prototypes for robots to ensure that they work?
- What happens if the robots have problems that need to be fixed?
- How can your robot and algorithm help others?
- If you could create any robot to fix any problem in the world, what would the robot do?



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 create a presentation and share your design with others. After, explore robotics competitions and find out what it's like to be on a robotics team.



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

ITEMS NEEDED

- Devices - video camera, laptop (optional)
- VEX IQ Mia prototype from Badge 2
- Pen and paper - for speech
- Resources - GS volunteer, Robotics team coach, prior competitors for Robotics competitions (for knowledge sharing)

ASK

- Have you ever given a presentation?

ACTIVITY

1. Create a show-and-tell presentation with at least one partner from the engineering team. The girls will plan a presentation describing their VEX IQ Mia and the steps taken to build it.
2. Presentations usually include:
 - Introduce yourself and your robot
 - Describe what the robot does
 - How did you make it?
3. Describe some problems experienced and how they were solved
4. Prepare and practice a short presentation with a partner. Share the presentation with others in the troop. Be sure to include a demonstration of your VEX IQ Mia robot and ask for feedback.

DISCUSS

Did sharing your VEX IQ Mia give you constructive feedback? How could you take the feedback and improve the Mia? 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, another Girl Scout troop or classmates

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

- Do you know what happens at a robotics competition?
- Do you know someone who has participated in a robotics competition?
- What do you think engineers do?

ACTIVITY

- **Option 1: Go to an actual competition or science fair** - to see how robots are showcased
- **Option 2: Talk to someone who competed** - for example, an older girl, a robotics team coach or a GS volunteer. Girls should brainstorm and prepare questions in advance
- **Option 3: Learn about competitions online** - check the Backpack for details about robotics competitions for your area and age group



Badge 3 • Step 3: Learn About Robotics Competitions (continued)

DISCUSS

- How was your experience? What have you learned about robotics competitions?
- Did you happen to have a favorite robot that you saw? Why was it your favorite?
- Why do you think teamwork matters in such a competition?

Badge 3 • Step 4: Learn About Robotics Teams

ASK

- What are the characteristics of a good team?
- Do you think it is important for the team members to have different skills?
- Why or why not? Why is communication important in a team?

ACTIVITY

- **Option 1:** Join or create a robotics team in your area.
- 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 2:** Interview someone who has been a part of the team such as an older girl, a robotics team coach, a Girl Scouts volunteer. Make a list of questions before approaching them.
- **Option 3:** Use online resources to research more about a robotics team. Watch videos to observe how a robotics team works together. Visit this link to learn more about this year's VEX IQ Challenge. <https://www.vexrobotics.com/vexiq/competition/viqc-current-game>

DISCUSS

- What different responsibilities does each team member have on a robotics team? How would having distinct roles benefit the team?
- What skills would you look for in a team member joining your team?
- What skills and strengths do you have to contribute to being part of a robotics team?



Badge 3 • Step 5: See Robots in Action

ASK

- Where could we go to see robots in action?

ACTIVITY

Experience an actual robot in action. Think of the various places where you can interact with a robot.

Below are a few options:

- **Field trip** - take the help of a robotics team (at high school, college or business setting), to learn how robots work. Explore the lab environment and technology used in making the robot.
- **Arrange meeting with someone who has built robots like other students, teachers, engineers, siblings, etc.** - brainstorm questions before they arrive
- **Online robotics lab** - through “Robotics Lab Virtual Tours” to find videos and virtual tours of robots around the world.

DISCUSS

- What new technology did you learn about? What types of robots did you see?
- In the future would you be interested in building more robots?
- Would you be interested in joining a robotics team at your school?
- Would you be interested in becoming a robotics engineer?



Badge Completion Conclusion

- How do you feel about presenting your prototype on your own?
- Would you be interested in becoming an engineer?

Next Steps

- Telling others about robotics teams and competitions
- Sharing your robot presentation with others
- Joining a robotics team to continue creating robots that solve problems for others





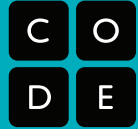
Unplugged

Name: _____

Date: _____

Algorithms

Tangrams Algorithm Activity

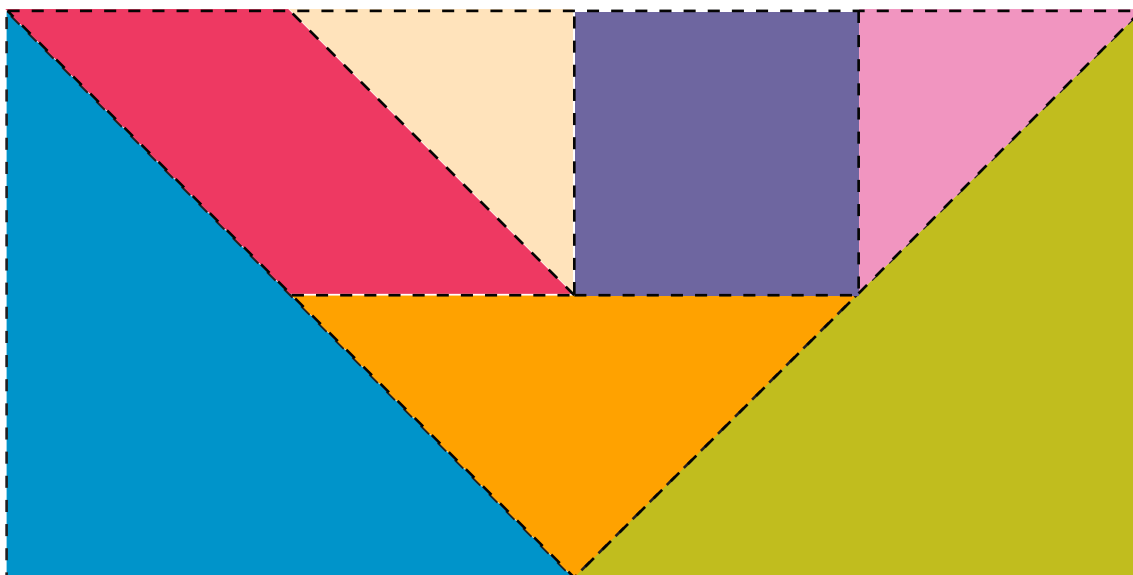


This lesson shows us something important about algorithms. If you keep an algorithm simple there are lots of ways to use it. If you want to make sure everyone ends up with the same thing, then your algorithm needs to have a lot of detail.

This activity will show both options.

Directions:

1. Divide into groups of 3-5.
2. Each player should cut out their own set of tangrams.
2. Have one member of each group select an Algorithm Card without showing it to anyone else.
3. The person with the Algorithm Card will try to explain the image to everyone else without letting them actually see it.
4. The other players will build their pictures off of the description given by the Card Holder.
5. When the Card Holder is done, everyone will show their pictures and see if they all ended up with the same image.
6. If everyone ends up with the same drawing, the Card Holder can show the card and see if everyone matched the card.
7. If any of the pictures in the group are different from each other, have the Card Holder try describing the image again, using more detail.
8. Choose a new Card Holder and a new Algorithm Card and repeat until everyone has had a chance to describe an image.

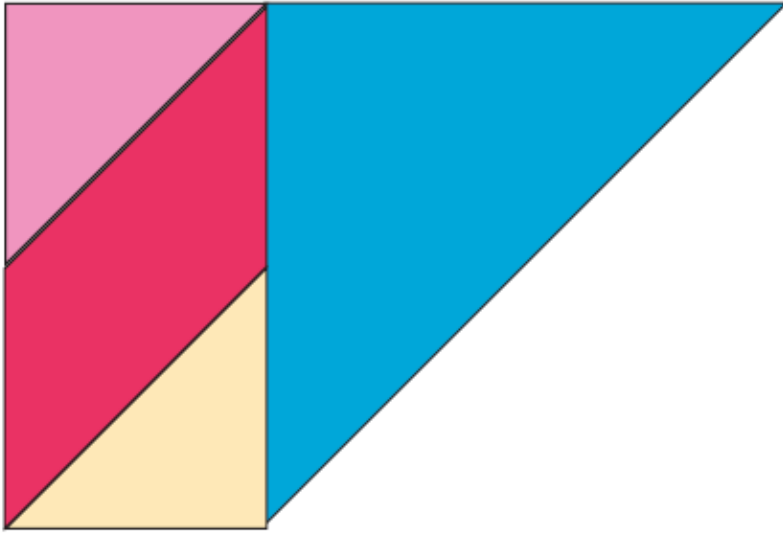


U

Algorithms

Algorithms Card 3

C O
D E



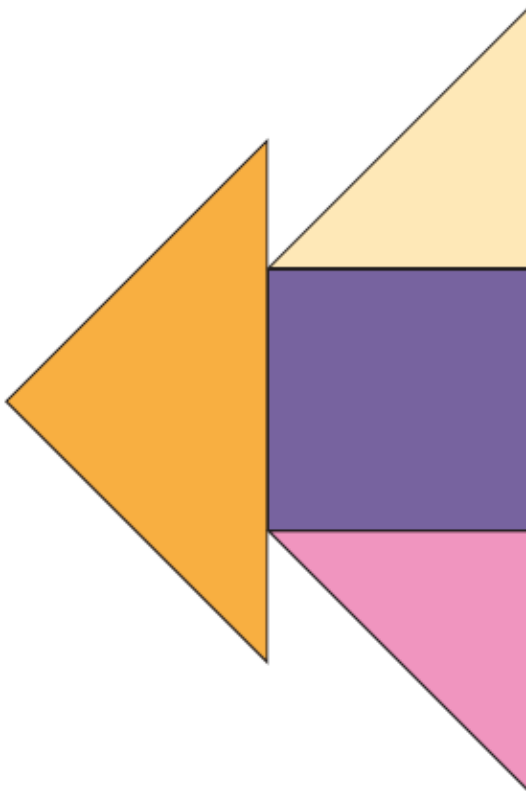
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Algorithms

Algorithms Card 4

C O
D E



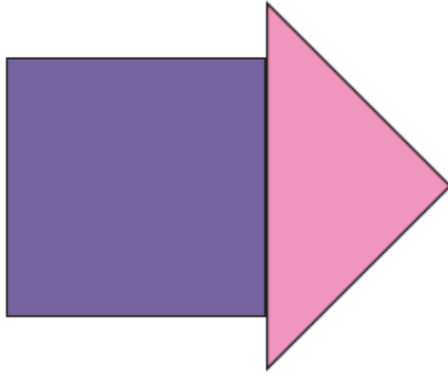
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U

Algorithms

Algorithms Card 1

C O
D E

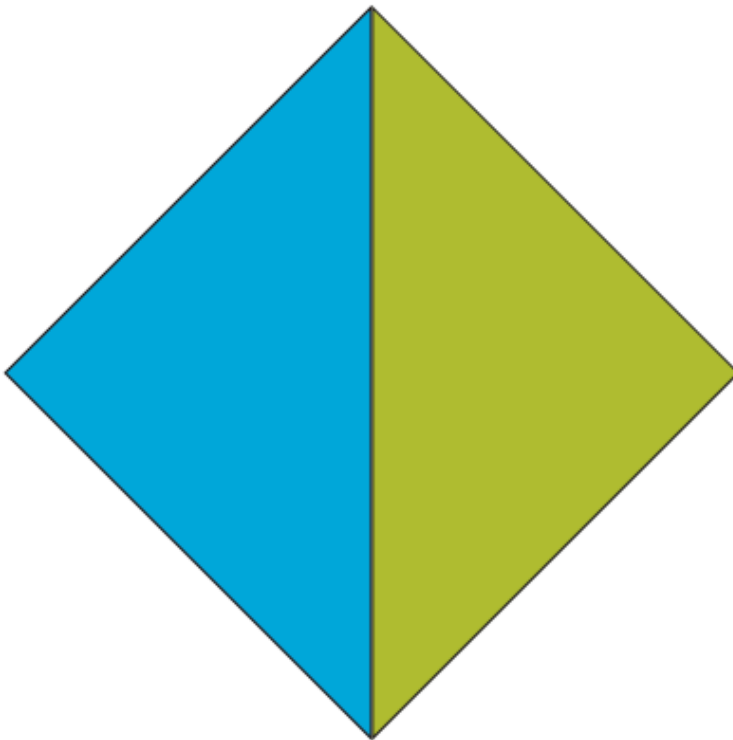


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Algorithms

Algorithms Card 2

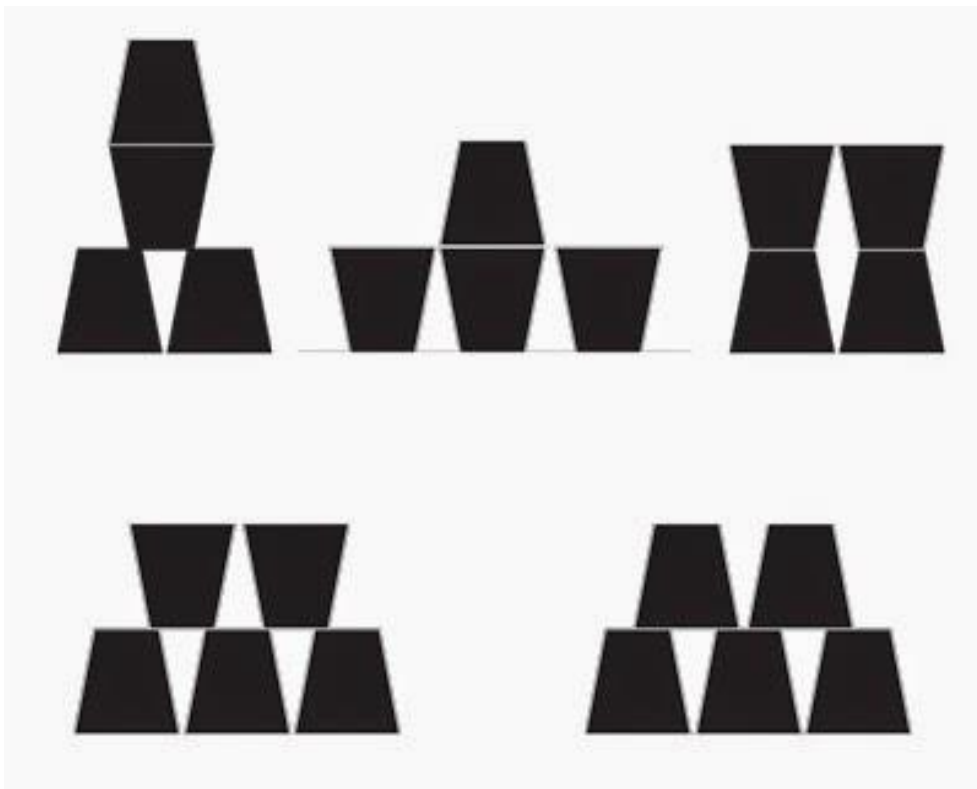
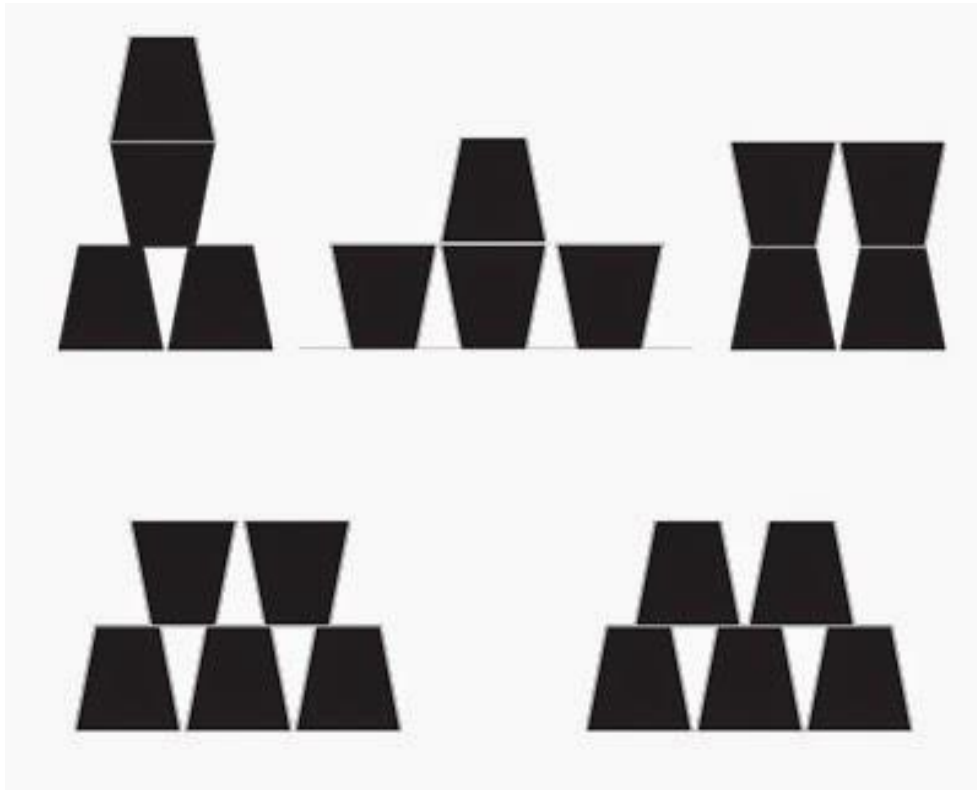
C O
D E



Revision 140929.1a

Revision 140929.1a

Cup Stacking Cards



STEP 2: DISCOVER THE ROBOT BRAIN
Flashcards

shake your left leg	Wave your right hand	Jump up and down
Shake your head up and down	Clap your hands	Turn around in a full circle
Make the peace sign with your left hand	Put your right hand on top of your head	Touch your hands to your toes



Pick Up Cup



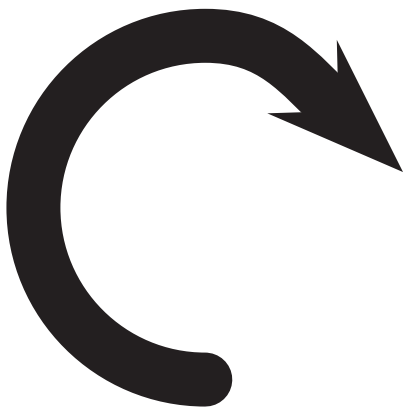
Put Down Cup



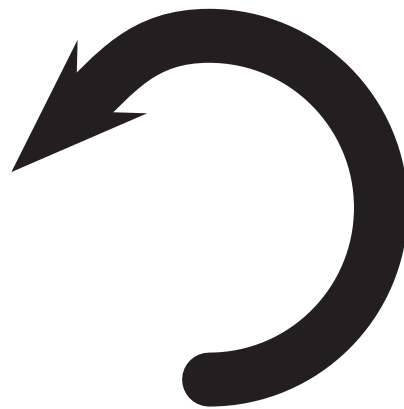
Step Forward



Step Backward

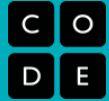


Turn Cup Right 90°



Turn Cup Left 90°

Activity Guide - Personal Innovations



Technological innovation is about recognizing a problem that needs to be solved, or recognizing something needs improving and then building a tool to solve it.

As a class we're going to see how innovative we can be, and we'll share our ideas through something called "rapid prototyping." (*Prototype is a fancy word that means a preliminary sketch of an idea or model for something new. It's the original drawing from which something real might be built or created.*)

First: Looking at the list of 4 interests at your table, let's **think about how technology is impacted by, or related to, those interests.**

How could **technology** improve your interest to make it **better, faster, or easier** to use?

What is a **problem**, or aspect of your interest, that a **creative or innovative technology** might **help solve**, or at least make better?

Interest	Improvements	Problems

Next: As a group, nominate the idea you've discussed that you think would be the *most interesting to everyone else* in the class.

Start to sketch it out on a poster. Make a visual representation of your ideas. Remember this is a rapid prototype, just something to quickly convey the idea. Feel free to jot down ideas or sketches in the space below:

Brainstorming and Notes

