Junior Robotics

Develop your robotics skills by earning these three badges!

Badge 1:
Programming Robots

Badge 2:
Designing Robots

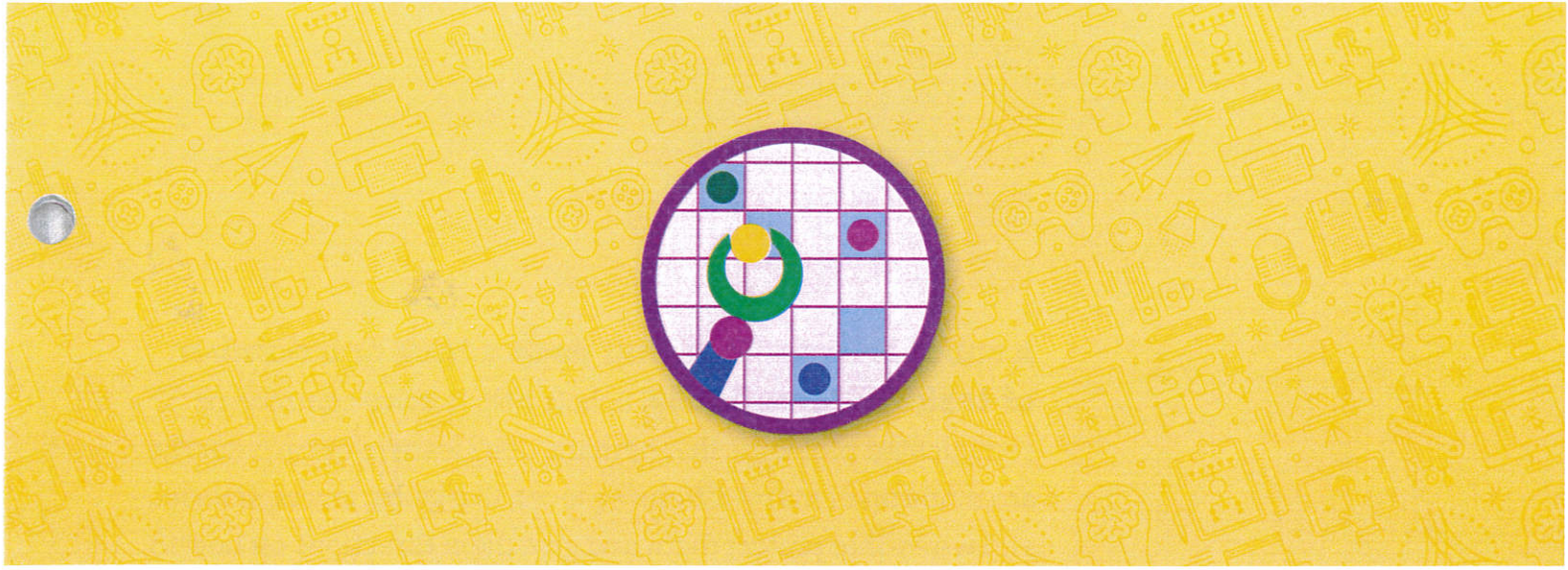
Badge 3:
Showcasing Robots

Welcome to the world of robots!

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, yes, 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 can you can invent what our future looks like!



Badge 1: Programming Robots

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.

Steps

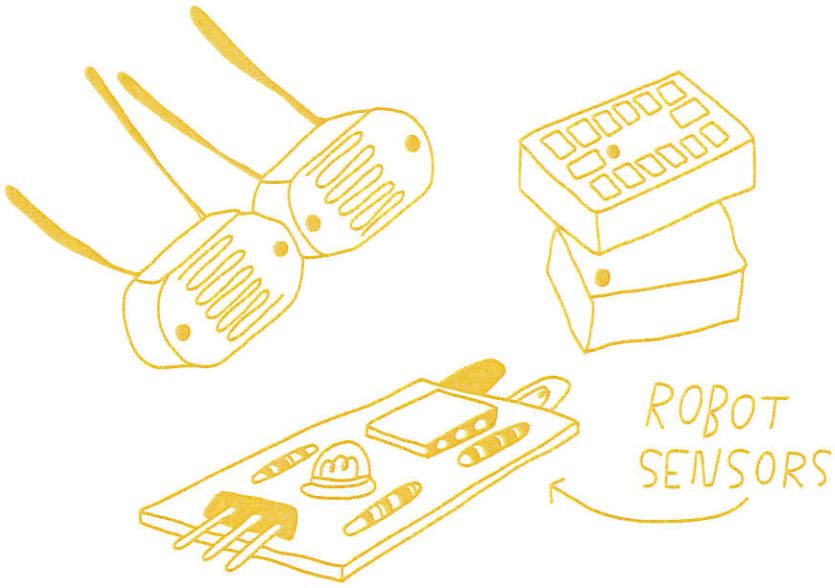
1. Learn how robots work
2. Discover the robot brain
3. Learn about programming
4. Try simple programming
5. Code a robot

Purpose

When I've earned this badge, I will know how to create a program that could be run by a robot.

STEP 1 Learn how robots work

A robot is a machine that does a task or a number of tasks automatically. Robots help to solve common or complicated problems that humans don't want to or can't do. They are made up of many different pieces, like gears, levers, sensors, and wires, that protect them and give them directions on how to act, move, and respond to different situations. Learn about the Mars Rovers and simple machines as you create a "Safety Lander" that can land a Rover without damaging the robot.



Robots On the Move

Robots that move on their own are called mobile robots. They have wheels or legs and can move from one place to another. These are commonly used in space or deep sea exploration. These places are too difficult or dangerous for humans to explore.

Since the robot serves as a human's eyes and ears, it's important for the robot to be able to move around easily. That's why mobile robots are equipped with lots of sensors and programmed to climb over obstacles or go around them. If a robot got stuck at every rock, soft surface or obstacle, they wouldn't be able to do much exploring!

STEP 2 Discover the robot brain

Without instructions to tell them what to do, robots are just simple machines. Computer engineers, or programmers, create algorithms, or sets of step-by-step instructions, that are coded into the robot's "brain" so they can move and act automatically. The computer or robot brain works similarly to our brains, with parts that help us to see, understand, and react to our environment. Relay messages with your fellow Juniors to discover how robots send and receive messages between different parts of their body.

WORDS TO KNOW

Prototype - A prototype is a hand-built model of an idea. The word prototype comes from two Latin words: *proto* (which means first) and *typus* (which means model). Once you get an idea for a new robot or a new invention, you can build a prototype to see how your idea might look, feel and work in real life. You can also test your prototype and see what is working and what isn't. A prototype can be a model that's made from common objects, like cardboard and wire. It can also be a simple sketch of your idea that you can show to people to see what they think about your design.

Algorithm - This is a set of step-by-step instructions for how to do something. 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.

Program - This is an algorithm that has been coded into something that can be run by a machine.

Debugging - Sometimes a programmer writes code for a robot — but the robot doesn't do what it's supposed to. That means there's something wrong with the code. Programmers say that there's a "bug" in the program. When they find and fix the problem, they call it "debugging."

Meet the Nanorobots

Nanorobots are tiny robots. They are so small you need a microscope to see them! These teeny-tiny robots can be injected into a person's body and treat the patient from the inside. The nanorobots can travel through blood vessels and get rid of blockages that might cause heart attacks or strokes. They can find what's making the patient sick and deliver medicine exactly where it will help the most.

STEP 3

Learn about programming

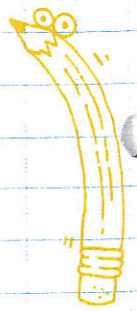
Programmers create algorithms that instruct robots on how to move and react. Do you think you could create a program to instruct a "robot" friend? Create a program on paper to help a fellow Junior, your "robot," to build an image made of tangrams, and learn about algorithms and computer programming.

STEP 4

Try simple programming

Programmers translate their algorithms, sets of step-by-step instructions, into a special code that can be understood and run by robots. Create your own special coding language to create step-by-step algorithms for your robot to stack cups that could be run over and over again.

PROGRAMMING



3 WAYS YOU USE ALGORITHMS IN EVERYDAY LIFE

Algorithms are a series of directions for a robot to follow in order to make something happen. We actually use algorithms all the time in our lives.

Here are three ways you use algorithms.

1. **Want to make a cake?** Find a recipe. The recipe is a series of steps that tells you what ingredients to get, what steps to take to make the batter, how long to bake the cake, and so on. You'll get a perfect and tasty cake if you follow the directions in the correct order. A recipe is an algorithm.

2. **Want to go to your new friend's house after school?** Ask for directions. When someone gives you directions, they tell you step-by-step how to get from one place to another ("walk two blocks, turn left at the corner, go past the library, turn right, and my house is the yellow one at the end of the street"). Directions are an algorithm.

3. **Want to put together a piece of furniture?** Use the instruction manual. If your new bookcase was delivered in pieces, you need to assemble it yourself. You take each piece of information in order and act on it. If you do every step in the right order, you will have a sturdy bookcase. Instructions are an algorithm.

STEP

5 Code a robot

Engineers program their robots to move, act, and understand. Now is your chance to code on a device, like a tablet or computer, and complete an Hour of Code. Choose a game from the site and program your robot or character to complete the tasks. Remember, no matter what game you play, you could give the same instructions to a robot, just like you are giving instructions to the game's characters. Your algorithms could be coded into a robot!

Armed and Helpful

Say you make a new product, like a better skateboard or bike. Now, say you want to make a lot of them and sell them. You need to manufacture them. Manufacturing is when you use machines to make a lot of copies of something. It's how cars are made. It's also how washing machines, basketballs, cellphones, hairdryers and even certain kinds of candy and bubble gum are made.

When it comes to manufacturing, robots can help. The most common robot used in manufacturing is a robotic arm. It is stationed in place and programmed to do a single task in the process of making something. Robotic arms can weld things, hammer things, lift heavy stuff and shape hot metal.

Most robotic arms have seven segments and six joints. A robotic arm is similar to a human arm with a shoulder, elbow, wrist and finger joints. This gives a robotic arm flexibility and freedom of movement, which means it can turn, reach, grasp and do almost anything.

There are motors at each of the joints. There are also sensors that can be programmed to detect distance, movement and pressure. A computer program gives directions to the robot about where to move, how far to move and how fast to move. The robot may be sticking a label on a product on a label or painting a part. Even though this action may be repeated over and over again, the robot will never get bored!

Now that I've earned this badge, I can give service by:

- Sharing what I've learned about the human and robot brain.
- Creating algorithms to teach others about something I am good at.
- Encouraging others to learn how to code.

I'm inspired to:

Badge 2: Designing Robots

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!

Steps

1. Discover the future of robots
2. Determine your robot's expertise
3. Plan your robot
4. Create a prototype
5. Get feedback on your robot

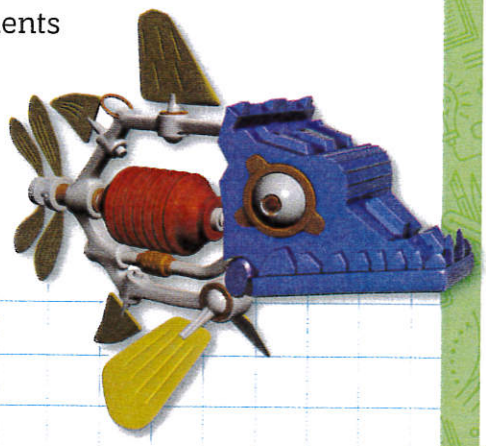
Purpose

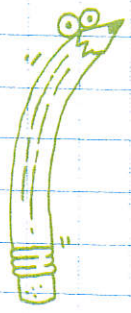
When I've earned this badge, I will know how to design a robot that solves a global problem.

STEP

1 Discover the future of robots

A lot of the time, we think of robots as shiny metal figures that kind of look like us, with heads, bodies, arms, and legs. Biomimicry is when an engineer makes a machine that looks and acts like a human, animal, or plant. Engineers study how humans and animals look and act to brainstorm creative ways to design their robots. Artificial intelligence is when robots or other machines are programmed to learn and adapt to their environments over time. Explore what makes something intelligent and learn how artificial intelligence can help to solve global problems.





Can Robots Think?

Computers can be programmed to do amazing things, but does that make them intelligent? They follow the directions that their programs give them — and those programs are created by people.

But what if a computer could think on its own?

Computer scientists are trying to program computers to learn from an experience and make decisions based on what they've learned, just like humans do. This is called Artificial Intelligence, which some people call AI for short.

For instance, Artificial Intelligence could make it possible for machines to read the expressions on people's faces, understand what the person might be feeling, and respond in a helpful way.

Today, computers can't decide to do things on their own. But computer scientists, working on artificial intelligence, hope that might change some day.

WHERE ROBOTS WORK

All kinds of businesses use robots to get the job done! Here are just a few:

1. Healthcare– Robots can do surgery, take blood, and take care of patients.

2. Entertainment– Yes, robots appear in the movies! They can be animatrons, such as the live-action robot dinosaurs in Jurassic Park. Robots can also be used to handle camera work, lighting, and special effects.

3. Space– Because exploring space is dangerous for human beings, lots of robots are used in space exploration. Some observe and record light from distant stars. Some travel to the Space Station and are used to make repairs. Others explore the surface of other planets, like Mars.

4. Safety– Moving hazardous waste, protecting valuable equipment, or performing dangerous jobs are all ways that robots keep people safe.

5. Agriculture– Robots can be programmed to harvest crops, feed and monitor animals and plant seeds.

6. Manufacturing– Robots can create parts, assemble equipment, move items, and pack products.

7. Automotive– Robots can assemble and test cars and trucks.

8. Mining– Robots can scout areas for excavation, dig into the earth, detect poisonous gasses and sort what they find underground.

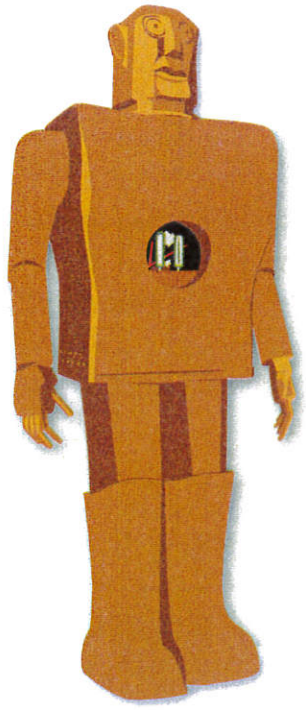
9. Construction– Robots can lay bricks, weld metal, level ground and even print materials for buildings.

STEP 2 Determine your robot's expertise

Just like engineers create step-by-step programs for robots to follow, algorithms are a way we can share our talents and teach others to do something we are good at. Think about what you could teach others to do, and create a program for your talent. Then, work with your fellow Juniors to brainstorm ways to add technology and innovation to solve problems and teach others.

STEP 3 Plan your robot

Engineers look for needs in our world and build robots that solve problems both big and small. If you could build a robot that solves a global problem, what would your robot do? What would it look like? What parts would it need? Brainstorm and sketch your ideas for robots that can help others. Share your sketches with other Juniors to improve your designs, and choose one to create a prototype of in Step Four.



Man and Dog

Elektro was a human-like robot designed for the New York World's Fair in 1939. Elektro was 7 feet tall. He could make 26 different kinds of movements and could speak 700 words. He could blow up a balloon and tell a joke. Elektro moved through a series of motors, pulleys and vacuum tubes. A year later, the engineer who created Elektro invented a robotic dog named Sparko. Sparko could bark and sit in response to Elektro's commands.

Deep Sea Diver

A robot called Ocean One can swim deep into the ocean to help study coral reefs and explore shipwrecks.

Ocean One looks like a human, with a head, face and arms — and there's a reason for that. It's because the robot is operated from the surface by a person.

Cameras are placed where a human's eyes would be. That's so Ocean One (and its human operator) can see what the robot's hands are doing.

The hands are flexible, soft and loaded with sensors. The human operator wears programmed gloves so that she can feel what the robot feels.

This means that the person can see and feel what it's like to explore the ocean floor, without putting herself in danger.

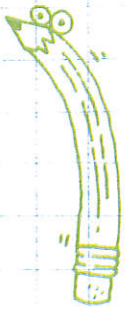
STEP 4 Create a prototype

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 build a 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".

STEP 5 Get feedback on your robot

Once engineers create a prototype, they test it to find ways to improve and redesign their new products. Work with a fellow Junior 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!

FEEDBACK



ROBOTS IN SPACE

When it comes to outer space, robots have certainly gone where no man has gone before. Here are seven amazing robots that helped people learn more about space:

1. The Hubble Space Telescope—This robot sent us amazing photos of moons, planets and stars that have never been seen before. It also measured the expansion of the universe.

2. Dextre—This two-armed, robotic handyman takes care of the International Space Station. It changes batteries and replaces equipment.

3. Rosetta—This spacebot was the first to track down and land on a comet. Scientists hope to use the data sent back from cameras, thermal sensors and other instruments onboard to answer questions about what the early solar system was like when comets were formed.

4. Curiosity—This robot is a rover. It landed on August 6, 2012 and is still rolling around and exploring Mars, gathering samples of soil and rock. About the size of a small car, it's loaded with cameras and instruments for gathering and analyzing samples. Scientists hope Curiosity will help them learn more about Mars and whether or not it can support life.

5. ACE—Advanced Composition Explorer—This spacebot is exploring the sun by gathering information about solar winds and radiation. ACE can help us understand more about the origins of the solar system.

6. New Horizons—This spacebot is exploring Pluto, which was once thought of as the 9th planet in our solar system. Now it's believed to be a dwarf planet. Pluto is shaped like a potato, spins backwards and seems to be covered with ice. New Horizons can help us understand the worlds at the very edge of our solar system.

The Hubble Space Telescope was launched into space in 1990. It has been helping scientists to learn more about space ever since!

Now that I've earned this badge, I can give service by:

- Telling others what I learned about artificial intelligence.
- Sharing with someone else how to make a prototype.
- Teaching others my special talent using the algorithm I created.

I'm inspired to:

Badge 3: Showcasing Robots

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!

Steps

1. Create a presentation to share how you designed your robot
2. Tell others how you designed your robot
3. Learn about robotics competitions
4. Learn about robotics teams
5. See robots in action

Purpose

When I've earned this badge, I will know how to share my robot with others.

Robotic Roaches

Most people want to get rid of cockroaches — but not everyone. Some scientists wanted to make a robot that can act like a cockroach.

Why? Cockroaches slip through cracks. While this is creepy if the roach is in your house, it's a great skill for a rescue robot to have. By studying how a roach flattens itself, researchers have created a robot that can shrink and squeeze through small openings. This allows the robot to go into places where nothing else can. Fitted with cameras and microphones and other sensors, the robot roach is designed to find people trapped under debris after an earthquake or a tornado.

STEP 1 Create a presentation to share how you designed your robot

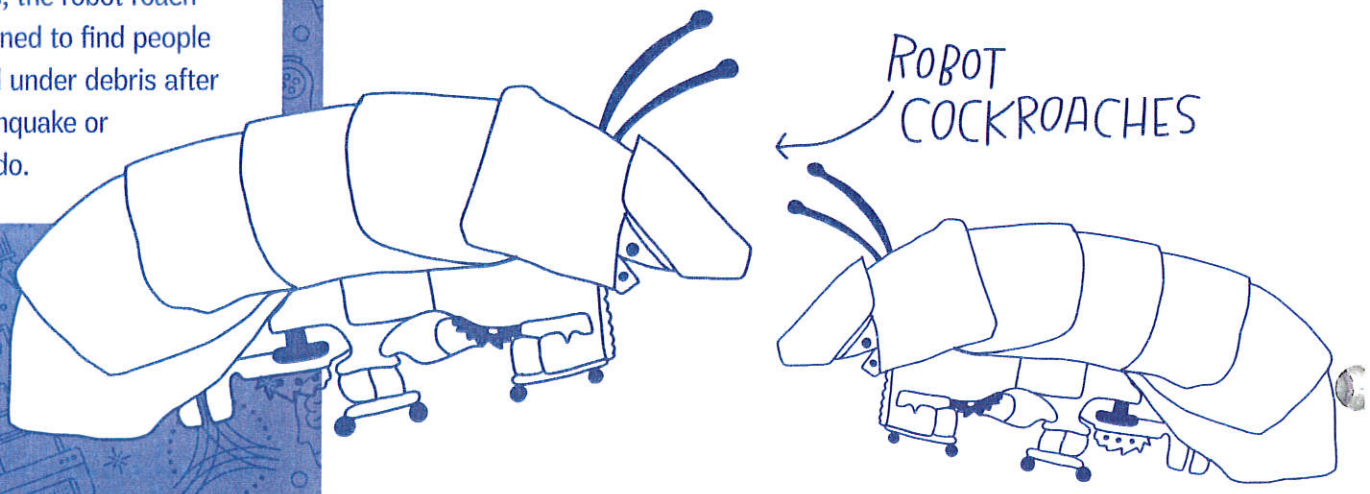
After an engineer creates a prototype, she shares it with others. This is important because it gives her a chance to share her work, get feedback, and teach others how to build their prototype. Choose a way to share your prototype, and explain how you designed it.

OPTION 1: Create a media presentation (video, photo collage, etc.)

One way to share your prototype is with photos, videos, and other media. Work in your prototype design teams to create a presentation using craft materials or technology. You might need help from others to film, edit, or gather materials for your presentation.

OPTION 2: Create a show-and-tell presentation

You can also share your prototype using your words, just like a show-and-tell. Prepare and practice a short presentation with your prototype design team. Make sure to explain the process you went through to design and build your prototype, including any problems you encountered along the way. Include a demonstration of your robot acting out its program to show others how you coded your robot.



STEP

2 Tell others how you designed your robot

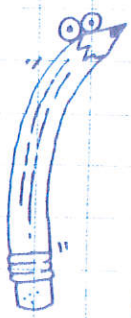
Once you've created your presentation, it's time to share what you've made with an audience. Whether you've made a media presentation or prepared for a show-and-tell, demonstrate your robot prototype and explain how you designed it. Sharing your work is an important part of being an engineer. It's your chance to teach, inspire, and get feedback to improve your robot.

OPTION 1: Share your video or presentation at a troop celebration for friends and family

Premiere your video or share your media presentation at a troop celebration for friends and family.

OPTION 2: Give a show-and-tell presentation at a school or community event

Share your prototype and what you have learned while designing it with others from your school or community. You can present to your class or community group, or create your own show-and-tell show for friends and family.



Power Up

Robots need energy to move. Some robots work on battery power while others use electrical power and need to be plugged in to charge. Some robots can be powered by fluids like water, oil or even air.

The power sometimes comes from putting fluid under pressure. Think about a garden hose connected to a long balloon. When the hose is off, the balloon is relaxed. If you put a board on top of the balloon, nothing would happen. But when you turn the hose on, the balloon fills up fast and expands. This is called hydraulic power. Hydraulic robots move when fluid inside them, like water or oil, is squeezed and pushed under pressure. It pushes so hard that the fluid expands and moves the robot's joints.

You can do the same kind of thing with air. Pneumatic robots are powered by highly pressurized air. They need an air compressor — or pressurized air tanks — to push the air and move the machine.

Handy Helpers

Robots can be handy helpers around the house, programmed to tidy up and do a variety of simple tasks. Here are few things that handy Homebots are already doing for households across the country:

1. **Vacuum and mop floors**
2. **Change the television channel or put on a movie**
3. **Clean gutters**
4. **Patrol a house and protect it from invaders**
5. **Wake you up and get you out of bed**
6. **Iron your clothes**
7. **Clean the cat's litter box**

As if that's not enough, scientists are building robots that can talk to you, cook your dinner, dance, or answer questions you might have.

STEP 3 Learn about robotics competitions

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 objects, and solve other problems. Teams are posed with challenges, then design prototypes to solve the problem using robotics kits. Competitions like these are held around the world! Girls like you can sign up to join robotics teams to engineer and design robots. Choose a way to learn more about robotics competitions.

OPTION 1: Go to a competition or science fair

Engineering teams present their robots at competitions and science fairs. Take a trip to a robotics competition or science fair to see how robots are being showcased. If you can, talk to other girls about why they are there and why they love being on a robotics team.

OPTION 2: Talk to someone who competed

Talk to an older girl, a robotics team coach, a GS volunteer, or anyone else who has attended or competed in a robotics competition to learn more. Prepare by brainstorming questions you'd like to ask ahead of time.

OPTION 3: Learn about competitions online

Watch videos to see what happens at robotics competitions. Take note of what you see robots doing in the competitions and how you see teams working together.

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 you've seen what teams do at robotics competitions, consider if you'd you like to join a robotics team.

OPTION 1: Join or create a robotics team in your area

After all you've learned about robotics, you might want to join a team. See if any of your fellow Juniors would like to join with you or even create a brand new team. Research your options for robotics competitions and challenges to figure out next steps.

OPTION 2: Talk to someone who has been part of a team

Talk to an older girl, a robotics team coach, a GS volunteer, or anyone else who has been part of a robotics team about their experience. Brainstorm what you'd like to ask.

OPTION 3: Learn about robotics teams online

Watch videos to see how robotics teams work. Think about how you see teams working together and what sort of responsibilities different team members have.

Meow! Woof!

Robot pets have been developed to do pet-like things like purr and meow and bark and wag. These furry, warm robots can really put smiles on people's faces. But they're more than just cute. These robots comfort people who feel lonely. Someday, they may also be programmed to record the patients' health and even call for help if needed.

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 life.

OPTION 1: Go on a field trip to see a real robot

Find a robotics team with a robot, perhaps at the high school or local college, and visit their workspace. You can also visit a local business and learn how they use technology and/or robotics in their work. Explore the lab or watch the robot to see how a robot looks in action. Ask the engineers or business how the robot works.

OPTION 2: Talk to someone who has been in a lab or used a robot

Talk to an older girl, a robotics team coach, a GS volunteer, or anyone else who has been in a robotics lab or used a robot. Before they arrive, brainstorm questions to ask them about their experience.

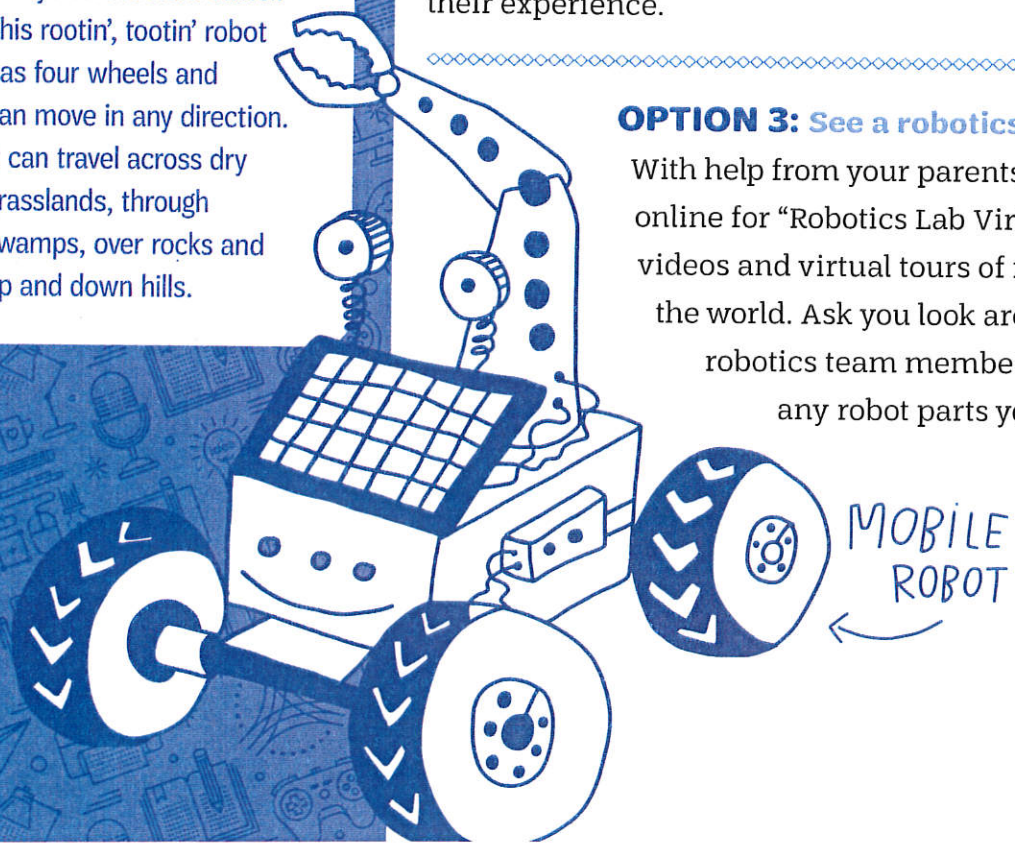
OPTION 3: See a robotics lab online

With help from your parents or Leader, search online for "Robotics Lab Virtual Tours" to find videos and virtual tours of robotics labs around the world. Ask you look around, point out what robotics team members are working on and any robot parts you see.

Yee-ha, Robot Cowboy!

A robot called SwagBot is herding cattle in Australia. That's because the country has a lot of rugged terrain. The Outback is remote and hard to get to. Cows are often left to graze by themselves. Farmers may only check on their animals once or twice a year.

But Swagbot makes keeping an eye on the herd easier. This rootin', tootin' robot has four wheels and can move in any direction. It can travel across dry grasslands, through swamps, over rocks and up and down hills.



Now that I've earned this badge, I can give service by:

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

I'm inspired to: