girl scouts
of wisconsin
badgerland

Brownie Robotics Badge Sequence

Badge in a Box

Badge #1: Programming Robots

Overview for Leaders	The sequence of 3 Brownie Robotics badges are designed to be done in order. You could skip the first one, Programming Robots, and just do the second one, Designing Robots, if you choose. However, the third one, Showcasing Robots, assumes you have done the second badge because that work is used to complete steps 1 and 2 of the third badge. This Badge in a Box kit is designed to complete all three badges. It assumes that your troop meeting place has access to the internet for some steps in order to watch a youtube or other video to complete a few steps. However, it does not assume that you have devices accessing the internet for every pair of girls. The hands-on activities done by the girls are designed to be unplugged. There is a summary at the beginning of each badge that calls out the supplies that a troop needs to obtain or the actions that a troop needs to do so that leaders can find a list in just one place. For each badge requirement, the materials provided as part of this Badge in a Box are listed. Materials or game pieces for each step are designed so that 10 girls can do the activity at a time. Please be a sister to the next troop when using these materials. Put them away in the same manner as you received them, and report any broken/missing items when returning the box to Badgerland.

Badge Requiremen ts	**Programming Robots, badge #1**
	    1. Create a simple machine
	    2. Test your robot senses
	    3. Learn about programming
	    4. Try simple programming
	    5. Code a robot

Length of time, per step (est.)	**Programming Robots, badge #1**
	    1. Create a simple machine
	        o 15-20 minutes
	    2. Test your robot senses
	        o 15 minutes
	    3. Learn about programming
	        o 20 minutes

	4. Try simple programming ○ 20-30 minutes, or more, depending on how many times you play the game 5. Code a robot ○ Optional: 20 minutes ○ Main activity: 20-30 minutes

Materials Troop Needs to Supply and Preparation Actions	**Programming Robots, badge #1**
	    0. Optional Arrival Activity
	        a. Markers
	        b. Make copies of activity sheets from master
	    1. Create a simple machine
	        a. If possible, have the ability to show a video.
	    2. Test your robot senses
	        a. If possible, have the ability to show a video.
	    3. Learn about programming
	        a. There is a master sheet with two 5x10 grids. Make copies and cut them in half.
	        b. Markers
	    4. Try simple programming
	        a. Read the game instructions. Or watch this video to learn about how to play the game: https://www.thinkfun.com/robot-turtles/howtoplay.php .
	    5. Code a robot
	        ○ tape the route that the 'Robots' travel
	        ○ markers

Step #0: Optional Arrival Activity	**Materials:** - There are 5 optional worksheets that the girls can do when they arrive as you wait for everyone to settle in. **Preparation:** - There is a master sheet of 5 different activities. Make copies of the ones that interest you. Depending on the copier, you may be able to make the copies without taking the master out of the protective cover. - None of these worksheets are required for this badge. **Troop provides:** - markers. - copies
Step #1: Create a simple machine	**Materials:** **1.** If possible, have the ability to show a video. Otherwise, there is a paper alternative, using the provided Orange page titled 'How Do Robots Move?

2. Provided: the envelope labeled Programming Robots Step 1, containing:
   a. Single page description of the 6 simple machines
   b. The names of the six simple machines on orange cards
   c. A packet of everyday objects

Activity:
ASK: What is a robot? **ANSWER:** A robot is a machine that can follow instructions to do jobs that are too boring, dangerous or impossible for people to do. Robots are made up of simple machines that move due to the instructions in their programs.

There are 6 simple machines. These machines are combined to make a robot.

In this step we are going to learn about the 6 simple machines.

1.
Introduce the 6 simple machines to the girls. If you have access to the internet, show the girls this video:
https://wisconsin.pbslearningmedia.org/resource/idptv11.sci.phys.maf.d4ksim/simple-machines/#.YEWFo3dKhTZ
Otherwise, hand out copies of the orange page titled 'How Do Robots Move?' and go through the machine definitions by reading through the descriptions.

2.
Sit in a circle around a table or on the floor.

3.
Game: There are 6 orange cards with the names of the 6 simple machines. Spread these out in the middle of the girls, face up.

4.
There are picture cards of everyday objects. Pass these cards out to the girls. Each girl should have at least 2-3 cards but you don't have to use them all.

5.
Taking turns, a girl should tell the group what picture she has and decide which simple machine it matches. Then she can place it on top of the orange card with the name of the right simple machine.

Continue until all cards have been played.

6.
Some of the pictures may have more than one machine. Try to go with the most obvious one. For instance, if a girl has a picture of a fishing pole, she is most likely to say that the reel is a wheel and axle and that the line is a pulley. But she might also realize that the point of the fish hook is a wedge, and the pole itself acts like a lever. She only needs to suggest one of the four. None of those answers is wrong, and you can just go with the first one that she suggests.

7.
Answers:

- Ax: wedge (with the handle acting like a lever)
- Bike: wheel and axle, brake handles are levers, bike chain is a pulley
- Boat: the bow is a wedge
- Bottle Opener: lever
- Can Opener: handle is a lever, cutting wheel is a wheel and axle, cutting edge is a wedge
- Crane: pulleys
- Doorknob: wheel and axle
- Doorstop: wedge
- Faucet: the handles are levers, and they turn with a screw
- Ferris Wheel: wheel and axle
- Fishing Pole: the reel is a wheel and axle, the line is a pulley, the point of the fish hook is a wedge, and the pole itself acts like a lever
- Flagpole: pulleys
- Hammer: lever (and the edges of the claw are a wedge
- Hockey stick: lever
- Jar: screw
- Knife: wedge
- Lightbulb: screw
- Lightswitch: lever
- Nail: wedge
- Nutcracker: level (actually, two levers)
- Pencil sharpener: wheel and axle (with a screw doing the sharpening inside)
- Ramp: inclined plane (just a ramp with a twist)
- Roller coaster: inclined plane
- Roller Skates: wheel and axle
- Rolling Pin: wheel and axle
- Roof: inclined plane
- Scissors: two levers (with the sharp edges being a wedge)
- Screw: screw
- Screwdriver: wheel and axle or a lever, depending on how it is used
- SeeSaw: lever

- o Ship's wheel: wheel and axle
- o Shovel: lever (and the edge of the shovel could be a wedge)
- o Skateboard and ramp: wheel and axle, ramp is an inclined plane
- o Slide: inclined plane
- o Stair: inclined plane
- o Tooth: wedge
- o Wagon: wheel and axle
- o Well: pulley
- o Wheelbarrow: wheel and axle, lever
- o Window blinds: pulleys
- o Window washer: pulley

8.
Optional: Ask the girls to Find all the simple machines you can see from where you are sitting. This allows girls to understand simple machines as they pertain to their real life and helps them draw real world connections. They might start seeing simple machines everywhere. This can get to be a bit competitive as girls try to see who can identify the most. Try and have them find at least one example of each machine.

9.
Summary: Robots are made up of simple machines. And then Programming is added.

Step #2: Test your robot senses	**Materials:** 1. If possible, have the ability to show a video. 2. Provided: 10 small boxes and 20 small items that can be placed in the boxes. 3. Optional: You can bring additional items to be discovered if you want. Your junk drawer is an excellent source! **Preparation:** Place an object into each box prior to the meeting. **Activity:** **Ask:** What 5 senses do humans have and how do they help us? **Answer:** Sight, sound, smell, taste, touch. They help us understand what is around us, what actions we can take, and which directions we can go. Robots have similar requirements: they need to understand their surroundings and therefore need to have senses to obtain the information they need.

1.
Introduce a sophisticated robot to the girls. If you have access to the internet, show the girls this video:
https://www.youtube.com/watch?v=6Zbhvaac68Y

2.
Tell the girls that they are going to imagine that they are robots and they only have the sense of touch. Hand each girl a box. They can shake the box, tip the box fast or slow, turn the box upside down, and general cause the item inside the box to move. As a bonus, they can use their sense of hearing too. Give the girls about a minute to do this.

3.
Go quickly around the circle and each girl can describe what she knows about her item. Is it heavy or light? Does it slide easily? Does it roll? Is is long? Is it large? Is it soft or hard?

4.
Next each girl needs to close her eyes and then she can open her box and feel her object for about 30 seconds. We have added a third sense: touch. Then close the box and open her eyes.

5.
Go quickly around the circle and each girl can describe what NEW thing that she knows about her item. Is it heavy or light? Does it slide easily? Does it roll? Is is long? Is it large? Is it soft or hard?

6.
Now the girls can open their box and see what they have. Surprise! This is the fourth sense that we have used.

7.
Now that they know their object, they can put it back in the box and shake and tip it again. They know what their object is, so what new noises do they hear that they missed the first time? What do they observe about the sliding of their object that is new to them?

8.
Optional: There should be enough items to do this activity a second time if you wish. It might be interesting to put two objects in a box and see how the girls do.

9.
If you wish, you can add your items into the box for the next group.

Step #3: Learn about programming	**Materials:**
	1. Provided: Patterns for the girl acting as the 'Observer'. Each pattern has 8 squares that are filled in. There are 3 levels of difficulty: plain blue: easiest. multi-colored: middle. Black: hardest.
	2. Provided: 10 pieces of cardboard that you can use as clipboards.
	3. Troop provides: markers.

Preparation:
1. There is a master sheet with two 5x10 grids. Make copies and cut them in half so that each girl will have one for each round of this activity that you plan to do. Depending on the copier, you may be able to make the copies without taking the master out of the protective cover.

Activity:
ASK: What do you do in your daily life that can be broken down into step by step instructions? Answers may include: brush teeth, make a sandwich, wash hands, putting on socks, unlock a door, get the mail, etc.
ASK: Pick one of the answers that they just provided and ask girls to give step by step instructions, using 5 steps.
ASK (Optional): Pick one of the answers that they just provided and ask girls to give step by step instructions, using 10 steps.

TELL: a set of step-by-step instructions is called an <u>algorithm.</u>
TELL: when the algorithm, or the step-by-step instructions, are written down in a such a way that a computer can understand it, then it is called a <u>program</u>.
TELL: the work of changing the <u>algorithm</u> into a <u>program</u> is called <u>programming</u>.

We are going to practice breaking an activity down into steps. One girl will be looking at a picture which she keeps hidden; she is called the Observer. The other girl is going to draw the picture; she is called the Artist.

The girls are going to sit back-to-back. The Observer is going to tell the Artist what squares need to be filled in order to draw a picture that matches her pattern.

The Observer needs a pattern.

The Artist needs a marker. (If using the middle-difficulty-patterns, the Observer will tell the Artist which colors she will need.). The Artist will have a piece of cardboard to use as a clipboard, and a blank grid to draw on.

For example, the Observer might say 'color in the box at the top left corner'. She has forgotten to tell the Artist what color. So the Artist can ask for her

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	to repeat it, hoping she realizes what she forgot, but she cannot ask her 'what color?'. The Artist cannot ask a clarifying question. Then the next instruction might be 'go down one square and color that square green'. This is an example of a complete instruction. After the picture is completed, compare it to the master. Then the girls can switch places, and repeat.

Step #4: Try simple programming	**Materials:**
	  1. Provided: two copies of the Robot Turtles game. Plus two sets of 'extra pieces' so that 10 girls can play at the same time.
	Preparation:
	  1. Read the game instructions. Or watch this video to learn about how to play the game, which I think is faster and clearer: https://www.thinkfun.com/robot-turtles/howtoplay.php .
	  2. Based on what you know about your girls, and whether they have played this game before, decide what difficulty of game you want to play. The basic, getting-started level is a great one and it gets the girls involved and successful at the beginning. You can always play again and add harder elements.
	  3. Each game is for 4 girls. However, included is one extra set of cards that can be used for a fifth girl; it isn't as pretty as the standard set but it means that if you have 10 girls in your troop then all 10 girls can play. You will find those game pieces in a bag under the tray.
	  4. One of the key concepts in this game is that the girl is the 'Turtle Master' – that is, they decide where the turtle should go or how they should move. And an adult is the 'Turtle Mover' – that is, that adult executes the movement. This is true to life: the program (that is, the cards selected by the Turtle Master) is separate from the computer that executes them (the Turtle Mover).
	
	Activity:
	ASK: How does a robot know what to do? Answer: The robot gets step by step instructions through its program.
	
	TELL: We are going to play a game called Robot Turtles where we will provide a turtle step by step instructions to move and reach their jewel.
	
	Divide the girls into groups and assign them to one of the games. Each group of girls also needs an adult. Tell them how what game pieces they need for the level of the game that you have chosen. Also, describe how to set up the board.

	The girls are the Turtle Masters and the adult is the Turtle Mover. Everyone is a winner in this game because everyone plays until they reach their own jewel. You can play multiple times, increasing to the more difficult games if you wish.

Step #5:
Code a robot
	Materials:
	    1. Provided: painters tape for creating a route on the floor
	    2. Provided for optional activity: cardstock for creating 'robot faces', hole punch, hole protectors, rubber bands
	    3. Troop provides: markers.
	
	Preparation:
	    1. If you are able to get into your meeting place before the girls arrive, you can tape the route that the 'robots' travel in advance.
	    2. If you choose to do the optional 'Create your Robot Face' activity, you might punch the holes, attach the hole protectors, and loop the rubber bands in advance. This is not required and certainly can be done as part of the activity.
	
	Activity: Optional Make Your 'Robot Face'
	
	    1. Girls can create their own 'Robot Face'. If you have prepunched the holes, you might need to guide them which way should be up and down.
	    2. Punch holes at the midpoint of the long side of the cardstock. Put hole protectors on front and back.

3. Place a rubber band through the hole and then loop one end through.

4. Similarly, loop a second rubber band through the first.
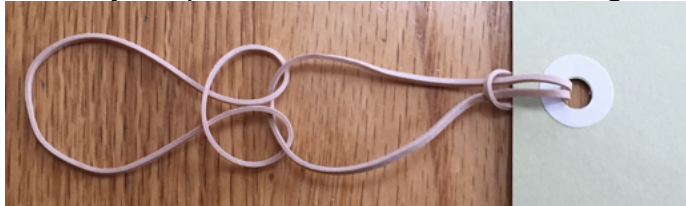
5. Repeat on the other side. When the girl has finished drawing her robot face, the two ends can be tied together behind her head for an easy mask that is comfortable and can be taken on and off.

Primary Activity: Code a Robot!
   1. In general, one girl will be a Robot and other girl(s) (called Programmers) will provide her step-by-step instructions to follow a route that has been taped to the floor.

2. Create some routes that the Robot Girls will follow. Here are some ideas:
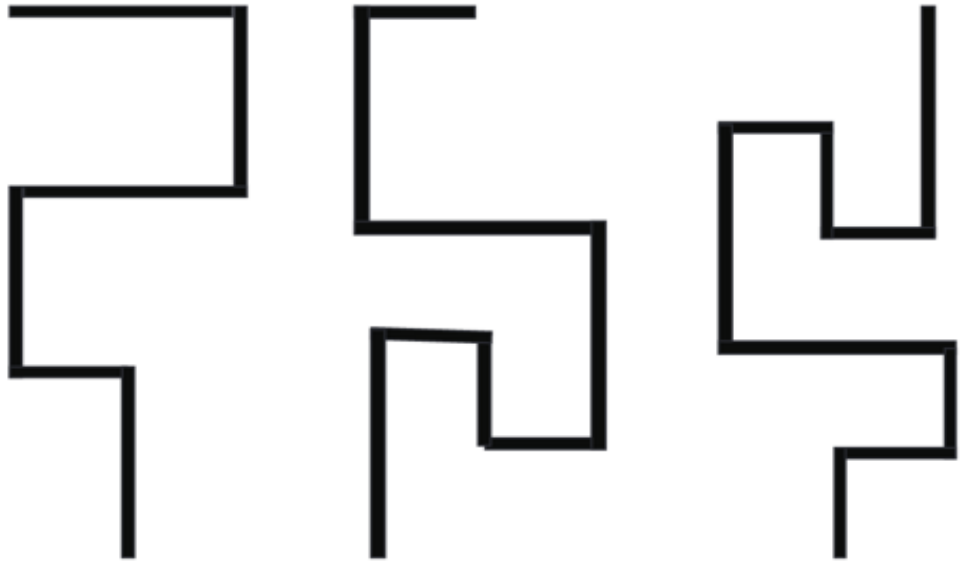
3. Divide the girls into groups. You may choose to divide them into pairs, if you have enough routes so that they don't wait very long. Or you can divide into groups of 3-4, and one girl will be the Robot and the other girls will work together to be the Programmers.
4. Each group selects their Robot. If you did the optional activity, the Robot girl can put on her Robot Face. The Robot girl goes to the beginning of the route and closes her eyes.
5. The Programmers provide instructions, and the Robot follows them *exactly*. For example:
   a. Programmers say 'walk forward'. Robot walks forward and keeps walking until the Programmers say 'stop'.
   b. Programmers say 'take 3 steps forward'. Robot walks all 3 steps and then stops, no matter where she is, on or off of the route.
   c. Programmers say 'turn right'. Robot turns right and stops, waiting for the next instruction.
   d. If the Robot overshoots a corner, the Programmers can say 'take one step backwards.' Or they can have the Robot turn twice: 'turn right.' Then, 'turn right' again. And then say 'take one step forward.'
   e. If the Programmers want to be mischievious, they can say 'take 3 bunny hops forward' or 'twirl' when the Robot reaches a corner or 'stand on one leg like a flamingo'. Not every instruction has to be dedicated to following the route; some can just be fun!
6. Once the Robot has reached the end, a new girl becomes the Robot and the group will switch routes.

End	**Great! You have completed the Brownie Programming Robots badge! This is the first in the 3 Brownie Robotics Badge Series. Hope you had fun!**

Contents in the Box	0. Master set of activity sheets
	00. Leader's Guide
	1. Create a simple machine
	   o Large envelope containing
	       ▪ Single page description of the 6 simple machines
	       ▪ The names of the six simple machines on orange cards
	       ▪ A packet of everyday objects
	2. Test your robot senses
	   o 10 small boxes
	   o 20 small items that can be placed in the boxes.
	3. Learn about programming
	   o a master page for making copies of the grid to be used by the Artist
	   o Patterns for the girl acting as the 'Observer'. Each pattern has 8 squares that are filled in. There are 3 levels of difficulty: plain blue: easiest. multi-colored: middle. Black: hardest.
	   o 10 pieces of cardboard that you can use as clipboards.
	4. Try simple programming
	   o Two sets of the Robot Turtles game
	5. Code a robot
	   o painters tape for creating a route on the floor
	   o Optional activity: cardstock for creating 'robot faces', hole punch, hole protectors, rubber bands

Supplies	**Consumables to be replenished by Badgerland**
	   • Cardstock
	   • Rubber bands
	   • Hole protectors
	   • Blue Painters tape

Outcomes

Overall
- Strong sense of self: Girls have confidence in themselves and their abilities, and form positive identities.
- Challenge seeking: Girls take appropriate risks, try things even if they might fail, and learn from their mistakes.
- Healthy relationships: Girls develop and maintain healthy relationships by communicating their feelings directly and resolving conflicts constructively.
- Community problem solving: Girls desire to contribute to the world in purposeful and meaningful ways, learn how to identify problems in the community, and create "action plans" to solve them.

STEM specific outcomes
- Girls are excited about STEM subjects and want to learn more about them.
- Girls have confidence in their STEM skills and abilities.
- Girls think scientifically to solve problems.
- Girls learn the importance and relevance to STEM to people and society.