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CODING WITH THE OZOBOT

Pledge of Allegiance, Scout Oath, and Scout Law 3

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Module Survey97

The adult leaders should read through all the meeting activities ahead of time. If this is your first time managing a Lab, please review the Lab Leaders Operations Guide, which contains general instructions, lab setup information, the Scout Oath and Scout Law, and more.

Print DOUBLE-sided



Junior Lab: Leader’s Meeting Preview and “Ozobots” Meeting Plan



MODULE OVERVIEW

Specific steps. Patience. Innovation. Thanks to coding, we are able to live our lives in a more convenient and revolutionized way! Throughout this module, Scouts will use Ozobot robots in a variety of ways to boost their familiarity with robotics, coding, problem-solving, and design-thinking. Starting with color codes, Scouts will become comfortable with the idea of inputs and outputs and will then move on to block-coding with Ozobot’s online programming language, OzoBlockly. They will also focus on integrating art into STEM by creating various designs while also learning about real-world concepts like data collection, Venn diagrams, and blueprints. Those who code hold the world’s technological future in their hands, and the opportunities are unlimited!

Grades 3–5
Next Generation Science Standards:
3-5-ETS1-3

MODULE AUTHOR

This module was developed for STEM Scouts by Eduporium. Eduporium (www.eduporium.com) is an all-encompassing partner of schools, districts, and educational organizations, specializing in creating innovative educational and computer technology solutions to enhance the meaningful use of STEM technology in education and to help students develop crucial 21st-century skills. Their experts creatively combine technology tools into custom solutions for use in classrooms, makerspaces, libraries, and after-school programs. Eduporium encourages early exposure to invention, problem-solving, coding, and collaboration in an effort to inspire lifelong STEM learning for our educators and future generations in the classroom!



Meeting 1: Maze Design (70–80 minutes)

Scouts will take on different roles in their teams of three as they work together to get the Ozobot through a maze successfully. Two Scouts from each team will draw a maze course for the Ozobot without letting the third Scout see it. Those two will then give the third Scout instructions to draw the same course, putting the lines in the same directions and including the same color codes.

Meeting 2: Best Things About Us (75–90 minutes)

Scouts will learn about Venn diagrams and will use them to collect and analyze data about themselves and their fellow team members. They will then practice their color coding by coding their Ozobot through a word from their shared traits in the Venn diagram. They will write out this word in cursive and add color codes.

Meeting 3: Once Upon a Time (80–90 minutes)

Scouts will explore the three main parts of a story (exposition, climax, and resolution). They will then work in teams to write a short story that includes the three main parts, a theme, and main characters, for their Ozobot to travel through by reading various color codes throughout.



Junior Lab: Leader's Meeting Preview and "Ozobots" Meeting Plan



Meeting 4: 3-D Obstacles (80–90 minutes)

Scouts will incorporate basic engineering techniques as they design simple structures out of various materials for their Ozobot to travel through and around. They will use lines and color codes to draw a course for their Ozobot to move through, including tunnels and other obstacles along the way. In the process, they'll also discover the principles of 3-D design and what it takes to engineer a sturdy structure.

Meeting 5: Light Up the House (75–85 minutes)

In this meeting, Scouts will take their Ozobot programming to the next level by incorporating Ozobot's web-based programming environment, OzoBlockly. Scouts will draw the blueprint of a house with at least five rooms and then write a program that gets the Ozobot to travel to each room of the house and perform a cool move once it arrives!

Meeting 6: Color Code Challenge (70–80 minutes)

Scouts will work collaboratively as they decipher clues to reveal six color codes. Then they will look for similar codes in OzoBlockly to create a program for their Ozobot to perform. The Scouts will practice their computational thinking and problem-solving skills to decipher their codes as they explore more in OzoBlockly! *Leaders, please complete the survey at end of module; pg. 97.*



Junior Lab: Leader's Meeting Preview and "Ozobots" Meeting Plan



Weekly Meeting Prep at a Glance

The following are lists of kit materials as well as council- and unit-supplied materials for this module. Unit-supplied materials can often be supplied by parents if requested well in advance.

PLEASE USE PACKING SLIP to check kit contents **one week prior** to first meeting. Slip can be found in the Kit Shipment email and/or the STEM Scouts Portal (where this guide was downloaded). Please **DO NOT** skip this part!

Scouts will be divided into teams of **THREE** for this module. Material quantities are defined below for **EACH TEAM**. Scouts can work in the same three teams throughout this module. However, you can mix teams up to due to behavior, as needed.

Week 1

Materials From Kit

- 1 Ozobot robot
- 1 set of Ozobot markers
- 5 large sheets of graph paper
- 1 Ozobot color code sheet
- Sheets of scrap paper as needed
- Calibration cards

Printed Materials

Scout Notebook (The notebook contains meetings 1–6. Scouts will turn it back in after every lab for safekeeping until the next meeting.)

Materials Needed But Not Provided in Kit

NONE

Week 2

Materials From Kit

- 1 Ozobot robot
- 1 set of Ozobot markers
- 5 sheets of 11×14 paper
- 1 Ozobot color code sheet
- 1 roll of tape
- Sheets of scrap paper as needed
- Calibration cards
- Venn diagram sheet

Printed Materials

Scout Notebook

Materials Needed But Not Provided in Kit

NONE

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Junior Lab: Leader's Meeting Preview and "Ozobots" Meeting Plan



Week 3

Materials From Kit

- 1 Ozobot robot
- 1 set of Ozobot markers
- 5 sheets of 11×14 paper
- 1 Ozobot color code sheet
- 1 roll of tape
- 1 pair of scissors
- Sheets of scrap paper as needed
- Calibration cards
- Printed page with 2 squares (Scouts will cut out)

Printed Materials

Scout Notebook

Materials Needed But Not Provided in Kit

NONE

Week 4

Materials From Kit

- 1 Ozobot robot
- 1 set of Ozobot markers
- 10 large sheets of paper
- 1 color code sheet
- 1 roll of tape
- 1 pair of scissors
- 1 deck of cards
- 6 chenille stems
- 10 regular craft sticks
- 10 Popsicle sticks
- 1 measuring tape
- Calibration cards

Printed Materials

Scout Notebook

Materials Needed But Not Provided in Kit

NONE



Week 5

Materials From Kit

- 1 Ozobot robot
- 1 set of Ozobot markers
- 1 Ozobot color code sheet
- 5 sheets of graph paper
- Sheets of scrap paper as needed
- 1 pair of scissors
- 2 pieces of tagboard
- Calibration cards

Printed Materials

Scout Notebook

Materials Needed But Not Provided in Kit

- Laptop (council-supplied)—1 per Scout team
- Pen or pencil (unit-supplied) 1 per Scout team

Week 6

Materials From Kit

- 1 Ozobot robot
- Large sheets of paper
- 1 Ozobot color code sheet
- Calibration cards

Printed Materials

Scout Notebook

Materials Needed But Not Provided in Kit

Laptop (council-supplied)—1 per Scout team

Pen or pencil (unit-supplied)—1 per Scout team

Service Project Idea: Giving Back!



After Scouts complete this six-week module, Scouts could plan to host an intro to coding class at their school, a local nursing home, or their host's location!
Check the STEM Scout Portal download files for more service project ideas!

NOTE: Instructions for calibrating the Ozobot can be found in the Leader's Guide and Scout Notebook within each meeting.

For Meetings 1-4, the Ozobot can be calibrated using the included calibration card. For Meetings 5-6, it can also be calibrated on the laptop screen using OzoBlockly.



Meeting Facilitation Tips

- Choose an **Attention Getter** with your Scouts. This is a “call and response” technique used to capture the Scouts’ attention for a focused moment.

Step 1: Have Scouts *vote* on an Attention Getter. For example, you could use

Making the Scout salute, you say:

One, two, three!
Scout’s honor!
Potential energy!
Holy moly!

Making the Scout salute, they respond:

All eyes on me!
Scout’s duty!
Everybody freeze!
Guacamole!

Step 2: Have Scouts decide *with you* what is expected when this Attention Getter is used.

For example, the expectations may be to have mouths closed, hands still, ears open, and eyes on you. (Post the expectations, if possible.)

Step 3: Practice!

- For a **calming moment** at any point during the activity, get the Scouts’ attention by using the Attention Getter, then have them take two or three deep breaths together to reset or refocus.
- **“Guide by the side.”** Walk around the space to guide Scouts through the activity. Instead of giving the answers, ask open-ended, leading questions to help them think through the challenges.
Note: This is a *safe* time for Scouts to discover, experiment, and even possibly fail. This helps build a growth mindset and resilience. What matters is how much *effort* we put into our work, not our ability to get it right the first time. That’s what STEM is all about—failure is a part of the process!
- For the various types of learners, use the **Key Terms** page in each meeting plan for Scouts to pass around, hold, and read. Note: If possible, post these terms in the room.
- **Meet the Scouts where they’re at.** Use the Activity Adaptations section in the meeting plan to adjust activities based on each Scout’s behavior and/or ability. If you notice a Scout struggling with an activity or a Scout who has finished early, use these adaptations to continue to keep the Scout engaged and excited about learning!
- **Team dynamics.** If teams are too rowdy, or you notice some unhealthy team behavior, feel free to move members to different teams at any time. This will help to establish a healthy learning environment, and it will support you in facilitating and “guiding by the side.”
- **Remember,** it’s OK if you don’t know the answer to something. Discover *with* the Scouts and learn together.



Junior Lab: Ozobots
Meeting 1: Maze Design



MEETING PREVIEW AND SETUP	
Meeting 1: Maze Design	STEM Focus: Coding
<p>After this meeting, Scouts will be able to</p> <ul style="list-style-type: none"> • Work together to accomplish the goal of getting the Ozobot through a maze • Draw a course that includes color codes so that the Ozobot can get to the end • Communicate instructions effectively to their peers and practice teamwork 	
<p>Scout Law Character Focus Helpful</p>	
<p>Total Meeting Time 70–80 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p>Activity Prep</p> <ul style="list-style-type: none"> • Collect supplies for the meeting. • Charge all Ozobots for ONE HOUR prior to meeting. • Review the Safety Data Sheets in the portal for this lab. • Scout Notebook: Meeting 1 (one per team) <ul style="list-style-type: none"> ○ All six meetings are included in the Scout Notebook. You can choose to give the teams the entire notebook or only the handouts that pertain to each meeting. • Prior to the meeting, watch these two short videos about Ozobot basics and creating Ozobot color codes with markers (you do not need laptops <i>during</i> this meeting). <ul style="list-style-type: none"> ○ www.youtube.com/watch?v=h8lJhCz7_dU ○ www.youtube.com/watch?v=IZPQ4VCZrKQ <p>Space Needed Large table or floor space</p> <p>Teams of Three OPTIONAL: In each team, there will be three roles—have teams decide who will do each role before the lesson begins:</p> <p>Two Architects—Draw a maze that the Navigator will then recreate using the materials.</p> <p>One Navigator—Gathers all the materials, listens to the Architects describing the maze they have drawn, and then recreates that maze.</p>



Junior Lab: Ozobots Meeting 1: Maze Design



<p>Materials from Kit Per Team</p> <ul style="list-style-type: none">• 1 Ozobot robot• 1 set of Ozobot markers• 5 large sheets of graph paper• 1 Ozobot color code sheet• Sheets of scrap paper as needed• Calibration cards	<p>Materials Needed But NOT Included in Kit NONE</p>
	<p>Lab Leaders Optional Notes Section <i>(This section is for YOU! List notes, reminders, and/or responsibilities and roles of Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!)</i></p>



MEETING PLAN

Meeting 1: Maze Design

STEM Focus: Coding

Activity Overview

Scouts will take on different roles in their teams of three as they work together to help get the Ozobot through a maze successfully. Two Scouts from each team will draw a maze course for the Ozobot without letting the third Scout see it. Those two will then give the third Scout instructions to draw the same course, putting the lines in the same directions and including the same color codes.

PART 1

Introduction/Background Information

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

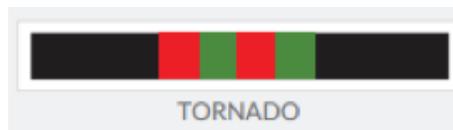
- This meeting is called Maze Design. Before we start, we all need to learn about what an Ozobot is and what it is capable of doing!
- Who knows what an Ozobot is? *(An Ozobot is a robot that can be coded in two ways: Online with Ozoblockly and “screen-free” with color codes.)*
- What is coding? *(Coding is the process of creating specific instructions for something to do a specific task.)*
- To do this, computer programmers use **inputs** and **outputs**. What do you know about inputs and outputs? *(Inputs are what cause something to happen, like a message being sent. Outputs are what happens because of the input that was received.)*
- Have a Scout volunteer to demonstrate input and output. The Scout must follow your instructions.
 - Tell the Scout to lift their right foot. *(This is an input.)*
 - The Scout should lift their right foot. *(This is an output.)*
 - Tell the Scout to put their right foot down when the others clap.
 - Tell the group of Scouts to clap! *(input)*
 - The Scout should put down their right foot. *(output)*
 - Explain to the Scouts that an output is usually tied directly to whatever input is given.
- What can coding be used for? *(Coding can allow us to use computers to control objects and accomplish other challenges.)*
- Why do you think coding and robotics are so closely related? *(Coding and programs can be used to control the movements and actions of a robot.)*



- **Color codes** are groups of colors that can fit on a line. They can be made up of three to five small sections of colors. When the Ozobot passes over the sections, it reads the codes, which contain instructions that tell it to do something. For example, green-black-red means Go Left and red-green-black-blue means Backwalk.
- These color codes have been created by Ozobot and are exclusive to Ozobot robots rather than something all robots would be able to recognize.

Demonstration

- Draw the sequence below with the Ozobot markers on a sheet of scrap paper.



- A few inches of black
 - Add the sequence: Red, green, red, green (the “tornado” color code)
 - Finish with a few inches of black
- Turn the Ozobot on and place it at the start of the line on the black. It should start moving over the black line and then do the “tornado” move once it reads the color code!
 - This will show Scouts how the Ozobot is able to follow colored lines, how its light will change depending on the color it is traveling on, and how it reads and reacts to certain groups of color codes.

TIP: *If the Ozobot is having trouble reading the code, it may need to be calibrated. For this meeting, the Ozobot can be calibrated using the black dot on the calibration cards included in the kit.*

- *Start by holding down the Ozobot’s power button for two seconds (until the light flashes white).*
- *Quickly place the Ozobot in the middle of the black dot.*
- *It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over. Giving each Scout a chance to try this could be helpful.*

LEADER NOTE: *For the next 3-5 minutes, have the Scouts practice color coding on pages 3–4 of their Scout Notebook, then move to Part 2 and Part 3 of this guide before continuing to their maze design.*



PART 2

Discuss the Scout's Law Character Point

Today we are focusing on the character point **Helpful**.
 For today's meeting, how can we practice being Helpful? What can we do?

PART 3

Safety Moment

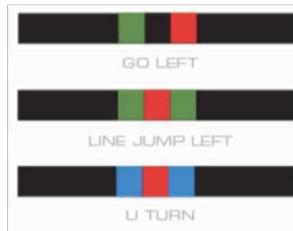
- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful of where your Ozobots are. Do not knock them off the table or step on them.
- Try to keep liquids away from the Ozobots since they could be damaged if they get wet.

PART 4

Activity Steps

Scouts will follow the procedures below in their Scout Notebook.

What is color coding?



Input is the message of the code that tells the robot what to do.

Output is what the robot does based on the input it has received.

Practicing Color Codes!

Scout Roles:

Two Architects—Draw a maze that the Navigator will then recreate.

One Navigator—Gathers all the materials, listens to the Architects describing the maze they have drawn, and then recreates that maze.

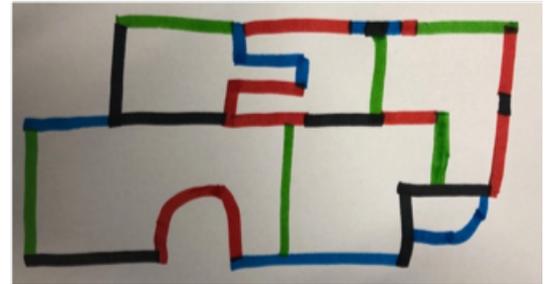
Materials:

- 1 Ozobot robot
- 1 set of Ozobot markers
- 5 large sheets of graph paper
- 1 Ozobot color code sheet
- Sheets of scrap paper as needed
- Calibration cards



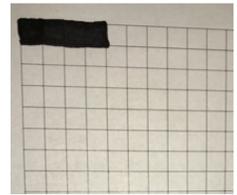
Procedure:

1. Take turns as your team practices drawing three to five color codes from the Ozobot color code sheet on a sheet of scrap paper.
2. Turn the Ozobot on and place it at the start of the black line to see if the codes work!
3. Notice that the color of the Ozobot's light changes according to the color it is traveling on.



Practicing Thick Lines on Graph Paper

1. On graph paper, take turns drawing thick black lines by coloring in three to five squares in a row. (See example at right.)
2. Next, use the color code sheet to choose and add color codes after each black line.
 - Color in one or two squares for each color in the color code sequence. (See example below.)
3. Remember that the Ozobot's ability to follow lines and read color codes could be affected if the lines are not thick or dark enough and if there is not a clear separation between the different colors.



If the Ozobot is having trouble reading the lines or codes, it may need to be calibrated. *For this meeting, the Ozobot can be calibrated using the black dot in the kit. Start by holding down the Ozobot's power button for two seconds (until the light flashes white). Quickly place the Ozobot in the middle of the black dot. It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.*

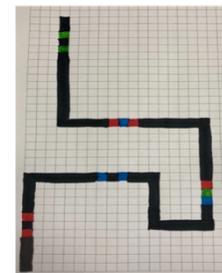
Maze Design

The two Architects will create a maze map on graph paper using FIVE color codes. Then, without showing what they have drawn, the Architects must describe HOW to draw their maze map while the Navigator tries to recreate it on a new sheet of graph paper!

Choose who will be the Navigator and the two Architects on each team.

Activity Procedure:

1. **Architects:** Color in a straight black line three to five squares in length, starting with the very bottom left square. *Don't show your Navigator!*
2. Add a color code after the black starting line.
3. Now color a few more squares black to continue the line.
 - You can choose to go straight or take some turns. (See example at right.)
4. Keep adding different color codes until you have FIVE.
5. End your maze with a final black line.





6. **Navigator:** Take a new sheet of graph paper.
7. **Architects:** Describe to your Navigator where you started. Then describe the exact number of squares to fill in, what colors to use, and which direction to go.
8. Once complete, compare the Navigator’s maze to the Architects’ maze. How did your team do?
Just like a programmer, the Architects had to “program” the Navigator to code a new maze!
9. Test each maze with an Ozobot!
 - See how the Ozobot’s **sensors** react to the color codes.
10. If time allows, work together as a team to design a new maze for a different team to try and get through!

Ozobot sensors



Activity Adaptations for Scouts, as Needed

If Scouts finish early ...

Keep extending the maze!

- Switch roles between team members.
- Use the code sheet to create codes of four blocks instead of three blocks.
- Have Scouts make a longer course—the more twists and turns, the better!

If Scouts are too challenged ...

- The Architects can tell the Navigator which colors to use without specifying the number of squares they need to cover.
- Have them use two- or three-color codes instead of codes with five colors.

**PART 5****Circle Up for Reflection Questions**

- How did you and your team have to collaborate together to accomplish this activity?
- In this meeting, the roles were Navigators and Architects. What were the differences in these roles, and what are some of the important qualities that the Scouts in these roles showed?
- Ask those who were the Navigator: *How did you feel when you weren't allowed to see the maze?*
- Just like the Ozobots, we have sensors too! Our sensor is our conscience. The conscience is the little “sensor” in our head and heart that guides us to know what’s right and wrong.
 - Next time you feel that something might not be the right choice, listen to your sensor—it’s coded to tell you what good actions to take and what bad actions not to take! And whenever you are having a hard time “reading the codes” of your sensor, ask a trusted adult or friend for advice.

PART 6**STEM Innovator Moment: George Devol**

George Devol was an American inventor and scientist who was credited with inventing the first digital and programmable robot back in 1954. This robot was also considered to be the first modern and teachable robot. The size of the robots that were built back in the 1950s were quite large—some even appearing to be about the size of a washing machine. Compared to the Ozobot, which is the size of a ping-pong ball and can fit in your hand, these robots were enormous. To learn more about the history of robotics, watch this brief video when you get home and consider how far robots have come in just the last few years alone!

Source: www.youtube.com/watch?v=mbHy7TZO6_s

PART 7**Leaving It Better Than We Found It!**

- Have Scouts help clean up supplies and make sure all of the markers are capped.
- Throw away any trash.
- Power off the Ozobots and place them back in the case.
- Store color code sheets safely for the next meeting.
- Make any needed announcements.



Key Words

- **COLOR CODING:** *Creating sets of colors that act as commands for a robot to perform.*

- **INPUT:** *The message of the code that tells the robot what to do.*

- **OUTPUT:** *What the robot does based on the input it receives.* Below, the inputs are on the left and the outputs are on the right. (The second color code bar contains two codes, “Play again” and “Slow.”)



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MEETING PREVIEW AND SETUP	
Meeting 2: Best Things About Us	STEM Focus: Coding
After this meeting, Scouts will be able to:	
<ul style="list-style-type: none"> • Understand the relationship between inputs and outputs when coding • Learn how and why the Ozobot responds to color codes • Understand how to create a Venn diagram to collect data 	
Scout Law Character Focus Friendly	
<p><u>Total Meeting Time</u> 75–90 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p><u>Activity Prep</u></p> <ul style="list-style-type: none"> • Charge Ozobots for ONE HOUR prior to meeting. • Collect supplies needed for each team. • Scout Notebook: Meeting 2 (one per team) • Draw the color code shown below on a scrap piece of paper to discuss when prompted during the introduction. <div style="text-align: center;">  <p>U TURN</p> </div> <p><u>Space Needed</u> Large table or floor space</p> <p><u>Teams of Three</u> OPTIONAL: In each group, there will be three roles—have Scouts get into groups and decide who does each role before the lesson begins:</p> <p>Project Manager—Gathers and manages all materials for the team. Oversees the overall success of the project.</p> <p>Principal Investigator—Leads observation and documents findings in Scout Notebook.</p> <p>Co-Principal Investigator—Assists the Principal Investigator and helps with materials.</p>



Junior Lab: Ozobots Meeting 2: Best Things About Us



<p>Materials From Kit <u>Per Team</u></p> <ul style="list-style-type: none">• 1 Ozobot robot• 1 set of Ozobot markers• 5 sheets of 11×14 paper• 1 Ozobot color code sheet• 1 roll of tape• Sheets of scrap paper as needed• Calibration cards• Venn diagram sheet	<p>Materials Needed But NOT Included in Kit NONE</p> <hr/> <p>Lab Leaders Optional Notes Section <i>(This section is for YOU! List notes, reminders, and/or responsibilities and roles of the Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!)</i></p>
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MEETING PLAN

Meeting 2: Best Things About Us

STEM Focus: Coding

Activity Overview

Scouts will learn about Venn diagrams and will use them to collect and analyze data about themselves and their fellow team members. They will then practice their color coding by coding their Ozobot through a word from their shared traits in the Venn diagram. They will write out this word in cursive and add color codes.

PART 1

Introduction/Background Information

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

- This meeting is called Best Things About Us and you will use a lot of color coding throughout it. However, before we start, we all need to learn more about sensors!
- What is a **sensor**? *(A sensor is a device that detects or measures physical properties in an environment, records what it sees, and reacts to it in a certain way.)*
- Do the Ozobots have sensors? *(Yes.)*
- How do you know? *(Because when the Ozobot comes to a line that is a certain color, the color of its light changes. Also, when it travels over a color code, it does the action that is associated with that code.)*
- Where do you think the Ozobot’s sensors are? *(On its bottom surface.)*
- Why do you think they are in this location? *(Scouts can turn the Ozobot upside down and see the small grooves on the bottom. The Ozobot needs these grooves to read colors and color codes as it moves over them. Since these codes are usually on paper or a tablet screen below the Ozobot, this is the perfect place to have the sensors.)*
- Have a Scout volunteer to demonstrate the actions of a sensor. The Scout must follow your instructions.
 - Tell the Scout to walk forward until a barrier is reached, like a wall. *(This barrier is an input.)*
 - Tell the Scout to turn right after reaching the barrier. *(This action is an output.)*
 - Tell the Scout to continue walking until reaching something green. *(This is another input.)*
 - Tell the Scout to spin around after reaching the green object. *(This is another output.)*



- What can sensors be used for? (*In this case, the sensors can be used to see color codes and tell the Ozobot to do a new action. They can also be used for alerting drivers when there is a car in their blind spot or alerting families if an intruder has entered their house. As another example, a pressure sensor causes a certain action when pressure is applied to it; if you have used a touchscreen phone, you have used a pressure sensor. The screen determines where the pressure of your finger has been applied and completes the corresponding action.*)
- How do you think sensors and coding are related? (*When coding with robots, they need to be able to sense when to stop what they're doing and switch to the next action in the sequence.*)
- What kinds of sensors do you think the Ozobot has? (*Color, proximity, and light.*)
- Sensors can be big or small and are used in many different devices as a way for the technology in that device to know when to turn on, turn off, speed up, close, or perform another action.
- One of the sensors that the Ozobot has is a **proximity sensor**. This sensor alerts the Ozobot when it gets too close to a physical object (like a wall) and makes it turn around or move in a slightly different direction.
- The Ozobot also has **color sensors**, which recognize the color of a surface or line when the Ozobot is on top of it. You know these sensors are activated based on the color of the Ozobot's light—it will always be the same color as the surface it is on.
- Finally, the Ozobot has a **light sensor**, which converts light into an electronic signal. Since colors are forms of light, the Ozobot uses this sensor to convert color codes into signals that it responds to when it crosses over them.

Demonstration:



- Use the color code sequence that was drawn prior to the meeting (pictured at right).
- Turn the Ozobot on and place it at the start of the line (on the black). It should start moving over the black line and then complete a U-turn once it reads the color code! *Use calibration cards as needed.*
- This will show Scouts how the Ozobot can use its sensors to not only follow the black line but also to read the code and then do what the code is telling it to do!
- Remember, all lines need to be drawn as straight and as thick as possible so that the Ozobot can follow them correctly.



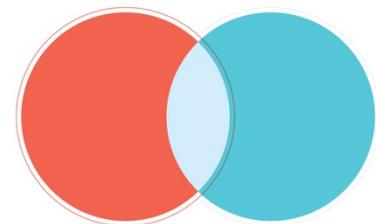
TIP: If the Ozobot is having trouble reading the lines or codes, it may need to be calibrated. The Ozobot can be calibrated using the black dot in the kit.

- Start by holding down the Ozobot’s power button for two seconds (until the light flashes white).
- Quickly place the Ozobot in the middle of the black dot.
- It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.

- **Venn diagrams** are sets of two or three circles that overlap, creating separate areas and shared areas. The separate areas show where the characteristics or features in the circles are different, and the shared areas show where they are similar.

Venn Diagram Demonstration

- Illustrate a Venn diagram by drawing two large, overlapping circles on a piece of paper.
- Label Circle 1: *Ozobot functions*
- Label Circle 2: *Things Scouts can do*
- Start by having Scouts list things that only Ozobots can do, and then list things that only Scouts can do. Categorize these things in the Venn diagram.
- In the overlapping section of the Ozobot and Scout circles, write “Read” as the first thing that both Ozobots and Scouts can do.
 - Remind Scouts that Ozobots are reading in their own way by scanning color codes and lines.
 - If the Scouts get stuck, remind them that another thing they have in common with Ozobots is sensors! We have eyes that read and the Ozobot has sensors that read.
- List three to five additional things for each category with the ones they have in common written in the overlapping section.



VENN DIAGRAM

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Have the Scouts practice filling in a Venn diagram for dogs and frogs on page 8 of their Scout Notebook.

After about five minutes, bring them back together to discuss the Scout Law Character Focus and Safety Moment before moving to their main activity.

PART 2

Discuss the Scout Law Character Focus

Today, we are focusing on the character point **Friendly**.

For today’s meeting, how can we practice being Friendly? What can we do?



PART 3

Safety Moment

- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful of where your Ozobots are. Do not knock them off the table or step on them.
- Try to keep liquids away from the Ozobots because they could be damaged if they get wet.

PART 4

Activity Steps

Scouts will follow the procedures below in their Scout Notebook.

Materials:

- 1 Ozobot robot
- 1 set of Ozobot markers
- 5 sheets of 11×14 paper
- 1 Ozobot color code sheet
- 1 roll of tape
- Sheets of scrap paper as needed
- Calibration cards
- Venn diagram sheet

What is a sensor?

Draw a line to match the key word to its definition:

Robotic sensors

How close one object gets to another.

Proximity

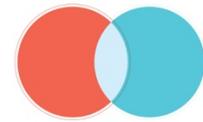
Used by a robot to identify its position in its environment and to recognize what tasks to perform and when to do so.



Activity Procedure:

Team Shared Characteristic _____

What is a Venn diagram?

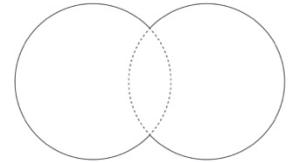


VENN DIAGRAM

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Practicing Venn Diagrams

1. On a large sheet of paper, draw two circles like the ones on the right.
2. Label the two circles:
 - Dogs
 - Frogs
3. Discuss the characteristics of each animal.
4. In your Venn diagram, write the characteristics that are different in the big part of each circle and write the characteristics that are similar in the overlapping segment.
5. List what dogs and frogs have in common: _____



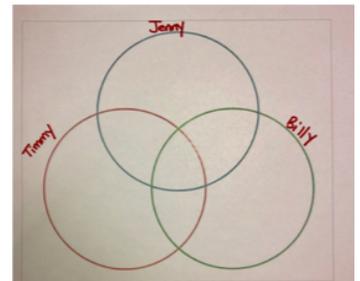
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A Scout Venn Diagram

Now you are going to use a Venn diagram to collect and organize data about your team's personality characteristics. This will help you see the best things about the team!

Activity Procedure:

1. On separate sheets of paper, work apart from each other to write down three to five characteristics about yourself and your personality.
 - Examples could include: Energetic, compassionate, a good listener, loves going to the movies, a good leader, enjoys reading, biking, etc.
2. Discuss with your team the characteristics everyone wrote down.
3. Now, on your triple Venn diagram sheet, write each team member's name next to one of the large circles. See the example at right.
4. **Data Input:**
 - If there are any characteristics that ALL THREE team members share, write them in the middle section where all three circles overlap.
 - For characteristics shared by only two team members, write them in the area where only those two circles overlap.
 - Write characteristics that are unique to only one team member in the part of that circle that doesn't overlap with the others.
5. With your teammates, decide on one characteristic from the section where you all overlap that BEST represents each of you, and circle it.





Let's Color Code!

Now you will write the team's shared characteristic from the Venn diagram on blank paper nice and big in cursive, using color codes throughout so that your Ozobot can travel through the word.

Activity Procedure: Code the Ozobot through your team's characteristic.

1. Put four pieces of paper together by taping them together on the back side. This will help prevent bumps in the Ozobot's "road."
2. Choose five to seven color codes from the color code sheet that you want to include. *Don't choose codes that will make the Ozobot turn around and go the other direction.*
3. Decide what order you want the codes to appear in the word.
4. Nice and big, start writing your word in cursive with *black marker* BUT leave empty spaces for your color codes!
 - The letters must be touching so that the Ozobot can travel through the whole word. See the first "happy" example, below left.
5. Now, add your color codes in the spaces you left empty. See the second "happy" example, below right.
 - Touch up the word with the black marker to fill in any gaps you see.



6. Turn on Ozobot by pressing the power button on the side, and place it at the beginning of your word.

TIP: *If the Ozobot is having trouble reading the lines or codes, it may need to be calibrated. The Ozobot can be calibrated using the black dot in the kit.*

- *Start by holding down the Ozobot's power button for two seconds (until the light flashes white).*
 - *Quickly place the Ozobot in the middle of the black dot.*
 - *It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.*
7. Once placed on the word, the Ozobot should begin moving through the course!
 - If it has any trouble recognizing the color codes, touch up your lines with the markers or make them thicker.
 - If the Ozobot still has trouble, calibrate it again using the calibration cards from your Lab Leader.

**Activity Adaptations for Scouts, as Needed**

If Scouts finish early ...

Try U-turns!

- Have Scouts draw a new Venn diagram with four circles instead of three. The same overlapping principles apply, but this time the center should be a one-word characteristic they all share. Have them code that word for the Ozobot to travel through.
- Now have the Scouts add a U-turn code at the end of their course to send the Ozobot back to the beginning.
 - Once they start the Ozobot, one Scout should draw the same U-turn code at the very beginning of the course so that it loops through their word repeatedly.
 - Remind Scouts that the color code being added at the beginning should be the opposite of the one at the end of the line so that it can get the Ozobot traveling in the opposite direction. (The code at the beginning should be red-blue and the code at the end should be blue-red.)

If Scouts are too challenged ...

- Have them choose a pre-typed cursive word on pages 12–13 in their Scout Notebook to trace and use as their characteristic.
- Instead of drawing color codes into a word, have them draw a straight or curvy line with a color code move that they think represents their team's word!

PART 5**Circle Up for Reflection Questions**

What did you think was the most challenging part of this experiment?

What did you learn about your teammates?

How would you describe the movements the Ozobot made and the relationship between what it did and the codes you drew?

Did you know that Ozobots can navigate through mazes? How do you think a robot would be able to find its way through a maze?

Think about that during the next week and, in our next meeting, you might get to find out!

**PART 6****STEM Innovator Moment: Nader Hamda**

Nader Hamda is the founder of Ozobot. His desire to have as many young people coding as possible led him to building these robots. Nader knew that coding was a very important skill for people to have and thought that the sooner students could start coding, the better. That's why he designed a robot small enough for kids to use but powerful enough to help them learn what it's like to be a programmer.

Two years after coming up with the concept and working tirelessly on perfecting the robot, Nader introduced the Ozobot Bit to the world at the Consumer Electronics Show—a huge science and technology event in Las Vegas. Shortly after that, he secured a patent for using color codes to teach programming to kids in a screen-free way. Learn more in this video about Nader's vision for transforming learning and how he relied on creativity to make it happen.

Source: www.youtube.com/watch?v=NU1eUtryhMo

PART 7**Leaving It Better Than We Found It!**

- Have Scouts help clean up the supplies, and make sure all of the markers are capped.
- Throw away any trash.
- Power off the Ozobots and place them back in the case.
- Store the color code sheets safely for the next meeting.
- Make any needed announcements.



Key Words

- ROBOTIC SENSORS:** *Used by a robot to identify its position in its environment and to recognize what tasks to perform and when to do so.*



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- PROXIMITY:** *How close one object is to another object.*



- **DATA COLLECTION:** *The process of gathering, recording, and measuring information like the traits the teams discussed in this meeting.*

- **VENN DIAGRAM:** *A diagram that is used to organize elements of data and show all possible relationships between the elements.*



MEETING PREVIEW AND SETUP	
Meeting 3: Once Upon a Time	STEM Focus: Coding
<p>After this meeting, Scouts will be able to</p> <ul style="list-style-type: none"> • Understand the three main parts of a story and decide how they all fit together • Develop their own short story that includes the main elements of a plot 	
<p>Scout Law Character Focus Cheerful</p>	
<p>Total Meeting Time 80–90 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p><u>Activity Prep</u></p> <ul style="list-style-type: none"> • Charge all Ozobots for ONE HOUR prior to meeting. • Collect supplies for the meeting. • Cut out story cards on page 47 of this guide. • Check to make sure markers have not run out of ink between meetings. • Scout Notebook: Meeting 3 (one per team) <p><u>Space Needed</u> Large table or floor space</p> <p><u>Teams of Three</u> OPTIONAL: In each team, there will be three roles—have teams decide who will do each role before the lesson begins:</p> <p>Project Manager—Gathers and manages all materials for the team. Oversees the overall success of the project.</p> <p>Principal Investigator—Leads observation and documents findings in Scout Notebook.</p> <p>Co-Principal Investigator—Assists the Principal Investigator and helps with materials.</p>



<p>Materials from Kit Per Team</p> <ul style="list-style-type: none"> • 1 Ozobot robot • 1 set of Ozobot markers • 5 sheets of 11×14 paper • 1 Ozobot color code sheet • 1 roll of tape • 1 pair of scissors • Sheets of scrap paper as needed • Calibration cards • Printed page with 2 squares (Scouts will cut out) 	<p>Materials Needed But NOT Included in Kit NONE</p> <hr/> <p>Lab Leaders Optional Notes Section <i>(This section is for YOU! List notes, reminders, and/or responsibilities and roles of the Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!)</i></p>
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MEETING PLAN

Meeting 3: Once Upon a Time

STEM Focus: Coding

Activity Overview

Scouts will explore the three main parts of a story (exposition, climax, and resolution). They will then work in teams to write a short story that includes the three main parts, a theme, and main characters for their Ozobot to travel through by reading various color codes throughout.

PART 1

Introduction/Background Information

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

- What is the language that the Ozobot understands best? *(Color codes. It can also see lines and blocks.)*
- The Ozobot can do a lot of different things, like turbo mode, spin, zigzag, and a lot more. Which one of these is its coolest ability in your opinion? Why? *(Answers to this question will vary.)*
- Today we are going to have our Ozobot read a story that we will write, and we will code the Ozobot to act it out as the main character! But first, we have to write our story!
- In every story, there are three main parts. Does anyone know what they are? *(Beginning, middle, and end.)*
- The beginning of a story is called the **exposition**, the middle is called the **climax** (this is where a particular conflict has to happen), and the end is called the **resolution** (this is when the conflict is resolved).
- After you have written your story, you are going to choose color codes that will express what the Ozobot feels or would do in that part of the story. For example, if the Ozobot needs to run from a mean dinosaur, maybe you can use a color code spin and then a U-turn so that it runs in the other direction!
- How could you use the different colors of the Ozobot’s lights to tell a story? *(The different colored lights could represent different parts of the story or emotions of the Ozobot: conflict, climax, resolution.)*

Have a Scout volunteer to tell a story with an Ozobot and a sheet of paper:

- Starting in any corner, have the Scout write “Once upon a time.” In the next corner, have them write “exposition,” in the next corner “climax,” and in the last corner “resolution.”
- Have the Scout add color codes to the “exposition,” “climax,” and “resolution” corners.
- No U-turns—the Ozobot must continue to travel forward through the plot.
- Now have the Scout draw thick, black lines to connect the color codes and corners.

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- Explain to the Lab that, after each team writes their story, they are going to code their Ozobot to travel to each corner.
- When the Ozobot reaches each corner, it must find a color code that represents what to do or feel at that point in the story.
- Share the following story:
 - Once upon a time ... (first corner)
 - Ozobot and his best friend, Nemo, decided to go for a swim (exposition corner)
 - But they ran into dangerous, BIG, hungry sharks (climax corner)
 - So, they started repeating the phrase, “Fish are friends, NOT food!” and the sharks agreed, and swam away (resolution corner)
- Have the Scout turn on an Ozobot and place it in the “Once upon a time” corner. Read through the story again as the Ozobot travels through the page and acts it out. Keep in mind that the Ozobot may need to be calibrated before beginning to travel on the line.
- *For this meeting, the Ozobot can be calibrated using the black dot in the kit. Start by holding down the Ozobot’s power button for two seconds (until the light flashes white). Quickly place the Ozobot in the middle of the black dot. It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.*
- Now let’s tell our stories!

PART 2

Discuss the Scout’s Law Character Point

Today we are focusing on the character point **Cheerful**.

For today’s meeting, how can we practice being Cheerful? What can we do?

PART 3

Safety Moment

- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful of where your Ozobots are. Do not knock them off the table or step on them.
- Try to keep liquids away from the Ozobots since they could be damaged if they get wet.
- Be careful when using scissors and when handing them to others.



PART 4

Activity Steps

Scouts will follow the procedures below in their Scout Notebook.

Materials—1 Ozobot, 1 set of Ozobot markers, 5 large sheets of graph paper, 1 Ozobot color code sheet, 1 roll of tape, 1 pair of scissors, scrap paper as needed, calibration cards

In every story, there is a theme. The theme is the main idea or main message that the story tells. Some common themes of stories are love, friendship, adventure, revenge, honesty, compassion, and courage.

Stories also have different parts or stages.

What are the three main pieces of a story called?

Beginning

Middle

End

Your Story

Write your own short story and then add color codes so that your Ozobot can act the story out as the main character or a supporting character.

- Pull one “character” card and one “place” card from your Lab Leader. Your team must include this character and place in your story.
- Your Ozobot can either act out the story as the character you pulled, or it can be a supporting character in the story with the character you pulled.
- Choose a theme for your story.
- Take 10 minutes to write your story following the table below.

Our Theme: _____

Our Characters: _____

Our Place: _____

Our Story Plot

Beginning: How does the story start? (Who, where, when, what happens)

Middle: What is the conflict of your story? How did it start?

End: How does the conflict get solved?



Designing Your Ozobot Skin

Materials: Scissors, markers, and the small blank square cut out from the kit (This will be your Ozobot’s “skin.”)

Skin Design:

- Using the markers, decorate your Ozobot skin however you’d like it to appear in your story—like a costume!
- Attach your “skin” to the Ozobot with a small piece of tape. (Be sure it doesn’t cover the sensors on the bottom.)



Story Color Codes

Materials: 1 sheet of paper, Ozobot markers

- In each corner of a sheet of paper, write out the following:
 - Corner 1: Blank—This is where the Ozobot will start.
 - Corner 2: Exposition—the beginning of your story
 - Corner 3: Climax—the major conflict of your story
 - Corner 4: Resolution—the ending of your story, where the conflict is resolved
- Use the markers to create black lines that will get the Ozobot to travel from one corner to another.
- In each corner, add a color code that you want the Ozobot to perform once it reaches that part of your story! Perhaps “snail dose” in your exposition or “tornado” during your conflict:



- Read your story out loud to the entire lab as your Ozobot travels to each part of the story and performs its color code!
 Keep in mind that the Ozobot may need to be calibrated before beginning to travel on the line.

For this meeting, the Ozobot can be calibrated using the black dot in the kit. Start by holding down the Ozobot’s power button for two seconds (until the light flashes white). Quickly place the Ozobot in the middle of the black dot. It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.

Activity Adaptations for Scouts, as Needed

If Scouts finish early ...
 Add another circle!

- Have each team pull another character and/or place card to add a plot twist in their story!

If Scouts are too challenged ...

- Have them code “snail dose” for their exposition, “tornado” for their conflict, and “zigzag” to celebrate their resolution.



PART 5

Circle Up for Reflection Questions

- What are the three main parts of a story? (*Exposition, climax, resolution.*)
- If you could do it again, what would you do differently in your story?
- Why do you think it's good for stories to have a conflict? (*To keep the audience engaged and rooting for the characters to succeed. Like in Black Panther!*)



PART 6

STEM Innovator Moment: The Laundroid

There have been some advanced robots invented over the last few years that are able to help families with chores around the house—for example, the Roomba vacuum is an advancement in robotics!

During this lab, you made a little something for your Ozobot to wear. But what if a robot could not only wear clothes, but also help you sort them and put them away? Well, that might not be as crazy as you think.

The Laundroid robot uses multiple robotic arms to pick up clothes, which are then scanned by its cameras. The robot is connected by Wi-Fi to a server that uses artificial intelligence (machines that are able to think and make decisions) to analyze each piece of clothing and then determine the best way to handle it. Learn more about the Laundroid in the video below! (Start at 0:28.)

Source: www.youtube.com/watch?v=rl7iNRdTncQ

PART 7

Leaving It Better Than We Found It!

- Have Scouts help clean up supplies, and make sure all of the markers are capped.
- Power off the Ozobots, place them in the case, and store the color code sheets for the next meeting.
- Make any needed announcements.



Key Terms

Major pieces to a story:

- **THEME:** *The idea or main message of the story.*
- **EXPOSITION:** *The beginning of a story, the introduction.*
- **CLIMAX:** *Major conflict and turning point in the story. The conflict or major struggle is typically between the “good guy” and the “bad guy.”*
- **RESOLUTION:** *The conflict is solved and the story ends.*



Storyline Cards

Cut out the characters and places below and make two separate stacks. Scout teams will choose one card from the “character” stack and one from the “place” stack.

Each team must write a story that uses their character and place, while also having a beginning (exposition), middle (climax), and end (resolution).

Their Ozobot can either act out the team’s story as the character they pulled, or it can be a supporting character along with the character they pulled.

Characters

Mr. Incredible

SpongeBob

Iron Man

Places

ZOO

school cafeteria

mall



MEETING PREVIEW AND SETUP	
Meeting 4: 3-D Obstacles	STEM Focus: Engineering
<p>After this meeting, Scouts will be able to</p> <ul style="list-style-type: none"> • Design 3-D objects and learn how to construct structures with good engineering • Use their creativity and engineering knowledge while coding • Use color codes to get the Ozobot to travel through a course that is 3-D and 2-D 	
<p>Scout Law Character Focus Thrifty</p>	
<p>Total Meeting Time 80–90 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p>Activity Prep</p> <ul style="list-style-type: none"> • Charge all Ozobots for ONE HOUR prior to meeting. • Be sure markers have not run out of ink. • Turn off all Ozobots after charging. • Scout Notebook: Meeting 4 (one copy per team) • Read over the activity instructions to familiarize yourself with the experiment. • Collect materials used for this lab. <p>Space Needed Large table or floor space</p> <p>Teams of Three OPTIONAL: In each team, there will be three roles—have teams decide who will do each role before the lesson begins:</p> <p>Project Manager—Gathers and manages all materials for the team, and oversees the overall success of the project.</p> <p>Principal Investigator—Leads observation and documents findings in Scout Notebook.</p> <p>Co-Principal Investigator—Assists Principal Investigator and helps with materials.</p>



Junior Lab: Ozobots
Meeting 4: 3-D Obstacles



<p>Materials from Kit Per Team</p> <ul style="list-style-type: none">• 1 Ozobot robot• 1 set of Ozobot markers• 1 color code sheet• 1 roll of tape• 1 pair of scissors• 1 deck of cards• 6 chenille stems• 10 regular craft sticks• 10 sheets of paper• 10 Popsicle sticks• 1 measuring tape• Calibration cards	<p>Materials Needed But NOT Included in Kit</p> <p>None</p> <hr/> <p>Lab Leaders Optional Notes Section <i>This section is for YOU! List notes, reminders, and/or responsibilities and roles of the Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!</i></p>
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MEETING PLAN

Meeting 4: 3-D Obstacles

STEM Focus: Engineering

Activity Overview

Scouts will incorporate basic engineering techniques by designing simple structures out of various materials for their Ozobot to travel through and around. They will use lines and color codes to draw a course for their Ozobot to move through, including tunnels and other obstacles along the way. In the process, they'll also discover the principles of 3-D design and what it takes to engineer a sturdy structure.

PART 1

Introduction/Background Information

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

- This meeting is called 3-D Obstacles. Before we start, we all need to learn more about engineering and 3-D objects.
- What does **three-dimensional** mean? *(Any object that has length, width, and height. In other words, it's something that has volume or could come up off of a surface.)*
- What is the difference between a 2-D object and a 3-D object? *(A 2-D object is flat, whereas a 3-D object has depth and volume.)*
- **3-D design** is the process of using computer software to create a digital representation of any surface or object in three dimensions. The final product of a 3-D design is called a 3-D model. In 3-D design, the representation of an object uses three dimensions—length, width, and height—just like the tunnels you will be building soon.
- Let's look at some 2-D and 3-D objects!

Creating 3-D Tunnels (5–10 minutes): one sheet of paper per Scout

- Paper is a 2-D object, having both length and width. *(Show Scouts a flat sheet of paper.)*
- However, it can be changed into a 3-D object!
- A rectangular solid is a 3-D, geometric shape that has a base (the bottom surface) and five outer sides. We are going to create a 3-D solid object (though our design will be missing two sides—you'll see why later).
- First, we are going to engineer some 3-D tunnels to code our Ozobot through—like an obstacle course!





Building Tunnels: (5–10 minutes)

- Your team will now follow the steps in your Scout Notebook (“Obstacle Course Design—3-D Tunnels,” pages 21–22) to create a 3-D rectangular solid shape that you will then cut into three different pieces, using tape to hold the pieces together. This “tunnel” will be used later in the activity along with other objects the team will create.
- Now, let’s discuss how engineering will affect our activity and why engineers need to consider factors other than sizes and shapes when designing structures.
- Many people think that engineers need advanced computer skills, and that is true, but engineering has a lot of other components too.
- Architects who design buildings and automotive engineers who design cars also have to think about things like sustainability and eco-friendliness.
- **Sustainability** means that something can be used for a long time without needing to be replaced and that it does not use up many natural resources. If an engineer is designing a new bridge, what kind of materials would be sustainable? (*Steel and concrete. However, wood would not be as sustainable because it will start to rot over time and they would have to cut down trees.*)
- **Eco-friendliness** means that something is beneficial to the environment and helps keep it clean. If the same engineer was considering eco-friendliness, what kind of materials would be best to avoid? (*Steel is not as good for the environment as other materials.*)
- Another component engineers have to think about when designing a building or other structure is the **foundation**, which must be very strong and able to support the weight of everything being built on top of it.
- The foundation is the lowest portion of the structure. It’s also the point at which the structure transfers its weight, or load, to the earth.
- What part of a structure is the most important, and why? (*The foundation, because it is the strongest part of the structure and holds up everything above it. Everything has a foundation, including buildings, telephone poles, and even our bodies—our feet!*)
- The foundation of a building often extends vertically underground so that it has more support (sometimes quite deep underground if is the structure has a lot of weight to be supported).
- When engineers build a tunnel underground, they have to be sure there is plenty of support on the sides and the top of the tunnel to prevent it from collapsing under the weight above. Your tunnels won’t be underground, but you will build more 3-D structures later in this lab, and you will need to make sure their foundations are strong by attaching them to your surface securely.



- How will we be similar to engineers as we design and build our 3-D obstacle course? Think about things like structure, speed, complexity, and materials. When it comes to speed, engineers are often under pressure to get a structure built before it will be needed—for example, before weather in the area gets bad. Also, they could be creating cars that need to be able to move fast, which is another way speed could come into play when they're building something.

PART 2**Discuss the Scout's Law Character Point**

Today we are focusing on the character point **Thrifty**.

For today's meeting, how can we practice being Thrifty? What can we do?

PART 3**Safety Moment**

- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful of where your Ozobots are. Do not knock them off the table or step on them.
- Try to keep liquids away from the Ozobots since they could be damaged if they get wet.
- Be careful when using scissors and when handing them to others.

PART 4**Activity Steps****LEADER NOTE:**

- Give Scouts 30–45 minutes to design their obstacle course.
- When time is up, or when all teams have finished their design and tested their course, have each team talk about their 3-D design, the challenges they faced, and what successes they had. Then, one at a time, have each team test their course with their Ozobot!
- Keep in mind that the Ozobot may need to be calibrated before beginning to travel on the line.

For this meeting, the Ozobot can be calibrated using the black dot in the kit. Start by holding down the Ozobot's power button for two seconds (until the light flashes white). Quickly place the Ozobot in the middle of the black dot. It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.



Have Scouts get into groups of three and follow the procedures below in their Scout Notebook.

What is 3-D Design?

Obstacle Course Design—Tunnels

Your team will design and engineer a 3-D obstacle course for your Ozobot to travel through.

Materials: 1 sheet of paper per Scout

1. Fold your sheet of paper along the short edge about 1½ inches toward the center (Figure 1).



Figure 1

2. Keep folding down 1½ inches at a time until all of the paper is folded (about five folds; Figure 2).



Figure 2

3. Unfold, and you should have six sections (Figure 3).



Figure 3

4. Fold and shape the paper to create a 3-D rectangle. Connect the ends with small pieces of tape so that the tunnel stays together. Some folds will overlap (Figure 4).



Figure 4

5. Cut the 3-D rectangle into three equal sizes by flattening and cutting (Figure 5).

Figure 5

6. Each Scout in the team should choose one piece to contribute to the course.

7. Secure the three 3-D shapes with small pieces of tape as needed to keep them in place. Remember to use small pieces of tape (Figure 6).



Come back to the Lab Leader to discuss sustainability, eco-friendliness, and engineering.



Adding Speed Codes to Tunnels

As a team, choose **THREE** color codes to use in your tunnels.

- Choose two **Speed codes**.
- Choose one **Cool Moves code**.
- Draw each color code on the inside of the tunnels in the middle. Draw the codes where there is no tape. (Figure 6).
- Check off your codes in the boxes below when they have been drawn on the inside.

Speed Code 1

Speed Code 2

Cool Moves Code

- Now, draw black lines from each end of the code inside each tunnel so that the lines reach both edges of the tunnel.



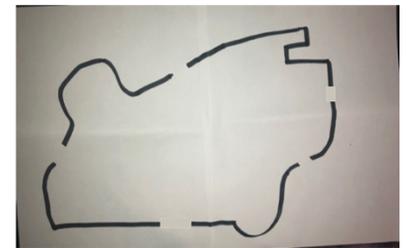
Figure 6

Obstacle Course Design

You will be designing an obstacle course for your Ozobot to drive through, using black lines and leaving space for obstacles. The pictures below are examples—you can make your course any shape you want.

Materials: Ozobot, Ozobot markers, 10 sheets of paper, Ozobot color code sheet, tape

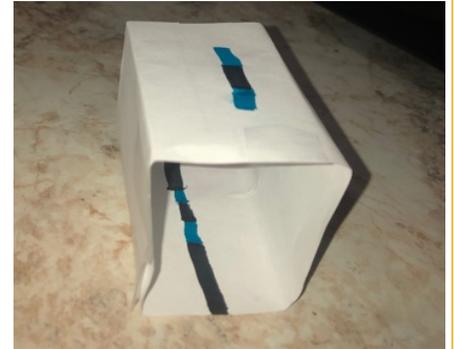
1. Tape four large pieces of paper together on one side.
2. After connecting them with tape, flip the combined sheets of paper over.
3. **Principle Investigator:** Use the black marker to draw a course that covers most of the paper on the side without the tape.
4. Course requirements:
 - The example at right shows five blank spaces. Be sure to leave five blanks in your course as well. Three of them will be for tunnels and the other two will have a different purpose.
 - Draw the lines of your course thick and dark.
 - Draw all the way around the paper—back to where you started.
 - You can draw your course in any shape you'd like as long as it is different from this example, and be sure to leave **FIVE** blanks.



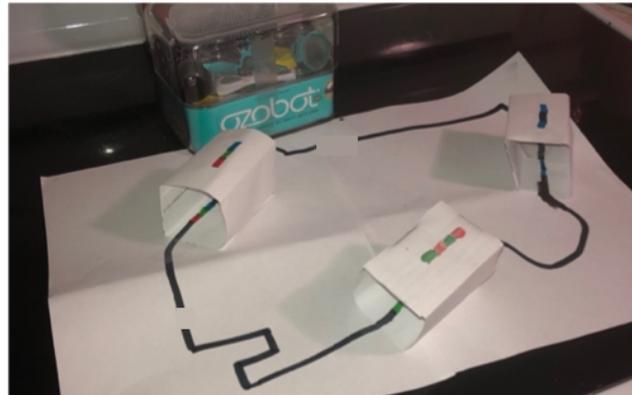


- Now, each of you should draw the same color code you drew on the inside of the tunnel on the top of the same tunnel (in the middle). This will help you remember which code you used on the inside!
- Check off your codes in the boxes below when they have been drawn on the top.

<input type="checkbox"/>	Speed Code 1
<input type="checkbox"/>	Speed Code 2
<input type="checkbox"/>	Cool Moves Code



- Make any touch-ups to the black lines before taping the tunnels to the paper because the marker will not write well on tape.
- Tape your three tunnels in place. Try to make the tape you use as flat and as smooth as possible.
 - Here is an example of what your course could look like with the three tunnels included.



Obstacle Design—Tower

Materials: 1 Ozobot robot, 1 roll of tape, 1 pair of scissors, 1 deck of cards, 5 Popsicle sticks, 1 measuring tape, 3 chenille stems, 5 craft sticks

*The **foundation** of a structure is the most important part! The foundation is the strongest part because it must bear the weight of the entire building or structure. You and your team will now make an additional obstacle to add to your course—a tower!*

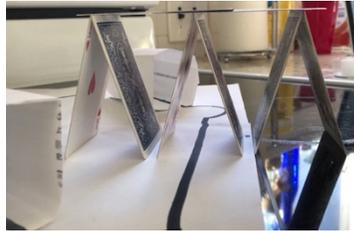
- Build a tower that is at least 6 inches tall. You can build it out of any materials you want. Be sure to think about the foundation!
- Place your tower obstacle on your course over one of the remaining blank spaces, and continue the black line so that it goes AROUND the obstacle and reconnects with your course on the other side of the obstacle.
- Tape the obstacle to your paper so that it stays in place.



Obstacle Design—Another Tunnel

Materials: 1 deck of cards, 1 roll of tape, 1 pair of scissors, 5 Popsicle sticks, 3 chenille stems, 5 craft sticks, and 1 set of Ozobot markers

1. Start by drawing a color code in the only remaining blank space on your course.
 - Pick a code that won't get the Ozobot to turn around or veer off the course.
2. Build another tunnel (any kind) out of your materials and place it over the color code you added.
 - Here is an example using the deck of cards.



Before sending the Ozobot through the course, keep in mind that it may need to be calibrated. For this meeting, the Ozobot can be calibrated using the black dot in the kit. Start by holding down the Ozobot's power button for two seconds (until the light flashes white). Quickly place the Ozobot in the middle of the black dot. It will move forward and blink green to indicate it has been successfully calibrated. If it blinks red, start this process over.

3. Complete at least TWO test runs before your Lab Leader calls all the teams together.
 - If the Ozobot runs into any difficulty before making it all the way around, you can make adjustments to your obstacles.

Activity Adaptations for Scouts, as Needed

If Scouts finish early ...

Add more obstacles!

- Have Scouts see how many additional sturdy structures they can build for the Ozobot to travel under using the cards or other supplies.
- They can add more color codes by drawing a color code on a small piece of paper and taping it over the black line anywhere in their course.

If Scouts are too challenged ...

- Have them use only one or two simple structures: a paper rectangular solid as demonstrated in the beginning and two parallel chenille stems to travel through like a track!

**PART 5****Circle Up for Reflection Questions**

- Was it harder to design this Ozobot course than the ones you created in the first three meetings? If so, what things made it more difficult? Did the use of 3-D objects change the way you designed the course?
- You created a rectangular solid to use as your 3-D structure. Did it work well? Why or why not?
- Engineers always rely on carefulness when they're constructing things like buildings and bridges. How did you practice carefulness during the construction of your designs?

PART 6**STEM Innovator Moment: Marc Raibert**

You might not realize it, but buildings and bridges aren't the only things that engineers are responsible for creating. There are all kinds of engineers, including software, mechanical, and chemical engineers.

There are also engineers that build robots like the Ozobot, and other robots that are a lot bigger and much more powerful. One of those engineers is Marc Raibert, a member of the team that designed and built a robot dog. This robot has four legs like a dog, but it is able to do things that most real dogs could never do—like open doors.

Marc's robot is considered one of the most advanced service robots today because it is capable of doing so much while also running smoothly. Marc has his engineering skills to thank for that!

Watch the video below at home to learn more about Marc's project, the BigDog robot.

Source: <https://www.youtube.com/watch?v=Gy5TcqSFdMw>

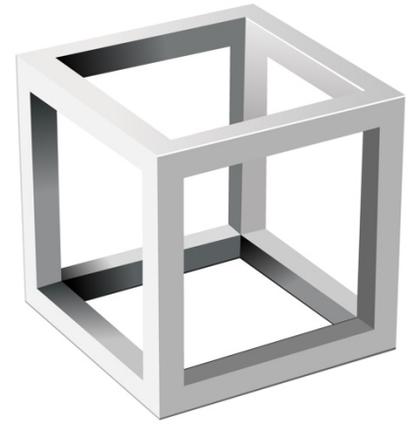
PART 7**Leaving It Better Than We Found It!**

- Have Scouts help clean up supplies, and make sure all of the markers are capped.
- Throw away any trash, including small paper scraps.
- Try to be sure all cards are returned to the box. You can give the cards to families or save them for playing a card game in the future.
- Power off the Ozobots and place them back in the case.
- Store the color code sheets safely for the next meeting.
- Make any needed announcements.



Key Terms

- **3-D DESIGN:** *The process of developing geometric shapes in three dimensions. This can be done in the physical world (like you did) or in the digital world using computers.*



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- **ENGINEERING:** *The field that uses science and technology to design and build so many of the things we use, including houses, buildings, machines, and more. It's also the “E” in STEM Scouts!*
- **FOUNDATION:** *The lowest part of a building or structure—the part that needs to be the strongest because it bears the load of the entire structure.*



MEETING PREVIEW AND SETUP

Meeting 5: Light Up the House	STEM Focus: Block coding
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- After this meeting, Scouts will be able to**
- Create programs for the robot using Ozobot’s OzoBlockly programming software
 - Understand how to successfully create programs with multiple components
 - See how coding and program construction can get a robot from Point A to Point B

Scout Law Character Focus
 Obedient

<p>Total Meeting Time 80–90 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p>Activity Prep</p> <ul style="list-style-type: none"> • Charge all Ozobots AND laptops for ONE HOUR prior to meeting and turn Ozobots off after charging. • Check for Wi-Fi connection. • Be sure markers have not run out of ink. • Read over the activity instructions to familiarize yourself with the experiment. • Watch this two-minute video below about OzoBlockly: www.youtube.com/watch?time_continue=112&v=fwIrAzZfvRc • Open OzoBlockly and experiment with Levels 1, 2, and 3 to familiarize yourself with the blocks included in those levels. • Scout Notebook: Meeting 5 (one copy per team) • Pens or pencils for Scouts to use <p>Space Needed Large table space</p> <p>Teams of Three OPTIONAL: In each team, there will be three roles—have teams decide who will do each role before the lesson begins:</p> <p>Project Manager—Gathers and manages all materials for the team. Oversees the overall success of the project.</p> <p>Principal Investigator—Leads observation and documents findings in Scout Notebook.</p> <p>Co-Principal Investigator—Assists Principal Investigator and helps with materials.</p>
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<p>Materials from Kit Per Team</p> <ul style="list-style-type: none"> • 1 Ozobot robot • 1 set of Ozobot markers • 5 sheets of graph paper • 5 sheets of scrap paper • 1 pair of scissors • 2 pieces of tagboard • Calibration cards 	<p>Materials Needed But NOT Included in Kit</p> <ul style="list-style-type: none"> • Laptops (council-supplied)—1 per Scout team <ul style="list-style-type: none"> ○ https://youtu.be/fwIrAzZfvRc ○ www.ozoblockly.com • Pens or pencils—1 per Scout team
	<p>Lab Leaders Optional Notes Section <i>(This section is for YOU! List notes, reminders, and/or responsibilities and roles of the Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!)</i></p>



MEETING PLAN

Meeting 5: Light Up the House

STEM Focus: Block coding

Activity Overview

In this meeting, Scouts will take their Ozobot programming to the next level by incorporating Ozobot’s web-based programming environment, OzoBlockly. Scouts will draw the blueprint of a house with at least five rooms and then write a program that gets the Ozobot to travel to each room of the house and perform a cool move once it arrives!

PART 1

Introduction/Background Information

Move Scouts into their teams of three prior to the discussion.

They will follow along in their Scout Notebooks during the discussion to fill in the definitions for the key terms discussed.

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

- This meeting is called Light Up the House. Before we start, we all need to learn more about the Ozobot’s lights, architecture, and Blockly programming.
- Who remembers how the Ozobot is able to change the color of its light? *(The Ozobot has a color sensor as part of its hardware, which helps it to be able to see and distinguish between different colors. This sensor then relays that information to the Ozobot’s light, which can change colors. The Ozobot’s light always corresponds with the color it is driving over. When creating a program in OzoBlockly, you can control the colors of the Ozobot’s lights without it needing to be on a line or seeing color codes.)*
- Today, we are going to engineer a program that sends our Ozobot through a house that you will design on paper!
- Before we begin, who can tell me what a **blueprint** is? *(A detailed architectural plan that is followed when constructing something. It shows how a future structure like a house would look from above—in other words, the “bird’s eye view.”)*
- You will be creating something similar to a blueprint, but what you draw on graph paper will be the front view of your house, so you can show that it has multiple floors. A sketch of the front view of a house or another structure is often called the **“face.”**
- Architects use this term to indicate they are looking at the structure from the front, not from the top like a blueprint shows. The face view of a structure gives people looking at it more of a sense of how tall the structure is and which rooms are on which floor.



- So, as engineers and architects of your house, you will be creating the face by drawing out the rooms. Then you will create a program to get the Ozobot to visit each of the rooms. We are also doing a face view of our house to measure out the size of each of the five rooms we are going to build.
- This time, you won't be using color codes to engineer the program for your Ozobot. Instead, using OzoBlockly, you will create a program that gets your Ozobot to take a tour of the house you design!
- This is **computer programming!** It's the process of designing and building a program that a computer can interpret and use to complete a specific task.
- Today, we will be using something called **block coding**. Block coding is an introductory form of programming in which programs are created in an "online platform" by combining various types of blocks in various orders.
 - Block coding gives you access to blocks that correspond to the functions you need to include.
 - Blockly is a beginner language in which the blocks can easily lock together to represent all kinds of movements and light effects—in this case, for the Ozobot. Blockly can also work with more complex programming concepts like loops and variables.
- By using block coding to manipulate each block, you can create unique programs that can cause robots to move, light up, speak, and more.
- We will be building our program online in OzoBlockly. How will it help you to be able to look at the face of your house while you are creating your program? (*The face view of the house can show how far the Ozobot needs to move and when it needs to turn. This will help us make sure we are using codes that will get the Ozobot through the house and keep it on course.*)
- Today, instead of color codes, you will be using OzoBlockly to program the Ozobot. You already know some of the color codes the Ozobot can read and follow. What are some of the movements you might be able to program the Ozobot to do using Blockly? These can be some of the same movements you've seen (*slow down, speed up, tornado, turn left, turn right, etc.*) or new ones.
- How do you think this will be different from the programming you have previously done with the Ozobot? (*Creating programs digitally, creating longer programs, or creating programs that are more complex.*)
- Now, let's explore OzoBlockly!



Demonstration: Introduction to OzoBlockly (laptop needed; 5–10 minutes)

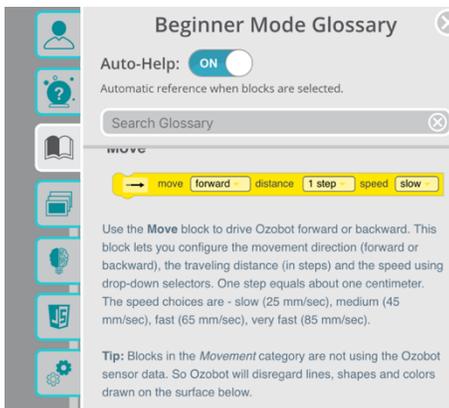
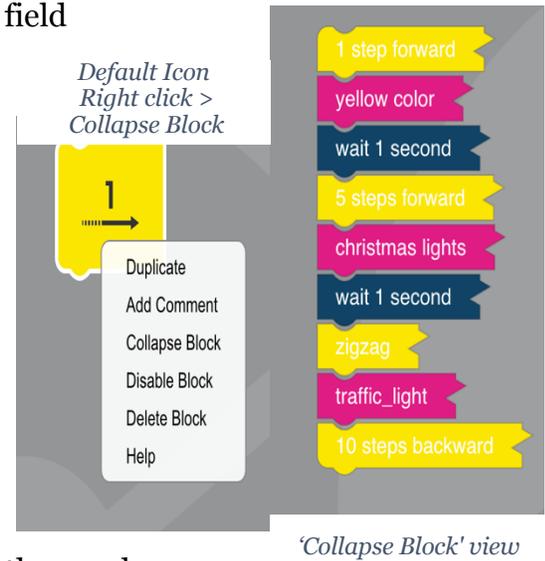
Part I—Show Scouts the following video:

www.youtube.com/watch?time_continue=112&v=fwIrAzZfvRc

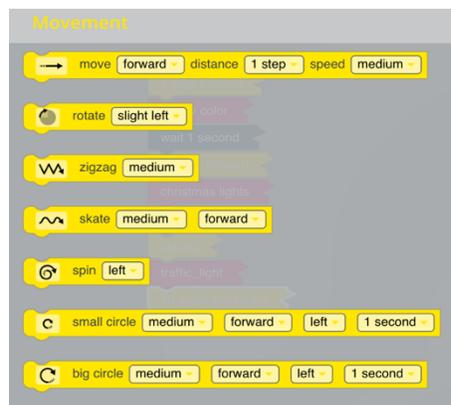
- There are five levels of OzoBlockly, referred to by numbers 1 through 5: Pre-reader, Beginner, Intermediate, Advanced, and Master.
- For this meeting, you will mostly be using Level 1 (Pre-reader) and Level 2 (Beginner).

Part II—Have all the Scouts learn together by leading a demonstration of the following:

- How to drag blocks from the menu into the programming field
- How the blocks connect to each other
- How to change icon displays to text display (right click)
- Where to find useful terms before you start programming (on the far-right side of the screen)
- Be sure Scouts are aware of all the different options they can use as part of programming with OzoBlockly. These include movements like rotate, zigzag, skate, spin, stop, and more. They can also control the Ozobot’s lights, its pauses, and its loops, which tell the Ozobot how many times to run a certain program.
- Have Scouts take note of how far one step is to the Ozobot. That way, they will know how far one step can take their Ozobot as they code it through their house. (On the graph paper, 10 steps will get it about 3½ inches, or 14 squares.)



Glossary



Movement options



Calibrating and loading the program

Now, have Scouts follow the steps on page 28 to practice building their own short program in OzoBlockly. (10 minutes)



After about 10 minutes, bring the Scouts back together for you to demonstrate how to calibrate the Ozobot to load their programs.

Part III—Calibrating Ozobot and loading program instructions:

Scouts will practice calibrating the Ozobot before beginning the activity. Use these instructions to guide them through the calibration and program loading processes.

- After their program is built, set the computer’s brightness to the maximum level. Have the Scouts click the “FLASHING” button in the bottom left of the OzoBlockly screen.
- Hold the Ozobot’s power button down for two seconds, wait for it to blink WHITE, then release the button.
- While the Ozobot continues to blink, quickly place it against the white spot on the screen.
- When the calibration is complete, the Ozobot will blink GREEN and then turn off.
- Have the Scouts turn the Ozobot back on. They should do this by pressing the power button once, then immediately pressing the Ozobot up against the bot outline to the right of the calibration circle on the screen.
- Click the “Load Bit” button, and the Ozobot’s lights will begin to flash. You will see a status bar indicating how much of the program has been uploaded to the robot. Keep it pressed to the screen the entire time the program is loading.
- Once the light goes off, have the Scouts pick up the robot and double tap the power button to activate the program.
- Place the robot on the table, and the sample program should run!



- It’s important to begin a program with the “10 steps forward” block. Why do you think that is? *(If we didn’t, the Ozobot’s first action would be lighting up or waiting. It’s better for the first action of the program to be a movement.)*
- To practice calibrating, have the Scouts now load and calibrate their short programs onto their Ozobots.
- Now that we have gotten to know OzoBlockly, you will create your blueprint and then build a program to get your Ozobot through your house.



PART 2

Discuss the Scout's Law Character Point

Today we are focusing on the character point **Obedient**.

For today's meeting, how can we practice being Obedient? What can we do?

PART 3

Safety Moment

- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful of where your Ozobots are. Do not knock them off the table or step on them.
- Also, be aware of where your computers are and be careful not to knock them over.
- Keep liquids away from the Ozobots and computers since they could be damaged if they get wet.

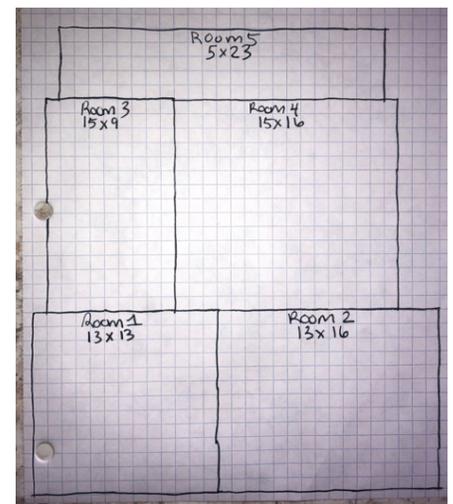
PART 4

Activity Steps

Have Scouts get into groups of three and follow the procedures below in their Scout Notebook.

Materials—1 Ozobot, 1 set of Ozobot markers, 5 sheets of graph paper, 1 Ozobot color code sheet, 1 roll of tape, 1 pair of scissors, 2 pieces of tagboard

1. Your house will have FIVE rooms. You must give each room a title and write a short description of it:
 - **Two** of your rooms must have an *animal* theme. Which animals live there? What type of habitat is in each room?
 - **One** room must have a *healthy living* theme. What is your favorite exercise, sport, vegetable, fruit, or healthy meal?
 - **One** other room must have a *movie* theme. Which movie and characters are there?
 - The **last** can be whatever you want. Get creative!





Room Areas (vertical × horizontal):

The picture above right represents the “face” of your house. Pretend you are standing across the street from your house and looking at it straight on. Rooms 1 and 2 are the bottom floor and Room 5 is the top (this room is optional).

First Floor:

- Room 1: 13 × 13 blocks
- Room 2: 13 × 16 blocks

Second Floor:

- Room 3: 15 × 9 blocks
- Room 4: 15 × 16 blocks

Optional—The Attic:

- Room 5: 5 × 23 blocks

1. Use the black marker to carefully draw each room on the graph paper according to the dimension requirements listed above. Start with Room 1 in the bottom left corner.
2. When drawing the second floor, begin slightly more toward the center of the house as shown in the picture above.

Activity Tip

You will be using the Level 1 movement blocks a lot in this meeting. The numbers on the blocks represent how many steps the Ozobot will move. Use the “distance chart” below to help you program your Ozobot:

Step Blocks	Distance Traveled	Graph Paper Distance
5-Step	1¾ inches	About 7 graph squares
10-Step	3½ inches	About 14 graph squares



Writing the Program

- Go online to www.ozoblockly.com.
- Click “Get Started.”
- Follow the steps below to build your program using the blocks.

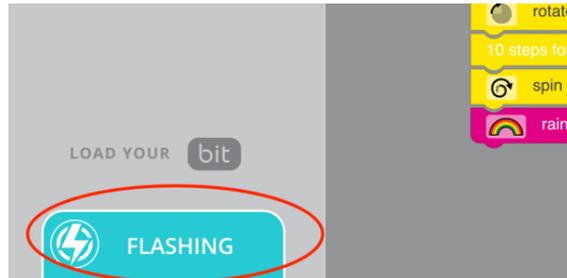
If Scouts would like, they can click the “Start Tutorial” button that pops up to watch the tutorial again. If not, they can “X” out of this pop-up and start with the following:

1. Add a block(s) that will get the Ozobot to move, and collapse it if necessary.
2. Add the light effect from Level 2, “police car lights,” and the Ozobot will flash red and blue lights when it’s in Room 1.
3. The Ozobot will need to turn to the right to go toward Room 2, so you’ll need to add a block that will turn the Ozobot in that direction.
4. Now, add two more blocks that will start the Ozobot driving toward Room 2. Connect them to the other blocks.
5. When you have finished Step 4, add the animation “firework” from the Level 2 light effects.
6. Now, add a block to get the Ozobot to turn to the left so that it can head “upstairs” to Room 4 (because it’s right above Room 2).
7. Add your next movement blocks to drive to Room 4, and then add the animation “disco” from the Level 2 light effects.
8. Now add a rotate block that gets the Ozobot to turn to the right, facing Room 3.
9. Add in two more movement blocks. Figure out which size each block should be for the Ozobot to drive to Room 3.
10. Once you’re in Room 3, add a “set top light color” block and set the color to light blue.
11. Add a block to get the Ozobot to turn toward the right, facing “upward” to Room 5, and then add a final movement block. Room 5 is optional.
12. This should bring your Ozobot to Room 5. It’s time to celebrate! Find the “spin” block, add it, and set the direction.
13. Now add your final light effect block, “rainbow,” and drag it to the bottom of your program.

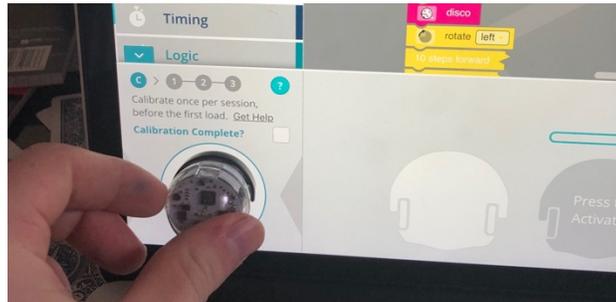


Your program is now complete! It should be able to get the Ozobot to each room of the house you drew.

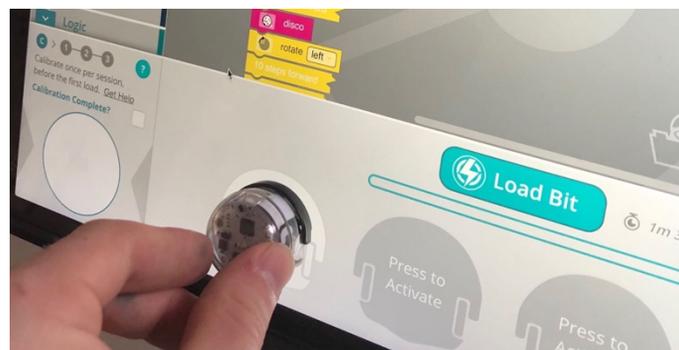
1. Once your program is finalized, click on the blue button in the bottom left of the OzoBlockly screen that says “FLASHING.” This is how you will calibrate the robot and load the program onto it.



2. Turn the brightness on your computer all the way up, then press and hold the Ozobot’s power button for two seconds. It should light up white. When that happens, let go of the button and immediately place the Ozobot over the white calibration circle on the screen.



3. Once the Ozobot is calibrated, it will blink green and then turn off. Turn it back on by pressing the power button once, and hold it up against the white Ozobot outline on the screen.



4. Click the “Load Bit” button to load your program onto the Ozobot. The Ozobot will flicker green to indicate the program is loading, and you will see the status bar indicate how much it has left to go. This program will take about 90 seconds to load onto the Ozobot.



IMPORTANT: The Scout who presses the Ozobot to the screen will need to be careful not to move it. Keep the Ozobot still and pressed to the screen the entire time the program is transferring. If the Ozobot's light turns from green to red during this process, something has gone wrong. If that happens, take the Ozobot away from the screen, turn it off, turn it on, calibrate it again, turn it back on, and load the program again.

- Once the program is transferred to the Ozobot, it is ready to run! Before your team sends the Ozobot through the house, share with the rest of the Lab the names of the rooms you created and why you chose those names.

Now it's time to see if your program works!

- Turn the Ozobot on by pressing the power button once. Then, double press the Ozobot's power button and place the robot slightly off the paper so that it moves toward Room 1. If necessary, tape the paper to your desk to make the surface as flat as possible and to avoid a bump when the Ozobot moves from the table onto the paper.



- The Ozobot should then do all the steps in the program and make its way through all the rooms of the house!

If something goes wrong and the Ozobot doesn't reach each room, go back, recount the squares on the graph paper, and measure the distance to see what to add or take out of your program. *Remember to check the distance chart on page 31.*

Use the coding tips on pages 77–79 of this guide as reference to help Scouts as needed!

Activity Adaptations for Scouts, as Needed

If Scouts finish early ...

Calculate the area in each room.

- Have Scouts open a calculator on their computer and calculate the area of each room in their house by multiplying the length times the width ($l \times w$). The dimensions of each room can be found under **Room Areas** in this activity (page 29 of the Scout Notebook).
- Add more rooms!
- They can then return to OzoBlockly to make their program longer, and even change some the Ozobot's actions if they would like! For example, they could switch to other light effects or swap out the movement blocks with some different options, like zigzag.

If Scouts are too challenged ...

- They could draw a two-bedroom house and create a simpler program using only Level 1 on OzoBlockly. *This would also eliminate the need to change the programming blocks from icon-based to text-based (they would not have to right click each block and collapse it after bringing it into the programming field). After they create their two-bedroom house and program, Scouts will be ready to follow the directions under "Calibrate and Load Program!" on page 33 of the Scout Notebook.*



PART 5

Circle Up for Reflection Questions

- How did you feel while coding your Ozobot through the house? What challenges did you face?
- What are the benefits of having a diagram, such as a blueprint or a face view, to look at when you're building something like an obstacle course or a computer program?
- How was the programming in this meeting more advanced than what you did before with your Ozobot? (*This time, Scouts created computer programs that directly controlled the movements and actions of the robot.*)

PART 6

STEM Innovator Moment: Neil Fraser

Neil Fraser is credited with being the top contributor to the invention of the Blockly programming language. He based Blockly on a Google project that allowed people who were new to programming to create apps for Android phones. He wanted to create a language that beginners could use in a browser without having to install anything else on their computer.

Blockly blocks can now be used by students in many different types of projects, and various companies are creating their own Blockly experiences based on Neil's initial creation. One of those Blockly experiences, of course, is the OzoBlockly software you just used.

Blockly languages are continuing to be enhanced, and Neil says there could be a bunch of new features coming eventually, including real-time collaboration and even keyboard controls for blind users.

If time allows, use the laptop to show Scouts the video below.

Source: www.youtube.com/watch?v=OYTzXcOtsTs

PART 7

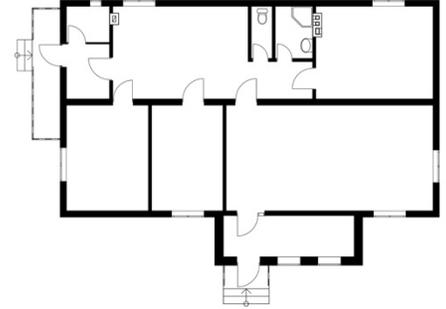
Leaving It Better Than We Found It!

- Have Scouts help clean up supplies, and make sure all of the markers are capped.
- Shut down all laptops and Ozobots, and be sure they are stored properly.
- Throw away any trash, including small paper scraps.
- Store color code sheets safely for the next meeting.
- Make any needed announcements.



Key Terms

- **BLUEPRINT:** *A design plan or technical map that engineers or builders follow when constructing something like a house. It often shows how a proposed structure would look from above, or the “bird’s eye view.”*
- **FACE:** *A sketch of the front view of a house or another structure.*



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- **COMPUTER PROGRAMMING:**

The process of designing and building a program that a computer can interpret and use to complete a specific task.

- **BLOCK CODING:** *An introductory form of programming in which programs are created in an “online platform” by combining various types of blocks in various orders.*



Tips for Coding the Ozobot Through the House

The Scouts will create their own program in OzoBlockly to code their Ozobot through their house.

However, feel free to use the instructions below to assist as needed.

NOTE: Do not present these tips to the whole Lab. They should be used only if a team gets stuck.

- Open OzoBlockly.
 1. Go online to www.ozoblockly.com.
 2. Click “Get Started.”
- Go to Level 1.
 1. Click on the Movement section.
 2. Add a 10-step block.
 3. Right click on it.
 4. Select “Collapse block.”



- Next, add the “police car lights” animation, which the Ozobot will do when it’s in Room 1.
 1. Go to Level 2.
 2. Select “Light Effects.”
 3. Select “police car lights.”
- Drag that block below the 10-step block and make sure they connect (see image below).



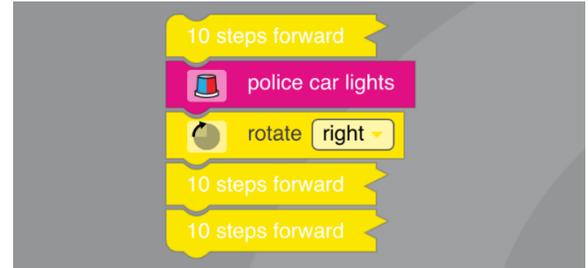
- Since the Ozobot needs to turn to the right to go toward Room 2, you’ll need to

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1. Add a rotate block from Level 3.
2. Click “Level 3.”
3. Click “Movement.”
4. Select the second rotate block.
5. Set the angle to “rotate right.”

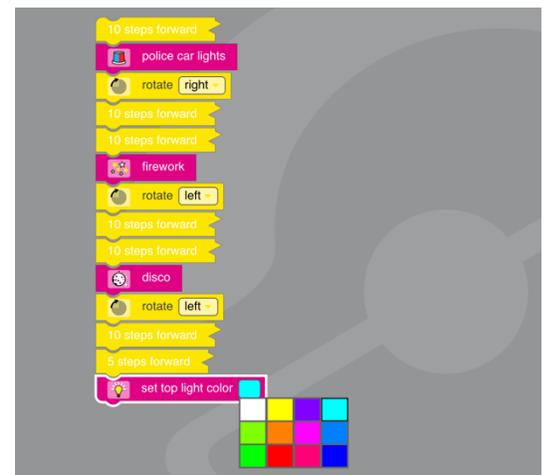
- Return to the Movement section of Level 1 and add two more 10-step blocks to follow the rotate block. Connect them to the other blocks.



- Add the next animation. Select “firework” from the Light Effects section in Level 2 and drag it to the bottom of the program.
- The Ozobot will need to turn left to get to room 4. From the Movement section of Level 3, select another rotate block and set the direction to left.



- Add two more 10-step movement blocks from Level 1 and collapse both of them. Then do the following:
 1. Add a “disco” light effects block from Level 2.
 2. Drag the disco block to the bottom of the program.
 3. Add another rotate block from the Movement section of Level 3.
 4. Drag this rotate block to the bottom of the program.
 5. Set the direction to left.



- Add in two more movement blocks from Level 1:



1. One 10-step block
 2. Then, one 5-step block
 3. Collapse both of these blocks.
- Open the Light Effects section in Level 3, and
 1. Add the “set top light color” block.
 2. Drag it to the bottom of the program.
 3. Click on the color field.
 4. Set it to light blue (see image at right).
 - Add a rotate block from Level 3 (Movement section). Set the direction to right. Then, add a final 10-step block from the Movement section of Level 1. Collapse it.
 - This should bring your Ozobot to Room 5 (optional), so have it celebrate! From Level 3:
 1. Select the “spin” movement block.
 2. Set the direction to right.
 3. Go to Level 3 and open Light Effects.
 4. Add your final block: “rainbow.”
 5. Drag it to the bottom of your program.

Your program is now complete, and it should look like the one to the below:





MEETING PREVIEW AND SETUP	
Meeting 6: Color Code Challenge	STEM Focus: Computational thinking
<p>After this meeting, Scouts will be able to</p> <ul style="list-style-type: none"> • Determine block codes to use based on color codes provided to them • Create a computer program using OzoBlockly that incorporates specific components • Discover new code blocks in OzoBlockly and learn how to use them in programs 	
<p>Scout Law Character Focus Brave</p>	
<p>Total Meeting Time 80–90 minutes</p> <p>Opening (Pledge, Oath, Law): 10 minutes</p> <p>Activity Introduction: 5–10 minutes</p> <p>Safety Moment: 1–2 minutes</p> <p>Activity: 45–55 minutes</p> <p>Reflection: 5–10 minutes</p> <p>STEM Innovator Moment: 2 minutes</p> <p>Announcements/Cleanup: 5–10 minutes</p>	<p style="text-align: center;">Meeting Prep Time: 60 minutes</p> <p>Activity Prep</p> <ul style="list-style-type: none"> • Charge all Ozobots AND laptops for ONE HOUR prior to meeting. • Turn off all Ozobots after charging to conserve the batteries. • Read over the activity instructions to familiarize yourself with the experiment. • Check for Wi-Fi connection in the meeting room, confirm that you know the password, and connect all laptops before the meeting begins. • Scout Notebook: Meeting 6 (one copy per team) • Collect supplies needed for this meeting. <p>Space Needed Large table space</p> <p>Teams of Three OPTIONAL: In each team, there will be three roles—have teams decide who will do each role before the lesson begins:</p> <p>Project Manager—Gathers and manages all materials for the team. Oversees overall success of the project.</p> <p>Principal Investigator—Leads observation and documents findings in Scout Notebook.</p> <p>Co-Principal Investigator—Assists Principal Investigator and helps with materials.</p>



<p>Materials from Kit Per Team</p> <ul style="list-style-type: none"> • 1 Ozobot robot • 1 Ozobot color code sheet • 5 large sheets of paper • Calibration cards 	<p>Materials Needed But NOT Included in Kit</p> <ul style="list-style-type: none"> • Laptops (council-supplied)—1 per Scout team • Pens or pencils (unit-supplied)—1 per Scout team
	<p>Lab Leaders Optional Notes Section <i>(This section is for YOU! List notes, reminders, and/or responsibilities and roles of the Scouts. You may also create a list of successes and challenges you experience during this activity and send it our way!)</i></p>



MEETING PLAN

Meeting 6: Color Code Challenge

STEM Focus: Computational thinking

Activity Overview

Scouts will work collaboratively as they decipher clues to reveal six color codes. Then they will look for similar codes in OzoBlockly to create a program for their Ozobot to perform. The Scouts will practice their computational thinking and problem-solving skills to decipher their codes as they explore more in OzoBlockly!

PART 1

Introduction/Background Information

Use the questions and background information below to engage Scouts. *(Typical answers are in italics.)*

- This meeting is called Color Code Challenge. Before we start, we are going to explore the different possibilities of the blocks you can use to create programs in OzoBlockly.
- To review, how would you describe block coding and OzoBlockly? *(Block coding is a simple and visual way to build code without typing it yourself. The blocks connect together and represent a coding program.)*
- There are hundreds of different blocks available in OzoBlockly, all with unique functions. They are represented by different colors and grouped in different categories based on the functions they can do.
- Even though the blocks look much different than the Ozobot’s color codes, they are still able to communicate messages to the Ozobot and control its actions.
- Remember, block coding is a visual way of building code. Rather than using complex tools and typing the code yourselves, OzoBlockly gives you blocks that correspond to the functions you need to include.
 - Blockly is a beginner language in which the blocks can easily lock together to represent all kinds of movements and light effects (in this case, for the Ozobot). Blockly can also work with more complex programming concepts like loops and variables.
- We know the movement blocks can be combined to create programs that tell the Ozobot to move. What else can these blocks do for the Ozobot? *(They can control its speed, how far it moves, how long it continues moving, the direction it moves, and special movements like zigzags and spins.)*
- If you wanted to get your Ozobot to travel fast to a specific place, what are some of the blocks you would include in your program? *(The 10-step block and the “Move” block with the direction set to “forward” and the speed set to “very fast.”)*



- Today, you will be given clues to tell you which blocks to use in the programs you’re going to build. But first, you’ll have to **decipher** the clues!
- What does **decipher** mean? (*It means converting words, phrases, or other clues that are written in code into normal, everyday language. In this case, you will be deciphering the color code combinations that appear in your Scout Notebook. Once the clues are deciphered, you’ll know which OzoBlockly blocks to use in your program.*)
- The codes you will be given won’t necessarily have a block that has the exact same name in OzoBlockly.
 - For example, you could be given the Snail Dose code of red-green-blue. There is no Snail Dose block in OzoBlockly, but there are blocks that can tell the Ozobot to move forward slowly: the Move block with the direction set to “forward” and the speed set to “slow.”
 - If the code is a “move” code, something similar will most likely be found in the Movement section of OzoBlockly. If the code is an “animation” code, something similar might be found in the Light Effects section.
 - And some codes might even be in Levels 4 and 5!
- First, you’ll want to look at the color codes you are given and decipher what they mean. Then look for a similar code in OzoBlockly. To do this, we are going to be practicing computational thinking.
- **Computational thinking** is a method used to solve a problem by making calculations and arriving at the best way of doing something. Computers do this all the time!
- The best way to use computational thinking is, first, to identify the problem. In this case, our problem is that the color codes we are given aren’t exactly the same as the blocks in OzoBlockly.
- Next, we want to find a pattern. In this case, we are going to look at our color codes and find a pattern or something similar that is present in OzoBlockly. Once we identify the similar blocks, we want to choose the block that fits BEST.
- Now we will use the block we’ve decided on as the best possible solution. And if something doesn’t go the way we thought, as computer scientists, we can look for other block solutions in OzoBlockly.

Demonstration—Deciphering a Color Code (laptop needed)

- Have a Scout volunteer try to decipher a color code.
- Use the red-black-red code below (the color code for “slow”). Say “red, black, red,” and tell the volunteer to look at their team’s color code sheet to find that code. Once the volunteer has found the correct color code on the sheet, have them find a block in OzoBlockly that would get the Ozobot to move slowly like the red-black-red color code.



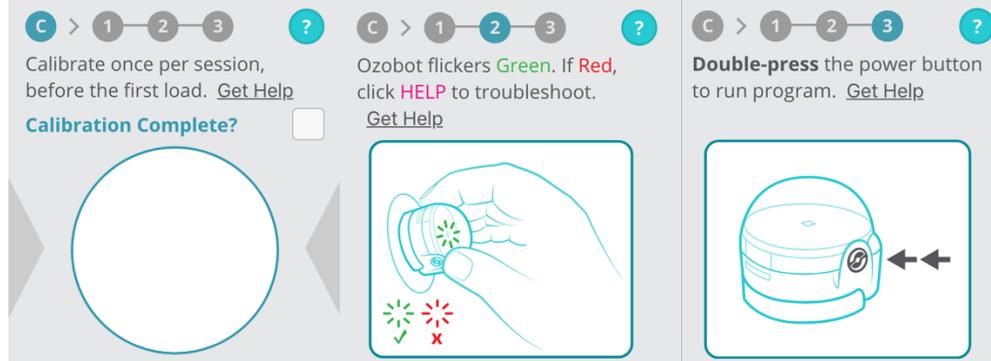


- Explain to the Scouts that this is the kind of computational thinking they will need to use throughout this lab.
- There are multiple ways in OzoBlockly to get the Ozobot to move forward at a slow speed. The first and third movement blocks in Level 3 and the fifth movement block in Level 4 will enable Scouts to create programs that get the Ozobot to move slowly.
- After the volunteer has chosen a block, tell the Lab that there are other blocks that would also work, and mention one of the alternative blocks. Then ask the volunteer: *Why did you choose the block you chose? Knowing that there are multiple blocks that could help you accomplish the same thing, do you think you picked the best one? Why or why not?*
- Now, have the volunteer clear the programming field, select the “move forward at speed” movement block in Level 4, and decide how many millimeters per second (mm/s) should be chosen to slow the Ozobot down. Show everyone how to change the variable in that field: Double click on the number that is there (30), type a new number, and then click on another part of the screen.
- Have the volunteer change the mm/s number to 5, and explain that this will tell the Ozobot to move much more slowly.

Reminder: How to Load and Calibrate the Ozobot

Give Scouts a reminder of how to transfer their programs from OzoBlockly to their Ozobot after they are done writing their program.

1. Click “FLASHING” on the OzoBlockly screen.
2. Turn the computer brightness all the way up.
3. Calibrate the Ozobot. (Turn it on, hold down the power button for two seconds, and place it on the white circle on the screen—it will then blink green and turn off.)
4. Turn it back on and place it over the white Ozobot outline on the screen.
5. Click the Load Bit button in OzoBlockly.
6. Keep the Ozobot pressed to the computer screen until the transfer is complete.
7. The white outline of the Ozobot on the screen will flash multiple colors and the Ozobot’s light will flash green and then stop.
8. Once the light turns off, the program has loaded. Turn the Ozobot back on by pressing the power button once.
9. Double press the power button to run the program.



Once this is done, tell the Lab: *Now you are going to follow the steps in your Scout Notebook to begin deciphering codes and practice your computational thinking!*

PART 2

Discuss the Scout's Law Character Point

Today we are focusing on the character point **Brave**.

For today's meeting, how can we practice being Brave? What can we do?

PART 3

Safety Moment

- Do NOT put any markers near your face, especially near your eyes or mouth.
- Be careful with your Ozobots and the computers. Do not knock them off the table or step on them.
- Keep liquids away from the Ozobots and the computers since they could be damaged if they get wet.

PART 4

Activity Steps

Scouts will follow the procedures below in their Scout Notebook.

When the Scouts get to Step 6, use the answer key provided on page 93 to check their block codes.

Materials—1 Ozobot, 5 large sheets of paper, 1 Ozobot color code sheet



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What does **decipher** mean?

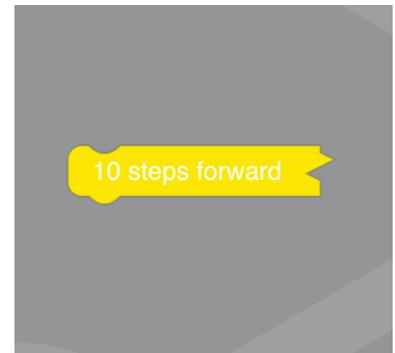


Computational thinking is a problem-solving method. Computational thinking includes identifying the problem, discovering any patterns, and determining the best possible solution.

1. Find these six color codes on your color code sheets and circle them.
 - Blue-black-green-red
 - Green-red-green-red
 - Blue-red-blue
 - Blue-green-blue
 - **Optional:** Red-blue-red
 - **Optional:** Red-green-black-blue
2. Open www.ozoblockly.com
3. Click “Get Started.” (“X” out of the pop-up.)
4. Explore to choose blocks that match each of the color codes that you circled.
 - **Remember**, the names will not be exact matches!
5. Write down all of the names of the blocks you choose to use on a sheet of paper.
6. When you’re done, check them with your Lab Leader.

Leader Note: Use the answer key on page 93 of the Leader Guide to check the Scouts’ work before they continue on to the next steps.

7. To start your program, use a 10-step movement block from Level 1 (pictured at right).
8. Then add the first action block that you chose from OzoBlockly.
9. Add another 10-step block.
10. Collapse the blocks so that it looks like the image to the right.
11. Repeat until all six blocks are added with 10-step movement blocks in between.



Now calibrate your Ozobot and upload your program! (Calibration steps are relisted on page 30 of the Scout notebook)

If Scouts get stuck in OzoBlockly, use the guide provided in the Answer Key for codes on page 93, and have them refer to the image of the completed program on page 95 to get an idea of what it should look like.



Junior Lab: Ozobots Meeting 6: Color Code Challenge



Activity Adaptations for Scouts, as Needed

If Scouts finish early ...

Challenge them to incorporate different kinds of blocks from OzoBlockly into their program. They can try “timing blocks” to tell the Ozobot to do one of the actions for a certain amount of time. Or they can include “loop blocks” to get their program to run forever!

If Scouts are too challenged ...

They can draw a course on paper using the markers and the original color codes rather than hunting for the corresponding blocks and creating a program. This will still help them see all the different movements the Ozobot can do through programming!

PART 5

Circle Up for Reflection Questions

- What was more challenging about creating this program than the OzoBlockly programs you created at the last meeting?

How did you and your teammates use computational thinking when you were building your program? (*Remember, you had to identify the problem, find the pattern, and choose the best possible solution.*)

- In these meetings, you got a simple start with color coding and eventually you were able to create a real computer program.
- As you have continued to learn, how do you feel about your ability to code?
- Coding takes a lot of dedication, patience, and practice, and it requires the ability to follow instructions. Why is this a good approach to take when you’re practicing coding—and even when you’re solving other kinds of problems?

**PART 6****STEM Innovator Moment: Hadi Partovi**

Hadi Partovi is an entrepreneur and the founder of Code.org, a non-profit that helps organize the annual Computer Science Education Week and Hour of Code. When Hadi was growing up in Iran, his schools never offered any kind of computer science classes, so he taught himself to code at home. He eventually moved to the United States and became a software engineer. Later, he earned a master's degree in computer science from Harvard University and went on to work for Microsoft before founding two start-ups and Code.org.

Now, Hadi is responsible for creating computer science opportunities for more than 100 million students and helps teachers learn how to teach these students.

Watch this video to learn more about Hadi and why he believes every single child should get to experience computer science.

Source: www.youtube.com/watch?v=GsaqBkLXtRE

PART 7**Leaving It Better Than We Found It!**

- Have Scouts help clean up supplies.
- Throw away any trash, including small paper scraps.
- Shut down all laptops and Ozobots, and be sure they are stored properly.
- Make any needed announcements.



Key Terms

- **DECIPHER:** *Converting words, phrases, or other clues that are written in code into normal, everyday language.*

- **COMPUTATIONAL THINKING:** *A method used to solve a problem by making calculations and arriving at the best way of doing something—the same way computers do things. Computational thinking includes identifying a problem, discovering any patterns, and determining the best solution.*



Answer Key for Six Codes

Color Code	OzoBlockly
<p>ZIGZAG</p>	<p>The zigzag block can be found in Levels 1, 2, and 3 and should be set to medium for the speed.</p>
<p>SPIN</p>	<p>The spin block can be found in Levels 1, 2, and 3 and can be set to left for the direction.</p>
<p>U TURN</p>	<p>The U-turn block can be found in all levels. In Level 1, it is the circle with the arrow going halfway around. In Levels 2 through 5, Scouts can create a U-turn by using two rotate blocks with both blocks set to have the Ozobot turn 90 degrees (180 degrees total).</p>
<p>TURBO</p>	<p>The turbo block is the second one in the top row of Level 1, with four arrows pointing to the right. In Levels 2 and 3, Scouts could use the block that says “move forward at ___ speed.” In Levels 4 and 5, they could use the block that says “move forward at speed ___” and set the speed.</p>
<p>PAUSE (3 SEC.)</p>	<p>(OPTIONAL) To get the Ozobot to pause, Scouts would need to use the “stop motors” block in Level 4 or 5 or the “Wait” blocks in Levels 1, 4, or 5. In Level 1, the “Wait” blocks can be found within the “Wait” section. In Levels 4 and 5, the “Wait” blocks can be found within the “Timing” section.</p>
<p>BACKWALK</p>	<p>(OPTIONAL) To get the Ozobot to do the Backwalk function, Scouts would need to use the first block in Level 3 and set the direction to backward, the distance to 10 steps, and the speed to medium.</p>



Note: The final program should look something like this one—with the variables set, respectively, to “medium,” “left,” “backward,” “10 steps,” and “medium.”





Junior Lab: Ozobots Survey



Boy Scouts of America STEM Scout Module Survey, 2019

iPhone/iPad Directions:

1. Open the Camera app on the iPhone or iPad.
2. Make sure you have adequate lighting so the camera can pick up the QR code.
3. Align the camera with the QR code.
4. The camera will read the QR code and provide you with a notification to access whatever it contains.

Android Instructions:

1. Tap the Navigation (three stripes on the upper left corner).
2. Choose: Settings.
3. Choose: Screen Search.
4. Swipe to activate it.



Computer Instructions:

1. Open a web browser (Explorer, Firefox, Google Chrome).
2. Type in this website:
http://scouting.co1.qualtrics.com/jfe/form/SV_dmd7eLarNQM62rz