

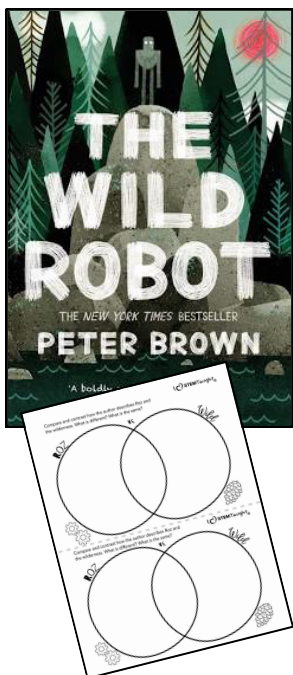
Engineering Adventure

Plan 2 4TH - 8TH GRADE

READING TIME (30 min)

Materials:

- Student sheet



READ CHAPTERS 5 TO 8 OF 'THE WILD ROBOT'

Continue reading the story with your students. Try calling on student volunteers to read one paragraph each aloud. Discuss.

Discussion Questions:

Ask: **How did Roz learn how to climb the cliffs?**

Example: **She observed the crabs.**

Ask: **What did you learn about the way Roz is built?**

Example: **She is programmed to stay safe and clean. She has a survival instinct and she can learn new things.**

Ask: **What does the word ROZZUM on the robot remains tell you?**

Example: **They might have all been made by the same lab or factory.**

Ask: **If you were designing a robot, what sensors or tools would you add to help it detect danger like Roz does?**

Example: **Students' own answers.**



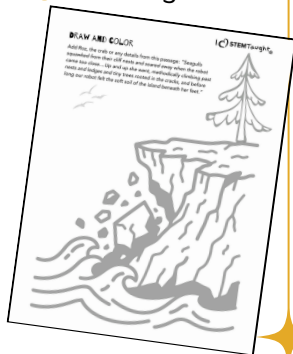
Say: **We're seeing two powerful forces at work: Roz, the robot, and the natural world of the island. Let's use a Venn diagram to compare how Roz is different from nature, how nature is different from Roz, and where they overlap. As we fill it in together, think about how both are trying to survive in the same environment—even though they're very different.**

ART TIME

(20 min)

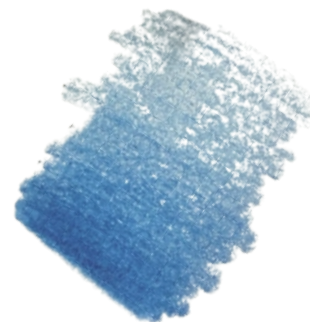
Materials:

- Printable
- Coloring utensils



COLOR BY CLUES

Say: **Great authors are like scientists of the imagination. Using only words, they help us build vivid pictures in our minds.**



Instructions:

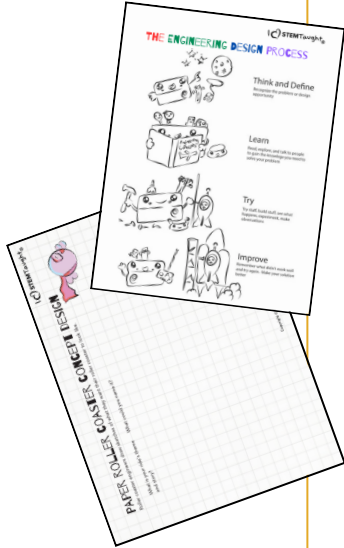
1. Students re-read the passage printed on the sheet and look for descriptive clues about the setting—colors, shapes, textures, and details.
2. They use this evidence to sketch and complete the landscape.
3. Color. Say: **When you color your artwork, try a challenge: create a monochromatic design by using just one color. Explore different shades by pressing lightly for pale tones and more firmly for deeper, richer hues. See how many values you can create with a single color!**

ENGINEERING CHALLENGE

(60-90 min)

Materials:

- Printable (1 per group)



A good tip for engaging in collaborative group discussions: Instead of responding to a peer's ideas with "No, but..." try building and feeding off of each other's creativity by saying "Yes, AND..."

PAPER ROLLER COASTER: BRAINSTORM YOUR DESIGN

Say: **Some of the coolest, most exciting engineering happens when you get to explore, test ideas, and build creatively. We will be following the engineering design process (show them the engineering design process handout and hang it up) Welcome to the Paper Roller Coaster Challenge! You will work together in teams of 3-6 over multiple days to create your own paper marble tracks and have a final competition at the end.**

What you'll do:

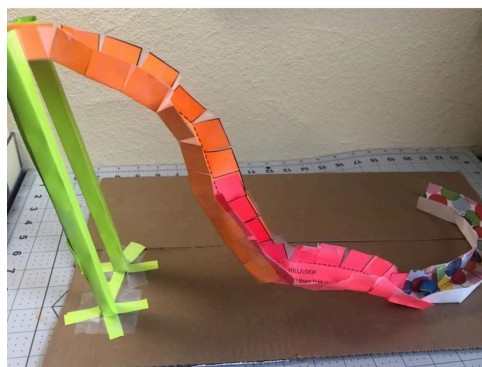
1. Discuss the project with the students. Get them excited! Say: **Building a roller coaster out of nothing more than paper and tape may seem like an impossible task, but with a patience and practice, you'll be able to create a magnificent roller coaster! This will also be a competition and I will share a paper with the points you are able to earn.**

Ask: **What parts do you think a roller coaster has?** Call on several student volunteers to share their ideas. (Example: **A beginning station, a hill to build suspense, a drop, twists and turns, brakes, safety features like seatbelts or harnesses, tracks, beams and columns, colors, etc.)**

Say: **The first step of the engineering design process is to think and design.** Ask: **What adventure will you create?**

2. Let students choose their groups or help assign groups and pass out the concept design papers to each group Say: **It is important for engineers working in teams to come up with a shared vision or game plan. Before they even start building, they think of a concept design together. Spend time sketching design ideas for your roller coaster.** Circulate and encourage them to share their ideas. Remind them to listen respectfully.

5. When students bring their completed concept design to you for a signature then you can give the group their marble track printables to start cutting and creating their tracks.

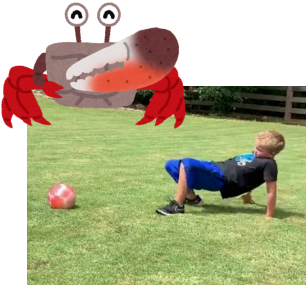


GAME TIME

(20 min)

Materials:

- Ball
- Marker for goals



PLAY CRAB SOCCER

Say: **Roz learns to climb up the cliff by observing a crab. Let's play a fun game of soccer while we scuttle around like crabs!**

How to play:

1. Organize students evenly into two teams. Choose 2 students to be the goalies. Grab a ball. Big, inflatable balls work well but you can play with any ball you have available.
2. Mark 2 goal areas. You can use chalk, bean bags, chairs, or play on the field outside.
3. All students must play like crabs (crawling with their tummy up). They can only touch the ball with their feet. Only the goalie can use their hands. Players must keep their hips elevated at all time. Dragging their bottom on the floor is a foul.
4. Teams work together to try to score a goal. Play continues until teams reach 3 points or the STEM Coach decides.

STEM TIME

(40 - 60 min)

Materials:

- Building barbs
- Straw



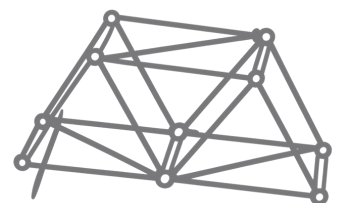
BUILD A BRIDGE FOR ROZ

Say: **Roz would have found it a lot easier to reach her destination if the island had a bridge! Engineers use science, math, and creativity to design structures that are strong enough to carry heavy loads. In this challenge, you will become a structural engineer and test how much weight your bridge can hold. Use building barbs and straws to construct a bridge strong enough to hold up our STEMTaught material box without sagging or collapsing!**

What you'll do:

1. Students grab building barbs and straw. They can work on their own or in groups.
2. Students set up 2 desks, 2 chairs, 2 stacks of books or anything else 1 and a half feet apart to create the bridge test sight.
3. They work with the barbs to create a bridge structure. They can add cardboard or paper to the base if they like, but cannot use tape or paper to build. Let them experiment and test their design as they go.
4. Test the bridge by placing the filled STEMTaught Material box on the bridge. The bridges that don't sag or collapse for 10 seconds win.
5. Ask: **How much more weight can your bridge support before it collapses? Test it out! How would you improve your design next time?**

Hint: A truss bridge uses a pattern of triangles to spread force evenly across the structure. Triangles are one of the strongest shapes in engineering and help bridges support heavy loads.



STEM CRAFT

(60 min)

Materials:

- Yarn
- Scissors

Step 1



Step 2



Step 3



Step 4



Step 5



LEARN TO FINGER-KNIT!

Say: **Today we will begin our journey of learning to finger-knit! When you're knitting, each loop or stitch acts like part of a connected system. Changing stitch size or tension changes the structure's strength and flexibility. Engineers work the same way when they go through the process of designing bridges, buildings, solutions or systems.**

What you'll do:

Cut your yarn. Each student needs a long piece of yarn, about 5 to 6 feet.

Tip: To measure your yarn, hold one end at your nose and stretch your arm straight out to your hand. That distance is about 3 feet. Measure this length twice.

Students follow along with this tutorial to learn to knit with two fingers. They can make a chain, a bracelet or a backpack hanger.

2 Finger Knitting How To

https://youtu.be/wVA9QzDuCH0?si=0hTdb4q6_1NlwUzu

Instructions:

Step 1: Put the short end of your yarn between your thumb and pointer finger.

Step 2: Bring the long end **BEHIND** your pointer finger and **OVER** your middle finger. Then, wind it behind your middle finger and over your pointer finger. You will be making a sideways '8'.

Step 3: Repeat until you have 2 loops on both fingers. Tuck the long end between your pinky and ring finger.

Step 4: Pinch the bottom loop and bring it up and over your pointer finger. Repeat for your middle finger.

Step 5: That is your first stitch! Repeat this process (wind the yarn over one finger and under the other; pinch the bottom loop and bring it over the top) until your chain is as long as you want it.

Step 6: To finish it off, trim the leftover yarn. Bring it through the right loop, then the left. Tug on the loose end of yarn. Tie it on like a bracelet!

Step 6



Snip



Pull through



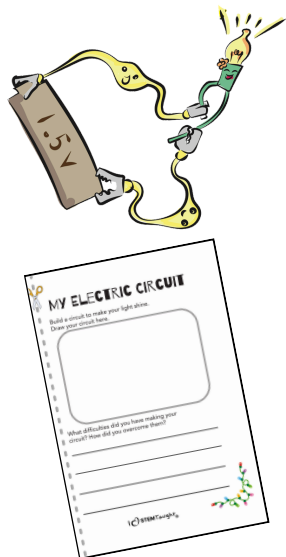
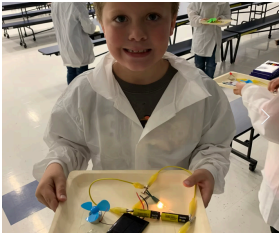
Tug!

STEM TIME

(60 minutes)

Materials:

- Prepped Christmas lights
- Alligator clips
- Battery
- Wires



MAKE A LIGHT SHINE (OPTIONAL - USE THE ELECTRONICS SUPPLY BOX ON YOUR STEM TAUGHT SHELF OR ELECTRONICS SUPPLIES CAN BE PURCHASED FROM STEMELOP.COM)

Teacher prep:

You can watch this teacher prep and class video before conducting the lab, but remember students are working with their strip of Christmas lights so all the steps will not apply. However, the basic principles of allowing open-ended investigation are the same.

Teacher Support_Make a light shine_Can you explain it?

<https://www.youtube.com/watch?v=B0XDDXeFrM>

Make a light shine_Can you explain it?

<https://www.youtube.com/watch?v=09EZNVeXGvI>



What you'll do:

Say: **Today we get to make our circuit! Every electronic circuit needs a power source, such as a battery or solar panel. Every circuit also needs something that will use the power, such as a light or a motor. Engineers figure out how things fit together and how energy can flow to make their inventions work. Let's see how you can do it with your materials to make Roz light up and your lights shine!**

1. Students work with the materials they prepped previously, and their alligator clips, wires and battery to create a circuit.
2. Safety announcement: **Don't put anything in an electrical outlet. The electricity from the outlet is too strong and can hurt you. If you feel your batteries getting hot, you've created a short circuit. This ruins batteries! Please disconnect them!**
3. Let students collaborate to figure out how to get their light to shine through trial and error.
4. If necessary, you can give your students tips:
 - A circuit needs to have a closed loop or no electricity can flow.
 - Alligator clips: When you push on both sides of the clamp it opens to connect metal to metal. Your circuits won't work if you connect to plastic. Remember you also stripped the plastic coating from your wires.
5. Students draw and label their circuit and write about their findings.
6. Ask: **What did you discover when you made your lights shine?** Students fill their student sheet.



CONSTRUCT A BRIDGE



PAPER ROLLER COASTER DESIGN



METRIC

3-5-ETS1-3:

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

3-5-ETS1-2.

Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Students share ideas and findings with others about design solutions to generate a variety of possible solutions.

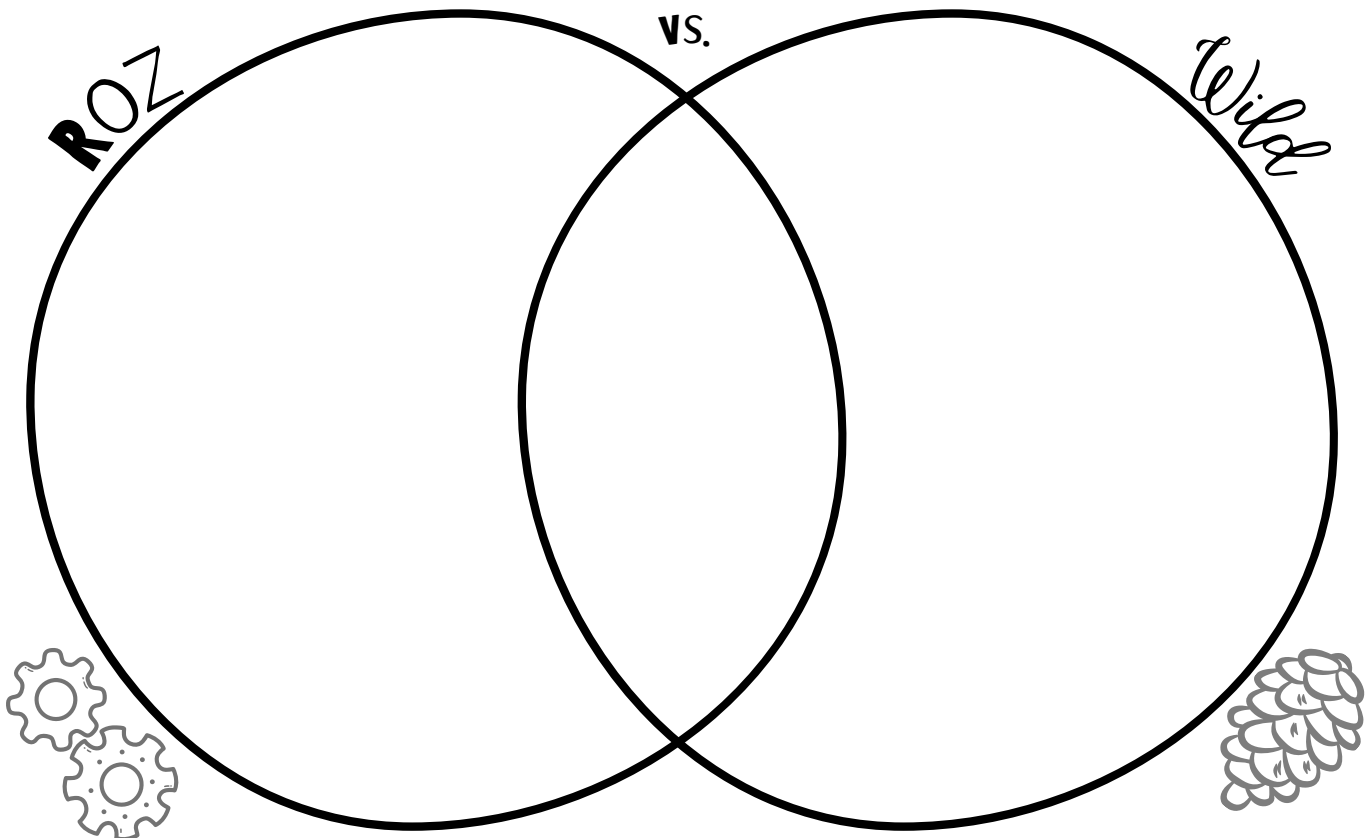
4-PS3-1.

Use evidence to construct an explanation relating the speed of an object to the energy of that object.

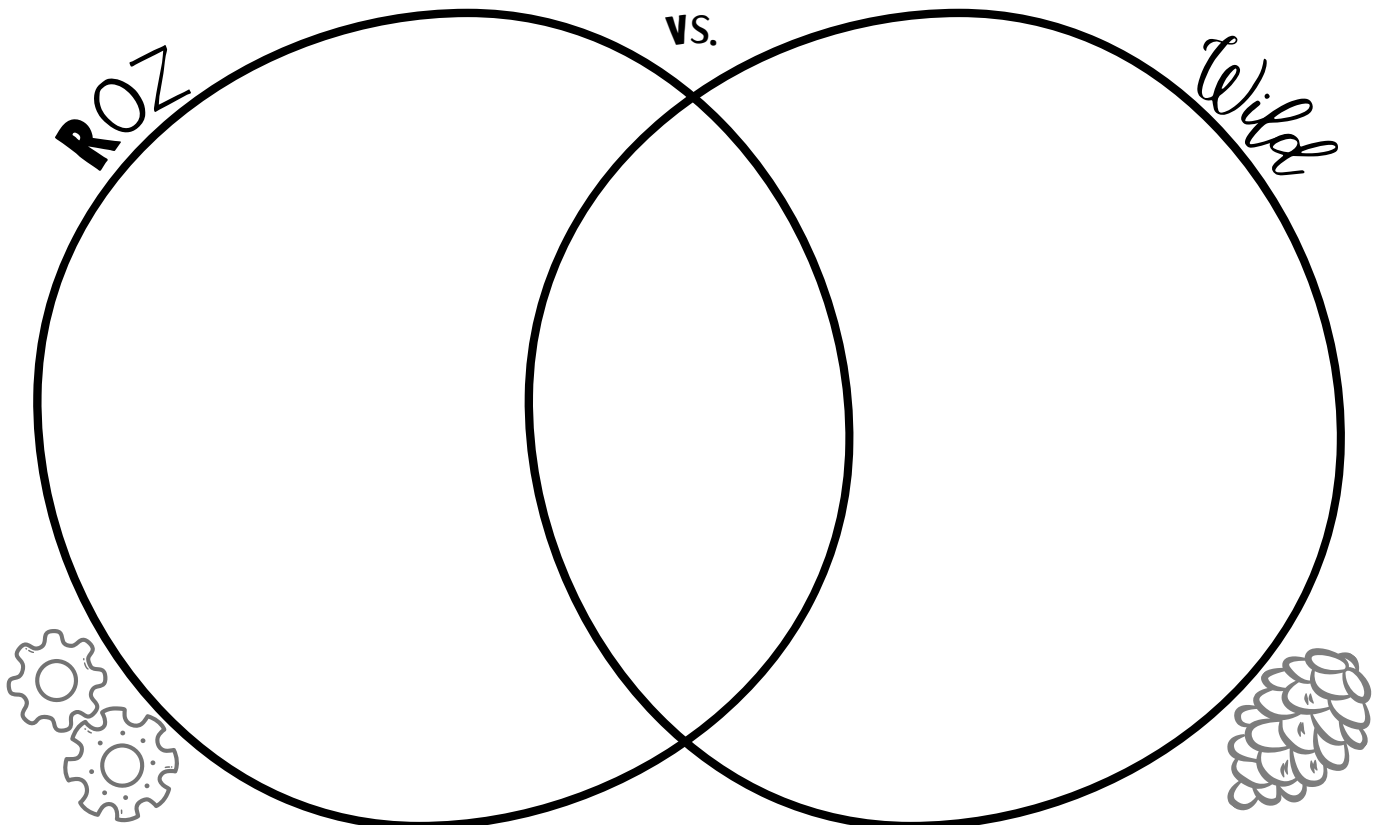
3-5-ETS1-3.

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Compare and contrast how the author describes Roz and the wilderness. What is different? What is the same?



Compare and contrast how the author describes Roz and the wilderness. What is different? What is the same?



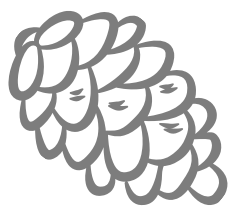
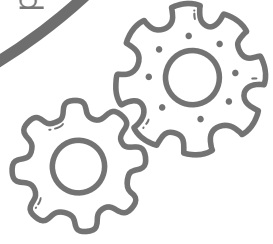
Wild (Animals)

VS.

Robot

- Is "All perfect lines and angles"
- Needs to be activated or booted up
- Gets dented or scratched
- Learns through observation and mimicking
- Is new to the forest
- Is programmed to keep herself in good working order
- Gets annoyed by the pinecones

- Both are...
- Affected by the storm
 - Must adapt to survive
 - Respond to their environment and need shelter
 - Can be hurt
 - Use patterns and instinct to survive
 - Depend on sunlight
 - Are curious and communicate
 - Make observations
- Are irregularly shaped/not sparkly
 - Some animals like the others are in groups
 - Are born with instincts/traits or their parents may have taught them
 - Are comfortable in the forest
 - Are used to the rhythms of nature like pinecones falling

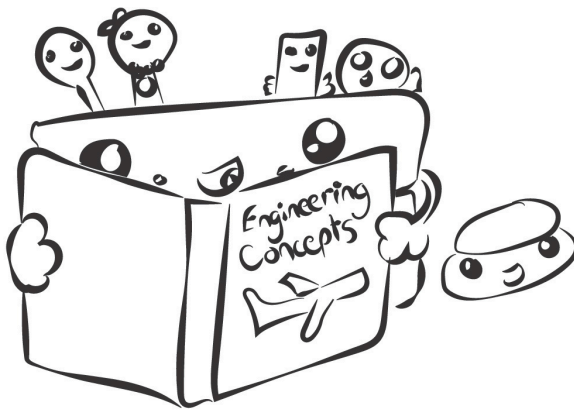


THE ENGINEERING DESIGN PROCESS



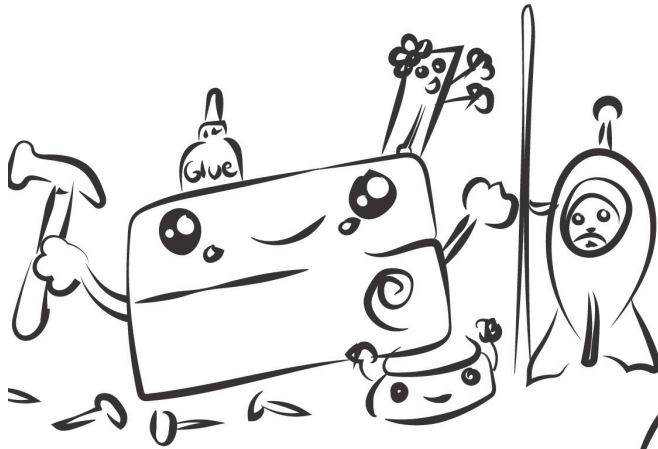
Think and Define

Recognize the problem or design opportunity



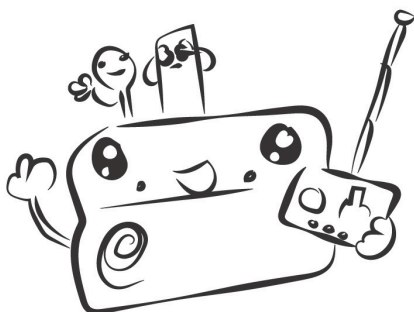
Learn

Read, explore, and talk to people to gain the knowledge you need to solve your problem



Try

Try stuff, build stuff, see what happens, experiment, make observations



Improve

Remember what didn't work well and try again. Make your solution better



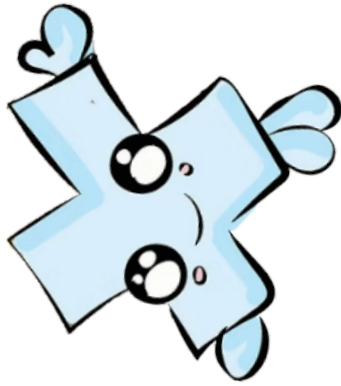
PAPER ROLLER COASTER **CONCEPT DESIGN**

Roller coaster engineers draw sketches of what they want their roller coaster to look like.



What is your ride's theme What could you name it?
and story?

THE GREAT PAPER ROLLER COASTER CHALLENGE: COMPETITION RUBRIC



Use this table to calculate the average run time of the roller coaster.

Ride length average time

Trial 1: _____ seconds

Trial 2: _____ seconds

Trial 3: _____ seconds

Trial 4: _____ seconds

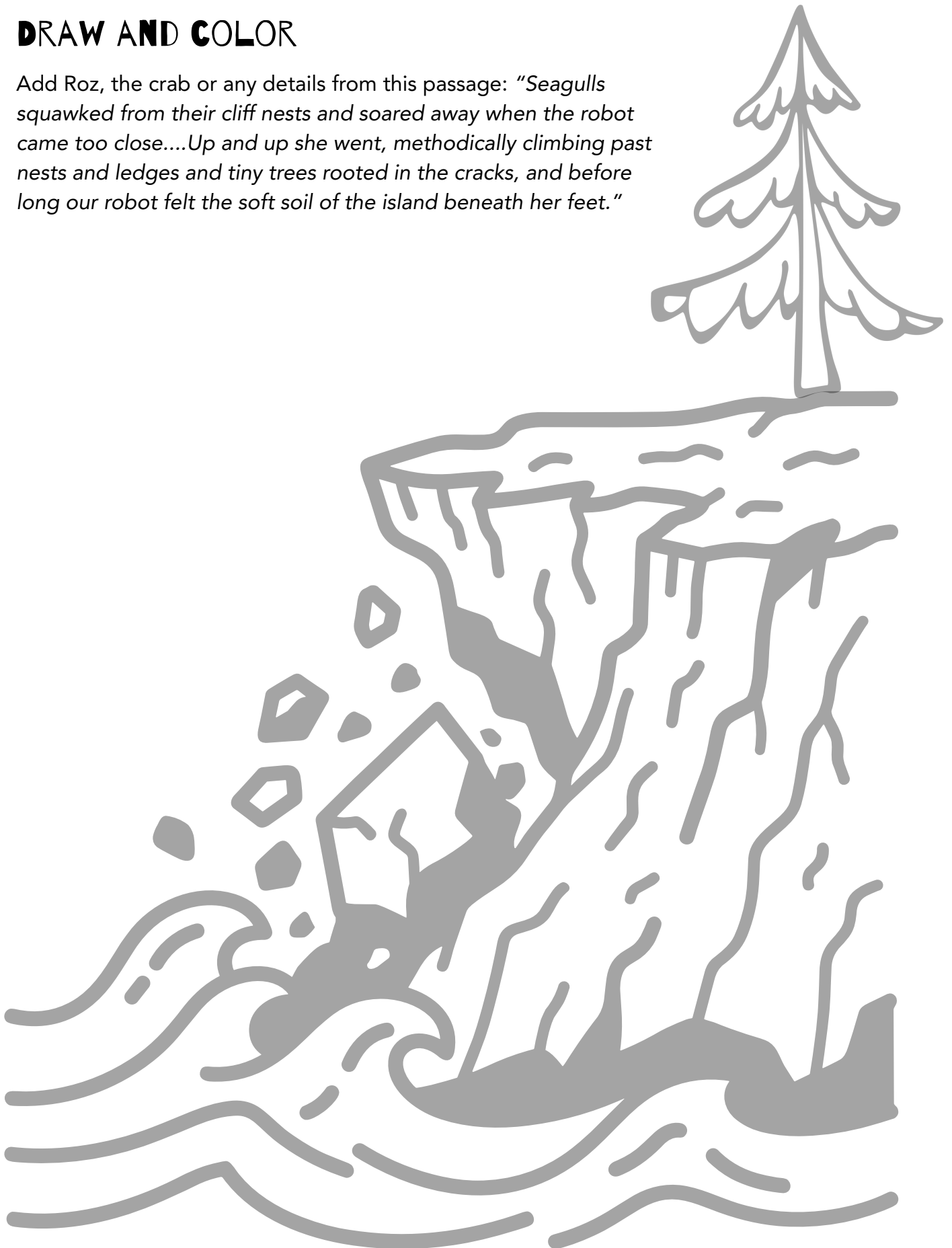
Trial 5: _____ seconds

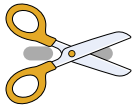
Average Run Time (add all trial times together and divide by 5): _____ seconds

Category	Points	Score
Height: At least 12 in	10 for 12 to 24 in 20 for above 24 in	
Track length > 60 in (150 cm) *Lay out the tracks end to end and measure	10	
At least 1 loop	10	
>30 second average	10	
At least 6 turns	10	
Decoration + Construction Quality	50	
Reliability bonus	30 if all 5 tries land in the bucket. 15 if at least 3 tries land.	
Uphill bonus	10 points per inch of uphill track	
Creativity bonus	Up to 50	
Total		

DRAW AND COLOR

Add Roz, the crab or any details from this passage: *"Seagulls squawked from their cliff nests and soared away when the robot came too close....Up and up she went, methodically climbing past nests and ledges and tiny trees rooted in the cracks, and before long our robot felt the soft soil of the island beneath her feet."*

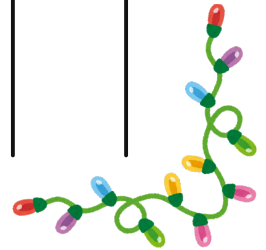




MY ELECTRIC CIRCUIT

Build a circuit to make your light shine.
Draw your circuit here.

What difficulties did you have making your circuit? How did you overcome them?

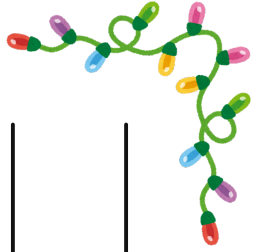


IC[®] STEM Taught[®]

MY ELECTRIC CIRCUIT

Build a circuit to make your light shine.
Draw your circuit here.

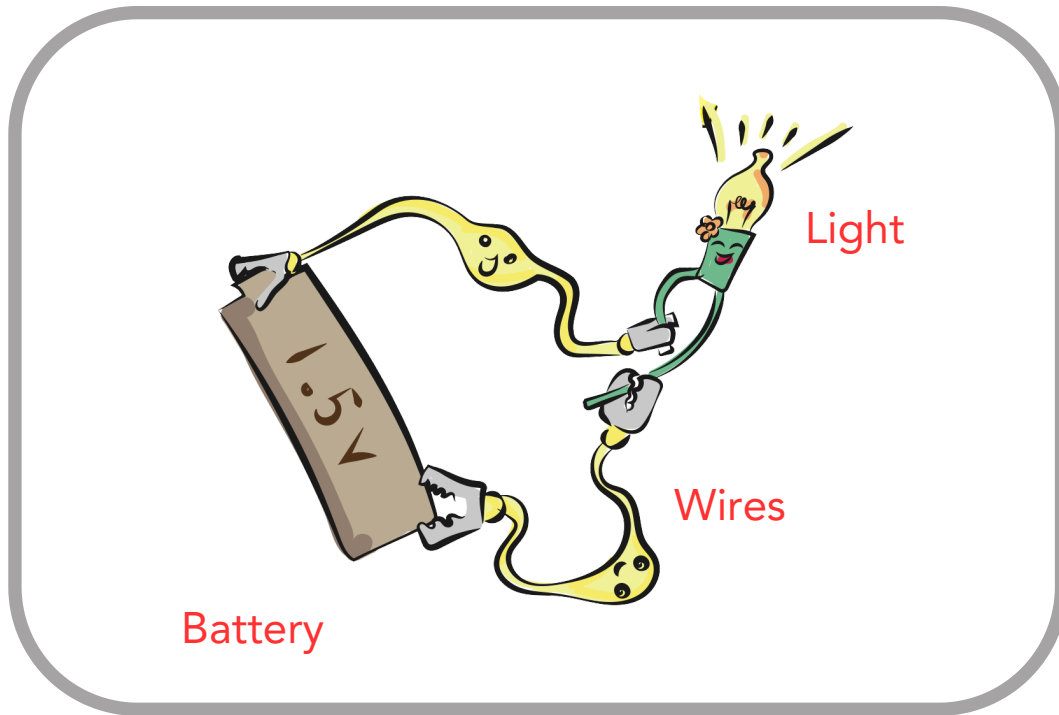
What difficulties did you have making your circuit? How did you overcome them?



IC[®] STEM Taught[®]

MY ELECTRIC CIRCUIT: TEACHER SHEET

Build a circuit to make your light shine.
Draw your circuit here.



What difficulties did you have making your circuit? How did you overcome them?

Example: I learned that the circuit must be connected to a power source and that the wires must touch both sides of the battery. I learned that electricity flows in a loop. If the circuit looks like a loop, or a necklace, the light will light up.