

EDUCATORS GUIDE

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This guide is geared toward teachers of grades PK - 5.

Supported by: Francis Hollis Brain Foundation Fund

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In memory of Harriet from the Haste Family Fund







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About This Guide

Use this guide to help your students anticipate, investigate, and reflect upon your virtual performance experience. This guide is geared toward teachers of grades PK - 5.

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LEARNING CONNECTIONS

- Visual and Performing Arts (Visual arts, Theater)
- English Language Arts (Reading, Speaking and Listening, Writing)
- Science (Engineering)
- Social Studies (Women's History)
- Social Emotional Learning (Self-Awareness, Self-Management, Relationship Skills, Social Awareness)
- 21st Century Skills (Critical Thinking, Creativity, Collaboration, Communication)



The great thing about the arts is that they can often evolve to meet their context. That means that many of the activities shared are flexible to a lot of different contexts depending on how you choose to frame them in your class. We know that you all are experts on your classroom and your students and so we invite you to use these lessons and activities as guideposts and adapt them to fit your classroom management style, range of student ability, and time constraints.



Educators, we invite you to share with us what you did in your classroom around this guide or the production. You can email **scoleman@portlandovations.org** or reach us via <u>Facebook</u> or <u>Twitter</u>.

We want to hear and see what great learning is happening in your classrooms.



Introducing the Performance

It is often helpful to share some context with your students before they attend a live performance. Many of them may be familiar with these characters and their stories from Andrea Beaty's books or the Netflix series, *Ada Twist, Scientist*. Feel free to use the below information at you feel fit to give your students more context about *Rosie Revere, Engineer & Friends* at Merrill Auditorium.





About the Performance

Ms. Greer's classroom includes three inquisitive out-of-the-box thinkers. Rosie Revere has big dreams. Iggy Peck has a relentless passion for architecture. And Ada Twist's curiosity can lead her to solve any problem. On a field trip gone awry, they are faced with the ultimate test of their problem-solving skills that can only be conquered with teamwork. This energetic musical is based on the books *Rosie Revere, Engineer; Iggy Peck, Architect;* and *Ada Twist Scientist* by Andrea Beaty.



ROSIE REVERE (played by Julia Lennon) is ambitious but also shy. A sweet kid who is used to blending into the background (where she can secretly build machines) as she presumes that no one will understand her ideas. She's an Engineer.

ADA TWIST (played by Megan Lomax) is happy, full of nonstop energy, and an insatiable curiosity which as her full of ideas and questions. She's a Scientist.

IGGY PECK (played by Bobby Eddy) is a sophisticated boy. A dreamer but a dreamer that can realize his ideas. Straightforward. Calm. Confident. He's an Architect.

MISS LILA GREER (played by Christy Fischer) is a second-grade teacher, a worrier who wants to make sure everything goes just right, and always a little nervous.

GREAT GREAT AUNT ROSE (played by Ayla Bellamy) is adventurous and fun, always cheering Rosie on.

About the Production

Rosie Revere, Engineer & Friends is currently touring to cities around the country. The book was written by Lauren Gunderson, who is one of the most produced playwrights in the country. She has written over 20 plays that have been produced at hundreds of theaters around the United States. The music and lyrics were written by Kait Kerrigan (lyrics) and Bree Lowdermilk (music). Together they have written many musicals, and have two albums. There are many more people who worked to bring the play together – see the Parts of a Play handout (page 19-20) for more information.





Theater Etiquette

An audience member is a part of a larger community – an audience – and you all work together to create your theater experience. Audience members play a special and important role in the performance. The performers are very aware of the audience while they perform. Sharing their hard work and joy with you is one of the best parts of being a performer. Each performance calls for different audience responses. Lively bands, musicians and dancers may desire audience members to clap and move to the beat. Other performers require silent focus on the stage and talking from the audience can be distracting. A theater is designed to magnify sound and even the smallest whispers can be heard throughout the auditorium. The cast of *Rosie Revere, Engineer & Friends* highly encourage clapping, laughing and cheering at the parts of the play that you enjoy.

As you enjoy the show, think about being a part of the performance.

- What are the differences between attending a live performance and going to a movie or watching television?
- What are some different types of live performances? How many can you name?
- What kind of responses might an audience give to different types of performances?
- What are the different cues that a performer will give you so that you know how to respond? For example, might they bow or pause for applause?



Students before the Portland Ovations presentation of "The Magic Tree House: Showtime with Shakespeare", 2019



Essential Questions

What does a scientist do?

A scientist is someone who is curious about the world and asks questions to help them figure it out. Anyone with these traits can call themselves a scientist (just like anyone who makes art can call themselves an artist). A person whose job it is to be a scientist is someone who has expert knowledge in life or physical sciences. Life sciences include biochemistry, microbiology, botany, zoology, and ecology. Physical sciences include physics, chemistry, astronomy, Earth science, geology, oceanography, meteorology, and Space science. Scientists gather information from observations and research, then they make a hypothesis (a guess) about what might happen next. They test to see if their guess is right and then sharing their learning with others.

What does an engineer do?

An engineer is someone who uses science and math to develop solutions to problems. There are many kinds of engineers including traffic engineers, architectural engineers, agricultural engineers, software engineers, and mechanical engineers.

How does a bridge work?

Bridges are ways for people to cross over bodies of water, canyons, railroads, or roads. If we didn't have bridges it would be much hard to get to places. The first bridge was likely a log or sturdy vine that went across a stream. The first person-made bridge is thought to be an arch bridge build in 2200 BCE in Babylon. It was made of stone. Today, engineers design and build bridges. A bridge can be just a few feet or many miles. A bridge needs to be very strong so that it can hold its own weight as well as the weight of people and vehicles that need to cross it. It also needs to be strong to stand up to natural occurrences such as strong winds, ocean currents, and earthquakes. Most bridges are made of concrete, steel, and wood framing. There are seven different kinds of bridges – girder bridges, truss bridges, arch bridges, cantilever bridges, suspension bridges, cable-stayed bridges, and movable bridges (like a drawbridge). Engineers design different types of bridges based where a bridge is needed. One of the most famous bridges in America, the Golden Gate Bridge in California is a suspension bridge.







What is failure?

In *Rosie Revere, Engineer & Friends*, Rosie's invention doesn't work right and she feels sad, frustrated and embarrassed that it failed. Failure is when something does not go as expected. We often think of failure as a bad thing but experts on human behavior, the brain, and education think that failure is an important part of being human. Failure is an inevitable part of learning (going all the way back the research of John Dewey)! When you learned to walk, you fell down a lot but you got back up and tried again. You learned from your falls how to use your body to find your balance. That is the same way you can approach failure in different parts of your life – through hard work, feedback, and multiple attempts. One of the important things to remember is that you are not a bad person if you fail. Often you might not get it "right" but this is okay because you still learned from the experience. (Educators, check out the great Edutopia resources in Sources on page 13).

Who is Rosie the Riveter?

In the play, Rosie's Great Great Aunt Rose, is based on a figure from American history named Rosie the Riveter. The 'real' Rosie the Riveter was a famous fictional character in American history. During World War II, millions of American men were overseas fighting. This meant that many jobs, especially ones in manufacturing and farming, were left without anyone to do the work. Previously, women had either not been allowed or were discouraged from doing these jobs. So, the American government created a poster to encourage women to get jobs in factories, farms, and mills. The strong woman on the poster was nicknamed Rosie the Riveter because one of these important war-time jobs was working the factories that produced equipment for the troops - things like tanks and artillery. These were factories in which women rarely, if ever, worked and the government needed to change that perspective. World War II was one of the first times in our history that women had access to jobs traditionally worked solely by men. Rosie really did rivet things but that was just one of her jobs! Unfortunately, when the war ended many of the women lost their jobs. However, the independence and agency that many of these women discovered helped fuel the revival of the feminist movement in the 1960s.

Read more about one of Maine's Rosie the Riveters!

https://bangordailynews. com/2021/11/10/news/real-lifemaine-rosie-the-riveter-96-looksback-on-her-world-war-ii-effort/





A "Rosie" putting rivets on an Vultee A-31 Vengeance in Nashville, Tennessee in 1943.



Women at work on bomber, Douglas Aircraft Company, Long Beach, California (1942)



PRE-PERFORMANCE LESSON ACTIVITIES

Here are some ideas for lesson activities that expand on the essential questions, topics, and themes of *Rosie Revere, Engineer & Friends*.

Vocabulary

Below is a list of words that are used in the performance that are helpful to know to understand the story.

ARCHITECT: A person who designs structures, like buildings. **ARCHITECTURE:** Doing the work of creating the building. It also means the design of a structure.

ENGINEER: Someone trained in the skill of creating engines or machines.

VOLCANO: A mountain or a hill from which lava and ash are released.

PHYSICS: A science that looks at matter and energy and the galaxy.

CHEMISTRY: A science that looks at what substances make up our world, from the air we breathe to the things we use.

TURRET: A small tower on top of a larger tower on a castle.

INVESTIGATE: To ask questions and discover answers about anything at all! **EXPEDITION:** A journey that people take with a purpose in mind, usually to investigate something.

VELOCITY: The speed at which something is moving, usually fast.

Character Trait Statues

What is the difference between a character trait and emotions? A character trait is the way a person or character in the story acts. It is part of their personality and comes from inside them. We learn what traits a character has by what they say and do. The character's emotions are usually temporary feelings that may be a result of an outside force, like an experiment failing, or not knowing the right answer to a problem. We learn about a character's emotions by what they say and do in response to what is happening to them.

Invite students to think of character traits that they possess. You can brainstorm different ones together or use a list like this. Have them choose two of their character traits. Invite them to stand in their own space and create a statue (a frozen pose) that represents that character trait. Have everyone in the class observe the other statues and describe how they see the character trait represented. Take photos of each students' poses and then display them in the classroom under their name. Create space for students to share with their classmates when they see them adding their unique character traits to the classroom community.

For more detailed instructions on Statues check out: <u>https://dbp.theatredance.utexas.edu/</u> teaching-strategies/statues.







"We Can Do It!" by J. Howard Miller, was made as an inspirational image to boost worker morale

Parts of a Play

Discuss the parts and people of a theatrical production before attending Rosie Revere, Engineers & Friends. Use the Parts of a Play handouts on page 18-20 to learn about Merrill Auditorium and the many different people who work together to create a play - from the script to the costume design. Challenge students to name as many parts of the theater when they arrive at Merrill Auditorium. Invite them to look out for the creativity and artistry of the designers onstage.

Narrative Pantomime

Practice telling a story using your body and no words! Narrative Pantomime is an activity that you guide students through together, inviting them to act out the physical and emotional journey of a character in a story (silently) using their body in their own space. Choose any story - ideally one with a clear main character that includes physical action (e.g. Caps for Sale, When Sophie Gets Angry, Really, Really Angry, etc.) Retell the story in your own words (mostly to shorten it), pulling out the sensory details and action. As you tell the story, the students mirror the emotions and actions through their own body. When you finish, reflect on the experience asking students what did your character do? What did your character feel? How did you show the emotions or actions in your body?

For more detailed instructions on Narrative Pantomime check out: <u>https://dbp.theatredance.</u> utexas.edu/content/narrative-pantomime.

Check out these example narrative pantomime http://www.childdrama.com/narrativepantomime.html.

Inspiring Images

Look at the Rosie the Riveter poster together, observing all the words and image. Discuss how this poster was meant to inspire women to go work in places where they previously weren't allowed to. Invite students to recreate Rosie's pose with their own body. How does it make them feel? Capture the emotions for all to see. Share that in the play and the book, Rosie Revere struggles with confidence. Ask students, do you ever feel like you can't do something? What words of encouragement are helpful when you feel this way? Inspired by these words, invite students to create their own poster with a motivational phrase that would inspire them. They can paint/draw them in the style of the Rosie the Riveter poster - or a particular style (collaborate with the visual art teacher!) Have a gallery walk and look at all the different ways everyone in the class feels motivate.

Use this link to to source an image of the original Rosie the Riveter poster: https://americanhistory.si.edu/collections/search/object/nmah_538122











Trailblazing Women

The women who worked in factory jobs during World War II were trailblazers. A trailblazer is someone who tackles something new for the first time, making it easier for others to follow and do the same. There were many women trailblazers in history. These were women who did things that were usually done only by men, often white men. Teach about or invite students to research trailblazing women in history. What made them a trailblazer? What character traits do they see in these women? How do these women's actions, accomplishments, and character traits inspire them?

Some trailblazing women to discover more about...

- Bessie Coleman: First Black woman to have a pilot's license.
- Marie Curie: A scientist who was the first woman to win the Nobel Prize.
- Wilma Mankiller: The first woman elected to serve as chief of the Cherokee Nation.
- Lili'uokalani: The only queen and last regent of the Kingdom of Hawaii.
- Joan Clarke: A British code-breaker who worked secretly with the British government during World War II to break Nazi codes and help end the war.



Bessie Coleman





Wilma Mankiller



Lili'uokalani



Joan Clarke



POST-PERFORMANCE LESSON ACTIVITIES

Post-Performance Discussion Questions

- 1. What is the story about?
- 2. Who are the main characters?
- 3. What problems do the characters encounter?
- 4. How do they create solutions to the obstacles they face?
- 5. What is the relationship like between Rosie and her Great Great Aunt? Between Rosie, Iggy, and Ada?
- 6. What does Rosie learn about failure? Is it a positive lesson or a negative one?
- 7. What part of the play did you like best, and why?
- 8. What character did you like best, and why?
- 9. If you haven't read the book, did seeing the play make you want to read the book?
- 10. Did seeing the play make you want to learn more about engineering and using math and science to solve problems?
- 11. Did seeing the play make you want to see more plays and performances in the future?

Use these questions if you did the pre-performance activity on character traits and emotions on page 8.

- 1. What character traits did you see Rosie/Iggy/Ada?
- 2. How did she/he/she show us those traits?
- 3. When was she/he/she behaving in response to a temporary or passing emotion?
- 4. What do you think the difference is between true character traits and passing emotion?



ACTIVITY: Engineer a Bridge

Hopefully you don't get stuck on an island and have to build a real bridge like Rosie, Ada and Iggy did! However, you can build a marshmallow and toothpick bridge and see how much weight it can hold. Check out the more detailed instructions on page 23.

ACTIVITY: Make a Play

that plays are all dialogue. This is a great way to get students to think about the importance of show don't tell and descriptive details. Choose a storybook (the shorter the better!) to "put on its feet" as is said in the theatre world. Use the From the Page to the Stage guide on page 21. (This is also an in-class workshop series that Portland Ovation's Offstage program offers. If you

are interested in this opportunity please email scoleman@portlandovations.org)

ACTIVITY: Describing What You Saw

Invite students to talk, draw or write about what elements of theater they observed in the performance. They should describe two or more elements using theatrical vocabulary (set, actor, costume, stage, etc.). Have students compare their observations with a partner and combine them for a more complete description of the performance. Use this activity in conjunction with Parts of a Play (pages 18-20).

ACTIVITY: Play or Book?

Read Rosie Revere, Engineer after seeing the performance. Have students compare and contrast the book Rosie Revere, Engineer with the play Rosie Revere, Engineer & Friends. Discussion questions or writing prompts might include: What was similar? What was different? How did the form (musical theater) make the story onstage feel different from the story you read? Using specific examples, explain which version of the story did you enjoy more and why?

Challenge students to turn a story into a play. The hardest part of adapting a book to a play is











ADDITIONAL RESOURCES

Engineering

Engineering For Kids: <u>https://www.engineeringforkids.com</u> Science For Kids: http://www.sciencekids.co.nz/sciencefacts/engineeringnz/typesofengineeringjobs

Architecture

Archkidecture.com, encouraging visual literacy and explaining math, science, and visual concepts to kids through architecture: <u>http://archkidccture.org</u> Kid World Citizen: <u>https://kidworldcitizen.org/world-architecture-for-kids/</u>

Failure

Gonser, Sarah. "Easy to Say-but How Do You Really Help Students Learn from Failure?" Edutopia, George Lucas Educational Foundation, 20 Dec. 2019, <u>https://www.edutopia.org/article/easy-say-how-do-you-really-help-students-learn-failure.</u>

Johnson, Ben. "Redefining Failure." Edutopia, George Lucas Educational Foundation, 17 Apr. 2017, <u>https://www.edutopia.org/blog/redefining-failure-ben-johnson.</u>

"Embracing Failure: Building a Growth Mindset through the Arts." Edutopia, George Lucas Educational Foundation, 4 Oct. 2016, <u>https://www.edutopia.org/video/embracing-failure-building-growth-mindset-through-arts.</u>

More on failure on Edutopia: <u>https://www.edutopia.org/search?query=failure</u>

From Andrea Beaty

https://www.andreabeaty.com/parents--teachers.html

SOURCES

Videon, Fred F. "Bridge." World Book Student, World Book, 2022, https://www-worldbookonline-com.wvo-ursus-proxy11.ursus.maine.edu/student/article?id=ar076320. (Access through the Digital Maine Library)

Santana, María Cristina. "From Empowerment to Domesticity: The Case of Rosie the Riveter and the WWII Campaign." Frontiers, 23 Dec. 2016, <u>https://www.frontiersin.org/articles/10.3389/fsoc.2016.00016/</u>full#:~:text=In%20the%20workforce%2C%20Rosie%20the,a%20short%20period%20in%20time.

List of Character Traits: <u>https://www.readwritethink.org/sites/default/files/resources/lesson_images/</u> lesson807/traits-list.pdf



Portland Ovations, founded in 1931, produces dynamic performing arts events including classical music, jazz, opera, dance, theater, and Broadway. We believe that cultural enrichment should be high quality and accessible to all. Ovations collaborates with other nonprofit organizations, education systems, and the business sector to promote lifelong learning while celebrating the power and virtuosity of the performing arts. We bring the exhilaration of the performing arts into our communities with free events as part of Ovations Offstage, connecting artists and audiences. Join us at unexpected "art happenings," classroom workshops, masterclasses, community discussions, and pre-performance lectures to explore together the relevance and connection of the performing arts to our lives.

Land Acknowledgment

Portland Ovations acknowledges that the places where we gather, dance, and sing is ancestral Wabanaki land. We wish to pay respect to the Abenaki, Maliseet, Mi'kmaq, Passamaquoddy, Penobscot - and their elders past, present and future.



Native-Land.ca

Cultivating Curiosity

Ovations Offstage's Cultivating Curiosity places books in the hands of Maine students and provides young learners with a unique opportunity to make connections between literacy and performance. The program pairs reading opportunities with selected School-Time Performances, by providing each child who attends the performance a free book born from its title or themes to add to their home library. During the 2020-2021 season, Ovations is partnering with I'm Your Neighbor Books to curate diverse books and provide resources for young people, families, and educators to engage deeply in literature and story.

Created and written by Sarah Coleman Additional writing provided by TheatreWorksUSA Designed by Katie Day © Portland Ovations 2022



STUDENT RESPONSE FORM

We want to know what *you* thought about the performance. You can write your answers below or draw a picture on the back of this page. Thank you!

PERFORMANCE: Rosie Revere, Engineer & Friends

SCHOOL NAME:	TEACHER NAME:	GRADE:
YOUR NAME:	May we use your name when we share y Ye	our comments? es No

What did you like about Rosie Revere, Engineer & Friends? Why did you like that part?

What was something that you learned during the performance?

What would you like to tell other kids about Rosie Revere, Engineer & Friends?

What types of performance would you like Portland Ovations to offer in the future? (Feel free to share what type of art you are interested in (theater, dance, music), what cultures you might like to see, what topics the art might connect with, or specific artists.)

MAIL RESPONSES TO: Portland Ovations PO Box 17573 Portland, ME 04112-8573 EMAIL SCANNED RESPONSES TO: offstage@portlandovations.org



TEACHER RESPONSE FORM

Please take a few moments to fill out this survey after you attend the performance. You can also fill it out <u>online here.</u> Your response provides valuable insight on the impact, accessibility, and relevancy of the School-Time Performance Series and will allow us to improve and strengthen the program. Thank you.

PERFORMANCE: Rosie Revere, Engineer & Friends – March 7, 2022

	_GRADE(S) OF STUDENTS:
SCHOOL NAME:	CITY/TOWN:
EMAIL ADDRESS:	

1. From your perspective as a teacher, how would you rate *Rosie Revere, Engineer & Friends*? □ Excellent □Very Good □Good □ Fair □Poor

3. What made this a valuable experience for your students? (If it wasn't, what can we do better?)

4. What was your primary reason for choosing to bring your students to *Rosie Revere, Engineer* & *Friends*?

- \Box I wanted my students to experience the performing arts.
- \Box The performance topic fit with my curriculum goals.
- \Box The date and time of the performance fit our schedule.
- \Box The ticket price is affordable.
- \Box Other (please specify):

5. How did this live performance connect to or enhance your curriculum?

6. Did you use the	Educators	Guide provided by	Portland Ovations	before or after	r attending the
performance?	🗆 Yes	🗆 No			

7. Why or why not?

8. What improvements could we make to the Educators Guide to serve you and your classroom better?

MAIL RESPONSES TO: Portland Ovations PO Box 17573 Portland, ME 04112-8573 EMAIL SCANNED RESPONSES TO: offstage@portlandovations.org



9. How would you rate the following components of attending the School-Time Performance?

	Excellent	Very Good	Good	Fair	Poor
Reserving & paying for tickets					
Communication about the day of the performance					
Arrival at the venue					
Departure from the venue					

10. What types of performances would you like to bring your students to in the future? (Feel free to share art forms, topics/themes, specific artists, etc.)?

11. A number of generous individuals and organizations make it possible for Portland Ovations to offer these School-Time Performance tickets at extremely discounted rates. Is there anything you'd like them to know in terms of your experiences or its impact on your students?

PARTS OF A PLAY



Theater Diagram





portlandovations.org



PARTS OF A PLAY The People Who Make a Play



Alyssa Caggiano

David Levene for The Guardian

Actor

The person who takes on the role of a character in the performance.

Audience

A group of people who watch the performance



Rachel Neville

Choreographer

The person who creates the dance and movement for the performers.

The person who creates the clothes for the performance.



Bryce Richter



Costume Designer



Kelly Maxwell

Director

Dramaturg

The person who tells the actors in the play or performance where to move and what emotion to show when they speak.

The person who works with the playwright and director to

help make sure the play makes sense and is accurate.



American Theatre



PARTS OF A PLAY The People Who Make a Play



Youth Academy of Dramic Arts

Lighting Designer

The person who creates what kind of light will be onstage during the performance.



Young Playwright's Theater



Playwright

The person who writes the script for the performance.



Point Park University

Set Designer

The person who creates what the stage will look like including what walls and furniture will be onstage.



Sound Designer

The person who creates the sound and music that is played during the performance.



James Ogden II

Stage Manager

The person who makes sure that all the actors are in the right places and that the lights and sound cues are played at the right moment.



FROM THE PAGE TO THE STAGE

Steps for Dramatizing Story

- 1. Read, discuss, and re-read the story.
- 2. Make a story map to determine the setting, characters and plot sequence. Start with a large brainstorm and then edit the story down to a manageable number (based on your class size and their ability to work in small groups) of scenes or moments.
- **3.** Write the dialogue. In small groups or pairs, have students create 5 10 lines of dialogue for each moment that communicates the key ideas.
- 4. **Create the setting.** Using their bodies or a few pieces of furniture have the students create the setting.
- 5. Cast the story. Have students decide who will play what part. Students be a part of the setting if they do not want to speak. Two students can play the same character and alternate lines.
- 6. Play the scene. Have students put all of the parts together the setting and the dialogue. As they play the scene invite them to think about what feelings/emotions they want to make sure the audience experiences. They can show emotions through their facial expression, body language, and tone of voice.
- 7. Watch and reflect. Have the students share their scene with other students. Invite the audience to look and listen for the ideas discussed in the story map along with emotions. Following each scene ask students:
- 8. Describe a moment that was interesting (or exciting, realistic, funny, etc.)?
- 9. What part of the story did the scene retell? What elements of the story map were included?
- 10. Was there anything missing? What could be improved for the next time the group plays the scene?
- 11. Play the story again. Invite students the play the scene again. They can practice in their own groups and then share out again. Or, they can just practice again and do a short written reflection on what changed.
- 12. Final Reflection. Have a discussion or invited students to respond in writing to the following questions.
- 13. How was it different to read the text as opposed to turn it into a play?
- 14. What more did you discover about the story, the characters, the setting, the plot?
- 15. Which version helped you understand the story better reading or turning it into a play? Why?

Note: For younger grades a simple story book is best. You can play out the entire story as a class. If there are multiple characters have groups of students perform each characters in clumps around a circle or at their desks. The teacher should remain the narrator and guide the pace of the story, inviting students to perform part of the setting or movements/emotions of the characters along with them.



ENGINEER A BRIDGE

Instructions to Build Marshmallow and Toothpick Bridges

Supplies:

- Bag of marshmallows (standard size)
- Toothpicks (100 per group)
- 2 chairs
- String (3 feet)
- Scissors
- Styrofoam or plastic cup
- A cup of pennies
- Pencils and paper

Let students know that they are going to become engineers and use marshmallows to build a bridge and discover how much weight (in the form of pennies) it can carry.

Teach or have students research different kinds of bridge structures. Share (or review) vocabulary and concepts with students.

- COMPRESSION: Compression is the force in which a material is squeezed together. Its opposite, or counterforce, is tension.
- TENSION: Tension is the force in which a material is pulled apart. Its opposition or counterforce is compression.
- GRAVITY: Gravity is the constant force that exists between any two objects that have mass. Earth's gravity is what keeps you on the ground and what causes objects to fall.
- BUCKLING: Buckling is what happens when a bridge loses its shape because there is too much compression.
- SNAPPING: Snapping happens when a bridge loses its shape because of too much tension.
- SPAN: The distance between two points on a bridge.

Invite students discuss in groups: What shape might be the strongest to build with marshmallows and toothpicks? How many marshmallows and toothpicks do they think they will need? Working together in groups, have the students sketch out their chosen bridge shape and design. Each bridge should be about one foot long.

Once they agree on a plan, have them build using only the marshmallows and toothpicks. Encourage them to try different approaches if they feel their design isn't working. Remember to learn from the failures!

ENGINEER A BRIDGE



Once built, reflect on: Does it look like what they thought it would? Does it look like real bridges that they have seen? How much weight do they think it will hold?

Time to test! (Tip: Let the bridges rest for a day so that the marshmallows have the chance to harden.) Place the two chairs a little less than a foot apart. These will represent the shoreline that the bridges will space across. Have the students place their bridges across the span. Do they think that their bridge can stand the force of gravity? Will it buckle?

Have each group test their own bridge. Start by pressing down lightly on the top and then with a bit more force. Does it hold or give? What forces do they think the bridge is experiencing? (See vocab.)

If it held steady, test to see if it can carry a load. Rest the styrofoam or plastic cup on the top of the bridge. (If this is not possible, make two holes in the cup, loop some string through the holes and tie the string together to create a bucket. Hang the cup/bucket from the bridge.) Add pennies one by one to see how many the bridge will hold. When it begins to buckle, that is the load limit of the bridge.

After every bridge has been tested discuss:

- What bridge held the most pennies?
- Which bridges worked the best, and why?

Reflect on the entire process.

- What new things did you learn about bridges?
- What is a force?
- What is the difference between compression and tension?
- What did the strongest bridges have in common? (Use the new vocabulary!)
- What did the weakest ones have in common?
- Did your original group vision and design look like your final bridge?
- Did you make changes as you constructed your bridge? What were those changes and why did you make them?