

Engaging Children in STEM Through Media Read-alouds



Produced By:



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EDUCATOR GUIDE

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What is STEM Tales?

STEM Tales: Investigating the effect of media read-alouds by diverse scientists and engineers on young children's literacy and interest in STEM careers is a 2.5-year project, funded by the National Science Foundation under grant No DRL 2148023. The project is designed to engage children (ages 4-8) and families through a digital children's media series and aligned library programs across the nation. Led by Twin Cities PBS (TPT), in partnership with the Space Science Institute's STAR Library Network (STAR Net), American University, and Story Time from Space, **STEM Tales** will create a video series (*Book Drop*) that includes diverse STEM professionals including astronauts, scientists, and engineers reading STEM picture books.

While research shows that in-person read-alouds are very effective at teaching children literacy skills, little is known about how media read-alouds impact children's literacy skills and academic knowledge, or if they motivate children to future careers. There is little research on how media read-alouds help children learn academic concepts and processes, such as language or math, science inquiry or the engineering design process. The *Book Drop* read-alouds will be complemented by children engaging in STEM activities, bookended by an animated story featuring characters who travel the Earth (and into space!) delivering books to real-life STEM professionals for story time.

STEM Tales will:

- Enrich the media read-alouds with animation and live-action of children doing STEM, easily replicable at home or in the library.
- Highlight key academic vocabulary related to STEM that will introduce children to new words in multiple contexts.
- Research how media read-alouds impact children's STEM content learning, literacy skills and interest in and awareness of STEM careers.

What is STEM?

STEM (Science, Technology, Engineering, and Math) describes an approach to teaching and learning that combines scientific inquiry and engineering design in hands-on personally relevant learning experiences that are grounded in real world applications and integrate technology and mathematics into all aspects of the investigation. STEM learning opportunities are active and foster skills such as critical thinking, creativity, problem solving, communication, and collaboration. STEM is an important topic in education today because these fields are important growth areas for the economy.



Why is STEM Education So Important?

Life Skills

At the most basic level, STEM attempts to answer how and why things work. The scientific and engineering processes offer a framework for understanding important ideas, big and small. In addition, while using these processes, youth learn how to plan, cooperate, communicate, problem solve, and apply their creativity.

Careers

STEM careers are great careers!

- They offer higher than average salaries, and employment in STEM occupations is expected to increase much faster than the overall growth rate for other areas.
- Encouraging youth from all backgrounds to enter these fields will ultimately improve these professions, maximizing innovation to create products and services that are better representative of all users.
- A strong foundation in STEM topics will open doors for career opportunities we don't even know about yet. The workforce is changing quickly and new jobs that don't even exist today will be available to the future workforce.
- Being confident in STEM will help prepare them for a wide range of possible opportunities.

Science Literacy

In today's society, it's important for everyone to have basic scientific knowledge to continue to learn and to make informed decisions. Even if youth choose to go into another field, a foundation in STEM studies will serve them well in the future. Science literacy gives us a sense of empowerment to make a difference in our community and the world!

Fun Times!

While pursuing their own interests in STEM topics, youth can try new things, meet engaging people, and go to interesting places. Activities such as designing a scientific investigation, creating a solution to a technical problem or visiting with a scientist or engineer can inspire youth and allow them to see STEM in a different light.





Learning Goals

Youth Will:

- Demonstrate high involvement with digital media and STEM activities.
- Seek out more STEM experiences.
- Believe they can do STEM.
- Have an interest in participating in future STEM activities.
- Identify with scientists and engineers and near-peer role models.
- Gain a perception of STEM careers as possible and rewarding.
- Have awareness of STEM concepts, processes, and skills.
- Have an awareness of various STEM careers.



Parents/Caregivers Will:

- Have a strengthened capacity to support children in multi-generational STEM activities at home and at the library.
- Demonstrate awareness of diverse STEM careers, confidence in doing and discussing STEM activities and encouraging their children towards STEM.

Librarians Will:

- Have improved confidence in how to engage children and families in STEM media and activities.
- Gain knowledge around culturally responsive STEM media read-alouds with children to build STEM and literacy skills.



Your STEM Tales Program

Program Requirements

Libraries must commit to the following programming requirements:

- Run four *STEM Tales* programs between February 15, 2024 and September 30, 2024.
- At least ten preK-2nd grade children (ages 4-8) and their families in each program will attend.
- Each session will focus on viewing one *Book Drop* episode and engaging children and families in the episode-aligned discussion and STEM activities outlined in this guide.
- Librarians will participate in evaluation of the STEM Tales program.

Program Facilitation Basics

- Watch the episode beforehand. Familiarize yourself with the themes in the episode.
- Test your tech. Make sure episodes will play and the audio is loud enough.
- Have activity materials ready in advance.
- Allow time for youth and families to get comfortable and settle in.
- Ask questions – include the families. Encourage youth to make predictions before they jump into an activity. Don't save questions for the end. Invite discussion throughout the program! What do you think a ___ does at work every day? What do you already know about ___? Ask questions that will help them find connections between their lives and STEM.
- Guide activities – don't solve problems for them. Provide specific feedback on things youth can control. Ask questions that get at the process of learning. "How did you get to that answer?" "How did you decide what to do next?" Offer comments such as, "That's great the way you and Kate worked together to solve that problem," or "I can see how hard you worked on that design."
- Make connections between the episodes, careers in the episodes, and the activity.



Using Media in Your Program

Why use media?

- Encourages vocabulary acquisition.
- Visual cues reinforce learning.
- Sparks interest and connects to prior learning.
- Allows for differentiated instruction.

Media Read-Aloud Tips

Before you press play:

- Watch Videos Ahead of Time.
- Introduce key themes and vocabulary.
- Focus learning with questions or key ideas.
- Make it Meaningful.





STEM for All Learning Environments and Culturally Responsive Teaching Practices

Create a STEM for ALL learning environment

It is critical to provide a supportive space and learning environment that fosters mutual respect, looks and feels inviting, and allows girls to feel that they belong. Research shows that a learning environment that is comfortable, personally meaningful, collegial, and supportive can positively impact girls' interest and motivation in STEM and positively influence girls' STEM identities. The learning environment must also be culturally responsive, one that recognizes, reflects, and validates the history, cultures, and world-views of youth. In such an environment, diversity is valued as an asset, which leads to effective teaching and learning.

Tips to create a STEM for ALL learning environment

- *Create a warm and welcoming space that is accessible to all and fosters cooperation and acceptance.* Create an organized space where everyone can move easily and safely and work in a collaborative way.
- *Learn about your youths' needs.* The tools to make the environment accessible and welcoming vary depending on individuals' needs (vision or hearing impairments, sensitivity to light, etc).
- *Practice and encourage active listening.* Active listening includes orienting your body to the speaker, maintaining eye contact, nodding your head, using facial expressions (e.g., smile, frown) and verbal cues (e.g., "That is interesting").
- *Create an atmosphere of mutual respect.* Shared expectations help develop a sense of community and encourage positive interactions.
- *Use icebreakers so youth can introduce themselves in a non-threatening manner.* This activity allows your youth to relate to each other and share and appreciate differences among them.
- *Provide opportunities for youth to voice their opinions and feel accepted.* Encourage active participation by all youth and structure tasks that have multiple paths to a solution.
- *Form meaningful connections with youth.* Take some time to view everyone as an individual—encourage them to share their own lives and interests—and show them that you believe in their abilities.

Adopt Culturally Responsive Practices

Youth you work with may differ from you and each other in ethnicity, race, language, and socio-economic background. To truly engage youth in STEM, it is critical to reach out to them in ways that are culturally responsive and appropriate.

Culturally responsive practices (CRP) support student achievement by providing effective teaching and learning in a culturally supported environment that is student-centered. In these environments, educators identify, nurture, and use the strengths that students bring to the learning space to facilitate and promote student achievement. Geneva Gay, a professor in multicultural education, describes *CRP* as teaching to and through the strengths of students who are culturally, ethnically, and linguistically diverse. She defines *culturally responsive teaching (CRT)* as a process of using cultural knowledge, prior experiences, and performance styles of diverse students to make learning more appropriate and effective for students.

CRP empowers youth by respecting and incorporating their interests, identities, cultures, backgrounds, and experiences as central to the learning process

Getting started on your journey to cultural responsiveness

A culturally responsive educator is someone with the knowledge, attitudes, and skills to work effectively with and successfully engage youth from different cultures. Cultural responsiveness is a sensibility that we acquire throughout our life. Here are a few tips on how to become more culturally responsive.

- *Understand your own culture and how it affects others.* Engage in self-reflection regarding how your values, attitudes, experiences, and social context shapes your instruction and how it might be improved.
- *Get to know your youth and build on their life experiences.* Provide opportunities for youth to share their interests and personal experiences and connect them to STEM.
- *Demonstrate caring.* Develop meaningful relationships with youth by engaging them personally and getting to know what they like and value.
- *Communicate high expectations for behavior and performance.* Communicate clear and specific expectations, and let youth know that you believe in their capabilities. This can increase their confidence and their motivation to tackle challenging problems.
- *Provide opportunities to belong.* Foster a sense of belonging with youth by listening to their ideas and letting them make real-world connections to the activities they participate in.
- *Embrace participants' home language.* Validate youth's bilingual abilities to leverage learning and make youth feel welcome and accepted.



SciGirls Strategies: How to Engage Girls in STEM

SciGirls Strategies for Engaging Girls in STEM

SciGirls airs nationally on PBS. Each half-hour *SciGirls* episode follows a different group of enthusiastic, real girls and their mentor, as they collaborate, communicate, engineer, and discover. The backbone of each *SciGirls* episode is the science, technology, engineering, and math (STEM) that drive each project. The *SciGirls* model important practices like brainstorming, questioning, predicting, observing, measuring, classifying, investigating, recording, interpreting, graphing, and communicating. These practices are at the heart of the scientific and engineering design processes. The *SciGirls* approach is rooted in research about how to engage girls in STEM. A quarter of a century of studies have converged on a set of common strategies that work, and they have become the framework for *SciGirls*.

1. Connect STEM experiences to girls' lives.

Make STEM real and meaningful by engaging girls in activities that draw on their interests, knowledge, skills, culture, and lived experiences. This helps girls develop a STEM identity and increases their sense of belonging in STEM.

2. Support girls as they investigate questions and solve problems using STEM practices.

Engage girls in hands-on, inquiry-based STEM experiences that incorporate practices used by STEM professionals. Let girls take ownership of their own STEM learning and engage in meaningful STEM work to positively impact their identities and re-define how they see STEM.



3. Empower girls to embrace struggle, overcome challenges, and increase self-confidence in STEM.

Help girls focus on and value the process of learning by supporting their strategies for problem solving and letting them know their skills can improve through practice. Support girls to develop a growth mindset—the belief that intelligence can develop with effort and learning.

4. Encourage girls to identify and challenge STEM stereotypes.

Support girls in pushing against existing stereotypes and the need to conform to gender roles. Helping girls make connections between their unique cultural and social backgrounds and STEM disciplines will negate potential stereotype barriers.

5. Emphasize that STEM is collaborative, social, and community-oriented.

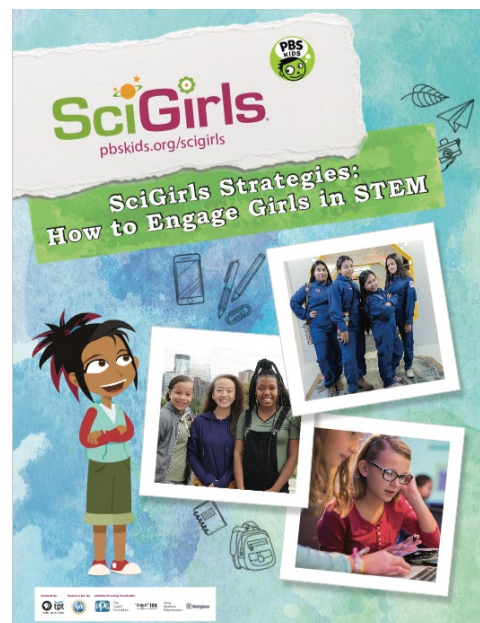
Highlight the social nature of STEM to increase interest and motivation and change the stereotypical perception that STEM jobs require people to work alone. Girls benefit from a supportive environment that offers opportunities to build relationships and form a collective identity.

6. Provide opportunities for girls to interact with and learn from diverse STEM role models.

Introduce girls to diverse women role models from varied STEM career pathways to help girls see potential futures and develop resilient STEM identities. Positive role models can increase girls' interests in, positive attitudes toward, and identification with STEM.



Find the complete *SciGirls Strategies: How to Engage Girls in STEM* guide in your STEM Tales packet.





About Book Drop Episodes

Book Drop is a new video series where youth and families can enjoy STEM and literacy together! *Book Drop* features real kids looking for problem solving ideas with the help of book suggestions from their animated friends, Kitty and Leo! Each episode features a book read by a real STEM professional, like an astronaut, a gardener, or an engineer!

Watch episodes of *Book Drop* at www.BookDropActivate.org

Bean Bags and Blueprints:

In this episode, Isaiah and Ellie learn why using blueprints is important in planning and design. They meet Civil Engineer Phil who reads the book *They're Tearing Up Mulberry Street* by Yvonne Ng from a construction site.

Nature Detectives:

In this episode, Isaiah and Ellie look for the details to learn about a plant. They meet gardener Ena who reads the book *Jayden's Impossible Garden* by Mélina Mangal. They use their senses and make observations!

Crater Creators:

In this episode, Isaiah and Ellie notice something interesting in the sky with their binoculars. They meet astronaut Frank Rubio who reads the book *Rocket Says Look Up!* by Nathan Bryon from the International Space Station.

Echoes and Obstacles:

In this episode, Isaiah and Ellie use echolocation to help them know where they are. They also meet bat expert Nancy who reads the book *Fiona the Fruit Bat* by Dan Riskin.



Activities Introduction

Participating in hands-on activities is a way for youth and families to experience how to design projects and conduct investigations as well as to satisfy their curiosity about how things work. Offer youth the chance to explain what they are doing and learning.

Engaging in interactive, creative, and collaborative activities can help dispel the stereotype that STEM is all about standing in a lab doing experiments or sitting at a desk and doing calculations. It shows that STEM can be fun and hands-on, and that creativity and teamwork are important skills in STEM fields. When you share the creative and collaborative nature of STEM, you can create a new picture of STEM professionals.

The following activities are designed for families of youth between the ages of 4 and 8. They are meant to introduce STEM practices of observation, making predictions, asking questions, making comparisons, communication, and gathering data. The *STEM Tales* program encourages full participation of parents and caregivers during the programs, with the intent that these important adults will learn new ways to encourage STEM learning at home through asking questions and encouraging their youth in acquiring STEM skills.

The general format for *STEM Tales* library program sessions is as follows:

- Welcome and Introduction, featuring a career-focused coloring page activity.
- Discussion to activate prior knowledge on the topics of the episode and activities.
- Co-viewing of *Book Drop* Episode, with group discussion after.
- First family activity exploring STEM topic (shorter activity).
- Second family activity exploring STEM topic (longer activity).

Family Take-Home Activity kits should be distributed to families at the end of each session. They are intended to be kept by families (not returned to the library). Each family take-home kit includes a copy of the book that was featured during the session, a family guide, and a few simple materials for doing some of the activities in the family guide that relate to the activities done during the library program.

Leading Hands-on Activities Tips

- Ask open-ended questions.
- Provide specific feedback on things youth can control.
- Offer youth a chance to explain what they are doing.
- Make connections between the activities and STEM careers.





Activity Kits

The following materials were provided to each of the libraries participating in *STEM Tales*. The materials were divided according to the 4 program sessions, and labeled based on the *Book Drop* episode the session will focus on. One additional bag of general materials contains items that will be used for multiple sessions, and a book that can be used as optional background reading for the educator leading the sessions.

An additional set of Family Kits will be mailed separately to each participating library. This shipment will contain 40 individually packed family kits that should be distributed to the families that participate in the library program. There are 10 family kits to correspond with each of the 4 *Book Drop* episodes/*STEM Tales* sessions (40 total). These family kits each contain the book featured in the corresponding *Book Drop* episode, family guide, and simple materials to complete the family activities at home. These kits are meant to be distributed at the end of *STEM Tales* sessions for families to take home and keep.

Nature Detectives

- 2 copies *Jayden's Impossible Garden*
- 11 Coloring pages
- Construction paper
- 4 Sheets scented stickers
- 50 Pipe cleaners
- 14 Jingle bells
- 14 Mini bells
- 5 Glue sticks
- 5 Rolls of tape

Crater Creators

- 2 copies *Rocket Says Look Up!*
- 11 Coloring pages
- 2 lb. bag of Flour
- 4 Wood beads
- 6 Ping pong balls
- 4 Marbles
- 4 Pie tins
- 1 Plastic Tablecloth
- 3 Binoculars
- 3 Printed photos of The Moon

General materials

- 1 copy *Teaching STEM in the Preschool Classroom*
- 10+ Pencils
- 5 Kid scissors
- Colored pencils
- 10 Magnifying glasses
- 5 Extra family guides
- 2 SciGirls Strategies Guides

Bean Bags and Blueprints

- 2 copies *They're Tearing up Mulberry Street*
- 11 Coloring pages
- 1 Set of Tangram blocks
- 10 Tangram building sheets
- 13 Building templates printed on cardstock
- Black paper for roads

Echoes & Obstacles

- 2 copies *Fiona the Fruit Bat*
- 11 Coloring pages
- 1 cup rice
- 1 cup beans
- 23 Plastic eggs
- 4 Small spoons
- 11 Plastic glasses
- 1 Small bag rubber bands
- 5 Rolls of washi tape

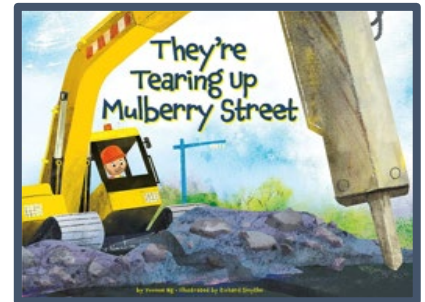


Program Session Outlines

EPISODE: *Bean Bags and Blueprints*

ACTIVITIES: Tangrams Activity and Town Designer

Start your session by having youth complete the coloring page while families are arriving. Encourage adults to help youth with the activity on the sheet that asks them to draw items that might be on a road during construction. (Fix the road! Draw what buildings, streetlights, or other construction you want to add to the road here.)



Welcome families and tell them what they will be doing today. Set an expectation for parent/adult participation from the start by saying “Welcome adults: We are so glad you are here today! You will be an active participant in the activities and discussions as part of this program.”

Encourage youth to share what they drew on their coloring page. If you have a large group, you can have them share and talk about what they drew with the other families near them instead of the whole group.

Introduce the *Book Drop* episode, *Bean Bags & Blueprints*. In this episode, Isaiah and Ellie learn why using blueprints is important in planning and design. They meet Civil Engineer Phil who reads the book *They're Tearing Up Mulberry Street* by Yvonne Ng from a construction site.

Before watching the episode, discuss:

- Have you ever seen construction? What kinds of people work at construction sites?
 - Allow for many answers to encourage lively participation. Be sure to mention that there are scientists and engineers that are an important part of the construction process too!
- Do you know what an engineer does?
 - Civil Engineers plan and design things like roads, buildings, and bridges to make sure they are safe.
- Do you like to build things?
- What kinds of vehicles will you find on a construction site?

Watch the *Bean Bags & Blueprints* episode. (10 minutes)

After the episode, discuss:

- What was your favorite part of the episode?
- Who was reading the book? What was his job?
 - Phil, a civil engineer, read the book.
- Why do you think it's important to make a plan before starting a project?

ACTIVITY 1: Tangrams

Use Shapes to Create Designs!

Tangrams are sets of geometric shapes that can be arranged together to make a wide array of designs. Naming shapes and manipulating figures such as these are important math skills for early learners. Some youth will struggle with the spatial manipulation of creating these tangram designs, but they will improve with practice!

Materials: 10 Printed full-sheet Tangram templates, set of tangram blocks. Optional: small tangram building cards

- Start this activity with a quick discussion about the shapes. Remind youth how Ellie and Isaiah used paper shapes to design the new reading area in the bedroom in the *Book Drop* episode you just watched. Hold up the tangram pieces and have the youth call out the shape names: orange triangle, purple square, red hexagon, green and blue parallelogram (or rhombus), yellow trapezoid.
- Set out the printed full-sheet templates with tangram pieces in stations. Have youth rotate through building each of the designs.
 - NOTE: the template sheets can be used in 2 ways: youth use the image as a reference and copy the design by placing the tangrams on the table next to the template OR they build directly on top of the template. Choose depending on the age and skill level of youth in your program.
 - It may work well to have them start by building next to the template. Allow them to build on top of the template if they are struggling
- Give adults direction so they understand their role: 'Adults, your role here is to encourage youth and give them hints if they get stuck. We don't want you to build the shape for them! If your first instinct is to do it for them, try putting your hands in your pockets and use your words to help encourage and give hints. Some youth may get stuck, and that's ok! This isn't a race!'
- Have youth rotate through the different stations. Note that several of the stations allow for youth to build any design they want.
- **Optional extension:** Use the smaller design cards that came with the tangram set as additional building if they have completed the larger building templates. Tangrams are also a fun way to practice making repeating patterns!

ACTIVITY 2: Town Designer

Design Your Own Town!

What do you like about where you live? Why do you think the park is where it is? Or the school? It takes a lot of people to design a town. Try designing one with your group and think about why certain places should be where they are and how people will get there.

Materials: Pencils, colored pencils, rulers, scissors, building templates, and black paper for roads. Optional: color paper for creating additional designs

Set up note: You will want an empty table or section of the floor where the group will set up their town model.

- Explain to youth that the group is going to design a town.
- Discuss why planning is important in construction and design. Remind the youth how Ellie and Isaiah made a blueprint to help rearrange the furniture in Isaiah’s room in the *Bean Bags & Blueprints* episode and how the civil engineer in *They’re Tearing Up Mulberry Street* used blueprints to help design the roads. Blueprints are like maps or models that show the parts of something.
- Discuss: For a town, what are the things we might include in our design? Accept many answers, and then direct the group that our town design is going to start with roads and buildings. What kinds of buildings might we have? (Library, hospital, school, grocery store, house, apartment, post office, etc.)
- Show one of the paper building templates to the group and demonstrate that they will cut along the solid line and fold on the dotted line to make a model of a little building that will stay upright on the table. Discuss as a group: Where should I draw the door to my house? How many windows should it have? What color should it be? Do I want to add anything else (like a mailbox or plants?).
- Explain that youth will design their own building by working on one of the templates. Then we will work together as a group to arrange all the buildings in our town, starting with the road. Demonstrate by going to the empty table or floor area, placing black strips of paper for the road, and putting your building down along the road somewhere.
- Distribute building templates to youth. It may be helpful to give adults some specific instructions. Example: “Adults, you will see that there are some short, printed instructions on the building template. Your job is to help the youth think about design and planning! Ask design questions like ‘where should the door go?’ and ‘what does our grocery store look like from the outside?’. This will help youth focus on the design of their building, and not just the color.”
- Design! Let youth design and decorate the buildings with crayons/markers. They can add windows and doors to the buildings and “paint” them the colors they want.
- When ready, youth can place the buildings and roads throughout their town.
- Discuss. After the town has been created, ask youth why they chose to put buildings where they did.
- **Optional Extension.** If youth are older or more engaged, allow them to add more than just buildings to their town design! Let them get creative! Add green paper for parks, blue paper for lakes and rivers, draw sidewalks along the roads, add stop signs and cross walks, add sports fields, restaurants, movie theaters, etc.!

Closing Discussion. Discuss the planning that would go into designing a real town. Talk about the people who work to make this happen (like civil engineers, city planners, architects, environmental scientists). Many of these jobs require people to use important STEM skills every day!

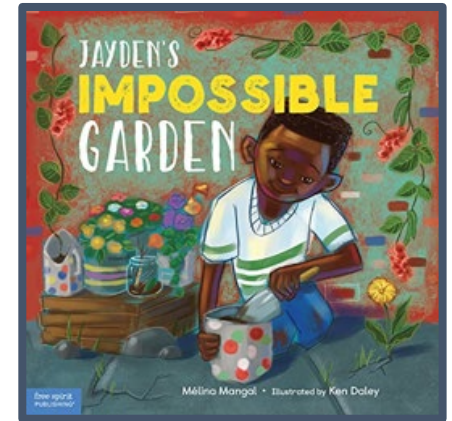
- How do the people in these careers help our community?
 - They keep us safe, like designing safe places to cross the street.
 - They make sure we have water and electricity in our homes and other buildings!
 - They plan out cities and spaces, so we have places to play, be in nature, go for walks, etc.



EPISODE: *Nature Detectives*

ACTIVITIES: Magnifying Mysteries and Art for the Senses

Start your session by having youth complete the coloring page while families are arriving. Encourage adults to help youth with the activity on the sheet that asks them to draw plants in the garden. (Draw what you want to grow in this garden!)



Welcome families and tell them what they will be doing today. Set an expectation for parent/adult participation from the start by saying “Welcome adults: We are so glad you are here today! You will be an active participant in the activities and discussions as part of this program.”

Encourage youth to share what they drew on their coloring page. If you have a large group, you can have them share and talk about what they drew with the other families near them instead of the whole group.

Introduce the episode, Nature Detectives. In this episode, Isaiah and Ellie look for the details to learn about a plant. They meet gardener Ena who reads the book *Jayden’s Impossible Garden* by Mélina Mangal. They use their senses and make observations!

Before watching the episode, discuss:

- Ask youth:
 - What is a garden? What kinds of things can grow in gardens?
 - What is a gardener? What do they do? Do they know any gardeners?
- Discuss with youth different ways to learn what things are. Examples: we make observations, we ask questions, we ask other people if they know, we look in books, etc.
- Introduce the 5 senses (touch, sight, hearing, smell, and taste). Ask the youth to give examples of things they can discover with each sense.

Watch the *Nature Detectives* episode. (12 minutes)

After the episode, discuss:

- Who was the reader and what is her job?
 - Ena is a gardener. She manages a community garden and helps her community grow things in the garden.
- What did Ellie and Isaiah do in the episode to find out what the mystery plant was?
 - They used their senses to make observations about the plant! They took notes on what it looked like and what it smelled like. Then they asked Gardener Ena for her help.

ACTIVITY 1: Magnifying Mysteries

Open Up Your World to All the Details!

By using a magnifying glass, you can see things you wouldn't normally see with your own eyes. The magnifying glasses convex lens (curved outward) bends light rays and makes small things bigger and easier to see.

Materials: Magnifying glasses, construction paper, pipe cleaners, pencils, fabric, additional miscellaneous items

- Introduce the activity and the term observation. Observing is noticing the things around us using all of our senses. For this activity, we are going to focus on using sight to make observations.
- Introduce the miscellaneous materials (do not give out magnifying glasses yet). Discuss with youth and families what makes the items different or the same? What shapes do they see? What colors? What do they observe?
- Hand out magnifying glasses and ask youth to look at the same items through the magnifying glasses. Give them time to first play around with the magnifying glasses. Focus their attention on how their observations of the items with a magnifying glass are different than with their eyes alone. Encourage them to thoroughly look and take notes (with their parent/caregiver) on what they see. Encourage them to compare and contrast.
- Share! Have youth share what they saw. Ask the same questions you asked at the beginning of the activity. Let youth compare what new things they observed on each item through the magnifying glasses.

ACTIVITY 2: Art for the Senses

Explore Your Senses with Art!

Art can be drawn, touched, smelled, and seen. Use different materials to create art for all your senses.

Materials: Paper, scented stickers, glue sticks, bells, pipe cleaners, clear tape, scissors

- Explore the materials. Let youth use their senses to discover the different materials they can create with. **SAFETY NOTE:** Do not let youth taste any of the art supplies! Have a short discussion about what senses we can use with the art materials.
 - a. Smell: scented stickers
 - b. Sight: everything!
 - c. Touch: pipe cleaners (fuzzy!), paper, tape (smooth, or sticky) etc.
 - d. Hearing/Sound: crinkly paper, bells
- Introduce the art project: Each youth will get a piece of paper to make an art project that uses their senses. If you feel the youth in your program are old enough, you can have a theme (a garden, or something they would find in a garden, etc.). Each youth will

get a piece of paper to create their project on, and there will be other shared materials that they can choose to use.

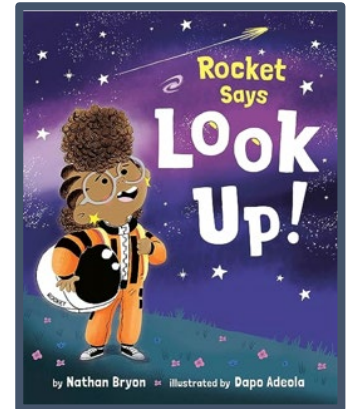
- Address the parents and caregivers directly: “Adults, your job today is to assist the youth in being creative and using their senses! Don’t do the project for them! It might not be perfect, but it will be theirs! Engage by asking questions like ‘what senses are we using with the pipe cleaner?’ and ‘how can we use our sense of hearing?’ Younger participants will likely need help with attaching materials to their paper.”
- Have a discussion with youth and adults about how to attach the different materials together:
 - a. “How can we attach the stickers to our paper?” (They are sticky and can attach right to the paper.)
 - b. “How can we attach paper to our paper?” (Glue stick or tape.)
 - c. “How can we attach the pipe cleaners to our paper?” (Tape, or by making a hole in the paper. Glue stick will not work well for attaching pipe cleaners.)
 - d. “How can we attach the bells?” (This is trickier! Glue stick will not work. Tape is ok, but it’s hard for them to make sounds if they can’t jiggle. Demonstrate how a pipe cleaner can be inserted into the end of the bell, and then the pipe cleaner can be attached to the paper.)
- Create and have fun!
- Share! Have youth share what they made. Ask them to talk about what senses their art was inspired by. If youth are older, you can have them share with the whole group. If participants are younger, or time is short, you can encourage youth to show (and talk about) their project to one family next to them.



EPISODE: *Crater Creators*

ACTIVITIES: Who's on the Moon? and Crater Creators

Start your session by having youth complete the coloring page while families are arriving. Encourage adults to help youth with the activity on the sheet that asks them to draw what they would want to do in space. (What would you want to do as an astronaut? Discover a new planet? Repair a space telescope? Draw what you'd do here!)



Welcome families and tell them what they will be doing today. Set an expectation for parent/adult participation from the start by saying “Welcome adults: We are so glad you are here today! You will be an active participant in the activities and discussions as part of this program.”

Encourage youth to share what they drew on their coloring page. If you have a large group, you can have them share and talk about what they drew with the other families near them instead of the whole group.

Introduce the episode, Crater Creators. In this episode, Isaiah and Ellie notice something interesting in the sky with their binoculars. They meet astronaut Frank Rubio who reads the book *Rocket Says Look Up!* by Nathan Bryon from the International Space Station.

Before watching the episode, discuss:

- Ask youth if they know what an astronaut is? What sort of jobs do they think an astronaut does?
- Ask youth what sort of things they've noticed in the sky before.
- Ask youth if they know what craters are.

Watch the *Crater Creators* episode. (12 minutes)

After the episode, discuss:

- Who was reading this book, and what was his job?
 - Astronaut Frank Rubio read the book.
- What did they notice about where the astronaut was reading the book?
 - Astronaut Frank read this book when he was in outer space, on the International Space Station.
- Have youth seen the Moon before? Be sure to discuss that the Moon is sometimes visible at night and sometimes visible during the day! It is a common (and incorrect) misconception that the Moon is only visible at night. Next time they see it, make sure to notice all of the spots where meteorites have hit it (craters)!

- In the book, what did Rocket do to invite neighbors to see the Phoenix meteor shower? She made signs and posters that she hung up and handed out. There is an activity like this (making a sign or flyer) in the family guide that you can do at home.

ACTIVITY 1: Who's on the Moon?

Can you find Kitty and Leo on the Moon?

Binoculars, magnifying glasses, and your own eyes all see the world in a different way.

Binoculars are tools that help you see things far away. Magnifying glasses make small things look bigger. Your eyes see things how you see them every day. Which tool do you need to find Kitty and Leo? Understanding that we can use different tools to help us make observations is important in STEM learning!

Materials: Moon photos, magnifying glasses, binoculars

Set up 3 stations before the program.

Station 1: Moon image with Kitty, no tools needed. Hang this moon image nearby. Youth should not need to use binoculars or magnifying glasses to inspect this image.

Station 2: Moon image with Leo, binoculars. Hang the Moon image somewhere so that youth will have to use the binoculars to see it (other side of the room, up on the ceiling, on a bookshelf, etc.)

Station 3: Crescent moon photo with Polly the Porcupine and Mo the Panda, magnifying glasses. Place this Moon image on a table. Youth will use magnifying glasses to investigate this image.

- Divide families into small groups and assign them to a station.
 - For Station 1: Ask youth to find Kitty, Leo, Mo the Panda, or Polly the Porcupine using only their eyes.
 - For Station 2: Ask youth to find Kitty, Leo, Mo the Panda, or Polly the Porcupine using binoculars. They should stand at least 3 feet away from the photo.
 - For Station 3: Ask youth to find Kitty, Leo, Mo the Panda, or Polly the Porcupine using the magnifying glasses. They'll need to get up close to the photo and hold the magnifying glass over it.
- **Discuss.** Once all youth have been able to test each station, ask them to share what they saw. Which photo was it easiest to spot who's on the moon? Which was the hardest?
 - Why do we use tools like binoculars and magnifying glasses?
 - What kinds of tools do you think scientists use to study Earth's Moon?
 - Scientists can use their eyes to study the phase of the moon, its location, its motion, etc.
 - Scientists use telescopes and satellites to zoom in and look at the Moon up close. You can even use binoculars at home to look at the Moon!
 - Astronauts have been to the surface of the Moon to look at it up close and bring back rock samples for scientists to study in their labs back on Earth. NASA plans to send astronauts back to the Moon in the next few years.

ACTIVITY 2: Crater Creators

Make An Impact!

Impact craters are created when an object like a meteorite crashes to the surface of a moon or planet. This doesn't happen very often on Earth today, and most impact craters that formed early in Earth's history have been erased by plate tectonics and erosion. We can still see many ancient impact craters when we look at places like Mars or Earth's Moon. Meteor showers, like the Phoenix meteor shower Rocket mentions in the book *Rocket Says Look Up!*, happen when tiny meteorites the size of dust grains burn up in Earth's atmosphere.

This activity will focus on the important STEM skill of making predictions. Youth should be encouraged to make predictions and explain why they think something is going to happen. Youth can also compare and contrast what they see in the experiment.

Materials: Flour, pie tins, wood balls, ping pong balls, marbles, tablecloth

Set up 3 stations before the program. Each pie tin should hold about an inch of flour.

SAFETY NOTE: Marbles are a choking hazard. If your program has very young participants, marbles may be omitted from this activity.

Station 1: Flour in pie tin, wood balls

Station 2: Flour in pie tin, ping pong balls

Station 3: Flour in pie tin, marbles (omit this station if very young children are present)

- **Explain and Discuss:** Families will be doing an experiment to make impact craters, just like Ellie and Isaiah did in the episode of *Book Drop*.
 - An important part of science experiments is making a prediction. Discuss predictions (a prediction is when you make a guess at what you think is going to happen).
 - Predictions are usually not all the way correct, but this is an important part of science! It's ok to not be correct!
- **Observe.** For today's experiment, let's start by making observations about the things we are going to use in our experiments. Let youth and families see and hold the wood beads, ping pong balls, and marbles. Have youth share their observations about the balls and encourage them to make comparisons. Example: the wood bead is about the same size as the ping pong ball, but the wood bead is heavier. The marble is smaller than the other balls, but heavier than the ping pong ball. Youth should also make observations about the flour.
 - **Note:** this observation phase is best done in a way that they are not yet doing the experiment. Let them observe the balls first (with the flour being kept away). Then collect the balls and let them observe the flour.
- **Predict.** Now that youth have observed the materials, it's time for them to make a prediction. It's important for each youth to be able to make a prediction, so they should share their prediction with their family, or the family next to them.

- Ask them what they think will happen when they drop one of the balls. How big do they think the impact will be? Will the wood or ping pong ball make a bigger impact?
- After allowing enough time for family/table sharing, see if anyone wants to share their prediction with the group. Encourage youth to say why they think something is going to happen. Example: I think the marble will make a smaller crater because it is smaller.
- Divide families into small groups and assign them to a station. Make sure adults know they should be making sure that youth are dropping the objects into the flour, not throwing!
- **Create!** Let youth make their own impact craters with the materials at their station. Have them hold one of the balls over the head and drop it into the pie tin. Make sure each youth gets to test out one of the balls. Once all youth have tested at their station, have them switch to a different station so they can try out all materials.
 - When they switch stations, instruct adults to have youth make predictions about their new materials before they start!
- **Discuss.** Once all youth have been able to test all stations, ask them to share what they saw. What were the differences between the wood, ping pong balls, and marbles? What other items could they try to make an impact with?



EPISODE: *Echoes and Obstacles*

ACTIVITIES: Echo Maker and String Sounds

Start your session by having youth complete the coloring page while families are arriving. Encourage adults to help youth with the activity on the sheet that asks them to draw animals. (What animals do you want to learn more about? Draw them here!)

Welcome families and tell them what they will be doing today. Set an expectation for parent/adult participation from the start by saying “Welcome adults: We are so glad you are here today! You will be an active participant in the activities and discussions as part of this program.”

Encourage youth to share what they drew on their coloring page. If you have a large group, you can have them share and talk about what they drew with the other families near them instead of the whole group.

Introduce the episode, *Echoes & Obstacles*. In this episode, Isaiah and Ellie use echolocation (the location of objects by reflected sound) to help them know where they are. They also meet bat expert Nancy who reads the book *Fiona the Fruit Bat* by Dan Riskin.

Before watching the episode, discuss:

- Ask youth what they know about bats. Bats “see” at night with their ears using echolocation! Bats are important for pollinating certain plants. Many bats found in North America eat hundreds or thousands of mosquitos and other insects a night, making them important for controlling insect populations! Beware the common misconception about bats being blind: most bats can see just fine with their eyes. They use echolocation because they spend so much time in the dark (in caves and at night).
- Ask youth if they know what an echo is. (Echoes are when sounds bounce back to us, and we can hear the sound again.)
- Listening to sounds is using our sense of hearing. What are our other senses? (Sight, touch, taste, smell.) Let’s watch this episode of *Book Drop*. When the reader is reading the book *Fiona The Fruit Bat*, let’s look for times they mention using senses.

Watch the episode *Echoes & Obstacles*. (13 minutes)

After the episode, discuss:

- What would they tell their family and friends about bats or echoes?
- Who read the book and what is her job? Nancy Simmons is a zoologist who specializes in bats. She works at the American Museum on Natural History.



- What are some jobs they could do in a zoo or a museum?
- What was their favorite part of the show?
- What's one thing they learned from the show?
- Did you notice a time in the book that Fiona was using her senses? Fiona's sense of sound is mentioned throughout the book! Fiona mentions smelling fruit and tasting warm milk. Fiona mentions cuddling with her mama (touch).
- Note: If youth have lots of questions about bats or echolocation, consider reading the information pages from the back of *Fiona the Fruit Bat* out loud. (They were not read during the episode of *Book Drop*.)

ACTIVITY 1: Echo Maker

Can You Make Your Voice Echo?

Have you ever shouted in an empty room and heard your own voice come back to you? That's an echo! Echoes are made when sound waves hit a surface and bounce back to the listener. Echoes can even help you find your way around with echolocation. Bats use echolocation to navigate their surroundings.

Materials: various materials can be used for this activity, depending on what is available. You will want some hard materials (pie tins, books, large bowls, or lids), and soft materials (jackets, backpacks, pillows, whatever is on hand).

- **Demonstrate.** Start with a simple demonstration about making your ears bigger, like Isaiah does in the episode. Have youth and adults cup their hands behind their ears and push their ears forward and talk to each other. Do their voices seem louder?
- **Discuss.** In the episode, Ellie held up a large round garbage can lid in front of Isaiah so his voice would bounce off the lid and help guide him through the obstacle course. We are going to do an experiment to see if we can hear a difference when different objects are held in front of us.
- Distribute materials to families. Tell them to hold the object (book, or pillow) a short distance (about 6 inches) in front of their face, then have them say their name loud and clear. Do they hear an echo? Does the sound seem different?
- Have families rotate between objects to determine if they can hear a difference. Encourage them to close their eyes and focus on their sense of hearing.
- **Discuss.** Which objects did they hear echoes with? Why might some objects create better echoes? (Sound reflects better off of hard smooth surfaces.)

ACTIVITY 2: String Sounds

Make an Instrument!

Sounds are made when things vibrate. Sometimes you can see or feel the vibrations! Try with a rubber band – what happens when you stretch a rubber band and pluck it like a guitar string? Does it make a sound? Can you see it vibrate?

Materials: Short clear cups, rubber bands, rice, beans, plastic eggs, washi tape, small spoons

Set up 3 instrument making stations ahead of time.

Station 1: cups and rubber bands

Station 2: plastic eggs, washi tape, spoon, rice

Station 3: plastic eggs, washi tape, spoon, beans

INSTRUCTIONS:

- **Explain & Discuss.** Introduce the materials and tell youth they will make 3 simple instruments. Show the materials and ask youth for ideas for how they will use these materials to make an instrument.
- **Create!** Have families go to each of the stations to make each instrument.
 - a. **Station 1:** Stretch 1 or 2 rubber bands on a cup so that it goes over the top and bottom of the cup for a guitar.
 - b. **Station 2:** Put rice inside a plastic egg for a shaker. Only a small spoonful is needed. Have adults secure the egg closed with tape.
 - c. **Station 3:** Put beans inside a plastic egg for a shaker. Only a small spoonful is needed. Have adults secure the egg closed with tape.
- **Play the new instruments.** Come back together as a group once everyone has their instruments. How do they sound? Are there things you can do to make them sound different?
- **Explore.** Do different sizes of rubber bands sound different? What if you use different sizes or shapes of cups? How do the eggs with rice or beans in them sound different? What happens if you pull the rubber band so it's tighter? Does it sound the same?
- **Optional Extensions:**
 - a. Use blindfolds and see if the youth can find their way following a sound. **SAFETY NOTE:** Make sure the area is clear of anything that could cause harm to the blindfolded youth walking around.
 - b. Have youth sit with their eyes closed. Have adults stand in various locations around the room with an instrument. Have adults take turns playing their instrument and have youth point towards where they think the sound is coming from (this will help them see that they can already tell a lot from their sense of hearing—they can tell the direction a sound is coming from!)