S.T.E.M. IN SUMMER

Creative science for everyone

A collection of resources from OregonASK, Museum of Science and Industry Chicago, the Educational Equity Center at AED, Woodburn Afterschool Club and Pacific University
IMPLEMENTING S.T.E.M. WITH YOUTH
FRAMEWORK
FOR INSPIRATION

STEM education is an approach to teaching and lifelong learning that emphasizes the natural interconnectedness of Science, Technology, Engineering, and Math, transforming the learner’s experience to be:

Cross-disciplinary  Relevant & Applied  Open-ended & hands-on  Reflective & Iterative  Rigorous

The Framework for Inspiration is a proposed system for implementing active learning in STEM which promotes youth voice and positive STEM Identity. The most important tool in creating an active learning environment is encouraging and sustaining a growth mindset in youth, educators, and providers. Focusing on STEM Processes can allow educators to make the most of any content within math and science.

TRAINING ON THE FRAMEWORK INCLUDE THREE BASIC PARTS:

- Tools that create an environment that supports & encourages youth
- Scientific process cycles: focusing on process
- Agile and other simple student guided systems for group work

AN EDUCATOR NEEDS

- Skill for asking questions
- Ability to step back
- Conflict management experience
- A manual or playbook with practical information such as Agile roles, tips on developing a showcase or event with examples of sharing opportunities, etc.
Inquiry-based learning is a youth-centered, active learning approach that involves questioning, critical thinking, and problem solving.

**STEP 1: ASK**

The inquiry process begins by asking questions tied to real-world problems, questions, or challenges. During this stage youth create an open-ended question about a phenomenon or a problem. Once youth have a question, they develop a working hypothesis—a prediction.

**TIPS FOR SUPPORTING YOUTH DURING THIS STAGE**

**Twenty Questions** is a strategy to help youth brainstorm questions they may have about a topic and focus their questions on a specific project. You can start by having youth select a topic they’re interested in learning more about. To help them get started, try questions like:

- What do you want to know more about?
- What is a problem or challenge you see that you’d really like to work on?
- Where do you see opportunity to make changes in your community?
Post-it notes can be a helpful tool to elicit youth engagement. Ask youth to write one question or topic per post-it and brainstorm multiple topics, or questions they’d like to know more about – the more ideas the better.
- After some time youth should have a wide range of issues that they’re interested in learning about with some overlap.
- Try re-grouping post-its in themes or patterns with the support of youth, and then ask youth to sticker vote on areas they’re most interested in. Continue until a specific topic is identified.
- Once youth have focused on a topic have them brainstorm twenty questions they have about the topic.
- Use fist to five, sticker voting, or group dialogue to support youth in narrowing down their questions to the five most important.
- Depending on the topic and question you might support youth to hone in on one question or divide the group to focus on different aspects of the project.

Once there’s consensus on a specific, problem, issue or topic youth will need support to fine tune their question. What specifically do they want to learn, identify, or answer?

Encourage youth to create an open-ended question, that can’t be answered with yes or no. Have them brainstorm who, what, when, where, and why questions related to their topic of interest.

Mapping is another great way to support youth to think through specific questions they have about a given topic.
- Using a poster paper or white board draw a small target circle in the center where youth can focus the project purpose.
- Outside of that circle draw another circle where youth will brainstorm a list of ideas.
- Outside of that circle draw a larger circle where youth can refine or advance their ideas.

Example: Suppose that youth have decided to focus on a garden project but they can’t decide on the project emphasis.

- The goal in this case is to help the group decide what kind of garden project they’re most interested in.
- As the facilitator write garden project in the center and circle it. The center of the map always shows the project focus or purpose to help the group focus.
- Using a different color of marker ask the group open-ended questions designed to help youth further brainstorm areas of interest in relationship to this topic:

**What can we do in the garden?**

**What are different steps to gardening?**
- Ask group members to shout out their ideas as you write them on the board/poster around the outside of the bull’s eye. You’ll draw a circle around these ideas too so try not to let the responses stray too far around the page.
- Prepare more open-ended questions expanding on the ideas listed in the previous circle. Direct the question first to one of the inner ideas

**What can we learn about in the garden?**

**What can we research about soil preparation?**
STEP 2: PLAN

The second stage of inquiry involves creating a plan to test the hypothesis. This often involves creating models to develop explanations. Participants should consider the influence of multiple variables when developing a plan to test hypothetical explanations. When planning an engineering project various models can test the strength and limitations of a design.

During this stage youth identify a list of all the steps necessary to conduct a project and then outline a chronological order.

Post-it Planning
- After youth have decided on a question and hypothesis, support them to take turns identifying all the tasks or steps necessary to undertake this project.
- As a group place sticky notes on a piece of poster paper to create a timeline of the steps they’ll need to take (brainstorm every step first then arrange chronologically).
- Make any additions or changes
- Document the final list

Backwards Planning
- Have youth identify the final outcome of the project.
- Ask youth to start writing (or stating aloud) the steps to get this done, starting with the one right before the final product or outcome and continuing until they reach what would be the first step.
- Use questioning to help the group get “unstuck” or for conflict management if disagreements occur.
- When finished, with index cards or sticky notes, have youth agree on an order and rearrange the steps as needed –see Post-it planning above.
- Have youth share their plans with a partner to ensure the group understands the plan.

STEP 3: OBSERVE

During the third stage of inquiry participants organize and interpret information, carry out a pan, analyze and interpret data, and look for patterns to derive meaning. At minimum this stage includes some form of measurement. In an engineering project this includes analysis of data collected in the application of models –examining the effectiveness, efficiency, and durability of designs.

Tips to supporting youth during this stage of inquiry: Planning & Observation Reflection

Handouts
- Readymade handouts that allow for efficient and effective data collection can be helpful for youth.
- Consider creating an observation handout that allows youth space to write down their question, hypothesis, plan and observations.

STEP 4: RECORD

After posing a question, enacting a plan, and making observations –during the fourth stage of inquiry youth utilize math and computational thinking to record and visually represent the relationships observed between the interactions of variables. This step can be as simple as rudimentary graphs or scales, or as complex as mathematical equations and statistical analysis.

Tips to supporting youth during this stage of inquiry:
- When using a handout like that described above consider incorporating helpful tools for recording information like graph paper, charts or other diagrams to help youth create relevant records. See sample Tallest Tower Activity.
STEP 5: REFLECT

After observing and recording findings, during the reflection stage youth get to examine the strengths and weaknesses of the evidence and develop the best available explanation or theory for their results. During this stage youth develop logical arguments to defend their findings based on the data.

Tips to supporting youth during this stage of inquiry

Learned So Far Reflection Activity

• In this reflection activity youth write down what they have learned so far about a given topic or skill.
• Give youth two different color index cards or scrap pieces of paper.
• On one card ask them to write one thing they’ve learned.
• On the other card ask them to write a question they still have.
• Collect the cards and redistribute them to the group and review aloud.

Green, Yellow, Red Light Reflection

• During this activity youth collectively reflect on things they would like to continue doing, stop doing, and start doing.
• Post a piece of large paper or use a whiteboard and draw 3 columns.
• In column one; “green light,” participants list the things they would like to start doing.
• In column two; “yellow light” participants list the things they would like to continue doing.
• In column three; “red light,” participants list the things they would like to stop doing.
• Distribute sticky-notes and have participants write their reflections on 3 different notes for each column and then place their reflections in the appropriate column.
• This reflection activity can lead to a helpful group discussion about decisions and a plan based on ideas generated.

STEP 6: PRESENT

In the final stage of inquiry youth communicate their ideas and the results of inquiry. Through clear and persuasive dialogue youth share orally, in writing (with documentation of the evidence: graphs, charts, tables etc.), and in conversation with peers. In this process youth derive meaning from the process itself and gain feedback to apply in the future.

Tips to supporting youth during this stage of inquiry

Postcards

• Support youth to mentally review their project and create a postcard for someone who was not there.
• Ask youth to reflect on the activities and experiences of the project. It may be helpful to lead them through a brief mental walk—through of all the project activities.
• Ask youth to take a mental snapshot of some experience they had during the project that they would like to send as a postcard to someone who was not there.
• Have each participant draw and briefly describe their postcards to the rest of the group.
This activity can be used as a way to prepare youth for presentations as they reflect on:
• What stood out to them
• What do they want others to know
• What questions remain

Practice Presentations

• After youth have shared their reflections support members of the group to identify elements of the project they’re most interested in sharing with their peers.
• Support each youth to identify a role within the presentation and help them practice independently and as a group.
Name: 
Date: 

Materials: 
• 20 sticks of spaghetti 
• 1 yard of masking tape 
• 1 yard of string 
• 1 marshmallow 

TALLEST TOWER DESIGN ACTIVITY 
INITIAL INQUIRY 

1. What variables might affect the height and stability of your tower? 

2. What variable is your group testing? Independent Variable (IV) = 

3. What do you think is going to happen when you change this variable? 

4. Dependent Variable (DV) = Height (cm) 

5. Controlled Variables = 

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APPLYING INQUIRY-BASED LEARNING 

STEM MENTORS TOOLKIT
PICTURE OF YOUR SET-UP

DATA TABLE FOR THE INQUIRY

<table>
<thead>
<tr>
<th>IV</th>
<th>DV= Height (cm)</th>
</tr>
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<tbody>
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<td></td>
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</tbody>
</table>

GRAPH OF VARIABLES
DATA-INFORMED PLANNING
What variables have the greatest effect on tower height?

SCENARIO: Your group’s task is to determine the combination of factors that will create the tallest tower.

PROBLEM: Identify the problem(s) your tower should address.

CRITERIA: What should your tower be able to do? Be specific.

PRIORITIES: Rank the criteria you identified above in order of importance. Be sure to explain your rankings.

CONSTRAINTS: What might limit your ability to build a tower? What might limit the effectiveness of the tower you build?

SOLUTIONS: Using what you learned from your first attempt sketch two different design ideas for your own tower. Be sure to label all the parts and include important measurements. Below are some questions to consider as you brainstorm ideas.

- What shape will you use?
- Where will you utilize the marshmallows?

| SOLUTION 1 | SOLUTION 2 |
**BUILD:** Choose one of your solutions to build first and then gather the materials you need and start building your solution. If you make changes as you build, be sure to update your original sketch as well (so you have an accurate record for future reference).

**TEST:** Test your design

<table>
<thead>
<tr>
<th>Tower Design</th>
<th>Trial 1 Height (cm)</th>
<th>Trial 2 Height (cm)</th>
<th>Trial 3 Height (cm)</th>
<th>Average</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>2</td>
<td></td>
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</tbody>
</table>

**EVALUATION:** Evaluate the effectiveness of your solutions and explain the engineering behind your tower. Which of your designs was the most effective in terms of criteria, priorities and constraints?

How could you improve your tower? Think beyond the constraints that restricted you in this activity.
Bubble Science  (For children ages 3-8)

It’s hard to resist the magical quality of blowing bubbles and watching them float away. But did you ever wonder, how bubbles form? Here’s a fun activity that examines the science of bubbles.

20 – 30 minutes

Skills Developed:
- Decision-making
- Large and small motor coordination
- Observing, inferring, and predicting
- Using tools

What’s the Science?

Water molecules, small particles of water, are made to stick together — they have cohesion which makes the surface too strong to stretch into a bubble shape. Adding soap weakens the surface. The soap and water molecules adhere, or stick together, so when you blow air into it, the surface stretches and bubbles are formed. The bubbles have “skins” made of many layers of soap and water which help water molecules stretch to become spherical, or round. Adding glycerine, which bonds with water molecules, slowing down evaporation, makes bubbles last longer.

The colors in bubbles occur because the skin is thick in some places and thin in others. Light bounces off, or is refracted through the thick areas, and enters through the thin ones. Where the bubble is thick, the light will appear red, and where it is thin, the light will appear violet. The colors in-between occur because of differences in thickness.

Materials Needed:
- 1/2 cup of liquid detergent
- 1/2 gallon of water
- 1 oz. of glycerine (available in the hand lotion section of drug stores)
- Basins, bowls, or any large pan
- A measuring cup
- Straws
- Small paper cups
- Pipe cleaners
- String
- Scissors
- Pencils (for making holes)
- Newspaper to cover the table and floor
- Paper towels for cleanup
- Smocks (optional)
Getting Ready:

Make the bubble mixture by pouring ½ gallon of water into a large container and adding 1/2 cup of liquid detergent and about 1 oz. of glycerine. Mix contents very gently and do not shake. Avoid making suds. If you can plan ahead, the best bubble solution is one that has been allowed to sit overnight. (Your bubble mixture can be stored and reused.)

Cover a table and the floor with newspaper – or take the bubble mixture outside. This is a great outdoor activity.

Activity:

1. For bubble-makers, start with the paper cups and, using a pencil, make a hole in the bottom. Let your child experiment with the sizes of the hole, or decide for herself if she wants to remove the bottom completely.

2. Let your child experiment with the other items for creating bubble-makers. Try making some samples together:
   - Use pipe cleaners to make a round bubble-maker. Then try to make square one. Be sure to twist the ends of the pipe cleaners securely.
   - Make a rectangular bubble-maker by threading a piece of string through two straws and knotting the string. Hold the straws as far apart as possible to form a rectangle.

3. While you are making bubbles and experimenting together, you may want to ask a few questions:
   - Could your hand be a bubble-maker?
   - What do you see when you hold bubbles to the light?
   - Can you make different sized bubbles? How?

4. Afterwards, talk about the role of air in bubbles (air takes up space, the more air, the bigger the bubble) and about the color in bubbles. Ask:
   - Do you see a rainbow?
   - Do the colors disappear right before the bubble breaks?

Additional activities for different age-levels:

3-4 year olds

Put a large sheet of waxed paper on the table and add some bubble solution. Ask your daughter to put a straw directly on the bubble solution and blow, which will make a big mound of bubbles, which she can feel, move around on the waxed paper, and have fun popping.

5-6 year olds

Create bubble-makers that will produce very large bubbles, for example, knot a long piece of yarn together to make a big circle; make a large rectangle with straws and string; or twist several pipe cleaners together to make a large, free-form shape. Blow some bubbles inside and some bubbles outside. Compare the results.
Activities for different age-levels (con’t)

7-8 year olds
Create three-dimensional bubble-makers using pipe cleaners to construct a pyramid or a cube. Ask your daughter to predict whether the bubbles will be the same or different than the ones she made with two-dimensional bubble-makers. Ask how she thinks she can change the shape of the bubbles.

Weather permitting, take the bubble activity outside. Was it hard or easy to blow the bubbles outside? How quickly did they blow away? How far away did they get before they popped? Repeat the activity on a day with different weather — hotter, colder, windier, or less windy. Record those results and then compare the two.

If Your Child Has a Disability
All the activities can be done with children with a wide range of disabilities by making some modifications. You are the best judge of what those modifications might need to be, but here are some suggestions that have worked well.

For a child who is blind or visually impaired:
Look for the commercial bubble making kits that make “touchable” bubbles. This can be useful to demonstrate the idea that a bubble is a skin with air inside. Put a half-inch of bubble solution into the bottom of a cup, place a straw into the solution and blow gently. Have your child hold her hand over the top of the cup. When the bubble reaches her hand, she’ll be able to feel the surface. Do the same with one of the bubble makers.

For a child who is deaf or hard of hearing:
Review ASL and English (or child’s native language) vocabulary words and concepts, such as “bubbles,” “bubble-maker,” and “burst.” Some children may need assistance with breath control. If bubble-blowing is not an option, have your child create bubbles by moving the bubble maker through the air.

For a child who has a physical disability:
Attach foam rubber to a pencil with masking tape to make an easy-to-use hole maker.

If bubble-blowing is not an option, have your child create bubbles by moving the bubble maker through the air or use a small fan.

For a child who has learning/emotional disabilities:
Create a step-by-step chart indicating what your child will be doing. Use a limited number of materials for making the bubble-makers. Add different materials each time you do the activity.
Looking at How Liquids Move (For children ages 4-8)

A quiet and calming experiment to observe the surface tension of water, and learn how colors mix

Skills Developed:
- Color mixing
- Recording data
- Observing, inferring, and predicting
- Understanding cause and effect

Materials Needed:
- Water basin or large foil pan about 3-4 inches deep
- Cold water
- Cornstarch
- Food coloring (package of four)
- Straws
- A small amount of liquid detergent (keep hidden)
- Newspaper
- Paper or a notebook to record observations

What’s the Science?
The top layer of water has something called surface tension, which means that the water molecules, the smallest particles of water, are shaped so they stick together — they have cohesion. If the water is cold, it has a stronger surface tension and a drop of food coloring will float on the surface before eventually breaking through. A few drops of detergent will break the surface tension, causing the water molecules to move away from each other, which will make the food coloring disperse more quickly. Cornstarch will absorb some of the water and the food coloring, eventually settling on the bottom.

Getting Ready:
Cover your work surface with newspaper to protect from spills. Fill a basin or pan with cold water about two inches deep and place it in the center of the table. Put a few drops of detergent into a small cup and keep it aside.
Activity:

1. Add a thin layer of cornstarch to the water in the basin and stir gently to mix. The water should be creamy white. Your daughter can help you prepare this solution.

2. Give your daughter a straw and show her how to hold the straw above the water and practice blowing gently on the water.

3. Have her squeeze 1-2 drops of one color of food coloring onto the mixture, observe what happens, and then blow very gently through the straw along the surface of the water. Together, observe as the color travels through the creamy liquid. Ask her to describe what she sees. Ask questions like:
   - How is the color moving?
   - Can you make it go another way?
   - What does it look like? Is there a pattern?
   - How can you change the pattern?

4. Now have her add 1-2 drops of the second color. Watch how the color moves through the liquid. Ask your daughter to describe what happens when the two colors join together.

5. Continue adding drops of the third and fourth colors. Let the color move naturally and watch the pattern it makes before blowing gently with the straw. When the color drops join together, that's called color mixing.

6. When you are finished, ask your daughter to watch carefully since the next part of the experiment can only be done once. Drop a fresh color into one spot on the water, but don’t blow on it. Pick up a few drops of the liquid detergent with the end of a straw and drop it into the food coloring. Watch as the color moves away from the detergent. Ask your daughter to describe what she saw and if she can explain what happened.

7. After experimenting, pour out most of the water and observe what happened to the cornstarch.

8. Press a piece of paper (paper towel works well) onto the cornstarch to make a print of the colors.

9. Help your daughter write down (or dictate) her observation and illustrate what she observed.

Additional activities for different age-levels:

4 year olds
Set up three small pans (foil pie pans work well) with the cornstarch and water solution. Mix 1-2 drops of red and blue food coloring in one pan to make purple, red and yellow in another to make orange, and blue and yellow in the third to make green. If your daughter wants to, she can mix all the colors in a fourth pan to make brown.

5-6 year olds
Do the activity first with very cold water, and then with very warm water. Look for the differences in how the food coloring mixes when the water is different temperatures. Talk about what those differences are and write them down in a list.

Make ice cubes using blue food coloring and put them in water that has been mixed with yellow food coloring. What color does the water become when the blue mixes with the yellow? Ask your daughter to think of other colors that can be mixed this way.
7-8 year olds
To compare the surface tension of hot and cold water, get two plastic cups and fill one with hot water and one with cold. Gather a pair of tweezers and a thin sewing needle. Use the tweezers to place the needle gently on the water’s surface in each cup without touching the water with the tweezers. You’ll notice that the needle will float in the cold water, but sink in the warm. This is because the surface tension is greater in cold water.

If Your Child Has a Disability
All the activities can be done with children with a wide range of disabilities by making some modifications. You are the best judge of what those modifications might need to be, but here are some suggestions that have worked well.

For a child who is blind or visually impaired:
Using a Braille or large print ruler, measure the amount of water in the basin. To help your daughter grasp the concept of surface tension, place cold water in a small bowl and sprinkle black pepper or sesame seeds on top. The pepper or seeds will be resting on the surface tension. Add a drop of detergent to break the surface tension and the pepper/seeds will be pulled to the side of the bowl. Your daughter can use her hands to feel this occur. To help her understand the circular motion of the food coloring, use finger paints, guiding her hands on the paper, to illustrate how the color moves through the water. If your daughter is able to see strong colors, use extra food coloring and make sure she is very close to the basin of water. Follow up with finger paints (see above).

For a child who is deaf or hard of hearing:
Review ASL and English (or child’s native language) vocabulary words and concepts, such as “blowing,” “swirling” “and scattering.” Some children may need assistance with breath control and may need a demonstration of how to blow gently but with enough force to move the color through the water.

For a child who is physically disabled:
If needed, transfer food coloring to larger squeeze bottles for easier grasping. Secure the basin with masking tape on the table or wheelchair lap tray.

For a child who has learning/emotional disabilities:
Create a step-by-step chart using pictures and words to help your daughter focus on the experiment. Review the chart before and after each step. Being able to manipulate the materials and think creatively will engage your child in the experiment.
Sink and Float (For children ages 4-8)

Do you know what determines whether an object will sink or float in water? Try this simple and fun experiment to find out.

30–40 minutes

Skills Developed:
- Classifying
- Comparing
- Hypothesizing
- Observing
- Predicting
- Recording data

Materials Needed:
- Plastic basin filled with water (If possible, use a clear plastic basin)
- Two medium-sized containers labeled:
  - Things that float
  - Things that sink
- A medium-sized container to hold objects for testing
- Small objects for testing, such as:
  - Wooden spoon
  - Small sponges, or pieces of sponge
  - One metal teaspoon and one plastic teaspoon
  - Plastic cup
  - Coins (pennies or a quarter) and paper clip

What’s the Science?

An object’s density and the amount of water it can displace determines whether it will sink or float. Density refers to the measure of the relative “heaviness” of an object, based on its volume, or dimensions. For example a Styrofoam cup is less dense than a ceramic cup of the same size. In the Ceramic cup, molecules are packed tighter together, giving it a higher density, which means it will sink in liquids. The molecules are spread out in the Styrofoam cup and it will float.

Liquids also have density and, in order to float, an object must be less dense than the liquid it floats in. Objects will sink more slowly, depending on the thickness of the liquid.
Getting Ready:
Assemble 15-20 items for testing and put them in the holding container. Keep the paper clips and coins separate, but nearby. Place the container, along with the basin filled with water, on a table and put the sink/float sorting containers nearby, along with paper towels and sponges. Make a data chart for recording results by drawing a line down the middle of a sheet of paper. Label one side with “Sink” and the other “Float.”

Activity:
1. Before beginning the activity, ask your daughter a few questions, such as:
   - Is there a name for what happens when an object stays on top of the water?
   - Is there a name for what happens when an object doesn’t stay on top of the water?
   - Do you think all of these things can stay on top of the water? Why? Why not?
2. Ask your daughter to pick something from the container that she thinks will float. Discuss why she thinks so and then have her test her prediction. After, have her put the item in the appropriate sink/float sorting container.
3. Continue to test, using the other items. Record findings on the sheet of paper.

4. Bring over the paper clips and coins and ask your child if she can make something sink that didn’t before. Try putting a coin on top of it or attaching a paper clip. Ask her why she thinks objects sometimes sink and sometimes float.

Bathtubs and bath time are made to order for sink/float activities. Collect items that are unbreakable and have no sharp edges. Follow the procedure of the activity: predict, test, and record.

If you live near a lake, marina, or river, your daughter can observe objects that float and sink, for example, stones, fish, anchors, buoys, life preservers, etc.

Additional activities for different age-levels:

4 year olds
Provide an opportunity for your daughter to explore sink/float on her own before beginning the experiment. Demonstrate with one of the objects to show her that if you put an object in the water it will sink or float. Let her experiment with some of the other objects. In summer, or if you live in a year-round warm climate, set up the sink/float experiment outdoors.

5-6 year olds
Try doing the activity using Oobleck instead of water, or by putting small objects in the oil and water in the Mystery Bottle (go to the Activities tab on http://facebook.dj/scienceitsagirlthing and download the Oobleck and Mystery Bottle activity cards for more information).
Activities for different age-levels (con’t)

7-8 year olds
Set up the experiment in two basins. Add water to both basins and then add one cup of salt to one of the basins. Have your daughter try the same object in each basin to see if they react differently. Have her record her findings on the chart. Try making small boats out of aluminum foil and weigh them down with paper clips or pennies and try floating them in both basins. Compare the differences and record the findings.

If Your Child Has a Disability
All the activities can be done with children with a wide range of disabilities by making some modifications. You are the best judge of what those modifications might need to be, but here are some suggestions that have worked well:

For a child who is blind or visually impaired:
If your child has low vision, use a clear plastic basin so she can see items through it. Make a tactile graphic that shows a line in the middle with “things that float” above the line and “things that sink” below the line. The words can be made tactile with yarn or pipe cleaners. Let your daughter touch the items when they’re in the water so she can determine if they’re sinking or floating.

For a child who is deaf or hard of hearing:
Use a clear plastic bin to enhance the visual experience. Review ASL and English (or child’s native language) vocabulary words and concepts, such as “sink” and “float,” and for names of all items to be tested.

For a child who is physically disabled:
Use a clear plastic basin to ensure your child will be able to see the items in the water. Secure the basin to the table with Velcro or masking tape. Be sure that all descriptive words and concepts are included in any communication device being used. Your daughter may indicate her choice of items to test by looking at, pointing to, or touching an object. If she isn’t able to place an object in the water by herself, she can use gestures to indicate whether she thinks it will sink or float.

For a child who has learning/emotional disabilities:
Include pictures of the objects being tested on the recording sheet. Use open-ended questions to ensure that your daughter understands the concepts of “sink” and “float.” For example, “What happens when you put this object in the water? Does it stay on top? Go to the bottom? Stay near the top, but under the water?” Allow time for her to look at and handle the objects.
GOODNIGHT, MOON (AND STARS)
EXPERIMENT: STARLIGHT FLASHLIGHT AND MOON JOURNAL

Do you ever notice how the night sky changes above you? The moon’s shape changes throughout the month, and the constellations change with the seasons. Make your own constellations shine with a starlight flashlight, and observe the moon’s phases by tracking its shape in a journal.

MATERIALS
- Flashlight
- Aluminum foil
- Paper
- Rubber bands
- 18-ounce cups (Styrofoam, paper or plastic)
- Moon journal (msichicago.org/summerbrain)
- Duct or masking tape
- Electrical tape
- Pen or pencil
- Pushpin
- Scissors or utility knife
- Rubber bands
- Aluminum foil

INSTRUCTIONS
Your starlight flashlight will work best with a bright, focused beam of light. If your flashlight has a shiny, reflective surface around the bulb, unscrew the top and remove the lens. Cover the reflector with black electrical tape and reassemble the flashlight without the lens.

Cut out a hole and insert the flashlight here.

Insert the flashlight into the hole at the bottom of the cup. Turn on the flashlight in a darkened room and aim the starlight flashlight at the wall. Make several constellation cups so you can change what you see in your night sky!

Check out the real night sky and track the phases of the moon in a moon journal (available at msichicago.org/summerbrain). Find the moon on a clear night and shade in the part of the moon that appears dark. You can also note the date and time of your observation. Make an “X” if it’s cloudy or rainy and you can’t see the moon. As you make your observations, notice how long it takes for the moon to return to the same shape.

WHAT’S HAPPENING?
A constellation is a group of stars that appears to form a pattern or picture. There are 88 official constellations, many of which were named after animals or mythological characters by ancient Greek astronomers. Constellations seem to move across the sky but it’s actually the movement of the Earth rotating on its axis that causes the constellations to shift positions.

The moon changes shape because of its orbit around the Earth. It takes about four weeks to go through all its phases: waxing crescent, first quarter, waxing gibbous, full moon, waning gibbous, third quarter and waning crescent before the next new moon. The moon doesn’t give off its own light; the bright part of the moon you see is light reflected from the sun.

VENUS
I may be similar in size to Earth, but I’m covered by thick clouds and lots of active volcanoes. The heat is so intense here it can melt lead!

GOLDEN YEARS OF THE NIGHT SKY
Use sky maps (skymaps.com) to help you find your way around the night sky.

RECOMMENDED READING
“Find the Constellations” by H. A. Rey
“Zoo in the Sky: A Book of Animal Constellations” by Jacqueline Mitton

GAME ON
Create your own constellation design for your starlight flashlight, and give it a name. Make up a story about it, and tell your friends. Create other constellation designs for the other characters in your story. Or try turning yourself into a constellation – just lay down on the sidewalk in an interesting pose and have a friend use chalk to make dots at your head, shoulders, elbows, hands, feet, knees, etc. Stand up and connect the dots to create your constellation!
GOODNIGHT, MOON (AND STARS)

EXPERIMENT: STARLIGHT FLASHLIGHT AND MOON JOURNAL

Do you ever notice how the night sky changes above you? The moon’s shape changes throughout the month, and the constellations change with the seasons. Make your own constellations shine with a starlight flashlight, and observe the moon’s phases by tracking its shape in a journal.

MATERIALS
- Flashlight
- Aluminum foil
- Paper
- Rubber bands
- 18-ounce cups (Styrofoam, paper or plastic)
- Moon journal (msichicago.org/summerbrain)
- Duct or masking tape
- Electrical tape
- Pen or pencil
- Pushpin
- Scissors or utility knife
- Rubber bands

INSTRUCTIONS
Your starlight flashlight will work best with a bright, focused beam of light. If your flashlight has a shiny, reflective surface around the bulb, unscrew the top and remove the lens. Cover the reflector with black electrical tape and reassemble the flashlight without the lens.

Insert the flashlight into the hole at the bottom of the cup. Turn on the flashlight in a darkened room and aim the starlight flashlight at the wall. Make several constellation cups so you can change what you see in your night sky!

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VENUS
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TIPS
- The full moon on July 31 will be a “blue moon” — the second full moon in a month (the first is on July 2). The last blue moon was in 2012. There will be a total lunar eclipse on September 28. This is also called a “blood moon” because the moon glows red.

MORE WAYS TO PLAY
WITH THE NIGHT SKY
Use sky maps (skymaps.com) to help you find your way around the night sky.

RECOMMENDED READING
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One way that you can explore hard-to-reach places is by using a robot. Robots are sophisticated machines that can sense, plan and act. The Curiosity rover is a robot that’s exploring Mars. Make a simple drawing machine that uses vibrations to move and see what artistic patterns it creates.

**ART-O-MATIC INTELLIGENCE**

**EXPERIMENT: SCRIBBLE BOT**

The scribble ‘bot is a type of bristlebot, which is a simple robot easily built with a brush and other household items. The vibration of the toothbrush causes the pool noodle to move. This energy of motion is called kinetic energy.

**MATERIALS**

- Batteries
- Pool noodle
- Markers
- Rubber bands
- Battery-powered toothbrush
- Paper
- Tape
- Scissors or utility knife
- Craft supplies, like pipe cleaners, construction paper, craft sticks, googly eyes, feathers, etc.

**INSTRUCTIONS**

Cut a piece of pool noodle that’s a bit longer than the battery-powered toothbrush. Insert the toothbrush into the middle of the pool noodle. Make sure you can reach the on/off switch. This is the body of your scribble ‘bot. Make the legs by attaching several markers to one end of the pool noodle with rubber bands. The markers should point outward and extend past the pool noodle body.

Personalize your scribble ‘bot by using craft supplies to give it hands, a face, hair, clothing – be creative! Attach arms by making small slits on the sides of the pool noodle and inserting bent pipe cleaners.

Put some paper down on the table and uncap the markers. Turn on the toothbrush and set the scribble ‘bot on the paper. You may need to adjust the marker “legs” if it’s unbalanced. Watch it go, and see what designs it makes.

**WHAT’S HAPPENING?**

The scribble ‘bot is a type of bristlebot, which is a simple robot easily built with a brush and other household items. The vibration of the toothbrush causes the pool noodle to move. This energy of motion is called kinetic energy.

**GAME ON**

Try making a different vibrating robot by removing the brush and neck from your battery-powered toothbrush (this is easily done on models with twist-off tops). Cut a square of cardboard big enough to fit the toothbrush base. Shape four feet from paper clips and attach them to the corners, bending them to point down and angling them slightly in the same direction. Tape the toothbrush base on top and decorate it to look like a bug. When you turn on the battery, the vibrations will make your bug skitter around.

**TIPS**

Affordable battery-powered toothbrushes are available at dollar stores. A more powerful motor means the scribble ‘bot will vibrate and move more vigorously. A body that’s too heavy makes it harder to move.

**MORE WAYS TO PLAY WITH ROBOTS**

Step into a visionary world where robots are not just a curiosity, but a vital asset, in MSI’s world-premiere exhibit Robot Revolution, supported by Google.org.

**RECOMMENDED READING**

- “Curiosity’s Mission on Mars: Exploring the Red Planet” by Ron Miller
- “Ricky Ricotta’s Mighty Robot” by Dav Pilkey
ART-O-MATIC INTELLIGENCE

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MATERIALS
☐ Batteries  ☐ Pool noodle
☐ Tape  ☐ Paper
☐ Scissors or utility knife  ☐ Craft supplies, like pipe cleaners, construction paper, craft sticks, googly eyes, feathers, etc.
☐ Markers  ☐ Rubber bands
☐ Battery-powered toothbrush  ☐ Cardboard and paper clips (optional)

INSTRUCTIONS
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SATURN
You probably recognize me because of my spectacular rings. They’re mostly made of chunks of ice and dust, and were discovered by the famous astronomer Galileo Galilei in 1610.

GAME ON
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DELIVERY SYSTEMS

Deliver A Message

Next Generation Science Standards (NGSS):
K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
K-2-ETS1-2: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
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.

Objective(s):
Students will deliver a message from one end of a table to the other (or between 2 desks).

Instructor Notes:

30 Minutes
Prep: None

Materials:
- Pencil & Paper for writing a message
- Stuff to build a message delivery system: string, scissors, straws, water bottles, masking tape, rubber bands, etc.

Setting the Stage:
Ask students: When you’re stranded on a deserted island, you can’t use a telephone or e-mail to communicate to others across the island. So how would you get a message to a friend on the other side of your island?

Explain the objective of the day: students will build a way to deliver a message from one side of the table (island) to the other. (Without throwing it or using their own feet to deliver it!)

Brainstorm ideas of what a delivery system might look like. Have them add their ideas to their Process Grid.

Activity Instructions:
1. Have students in teams of three. Each team can write a secret message to another team.
2. After they write their message, have them begin working on their delivery system. As they work, ask them questions about their plan. If something doesn’t work, ask them what they could do to redesign it. You may have to give a few suggestions to get them started. It could be as simple as rolling the message in a bottle across the table or folding it into an airplane to fly through the air, or a catapult. (Don’t give any hints unless there are some students really struggling and frustrated.)
3. If students succeed quickly, place “obstacles” in the way for more of a challenge.
4. At the end of the lesson, discuss what worked and what didn’t work.