

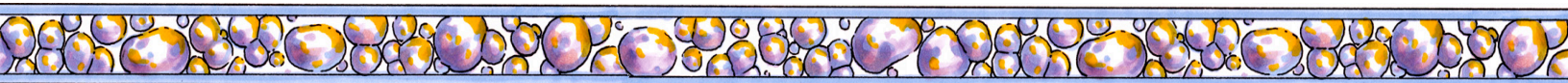
Engineering Adventures

Bubble Bonanza: Engineering Bubble Wands

Materials Engineering for Kids
in Out-of-School Time



Written by the Engineering is Elementary Team
Illustrated by Ross Sullivan-Wiley



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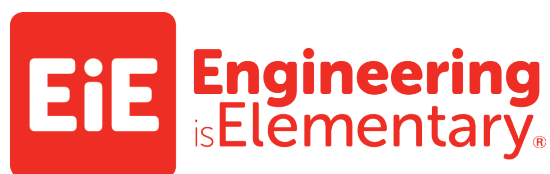
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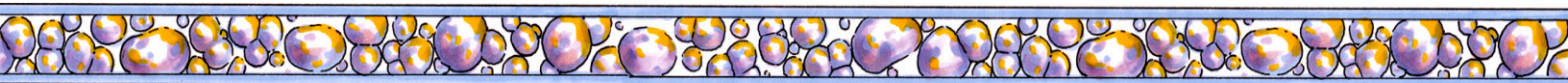
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Pilot Sites for Bubble Bonanza:

This unit would not be possible without the valuable feedback from our pilot sites!

21st CCLC Afterschool Program, Manchester, NH
AtlantiCare Family Success Centers, Atlantic City, NJ
Boys and Girls Club of Cypress, Cypress CA
Boys and Girls Club of Dorchester, Dorchester, MA
Boys and Girls Club of Greater Sacramento, Sacramento, CA
Boys and Girls Club of Huntington Valley, Fountain Valley, CA
Boys and Girls Club of the Harbor Area, Costa Mesa, CA
Boys and Girls Club of La Habra, La Habra CA
Boys and Girls Club of Laguna Beach, Laguna Beach CA
Boys and Girls Club of the South Coast Area, San Clemente CA
Bridge Street School, Yuba City, CA
Columbus Elementary Afterschool, Medford, MA
Cummings Elementary 21st Century Afterschool, Winthrop, MA
Curtis Hall Community Center, Jamaica Plain, MA
Discovery Place, Charlotte, NC
Girls, Inc. of Lynn, Lynn, MA
High Rocks Educational Corporation, Hillsboro, WV
Hope College, Holland, MI
International Spanish Language Academy, Hopkins, MN
Jordan Boys and Girls Club, Chelsea, MA
Mass General Hospital Youth Programs/Yawkee Boys and Girls Club of Roxbury, Roxbury, MA
Metropolitan Baptist Church Afterschool, Dorchester, MA
Minneapolis Public Schools, Minneapolis, MN
Missouri River Education Cooperative/Extended School Program, Mandan, ND
Roberts Elementary Afterschool, Medford, MA
Sacramento START/ Winn Elementary School, Sacramento, CA
Salvation Army Afterschool, Boston, MA
Sciencenter, Ithaca, NY
Short Pump Elementary School, Henrico, VA
The Sacramento Chinese Community Service Center, Sacramento, CA
UC Davis, Davis, CA
UCLA, Granada Hills, CA
Wendell P. Clark Memorial YMCA, Winchendon, MA
Wetherbee School, Lawrence, MA
Woodlake Elementary School, Sacramento, CA
YWCA Central Maine, Lewiston, ME
YWCA Greater Newburyport, Newburyport, MA
YWCA Southeastern MA, New Bedford, MA



Unit Map

Here's an overview of the order of the adventures in this unit and how they all fit together.

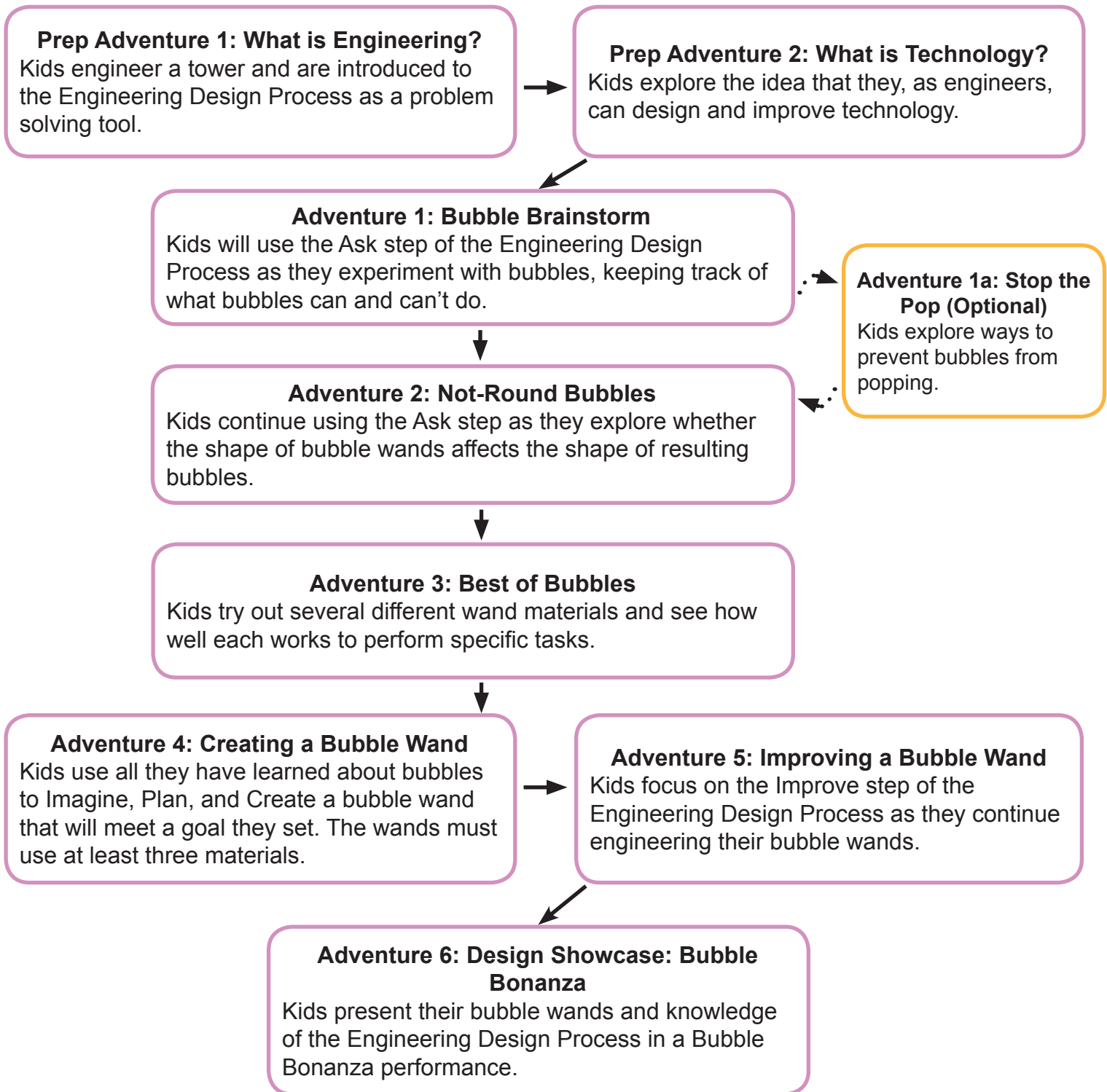




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About Engineering is Elementary

Engineering is Elementary® (EiE) fosters engineering and technological literacy among children. Most humans spend over 95% of their time interacting with technology. Pencils, chairs, water filters, toothbrushes, cell phones, and buildings are all technologies—solutions designed by engineers to fulfill human needs or wants. To understand the world we live in, it is vital that we foster engineering and technological literacy among all people, even young children! Fortunately, children are born engineers. They are fascinated with building, taking things apart, and how things work. Engineering is Elementary harnesses children’s natural curiosity to promote the learning of engineering and technology concepts.

The EiE program has four primary goals:

Goal 1: Increase children’s technological literacy.

Goal 2: Increase educators’ abilities to teach engineering and technology to elementary students.

Goal 3: Increase the number of schools and out-of-school time programs in the U.S. that include engineering at the elementary level.

Goal 4: Conduct research and assessment to further the first three goals and contribute knowledge about engineering teaching and learning at the elementary level.

The first product developed by the EiE program was the Engineering is Elementary curriculum series. This curriculum, designed specifically for use in elementary school classrooms, is research-based, standards-driven, and classroom-tested. The EiE curriculum integrates engineering and technology concepts and skills with elementary science topics and promotes K-12 science, technology, engineering, and mathematics (STEM) learning. For more information about EiE, visit: eie.org.

In 2011, EiE began development of Engineering Adventures (EA), a curriculum specifically for use in out-of-school time settings. While many of the underlying principles of the EiE and EA curricula are the same, EA is designed to address the unique challenges and advantages of the OST setting. More information about EA can be found on the next page, or online at: engineeringadventures.org.

Engineering is Elementary is a part of The National Center for Technological Literacy (NCTL) at the Museum of Science, Boston. The NCTL aims to enhance knowledge of technology and inspire the next generation of engineers, inventors, and innovators. Unique in recognizing that a 21st century curriculum must include today’s human-made world, the NCTL’s goal is to introduce engineering as early as elementary school and continue it through high school, college, and beyond. For more information about the NCTL, visit: nctl.org.



About Engineering Adventures

The mission of Engineering Adventures is to create exciting out-of-school time activities and experiences that allow all learners to act as engineers and engage in the engineering design process. Our goal is to positively impact children's attitudes about their abilities to engineer by providing materials uniquely appropriate for the varied landscapes of out-of-school time settings.

The main ideas that guide the developers of EA are listed below.

We believe kids will best learn engineering when they:

- engage in activities that are fun, exciting, and connect to the world in which they live.
- choose their path through open-ended challenges that have multiple solutions.
- have the opportunity to succeed in engineering challenges.
- communicate and collaborate in innovative, active, problem solving.

Through EA units, kids will learn that:

- they can use the Engineering Design Process to help solve problems.
- engineers design technologies to help people and solve problems.
- they have talent and potential for designing and improving technologies.
- they, too, are engineers.

As kids work through their engineering design challenges, they will have the opportunity to build their problem solving, teamwork, communication, and creative thinking skills. Most importantly, this curriculum is designed to provide a fun learning opportunity for kids!

For more information on Engineering Adventures, please visit:
engineeringadventures.org.

Each Engineering Adventure Includes:


Preview Pages with an overview, relevant background information, materials and preparation needed for the adventure, and the Engineering Journal pages kids will use.


An **Adventure Guide** with step-by-step instructions to guide you through the adventure, including discussion questions, extension ideas, and tips.


Adventure 1 Bubble Brainstorm Educator Page: Preview


Overview: Kids will review what they already know about bubbles, make bubbles with store-bought plastic wands, and discuss their observations.

Note to Educator: This open-ended activity is designed to let kids freely explore bubbles and challenge them to investigate what bubbles can and cannot do.

Duo Update (5 min)
 Message from the Duo, track 3 or Engineering Journal p. 7
 EDP poster

Set the Stage (5 min)


Activity (25 min)


Reflect (10 min)


Materials:

For the entire group:
 Message from the Duo, track 3 or Engineering Journal p. 7
 EDP poster

For each group of 2-5 kids:
 plastic cup filled with bubble solution (either store-bought or made from the recipe on p. xv)
 23-27 poster board or chart paper
 tape
 optional: newspaper

Preparation
Time Required: 15 Minutes
 1. Have the Message from the Duo ready to share.
 2. Copy and cut out the Bubble Cards. You may want to laminate them so you can easily reuse them.
 3. Pour bubble solution into small cups, one per group.
 4. You may want to cover tables and the floor underneath with newspaper.
 5. Create a Bubble Board like the one shown on the next page.

Engineering Adventures: Bubble Bonanza 15 © Museum of Science, 2012

Adventure 1 Bubble Brainstorm Educator Page: Adventure Guide

Kids will learn:

- asking questions is part of the Engineering Design Process.
- there are some interesting things that bubbles can and cannot do.

Present the Message from the Duo (5 min)
 1. Tell kids that they have received another message from India and Jacob. They've run into a problem and need some help.
 2. Have kids open their Engineering Journals to Message from the Duo p. 7, and follow along while you play the message (track 3).
 3. To check for understanding, ask:
 - What do India and Jacob want us to help them with?
 - What questions about what bubbles can and can't do do you have?
 - What step of the Engineering Design Process will we use? The Ask step.

Set the Stage: What Do You Know About Bubbles? (5 min)
 1. Let kids share what they know about bubbles. Ask:
 - What can bubbles do?
 - Are there things bubbles can't do?
 2. Fill in the Bubble Board with things kids suggest. If kids are having trouble thinking of things, focus on two or three Bubble Cards and have kids think about where they belong on the Bubble Board. It is okay if kids have misconceptions about bubbles, as they will have an opportunity to test and change their ideas during this activity.

Ask: What Do Bubbles Do? (25 min)
 1. Split kids into small groups. Place some Bubble Cards on each table and let kids know they can experiment with the actions shown on the cards if they have them.
 Tip: Some kids may have good luck making bubbles by blowing into their wands. Other kids may find it easier to wave their arms in order to move air through the wands and make bubbles. Either method is fine!

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A **Message from the Duo**, India and Jacob. We recommend presenting the audio versions of the messages, but paper copies are included as emails in each adventure and in kids' journals.

Engineering Journal pages that allow kids to record findings and reflect on their learning.

Adventure 1 Bubble Brainstorm Message from the Duo

reply forward archive delete

from: engineeringadventures@mos.org
 subject: Bubbles, bubbles, and more bubbles!
 to: You
 9:25 AM


Hi everyone,

We are visiting our friend Miguel in California. He has an awesome job—he's a materials engineer at an amusement park! Right now he's helping the park design a bubble show. People who visit the amusement park will come to the show to see all the things bubbles can do. We think they should call the show Bubble Bonanza!

Miguel is working on engineering some bubble wands for the show, and we said we would help out. But before we help engineer bubble wands, we need to know a lot more about bubbles. What do they look like? What can they do? Are there things they can't do?


We're going to start with the Ask step of the Engineering Design Process. Can you help us Ask lots of questions about what bubbles can and can't do?

India and Jacob, the Duo



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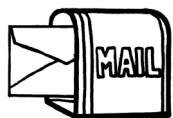
Engineering Adventures



Engineering Journal
 Bubble Bonanza

Name: _____

The Sections of the Adventures



Messages from the Duo

Messages from India and Jacob, a brother and sister world traveling Duo, are provided as a quick, exciting way to present the real-world context for the unit's engineering challenge. Providing a context helps kids to understand the challenge and motivates them to find solutions. If you have access to a CD or MP3 player, we strongly suggest using the audio recordings, although reading the emails aloud will convey the same information.



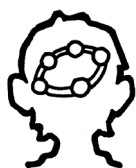
Set the Stage (or Ask)

The Set the Stage, or Ask, part of each adventure provides important information and questions that prepare kids for the main activity. During this section, you might ask questions prompting kids to share their prior knowledge, have them predict what they will find, or remind them of criteria that will help them as they engineer. This sets your kids up to succeed and feel confident in their ability to engineer.



Activities

The activities are designed to get kids thinking and working together to solve the unit's engineering design challenge. As the educator, it is your role to guide kids through these activities by encouraging them to pursue and communicate their own ideas, even if you think they may not work. In engineering, there are no right or wrong answers! Every problem has many possible solutions and multiple ways to reach them.



Reflect

Each adventure includes five to ten minutes at the end for kids to communicate with their peers by sharing their work. This gives kids the chance to discuss new ideas, think about their own work and the work of others, and reflect on what was learned. Group reflection can help reduce competition by encouraging kids to support each other as they move through the Engineering Design Process. For more individual reflection, each adventure also includes time for kids to record thoughts and ideas in their Engineering Journal.



Engineering Journals

Copy an Engineering Journal for each kid as you begin working on this EA unit. Kids will use them as directed in the Adventure Guide during every adventure.

The Engineering Journal is a central location for kids to record their thoughts and ideas as they move through the unit. It includes recording pages that will guide kids through the Engineering Design Process, poses questions, and prompts kids to reflect on their learning. The 5-10 minutes kids spend with their journals during each adventure will allow them to create a personalized record of their engineering learning.

The back page of each Engineering Journal is a passport page from the country or state in which the unit takes place. Kids are encouraged to stamp the passport page when they finish a unit and collect the pages from all of the units they've completed. A full passport can be found online at: www.mos.org/engineeringadventures/passport.





What You Need to Know **Before** Teaching an EA Unit

Engineering is fun.

The EA team hears this from many OST educators and kids. Engineering is really a way of problem solving—a way of thinking about the world—that is often very fun and creative. Any time you need to solve a problem in order to reach a goal, you are engineering.

There are no right or wrong answers.

There are often many great ways to solve the same problem. Not only is this a good engineering lesson for the kids in your program, it's a good life lesson.

It's okay to try it out!

It can be very helpful to try out the engineering challenge yourself—either beforehand or right alongside the kids in your program as they work through the adventures. This can help you understand the challenges the kids might face.

Scheduling the Unit's Adventures

Each adventure requires 45-60 minutes of teaching time. We recommend that you budget at least 7-10 hours in order to complete this unit, as some adventures may occasionally go longer than expected.

You can schedule this unit in several ways: once a week, several times a week, or daily. It is also possible to group certain adventures together. The chart below shows which adventures are easily taught together. Use this chart to help you plan your schedule.

Day 1	Prep Adventure 1: What is Engineering? Tower Power Prep Adventure 2: What is Technology? Technology Detectives	2-3 hours
Day 2	Adventure 1: Bubble Brainstorm *Adventure 1a: Stop the Pop!	2-3 hours
Day 3	Adventure 2: Not Round Bubbles Adventure 3: Best of Bubbles	2-3 hours
Day 4	Adventure 4: Creating a Bubble Wand Adventure 5: Improving a Bubble Wand	2-3 hours
Day 5	Adventure 6: Engineering Showcase: Bubble Bonanza	1-1.5 hours



Tips for Teaching the Unit

Post a Daily Agenda

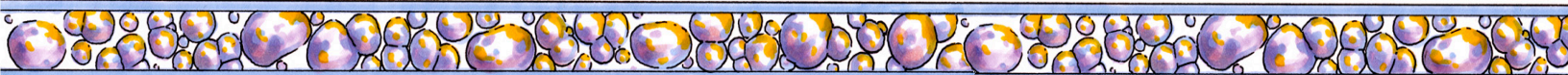
Giving kids a sense of the day's adventure will help them to plan ahead and manage their time during the activity.

Facilitate Teamwork

Being able to work well in teams is an important skill for any engineer. You may want to assign team roles to help kids if they struggle with teamwork. Possible roles include: the recorder, the materials gatherer, the tester, and the presenter.

Invite Others to the Showcase

The showcase, always the last adventure in the unit, is a big deal! This is a chance for kids to highlight the engineering they've done and share their accomplishments with others. Consider inviting families, program staff, and other kids to come to the showcase.



Unit Background

Materials Engineering

Materials engineers are people who use their understanding of different materials (such as metals, plastics, or woods) to make things that solve problems. As part of their work, materials engineers explore the properties of different materials to help them choose which material will work best to solve the problem.

In this unit, students experiment with many different materials that can be used to make bubble wands. They become materials engineers as they consider which materials are best for making different kinds of bubbles, and which combination of materials they will use to create their own unique bubble wands.

Bubbles

Bubbles are a very thin layer of liquid surrounding a pocket of gas. In the case of this unit, the liquid is bubble solution and the gas is air. If something punctures the surface of a bubble, the bubble will pop. Not all objects that come in contact with a bubble will puncture the surface, however. An object coated in liquid that has the same surface tension (the same attractive force between molecules) as a bubble can be inserted into a bubble without the bubble popping.

Once fully formed, bubbles always take on a spherical shape. A sphere is the shape that allows for the liquid (the bubble solution) to have the smallest surface area possible. When bubble solution is stretched across a frame (a circular bubble wand or a more amorphous wire or string shape, for example) the bubble solution will also always take on the shape that allows for the smallest surface area possible. As you and your kids are experimenting with bubbles, take note of the different shapes you see, particularly when bubbles come in contact with each other.

Bubble Wands

For some of the adventures in this unit, we note that either store bought wands or homemade wands can be used. The term store-bought wands refers to the ring-shaped bubble wands traditionally sold with bottles of bubble solution. Creating simple ring-shaped wands out of wire or pipe cleaners will also work to help complete the challenges in this unit.

Bubble Solution

Many people who have experience making bubble solutions have favorite “recipes” or special ingredients they like to add to standard recipes in order to increase the durability or longevity of bubbles. The recipe listed below is one that the Engineering Adventures team has had success with. If you would like to make a favorite recipe of your own, or if you would prefer to simply purchase bubble solution, feel free to do so.

The type of soap you use will matter. Use dish soap made to wash dishes by hand (not in a



dishwasher). The brand of soap is important, too. The Engineering Adventures team has found that Dawn® or Palmolive® work well.

A good recipe to start with for a group of about 25 students is:

- 1 gallon of water
- 3 cups of dish soap
- 1 cup of glycerin

Glycerin can be purchased fairly easily and cheaply online, but in a pinch you might try substituting vinegar instead. As long as you store the bubble solution in a covered container, it should last for a long time!

Bubble Troubleshooting

Whether indoors or outdoors, air currents can make it difficult to form bubbles without them popping. Try to be aware of the air currents in the space where you are working and consider shutting off air conditioning, heaters, or fans while you are working. Low humidity can also affect the durability and longevity of your bubbles. If you're in a very dry climate, a humidifier can help.

Keeping Engineering Journals Dry

The Engineering Journals provide important learning support for every Adventure, but finding a dry spot in the room to work on them can be tricky! If possible, leave at least one table in the room that is soap-free and available to use for journaling.

Bubble Safety

Bubbles can be messy! While the adventures in this unit are designed to be fun, encourage kids to conduct themselves carefully and responsibly as they explore. Consider setting up a limited number of testing stations and confining the bubble solution to specific areas in order to minimize mess. It is best to cover surfaces near the testing area with newsprint or tablecloths that can easily be removed later on. Do not cover the floor with plastic tarps or table cloths, however, as the plastic can become slippery and dangerous when coated with bubble solution. If you are conducting challenges on tile floors, consider taping down newsprint to minimize slipperiness.

Dipping hands into soap or detergents may not be recommended for children with eczema, contact dermatitis, or very sensitive skin. If a child complains of itching or redness, have them remove and rinse their hands immediately.

Online Resources

For a list of online video resources about bubbles, visit:
www.mos.org/eie/engineeringadventures/bubblevideos.php

Materials List

Quantity	Item
Non-Consumable Items	
1	stuffed animal, small
2	fans, small
4	hairbrushes
4	pans or trays for bubble solution
8	markers or pencils
8	rulers
8	scissors
10	tubes, plastic, appx. 3/4" diameter, 8" length
24	ring bubble wands
Consumable Items	
1 pack	construction paper
1 pad	newsprint (optional)
1 roll	string
3 gallons	bubble solution
8 rolls	tape, cellophane
8 sheets	paper
8 spools	wire, thin and flexible
9 sheets	sandpaper
12	screen, cut into 4" x 4" squares
20	balloons
20	transparency sheets, plastic
24	deli containers, plastic
30	cups, paper
30	paper towel tubes
80	straws
100	craft sticks
100	rubber bands
150	pipe cleaners
200	twist ties, paper coated
800	index cards
NOT INCLUDED IN KIT	
1	CD player or MP3 player
1	chart paper
1	clock/timepiece
30	markers/crayons

This materials list anticipates 24 kids, divided into 8 groups.



Vocabulary for Bubble Bonanza: Engineering Bubble Wands

Bubble: A thin layer of liquid surrounding a pocket of air.

Bubble solution: A liquid substance (i.e. material) used to make bubbles.

Engineer: Someone who uses his or her creativity and knowledge of math and science to design things that solve problems.

Engineering Design Process: The steps that engineers use to design something to solve a problem.

Material: The substance (or “stuff”) of which a thing is made.

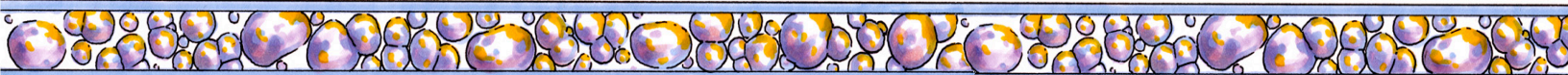
Materials engineer: A person who uses his or her creativity and knowledge of science and math to solve problems related to what things are made of and create new materials with new properties.

Technology: Any thing, system, or process designed by humans to help solve a problem.



National Education Standards

		Prep Activity 1: What is Engineering? Tower Power	Prep Activity 2: What is Technology? Technology Detectives	Adventure 1: Bubble Brainstorm	Adventure 1a: Not Round Bubbles	Adventure 2: Stop the Pop	Adventure 3: Best of Bubbles	Adventure 4: Creating Bubble Makers	Adventure 5: Improving Bubble Makers	Adventure 6: Engineering Showcase: Bubble Bonanza
National Science Education Standards	Science as Inquiry			✓	✓	✓	✓	✓	✓	
	Physical Science			✓	✓	✓	✓	✓	✓	
	Life Science									
	Earth and Space Science									
	Science and Technology	✓	✓					✓	✓	✓
	Science in Personal and Social Perspectives									
	History and Nature of Science									
ITEEA	The Nature of Technology		✓							
	Technology and Society									
	Design	✓		✓	✓	✓	✓	✓	✓	✓
	Abilities for a Technological World	✓					✓	✓	✓	
	The Designed World									



Dear Family,

Date: _____

We are beginning an engineering unit called Bubble Bonanza: Designing Bubble Makers, which is part of the Engineering Adventures curriculum developed by the Museum of Science, Boston. Engineering Adventures is a curricular program that introduces children to the engineering design process and various fields of engineering. Throughout this unit, children will learn about materials engineering and work to solve a materials engineering design challenge. The premise for this unit is that children will design different types of bubble wands to help a fictional California amusement park develop a Bubble Bonanza show to entertain park visitors.

There are many reasons to introduce children to engineering:

- **Engineering projects reinforce topics children are learning in school.** Engaging students in hands-on, real-world engineering experiences can enliven math, science, and other content areas.
- **Engineering fosters problem-solving skills,** including problem formulation, creativity, planning, and testing of alternative solutions.
- **Children are fascinated with building and with taking things apart to see how they work.** By encouraging these explorations, we can keep these interests alive. Describing their activities as “engineering” when children are engaged in the natural design process can help them develop positive associations with engineering, and increase their desire to pursue such activities in the future.
- **Engineering and technological literacy are necessary for the 21st century.** As our society increasingly depends on engineering and technology, our citizens need to understand these fields.

Because engineering projects are hands-on, materials are often required. Several materials necessary to this unit are listed below. If you have any of these materials available, please consider donating them to us.

If you have expertise about materials engineering or California, or have any general questions or comments about the engineering and design unit we are about to begin, please let me know.

Sincerely,

If you have any of the following materials available and would like to donate them, I would greatly appreciate having them by the following date: _____ . Thank you!

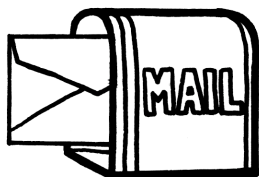
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_____	_____
_____	_____

What is Engineering? Tower Power

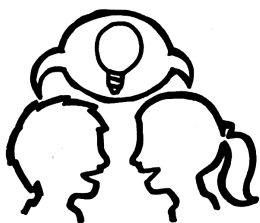
Overview: Kids will engineer and build an index card tower that will support a stuffed animal.

Note to Educator: Who are engineers? Engineers are people who use science, math, and creativity to solve problems. Today kids will be engineers as they use the Engineering Design Process to design towers.

Duo Update (5 min)



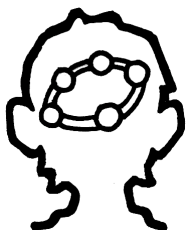
Set the Stage (10 min)



Activity (30 min)



Reflect (5 min)



Materials

For the entire group:

- Message from the Duo*, track 1 or Engineering Journal, p. 1
- EDP Poster
- Heightened Emotions*, this guide, p. 7
- timer or clock
- 1 small stuffed animal

For each group of 3-5 kids:

- 1 pack of index cards (about 100 cards)
- 1 pair of scissors
- 1 ruler
- At least 1 foot of tape

For each kid:

- Engineering Journal

Preparation

Time Required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. Make samples of the cards found on *Building with Cards*, Engineering Journal p. 2.



Journal Pages for Prep Adventure 1

Message From the Duo, p. 1

Prep Adventure 1
Message From the Duo

← reply → forward 🗑️ archive ✖ delete

from: engineeringadventures@mos.org
 subject: Engineering a Tower
 to: You 11:11 AM

Hi everyone,

We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

Engineers are problem solvers. They're people who design things that make our lives better, easier, and more fun! We heard you might be able to help us engineer solutions to some of the problems we find. That means you'll be engineers, too!

Today, we came across an engineering challenge we think you can help us solve. There are some animals living in a swamp along with lots of hungry alligators. The animals need to be at least 10 inches above the alligators to be out of their reach. India and I thought we could build a tall tower that the animals could stand on. Do you think you can engineer a tower for us?

We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!

Good luck!
India and Jacob

Engineering Adventures: Engineering Journal 1 © Museum of Science, 2012

Building with Cards, p. 2

Prep Adventure 1
Building with Cards

← → 🗑️ ✖

Here are three ways to build with index cards.

Roll it!

Fold it!

Cut it!

Will any of these ideas help your group build a tower? What other ideas do you have?

Talk with your group to figure it out!

Engineering Adventures: Engineering Journal 2 © Museum of Science, 2012

Heightened Emotions, p. 3

Prep Adventure 1
Heightened Emotions

Fearless
8 inches and up

Confident
6-8 inches

Calm
4-6 inches

Nervous
2-4 inches

Terrified
0-2 inches

Engineering Adventures: Engineering Journal 3 © Museum of Science, 2012

Recording Page, p. 4

Prep Adventure 1
Recording Page

← → 🗑️ ✖

Draw Your Tower
Use the space below to draw a picture of your tower.

What parts of your tower design would you change if you could do it again?

For the Record

I think engineering is:

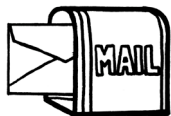
- Fun
- Exciting
- Difficult
- _____

Engineering Adventures: Engineering Journal 4 © Museum of Science, 2012

What is Engineering? Tower Power

Kids will learn:

- the Engineering Design Process is a tool they can use to help solve problems.



Present the Message From the Duo (5 min)

- Tell kids that India and Jacob are a brother and sister who travel the world. They find problems and solve them using engineering.
- Today, India and Jacob sent us a message about a problem they'd like us to solve. Have kids turn to Engineering Journal p. 1 for a message with more details (track 1).



Set the Stage (5 min)

- Tell kids that today they are going to be engineers and use the Engineering Design Process to solve India and Jacob's problem. To check for understanding, ask:
 - What do India and Jacob need us to engineer? A tower to lift the animal up 10 inches so it doesn't get eaten by alligators.**
- Show groups the Engineering Design Process poster and tell them they are going to Ask questions about the problem, Imagine ways to solve it, Plan a design, Create and test it, and then think about ways to Improve it.

Imagine (5 min)

- Tell kids it's time to look at the materials they can use and Imagine different ways to make them work.
- Split kids in groups of 3-5 and give each group a pack of index cards, scissors, and tape. Ask:
 - Can you Imagine any ways you could use these materials to engineer a tower?**
- If your kids want to see examples, show them the index card samples you prepared, or have them look at *Building with Cards*, p. 2. Ask:
 - Do you think any of these ideas might work well? Why?**

Tip: You may choose to offer unlimited tape, or to challenge groups by limiting the tape to one or two feet.

Tip: If you can, you may want to offer more time for this challenge.

Plan and Create (at least 20 min)

- Tell kids it is time to plan and create their towers.
- Show the stuffed animal and explain that:
 - The challenge is to work in groups to engineer a tower that can hold the animal 10 inches in the air for at least 10 seconds.
 - Each group will have (at least) 20 minutes.
 - You can hold the stuffed animal briefly, but you





can't test it on your tower until the 20 minutes are up.

3. As groups work, circulate around the room. Ask questions like:
 - **Why do you think your design will work well?**
 - **Which step of the Engineering Design Process are you using right now? How do you know?**

Tower Showcase (10 min)

1. Have each group present their tower. Ask each group questions like:
 - **Can you tell me about your design?**
 - **Which steps of the Engineering Design Process did your group use?**
2. Use a ruler to measure the tower. Compare the measurement to the diagrams on *Heightened Emotions*. Give one kid the stuffed animal and have him or her place it on top of the tower. Count to 10 and observe what happens. Ask:
 - **What parts would you improve if you could design your tower again? Why?**



Reflect (5 min)

1. Go through the Engineering Design Process poster with kids and have them talk about how they used each step to solve the problem. Ask questions like:
 - **How did you use this step of the Engineering Design Process to solve the problem?** *We Asked about the challenge; we Imagined ways to build with cards; we Planned when we decided what design to use; we Created and Improved when we built and fixed the tower.*
 - **Why do you think it's important to use these steps?** *It helps us keep track of our ideas and make sure we're meeting our goal.*
 - **Do you think you are an engineer?**
2. Tell kids that they've just used the same steps that engineers use to solve problems. This means that they are engineers, too! Tell kids they will have the opportunity to engineer solutions to even bigger problems with India and Jacob later on.
3. Give kids time to record their thoughts in their Engineering Journals on *Recording Page*, p. 4. Allowing kids to draw and write about their work in this adventure will help them to reflect on what they have learned.

What is Engineering? Tower Power



reply



forward



archive



delete

from

engineeringadventures@mos.org

subject

Engineering a Tower

to

You

11:11 AM

Hi everyone,

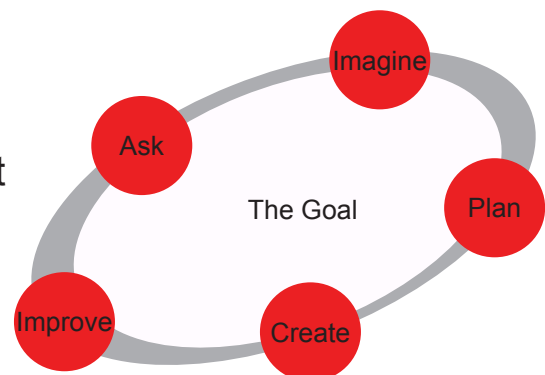
We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

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Today, we came across an engineering challenge we think you can help us solve. There are some animals living in a swamp along with lots of hungry alligators. The animals need to be at least 10 inches above the alligators to be out of their reach. India and I thought we could build a tall tower that the animals could stand on. Do you think you can engineer a tower to help?

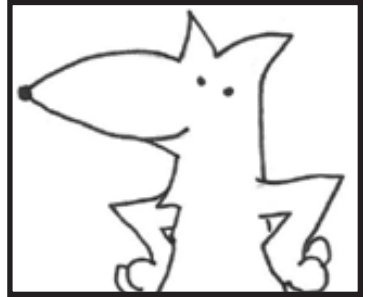
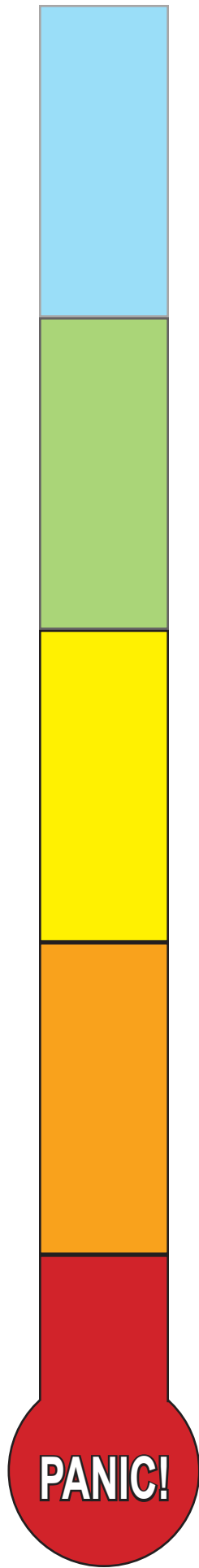
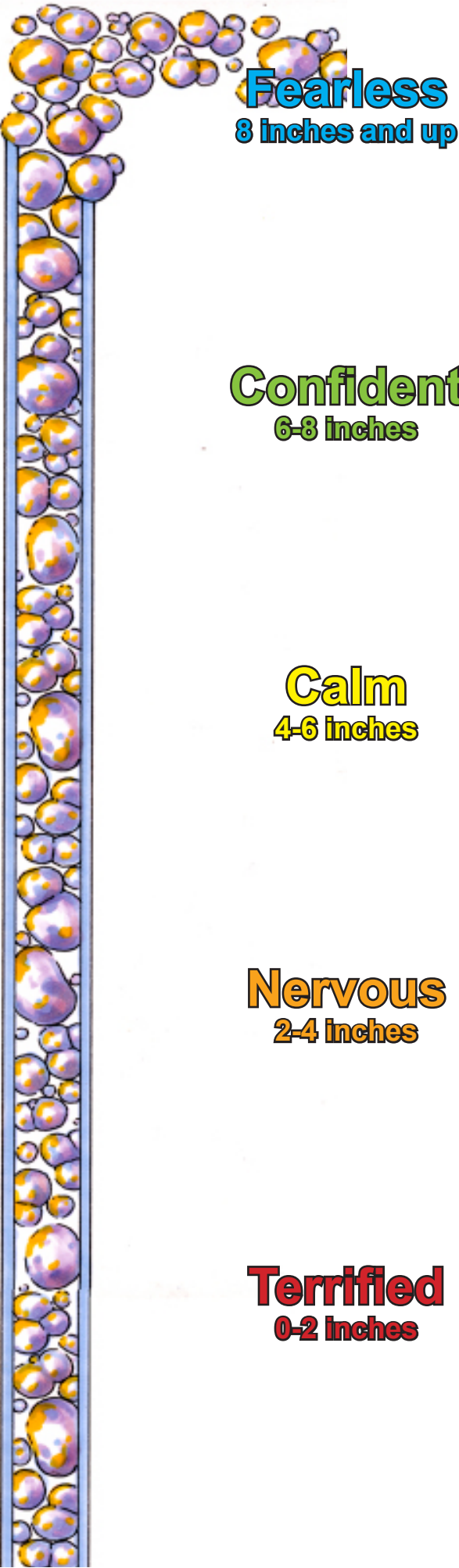
We sent you one tool that we usually find really helpful when we're trying to engineer a solution to a problem. It's called the Engineering Design Process. Take a look at it and see if it can help you!

Good luck!
India and Jacob



Heightened Emotions

Prep Adventure 1
What is Engineering? Tower Power

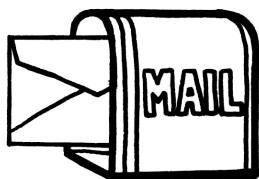


What is Technology? Technology Detectives

Overview: Kids will examine some technologies and imagine ways to improve them.

Note to Educator: Many people think of technologies as things that are only electronic, or things that are “high-tech.” Technology is actually anything designed by people to help solve a problem or meet a need.

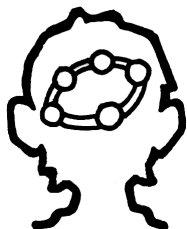
Duo Update (5 min)



Activity (20 min)



Reflect (20 min)



Materials

For the whole group:

- Message from the Duo*, track 2 or Engineering Journal, p. 5
- EDP Poster
- large sheet of paper or other writing space
- a small rock or leaf
- a cloth or bag large enough to cover all technologies

Technologies (choose 8):

- | | | |
|---|---|------------------------------------|
| <input type="checkbox"/> electronic device,
like a cell phone or
calculator | <input type="checkbox"/> stuffed animal | <input type="checkbox"/> hair clip |
| <input type="checkbox"/> water bottle | <input type="checkbox"/> hat | <input type="checkbox"/> button |
| <input type="checkbox"/> roll of tape | <input type="checkbox"/> scissors | <input type="checkbox"/> spoon |
| <input type="checkbox"/> ruler | <input type="checkbox"/> sweater | <input type="checkbox"/> key |
| <input type="checkbox"/> construction paper | <input type="checkbox"/> dice | <input type="checkbox"/> book |
| <input type="checkbox"/> bag | <input type="checkbox"/> juicebox | <input type="checkbox"/> stapler |
| | <input type="checkbox"/> glue stick | |

For each kid:

- Engineering Journal

Preparation

Time Required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. Place the eight technologies (see above) on a table or floor and cover with a cloth or bag. Do not put the rock or leaf under the cover.
3. On a sheet of large paper, make the *Technology Detective Tool* chart as shown on the next page.



Journal Pages for Prep Adventure 2

Message From the Duo, p. 5

Prep Adventure 2 **Message From the Duo**

reply forward archive delete

from engineeringadventures@mos.org
subject What is Technology?
to You 10:36 AM

Hi engineers,
You did a great job engineering a tower to protect the animals in the swamp! Now you can help us engineer more technologies.

Do you know that the things engineers create to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

Think about an airplane as an example. An airplane is a technology because people engineered it and it solves the problem of traveling long distances quickly. But something as simple as a paper cup is also a technology. A person engineered it, and it helps people hold drinks without spilling them everywhere.

We have a detective challenge for you today. We sent you some objects and we want you to figure out if they are technologies. Lots of times engineers think about ways to improve technologies. Can you use the Engineering Design Process to imagine ways make some of these technologies even better?

Talk to you soon,
India and Jacob

Engineering Adventures: Engineering Journal 5 © Museum of Science, 2012

Engineer It, p. 6

Prep Adventure 2 **Engineer It**

What is your group's object?

Is it a technology?
Did a person engineer it?
 Yes No
Does it help you solve a problem?
 Yes No

Bonus: What problem does your object solve?

If you answered YES to both questions, it is a technology!

You're an engineer. Write or draw how you would make this technology better.

If you could engineer a brand new technology, what would it be? What would it do?

Engineering Adventures: Engineering Journal 6 © Museum of Science, 2012

Chart for Prep Adventure 2

Technology Detective Tool

Did a person engineer it?

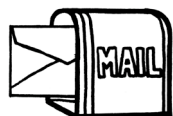
Does it help you solve a problem?

If you answered YES to both, it is a technology!

What is Technology? Technology Detectives

Kids will learn:

- technology is anything designed by people to help solve a problem or meet a need.
- engineers design and improve technologies.



Present the Message From the Duo (5 min)

1. Tell kids that India and Jacob sent them a message with more information about what engineers do. Have kids turn to p. 5 of their Engineering Journals to follow along and play track 2. To check for understanding, ask:
 - **India and Jacob said that a technology is anything designed by people to solve a problem. What are some technologies you can think of?**
Accept all answers at this point.
2. Give the kids about 1 minute to name all the technologies they can think of. If kids are only naming electronics, remind kids that India and Jacob mentioned that things like paper cups are also technology.

Tip: You may want to write down what the kids say is technology, so you can refer back to it at the end of the adventure.



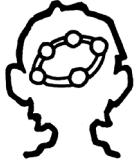
Undercover Detectives (15 min)

1. Explain to kids that now they'll get the chance to think about more technologies—some that might surprise them.
2. Tell kids that under the cover on the table are some objects that might be technologies, or might not. They will use detective skills and teamwork to figure out which objects are technologies and what problems they solve.
3. Split kids into groups of 3-5.
4. Show them the *Technology Detective Tool* and explain they can use it to help figure out if the objects are technologies.
5. Pull the cloth and give groups a minute to decide what object they will take.
6. Have each group choose one object they would like to focus on in their groups.
7. Tell kids that they will now think like an engineer. They will use the *Technology Detective Tool* to decide whether their object is a technology. Then they will imagine ways to improve the object they chose.
8. Have kids open their Engineering Journals to *Engineer It*, p. 6. Give groups about 10 minutes to complete the first three boxes. If groups are struggling, ask:

Tip: If kids are having trouble understanding what it means to engineer something, let them know that words like invent, design, and improve have a similar meaning. The more you use the term engineer, the more comfortable they will become with it!



- How can you make your technology more fun?
- How can you make your technology easier to use?



Reflect (20 min)

1. Tell kids they are going to present their ideas about their technologies to their fellow detectives. Encourage them to use the *Technology Detective Tool* and *Engineer It* to help them present. Ask each group:
 - **What is your technology?**
 - **How do you know it is a technology?** Refer to *Technology Detective Tool*.
2. After all groups have presented, check for understanding about technology. Ask:
 - **Were all the objects you saw technologies? Why or why not?** Yes, because people engineered them, and they help solve a problem.
3. Tell kids you have one more object for them to think about. Show them the rock/leaf. Ask:
 - **Is this a technology? Why or why not?** No, because a person did not engineer it.
4. Tell kids that they engineered today by thinking about technologies that already exist and how to improve them. Engineers also think about brand new technologies that no one has thought of before!
5. Have kids think about the engineering they've already done. Ask:
 - **Why do you think the tower you made before was a technology?**
6. Tell kids that in this unit they will be working in groups to engineer technologies that will help solve a problem.
7. Give kids a few moments to complete the last box on *Engineer It*. Thinking about things they might engineer in the future will help kids see themselves as engineers.

Tip: A rock, leaf, or any other natural object on their own are not technologies. If people turn those objects into tools, however, they could become technologies! For example, using a rock to grind corn or making it into an arrow head makes the rock a technology.

Tip: If you have enough time, encourage kids to share their ideas with a partner.

What is Technology? Technology Detectives



reply



forward



archive



delete

from

engineeringadventures@mos.org

subject

What is Technology?

to

You

10:36 AM

Hi engineers,

You did a great job engineering a tower to protect the animals in the swamp! Now you can help us engineer more technologies.

Do you know that the things engineers create to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

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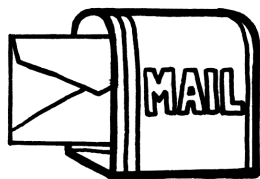
Talk to you soon,
India and Jacob



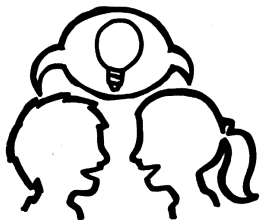
Overview: Kids will review what they already know about bubbles, make bubbles with store-bought plastic wands, and discuss their observations.

Note to Educator: This open-ended activity is designed to let kids freely explore bubbles and challenge them to investigate what bubbles can and cannot do.

Duo Update (5 min)



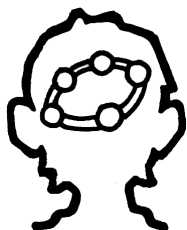
Set the Stage (5 min)



Activity (25 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 3 or *Engineering Journal* p. 7
- EDP poster
- Challenge of the Day*, this guide, p. 21
- Bubble Cards*, this guide pp. 23-27
- poster board or chart paper
- tape
- optional: newsprint

For each group of 3-5 kids:

- 1 plastic cup filled with bubble solution (either store-bought or made from the recipe on p. xiv)
- For each kid:**
- Engineering Journal*
 - bubble wand (store-bought)

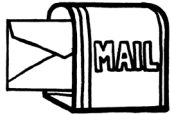
Preparation

Time Required: 15 Minutes

1. Have the *Message from the Duo* ready to share.
2. Copy and cut out the *Bubble Cards*. You may want to laminate them so you can easily reuse them.
3. Pour bubble solution into small cups, one per group.
4. You may want to cover tables and the floor underneath with newsprint.
5. Create a *Bubble Board* like the one shown on the next page.
6. Post the *Challenge of the Day* sheet.

Kids will learn:

- asking questions is part of the Engineering Design Process.
- there are some interesting things that bubbles can and cannot do.



Present the Message from the Duo (5 min)

1. Tell kids that they have received another message from India and Jacob. They've run into a problem and need some help.
2. Have kids open their Engineering Journals to *Message from the Duo* p. 7, and follow along while you play the message (track 3).
3. To check for understanding, ask:
 - **What do India and Jacob want us to help them with?** *Asking questions about what bubbles can and can't do.*
 - **What step of the Engineering Design Process will we use?** *The Ask step.*
4. Point out the Challenge of the Day sheet and encourage kids to refer to it as they work.

See It!: Visit our website and click on "Bubble Show" to see a bubble show in action.



Set the Stage: What Do You Know About Bubbles? (5 min)

1. Let kids share what they know about bubbles. Ask:
 - **What can bubbles do?**
 - **Are there things bubbles can't do?**
2. Fill in the *Bubble Board* with things kids suggest. If kids are having trouble thinking of things, focus on two or three *Bubble Cards* and have kids think about where they belong on the *Bubble Board*. It is okay if kids have misconceptions about bubbles, as they will have an opportunity to test and change their ideas during this activity.

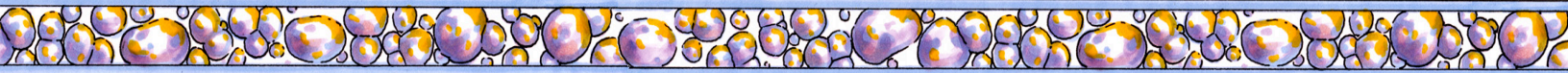
Tip: The *Bubble Board* serves as an anchor chart that kids will revisit, revise, and reconsider throughout the unit.



Ask: What Do Bubbles Do? (25 min)

1. Split kids into small groups. Place some *Bubble Cards* on each table and let kids know they can experiment with the actions shown on the cards if they would like, or they can come up with their own ideas to test and record on the blank cards.

Tip: Some kids may have good luck making bubbles by blowing into their wands. Other kids may find it easier to wave their arms in order to move air through the wands and make bubbles. Either method is fine!



2. Give each group a cup of bubble solution and several plastic bubble wands. Encourage kids to find out what bubbles can and can't do.
3. As groups explore, they should post their findings on the *Bubble Board* by taping up cards.

Reflect (10 min)



1. Come together as a group and look at the *Bubble Board*. Ask:
 - **What are some things you discovered about bubbles today?**
2. Show kids the Engineering Design Process poster. Remind kids how they used the Engineering Design Process when they made towers out of index cards. Ask:
 - **What steps of the Engineering Design Process did we use today?**
Accept all responses, but guide kids to focus on the Ask step. Remind them that they asked lots of questions about what bubbles can and cannot do.
3. Give kids time to record thoughts on *My Ideas About Bubbles*, p. 8. Having kids record their ideas will help them remember what they learned and apply it in the next adventure.

Tip: Keep the *Bubble Board* so you can refer back to it during later activities.



from	engineeringadventures@mos.org
subject	Bubbles, bubbles, and more bubbles!
to	You
	9:25 AM

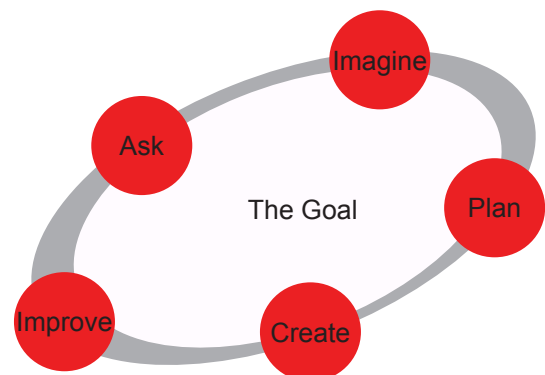
Hi everyone,

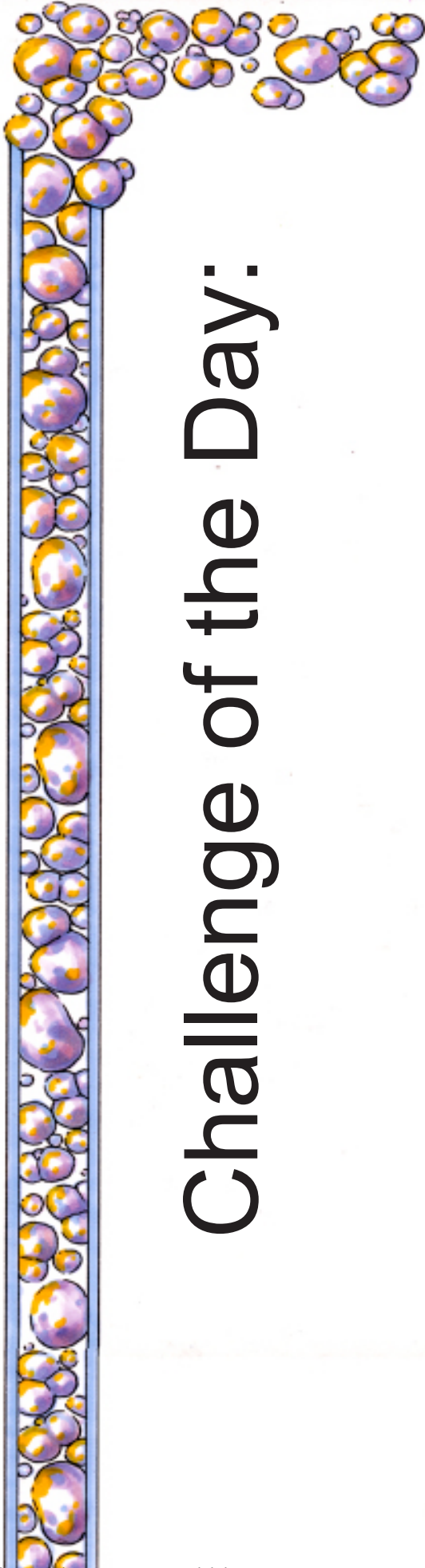
We are visiting our friend Miguel in California. He has an awesome job—he's a materials engineer at an amusement park! Right now he's helping the park design a bubble show. People who visit the amusement park will come to the show to see all the things bubbles can do. We think they should call the show Bubble Bonanza!

Miguel is working on engineering some bubble wands for the show, and we said we would help out. But before we help engineer bubble wands, we need to know a lot more about bubbles. What do they look like? What can they do? Are there things they can't do?

We're going to start with the Ask step of the Engineering Design Process. Can you help us Ask lots of questions about what bubbles can and can't do?

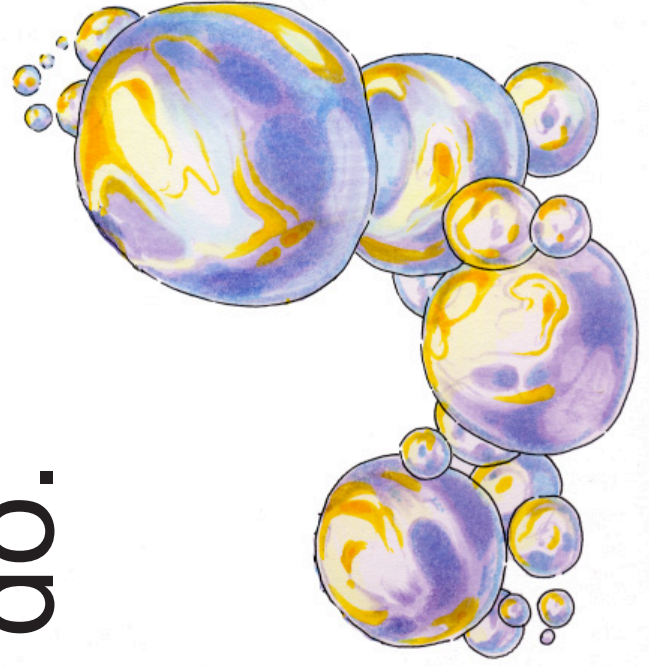
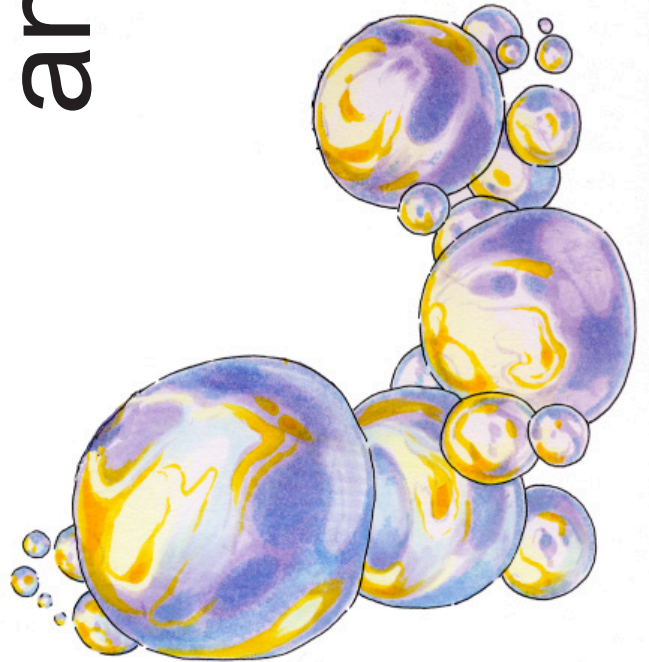
India and Jacob, the Duo



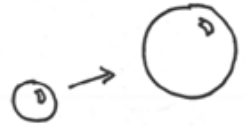
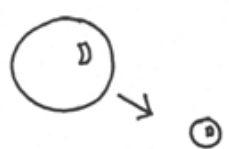
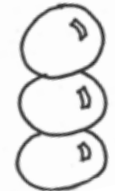




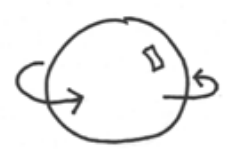

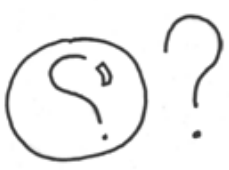
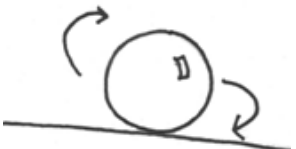
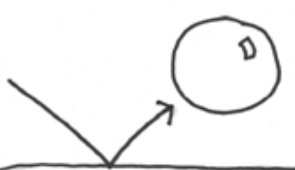








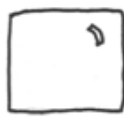







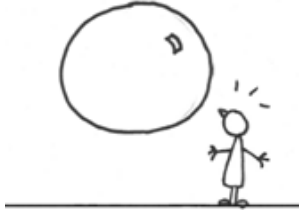



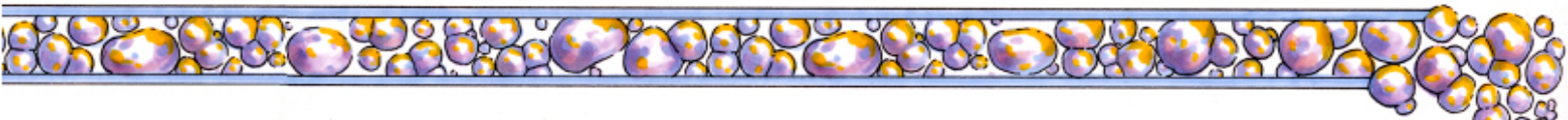
Challenge of the Day:

Explore some things bubbles can
and can not do.



<p>Float</p> 	<p>Stretch</p> 	<p>Grow</p> 
<p>Shrink</p> 	<p>Stack</p> 	<p>Split</p> 
<p>Crack</p> 	<p>Explode</p> 	<p>Bend</p> 
<p>Spin</p> 	<p>Drip</p> 	<p>Reflect</p> 
<p>Roll</p> 	<p>Bounce</p> 	<p>Flatten</p> 

<p>Balance</p> 	<p>Disappear</p> 	<p>Move Quickly</p> 
<p>Move Slowly</p> 	<p>Stand Still</p> 	<p>Look Like a Square</p> 
<p>Fall</p> 	<p>Pop</p> 	<p>Fold</p> 
<p>Stick to the Wall</p> 	<p>Stick to Clothes</p> 	<p>Stick to Skin</p> 
<p>Be Smaller than a Penny</p> 	<p>Be Bigger than a Person</p> 	<p>Make Sound</p> 



Adventure 1a (optional)

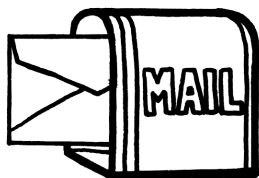
Stop the Pop

Educator Page: Preview

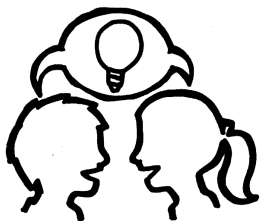
Overview: Kids will explore ways to stop bubbles from popping when landing on surfaces with different textures.

Note to Educator: Often, when a bubble touches something, the thin layer of solution is broken and the bubble pops. But sometimes, a bubble will land on a surface and remain intact. If a surface is coated in soapy water, bubbles can rest on the surface without popping.

Duo Update (5 min)



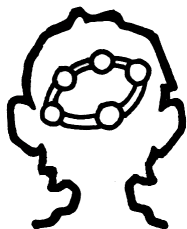
Set the Stage (5 min)



Activity (25 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 4 or *Engineering Journal* p. 9
- EDP poster
- Challenge of the Day*, this guide p. 35
- a table that can get wet
- hairbrush
- piece of sandpaper
- optional: newsprint

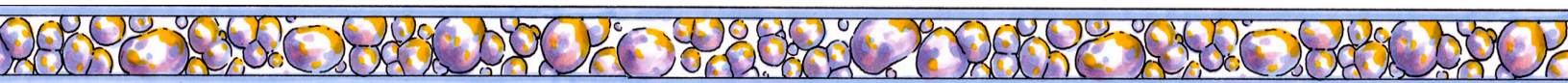
For each group of 3-5 kids:

- one plastic cup of bubble solution
 - hairbrush (groups can share)
 - piece of sandpaper
- For each kid:**
- Engineering Journal*
 - bubble wand (store-bought)

Preparation

Time Required: 15 minutes

1. Have the *Message from the Duo* ready to share.
2. Make a *Pop Chart* as shown on the next page.
3. Pour bubble solution into plastic cups, one for each group.
4. You may want to cover tables and floors with newsprint. Leave one table uncovered so that kids can try landing bubbles on it.
5. Post the *Challenge of the Day* sheet.
6. Place a piece of sandpaper and a hairbrush aside to keep them dry. You can bring out these dry items out later in the lesson for comparison purposes.
7. Optional: Test out some of the activities on the *Bubble Challenge Cards* in the *Engineering Journals* yourself before you try them with kids.



Journal Pages for Adventure 1a

Message From the Duo, p. 9 Bubble Challenge Card, p. 10 My Ideas About Popping, p. 11

Adventure 1a **Message From the Duo**

reply forward archive delete

from: engineeringadventures@mos.org
 subject: Engineering a Tower
 to: You 2:30 PM

Hi,

Jacob and I learned a lot when we explored what bubbles can and can't do. We've been working with Miguel to do more cool things with bubbles. Yesterday Jacob blew a bubble that floated onto the table. I thought it would pop, but it sat on the table for five whole minutes!

I tried to blow a bubble that would land on the table, but mine kept popping. I asked Jacob how he did it, but he said it was magic. I know that's not true!

I think I can use the Engineering Design Process to help me Ask more about bubbles and Imagine how to blow a bubble that will land on the table without popping. Maybe I could even figure out how to blow a bubble onto some other materials, like something rough. Maybe sandpaper would work? Or maybe I could catch a bubble and hold it in my hand! That would really impress Jacob and Miguel. Let me know what you find out!

India

Engineering Adventures: Engineering Journal 9 © Museum of Science, 2012

Adventure 1a **Bubble Challenge Card**

Is it possible to make a bubble land on these things without popping?

<p>Bubble on a Table</p>	<p>Bubble on Sandpaper</p>
<p>Bubble on a Hairbrush</p>	<p>Bubble on your Hand</p>

Engineering Adventures: Engineering Journal 10 © Museum of Science, 2012

Adventure 1a **My Ideas About Popping**

What does it look like when a bubble pops?

For the Record

Do you think people would like to see some bubbles that pop during the Bubble Bonanza show?

Yes

No

Maybe

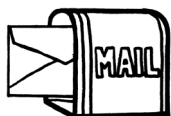
Engineering Adventures: Engineering Journal 11 © Museum of Science, 2012

Chart for Adventure 1a

Pop Chart		
Can you make the bubble land without popping?		
	Yes	No
Table		
Sandpaper		
Hairbrush		
Your Hand		

Kids will learn:

- bubbles tend to pop when they land on dry surfaces.
- bubbles will stay intact when they land on surfaces that are wet and soapy.



Present the Message from the Duo (5 min)

1. Tell kids that today they're going to explore ways to stop bubbles from popping.
2. Have kids open their Engineering Journals to p. 9, to follow along with the message India has sent them about stopping bubbles from popping (track 4).
3. To check for understanding, ask:
 - **What is India asking us to do?** *Figure out if bubbles can land on things without popping.*
 - **Which steps of the Engineering Design Process did she say might help us?** *Ask and Imagine.*



Set the Stage: How do Bubbles Pop? (5 min)

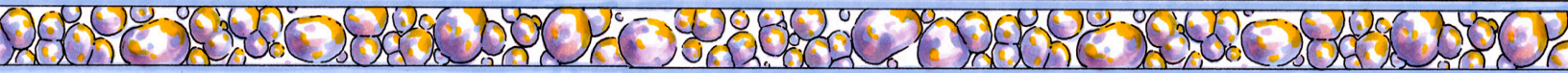
1. Guide students to think about bubbles they have experimented with. Ask:
 - **What happens to bubbles when they bump into other things?** *Some kids may say that they can land on things, but most will say the bubbles usually break.*
2. Explain to kids that today they will try to make bubbles land on things with different textures without popping. Ask:
 - **Do you think bubbles can land on rough textures, like sandpaper? How about smooth textures, like tabletops?**
3. Point out the *Challenge of the Day* sheet and encourage kids to refer to it as they work.



Ask: Can We Stop the Pop? (25 min)

1. Split kids into groups of 3 to 5 kids.
2. Give each group a piece of sandpaper, a hairbrush, and a cup of bubble solution. Allow kids to try some of the challenges on p. 10 of their Engineering Journals.
3. If groups have explored for a bit and no one has successfully made a bubble land on the surfaces, encourage kids to make the surfaces soapy before trying to land bubbles on them.

Tip: Have kids blow their bubbles into the air first, then land them on various surfaces. When kids blow bubbles directly onto the surfaces, the soap tends to dribble and spill, coating the surface with soap solution very quickly.



4. As kids explore, have them record their results by adding check marks to the *Pop Chart*. You will discuss results together after everyone has finished testing.
5. As kids work, ask:
 - **How would you describe the texture of the things you are working with?**
 - **Do you think this texture affects the bubbles?**



Reflect (10 min)

1. First, review the *Pop Chart*. Ask:
 - **Was anyone able to make bubbles land on different things without the bubbles popping? Did the texture matter?** *The texture doesn't matter too much. If something is covered with bubble solution, the bubble probably won't pop. It is harder to cover a rough or pointy texture with bubble solution than it is to cover a smooth texture with it.*
2. Refer back to the *Challenge of the Day*. Ask:
 - **How can you make a bubble land without popping?** *By making the thing it lands on soapy!*
 - **How would you tell India to hold a bubble?** *Dip your hand in bubble solution first.*
3. Show kids the Engineering Design Process poster. Ask:
 - **Which steps of the Engineering Design Process did you use today?** *Accept all responses, but guide kids to focus on how they used the Ask and Imagine steps. Remind them that they imagined what would happen to bubbles when they landed on rough surfaces and answered questions about how to prevent the bubble from popping.*
4. Give kids time to write and draw on *My Ideas About Popping*, p. 11. Journaling will allow kids to create a personal record of the days discoveries that they can refer back to during later adventures.

See It!: Have you ever wondered what exactly happens when a bubble pops? See it in slow motion: <http://www.mos.org/eie/engineeringadventures/bubblevideos> and click on "Bubble Pop".

reply forward archive delete

from engineeringadventures@mos.org
subject The popping won't stop!
to You
2:30 PM

Hi,

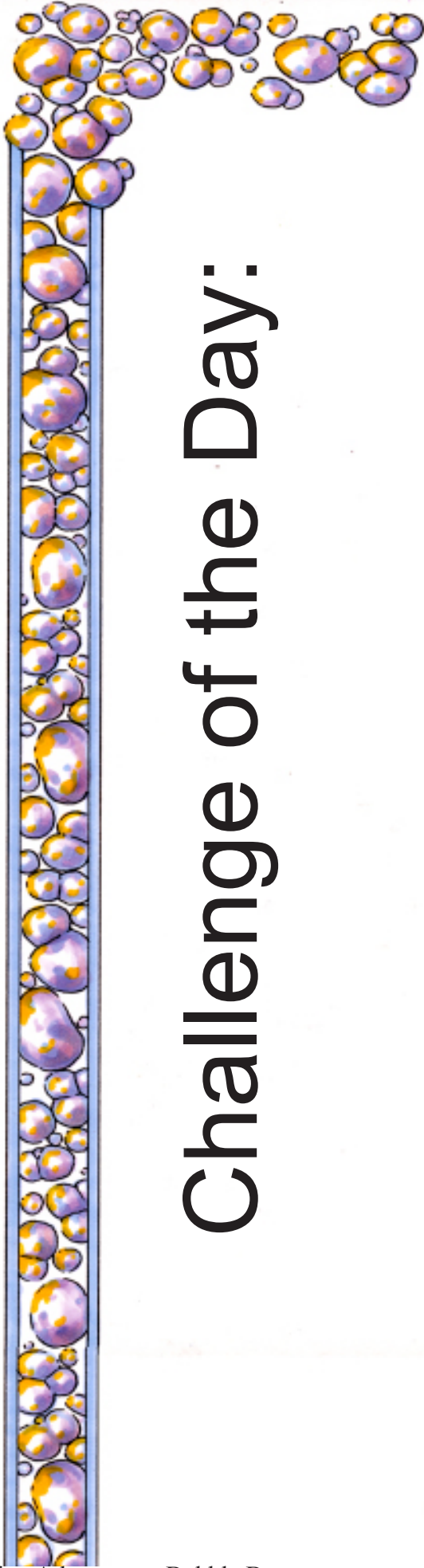
Jacob and I learned a lot when we explored what bubbles can and can't do. We've been working with Miguel to do more cool things with bubbles. Yesterday Jacob blew a bubble that floated onto the table. I thought it would pop, but it sat on the table for five whole minutes!

I tried to blow a bubble that would land on the table, but mine kept popping. I asked Jacob how he did it, but he said it was magic. I know that's not true!

I think I can use the Engineering Design Process to help me Ask more about bubbles and Imagine how to blow a bubble that will land on the table without popping. Maybe I could even figure out how to blow a bubble onto some other materials, like something rough. Maybe sandpaper would work? Or maybe I could catch a bubble and hold it in my hand! That would really impress Jacob and Miguel. Let me know what you find out!

India

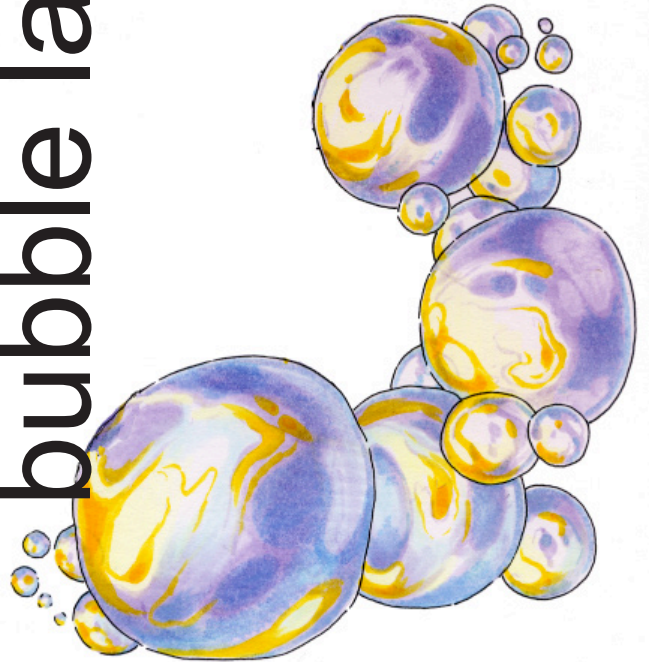




Challenge of the Day:

How can you make a

bubble land without popping?



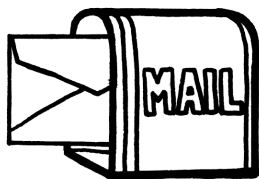
Adventure 2

Not-Round Bubbles

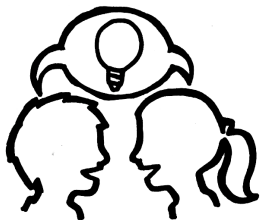
Overview: Kids will build wands of different shapes, observe the bubbles they create, and discuss how wand shape affects (or does not affect) bubble shape.

Note to Educator: Bubbles are made when a thin layer of soap film surrounds a pocket of air. The soap film pulls itself into a shape that has the smallest possible surface area, and this shape is always a sphere. This means that a bubble made from a wand of any shape will become a sphere once it is released from the wand.

Duo Update (5 min)



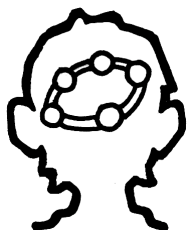
Set the Stage (5 min)



Activity (25 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 5 or Engineering Journal p. 12
- EDP poster
- Challenge of the Day*, this guide p. 43
- bubble solution
- optional: newsprint

For each group of 3-5 kids:

- plastic cup filled with bubble solution
- scissors
- spool of thin, flexible wire (floral wire)
- 10 paper twist ties

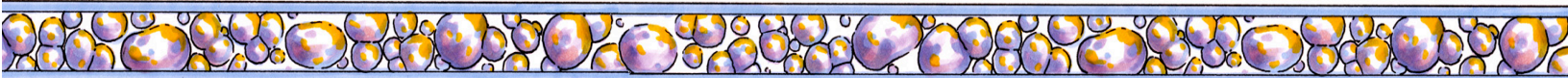
For each kid:

- Engineering Journal

Preparation

Time Required: 15 minutes

1. Have the *Message from the Duo* ready to share.
2. Prepare one cup of bubble solution for each group.
3. Post the *Challenge of the Day*.
4. You may want to cover tables and floors with newsprint.



Journal Pages for Adventure 2

Message From the Duo, p. 12

Adventure 2
Message From the Duo

reply
forward
archive
delete

from: engineeringadventures@mos.org
 subject: Engineering a Tower
 to: You 1:12 PM

Hi everyone,

India and I are having a blast playing with bubbles! We can make them stick together, catch them with our hands, and even make them land on a hairbrush. We did all this using the round plastic bubble wand that comes with store-bought bubble solution. But Miguel's job is to engineer wands for the show that do even more cool things than the round store-bought wands. We need to help him engineer even better wands.

Miguel tells us that materials engineers test and explore properties of materials before they use the materials to create things. We found two materials we think would be good for making wands: wire and twist ties. You'll have to let us know which material you like best.

Let's start by making wacky-shaped wands! We can use the Engineering Design Process to Ask some good questions. What kind of bubble can you make by using a square wand? What about a triangle? Can you imagine other shapes to try?

Jacob

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Wacky Wands, p. 13

Adventure 2
Wacky Wands

Adventure 2
Wacky Wands

Wacky Wands

Bend wire along the lines below so that the wire makes the same shape.

Triangle Wand

Square Wand

Fish Wand

Can you make a not-round bubble with these wands?

What will happen if you make a wand shaped like a cube or a pyramid? Can you make a not-round bubble?

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Recording Page, p. 14

Adventure 2
Recording Page

Adventure 2
Recording Page

Directions: Keep track of your experiments! Draw the bubble wands you use and the shapes of the bubbles they create.

<div style="border: 1px solid gray; padding: 5px; margin-bottom: 10px;"> <p style="font-size: small;">Wand #1</p> <div style="border: 1px solid gray; height: 100px; width: 100%;"></div> <div style="font-size: x-small;"> <input type="checkbox"/> the bubble I made was round <input type="checkbox"/> the bubble I made was not round </div> </div>	<div style="border: 1px solid gray; padding: 5px; margin-bottom: 10px;"> <p style="font-size: small;">Wand #2</p> <div style="border: 1px solid gray; height: 100px; width: 100%;"></div> <div style="font-size: x-small;"> <input type="checkbox"/> the bubble I made was round <input type="checkbox"/> the bubble I made was not round </div> </div>
<div style="border: 1px solid gray; padding: 5px; margin-bottom: 10px;"> <p style="font-size: small;">Wand #3</p> <div style="border: 1px solid gray; height: 100px; width: 100%;"></div> <div style="font-size: x-small;"> <input type="checkbox"/> the bubble I made was round <input type="checkbox"/> the bubble I made was not round </div> </div>	<div style="border: 1px solid gray; padding: 5px; margin-bottom: 10px;"> <p style="font-size: small;">Wand #4</p> <div style="border: 1px solid gray; height: 100px; width: 100%;"></div> <div style="font-size: x-small;"> <input type="checkbox"/> the bubble I made was round <input type="checkbox"/> the bubble I made was not round </div> </div>

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My Ideas About Bubble Shape, p. 15

Adventure 2
My Ideas About Bubble

Adventure 2
My Ideas About Bubble

Is it possible for a bubble wand to make a not round bubble?

For the Record

My favorite wand material was:

Wire

Twist ties

I'm not sure yet.

Draw a picture of a wand design you would like to try making next time.

Did you know?

All sorts of people play with bubbles. Even mathematicians use bubbles to help them solve math problems.

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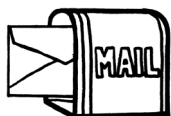
Adventure 2

Not-Round Bubbles

Educator Page: Adventure Guide

Kids will learn:

- bubbles can be made with differently shaped wands.
- once a bubble is made, it forms a sphere—a perfectly round symmetrical shape.



Present the Message from the Duo (5 min)

1. Explain to kids that Jacob has sent another message. Today he's asking kids to try making some wands that are different shapes.
2. Have kids open their Engineering Journals to *Message From the Duo*, p. 12 to read Jacob's message as you play the audio (track 5).
3. To check for understanding, ask:
 - **What would Jacob like us to try today?** *Making wands of different shapes to see if they make bubbles that are not round.*



Set the Stage (5 min)

1. Explain to kids that today they will get the chance to make and experiment with bubble wands of any shape to see how the shape of the wand affects the shape of the bubble. Ask:
 - **Think about bubbles you have seen. What shapes were they?** *Bubbles are round, circles, spheres, etc. Some kids may suggest other shapes, which is fine for now.*
 - **Do you think the shape of the wand matters?**
2. Point out the *Challenge of the Day* and encourage kids to refer back to it as they're working.



Imagine and Create Bubble Wands (25 min)

1. Show kids the wire and twist ties they'll have available for making wands.
2. Split kids into small groups. Give each group a cup of bubble solution and allow them to explore.
3. Encourage kids to create differently shaped wands and use them to make bubbles. The three designs on *Wacky Wands*, p. 13, can help kids who need more direction.
4. As kids are working, ask questions like:
 - **What shape is the bubble when it is in the wand?** *It takes on the shape of the wand.*

Tip: Kids may ask you if bubble solution still attached to a wand "counts" as a bubble. Tell kids that bubble solution does not become a bubble until it is released from the wand.

Tip: If kids finish early, challenge them to make wands that are shaped like animals, cartoon characters, or other shapes!



- **What shape is it after you release the bubble from the wand? Round, a sphere.**
 - **Do you think one wand material works better than the other? Some kids might not like that the paper twist ties get soggy, but others may like that the paper lets them soak up more solution.**
5. Have kids use the *Recording Page*, p. 14, to keep track of the wand shapes they used and what the bubbles looked like.

Tip: You may want to put all Engineering Journals on one dry table away from the testing area so kids can write down their findings after making different wands.



Reflect (10 min)

1. Have kids gather in a group, holding the wands they created. Refer back to the *Challenge of the Day*. Ask:
 - **Did anyone make a wand that made bubbles that were not round? What shape was the bubble you made? Most kids will say that all of the bubbles were round, but a few kids will probably say they made bubbles of other shapes.**
2. If anyone says “yes”, have them show how they made not-round bubbles with their wand. Kids will observe that when bubbles are blown, they are round, without flat edges or corners. Sometimes, bubbles that are very large can come out elongated and wobbly, but if they last long enough, they will eventually become spheres.
3. Have kids think about the wand materials they tested. Ask:
 - **Did anyone find a favorite wand material? Why did you like it?**
4. Show kids the Engineering Design Process poster. Ask:
 - **How did we use the Engineering Design Process today? Accept all responses, but guide kids to focus on the Imagine and Create steps.**
5. Give kids time to record thoughts using *My Ideas About Bubble Shape*, p.15. Writing about what they did today will help kids internalize and remember what they found out.

Extensions: Ring Around A Bubble

You will need a large open space to conduct this activity.

1. Have all the kids in the class hold hands.
2. While holding hands, have them step backwards as far apart from each other as they can, and point out the shape they have made is a circle.
3. Explain that they represent the soap film on the outside of a bubble and the space in the middle represents the air inside the bubble.
4. Have the kids demonstrate what happens when the bubble pops!





from	engineeringadventures@mos.org
subject	Not-round bubbles?
to	You
1:12 PM	

Hi everyone,

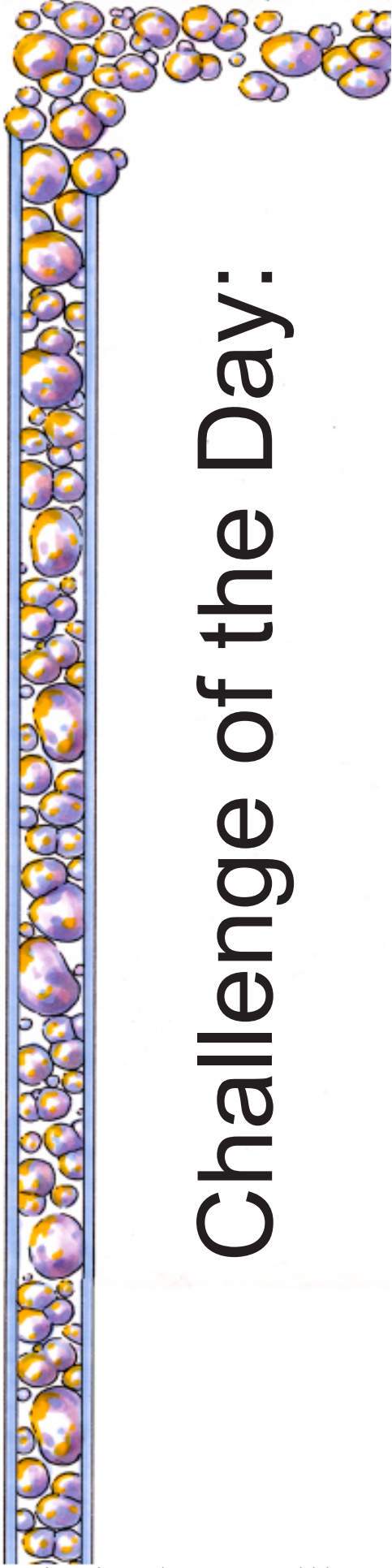
India and I are having a blast playing with bubbles! We can make them stick together, catch them with our hands, and even make them land on a hairbrush. We did all this using the round plastic bubble wand that comes with store-bought bubble solution. But Miguel's job is to engineer wands for the show that do even more cool things than the round store-bought wands. We need to help him engineer even better wands.

Miguel tells us that materials engineers test and explore properties of materials before they use the materials to create things. We found two materials we think would be good for making wands: wire and twist ties. You'll have to let us know which material you like best.

Let's start by making wacky-shaped wands! We can use the Engineering Design Process to Ask some good questions. What kind of bubble can you make by using a square wand? What about a triangle? Can you Imagine other shapes to try?

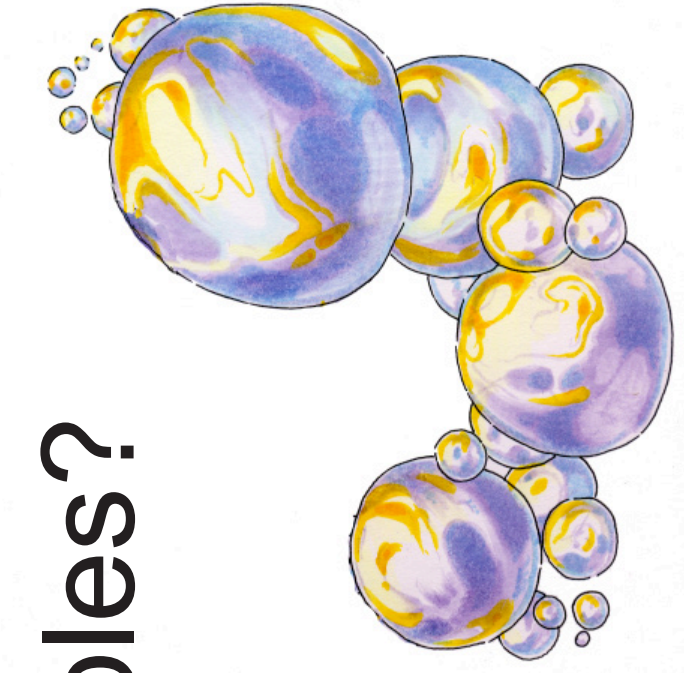
Jacob





Challenge of the Day:

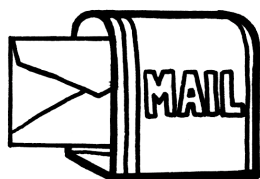
Can you find out how the shape
of a bubble wand affects the
shape of bubbles?



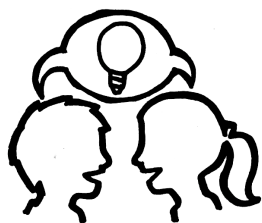
Overview: Kids test, record, and compare how well certain types of bubble tricks can be done with wands of different materials.

Note to Educator: Some objects are better than others at making certain kinds of bubbles. For example, an object like a paper towel tube can absorb lots of bubble solution and make really big bubbles. Because screen has many small holes, it can create lots of bubbles at once, but it does not hold a lot of solution so it can't make really big bubbles.

Duo Update (5 min)



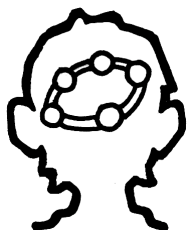
Set the Stage (5 min)



Activity (25 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 6 or *Engineering Journal* p. 16
- EDP poster
- Bubble Tricks*, this guide pp. 51-57
- roll of string
- 4 pans of bubble solution
- 4 spools wire
- 8 blank sheets of paper
- 8 markers or pencils

- 8 pairs of scissors

- 8 pieces of screen

- 10 paper towel tubes

- 20 straws

- 30 rubber bands

- 50 paper twist ties

- 50 pipe cleaners

- optional: newsprint

For each kid:

- Engineering Journal*

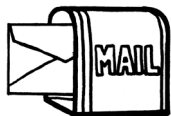
Preparation

Time required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. Copy and post the four *Bubble Trick* pages, each with a blank sheet of paper taped below it for recording.
3. Lay out the materials that kids can use in their explorations.
4. Set up a testing station with four pans of bubble solution where groups can test their bubble wands. You may want to cover this table and the floor underneath with newsprint.

Kids will learn:

- bubble wands can be made from many different materials.
- the material used to make the wand will affect the kind of bubbles they make.



Present the Message From the Duo (5 min)

1. Tell kids India has sent them a message about making bubble wands from different materials.
2. Have kids open their Engineering Journals to *Message from the Duo*, p. 16 to follow along with India's message (track 6).
3. To check for understanding, ask:
 - **What does India want us to do?** *Try using different wand materials to do bubble tricks.*



Set the Stage (5 min)

1. Show kids (or hand out samples of) the pipe cleaners, paper towel tubes, straws, string, rubber bands, and screen. Kids will also have the same wire and twist ties they experimented with before. Ask:
 - **Are any of these things similar to materials we've already used?** **How?** *The pipe cleaner is like the wire and twist ties, except it is fuzzy instead of smooth.*
 - **Are they different? How?** *Some are made of different materials, like plastic, cardboard, and cotton. Some are already circles, so we don't have to bend them.*
2. Point out the *Bubble Tricks* posted around the room. Ask:
 - **Do you think all materials will work well for all challenges? Why?**



Ask: What Materials Work Best? (25 min)

1. Split kids into small groups and explain that they should pick one of the tricks posted on the wall and use any of the materials to try to accomplish it.
2. As they work, remind kids to ask themselves:
 - **What would be the best material to use for this trick? Why?**
3. Encourage groups to test as many different materials and try many different tricks.
4. When someone succeeds at performing a specific trick, they should go to where that trick is posted and use the blank sheet of paper to record how they did it and which

Tip: You may want to make a "testing station" so that the bubble solution stays in one area.

Tip: If kids are having trouble using the cardboard tube, explain that they can dip one end of the tube in the bubble solution, then blow into the other end of the tube.



materials they used. At the end of the activity, they will share their findings with the group.



Reflect (10 min)

1. Gather kids together and have them put all materials down on the tables.
2. Review the posted notes about each trick. Ask:
 - **Is there anything that surprises you about the materials?**
Accept all responses, but guide kids to think about the predictions they made about materials and how good those materials actually were at performing tricks.
3. Review each of the tricks by asking questions like:
 - **Which material was best at making lots of tiny bubbles?** *Kids may suggest screen or materials they can bend into small circles.*
 - **Which material was best at making big bubbles?** *Kids may suggest materials that soak up a lot of solution, or materials they can bend into big circles.*
 - **Are there any materials you did not like? Why?** *Kids may not like that some of the paper materials get soggy in the solution.*
4. Show kids the Engineering Design Process poster. Ask:
 - **What step of the Engineering Design Process helped you most today?**
5. Give kids time to record thoughts using *My Own Bubble Trick Ideas*, p. 17, which guides them to write down the types of materials they used. This will help them prepare for the next adventure, in which they'll create wands using at least three materials.

See It!: For science background on bubbles and glimpses of a bubble artist and scientist at work, visit: <http://www.mos.org/eie/engineeringadventures/bubblevideos> and click on "Bubble Scientist."

Extensions: More Bubble Tricks

Let kids come up with more Bubble Trick ideas on their own, or suggest the following:

- Use the materials to make a wand that spins bubbles around.
- Use the materials to make a wand that makes double bubbles.

Extensions: Around the Room

Have the kids look around the area they are in. Have them make a list of anything they see that they could make bubble wands with.

reply forward archive delete

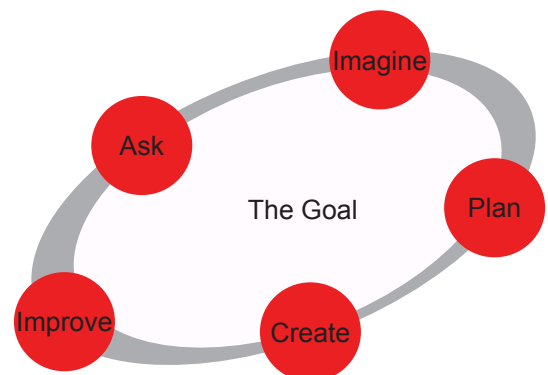
from engineeringadventures@mos.org
subject Wand materials for the Bubble Bonanza
to You
10:41 AM

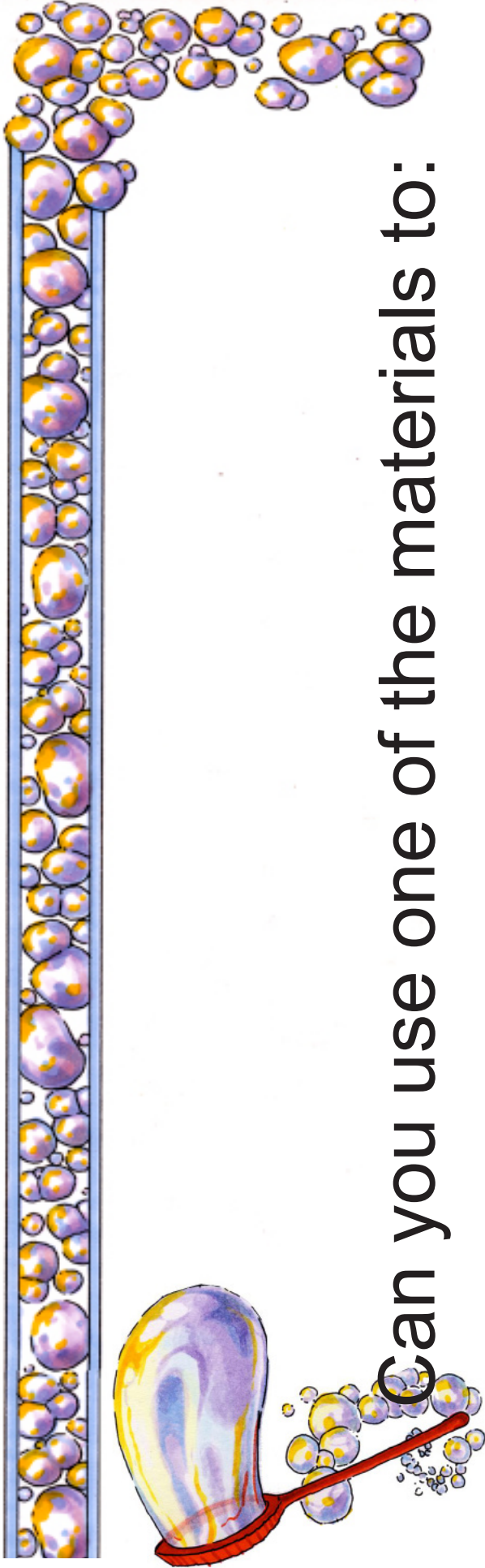
Hi everyone,

We learned a lot trying to engineer wands with different materials last week, but now we want to try even more materials. They're all different shapes, sizes, and made of different things like paper, wire, and plastic.

Miguel pointed out that some materials might be good to use to make certain kinds of bubbles, but not others. A material that's good for making tiny bubbles might not be good for making giant bubbles. We made a list of some bubble tricks we want to try out. Use the Engineering Design Process to help you Create and test different bubble wands with the materials. Let us know which materials are good for doing which tricks. After this, we think we'll be ready to design our bubble wands for the Bubble Bonanza!

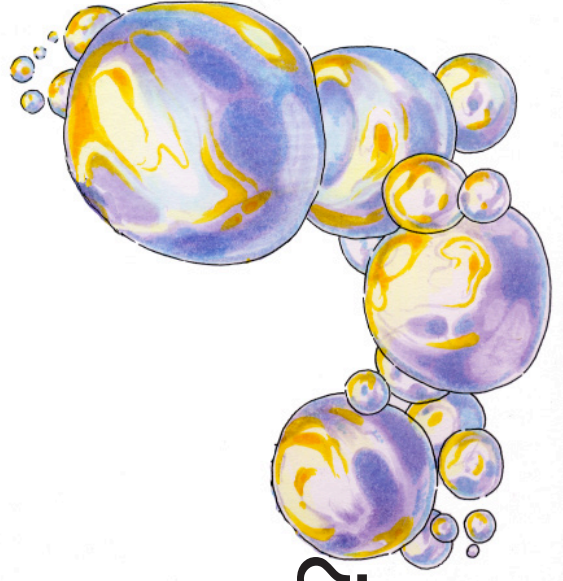
India





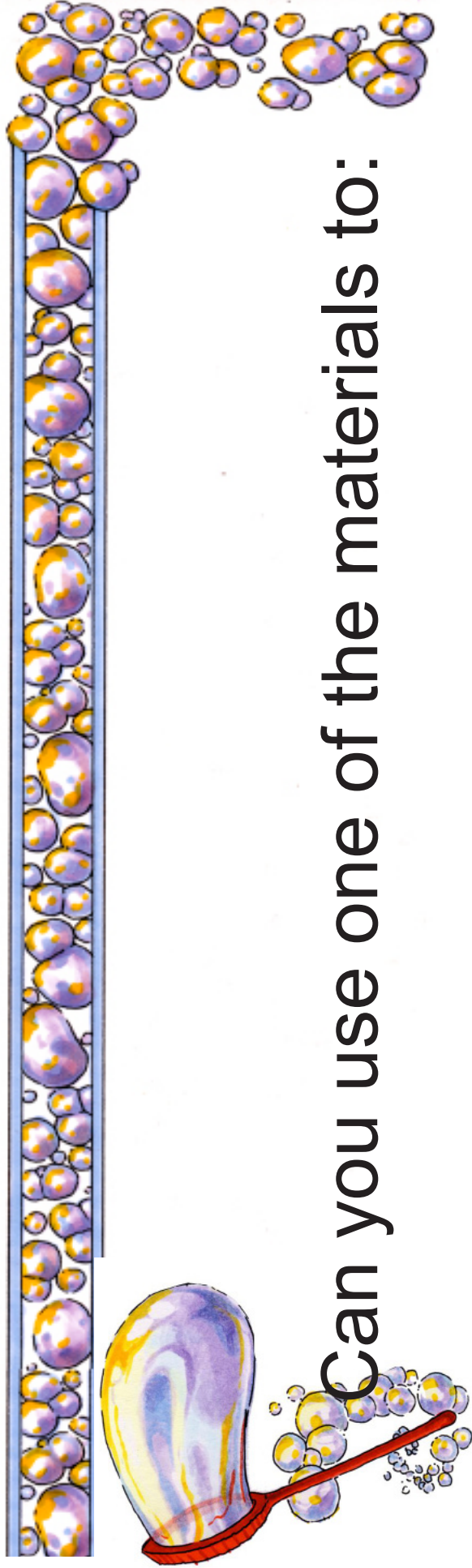
Can you use one of the materials to:

Make bubbles as big as your head!



How did you do it?

(write below)

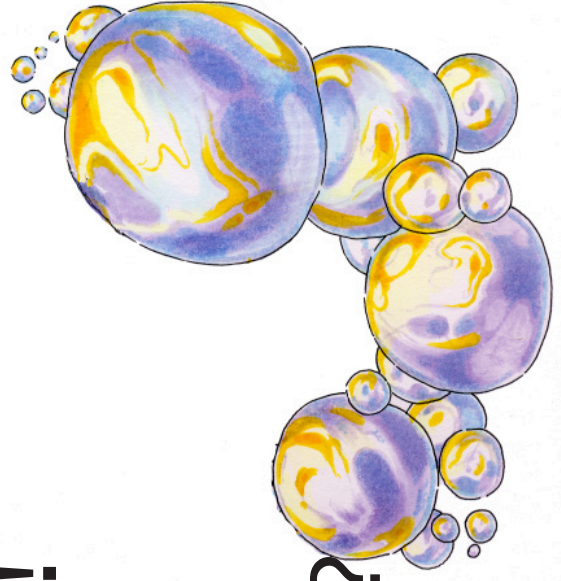


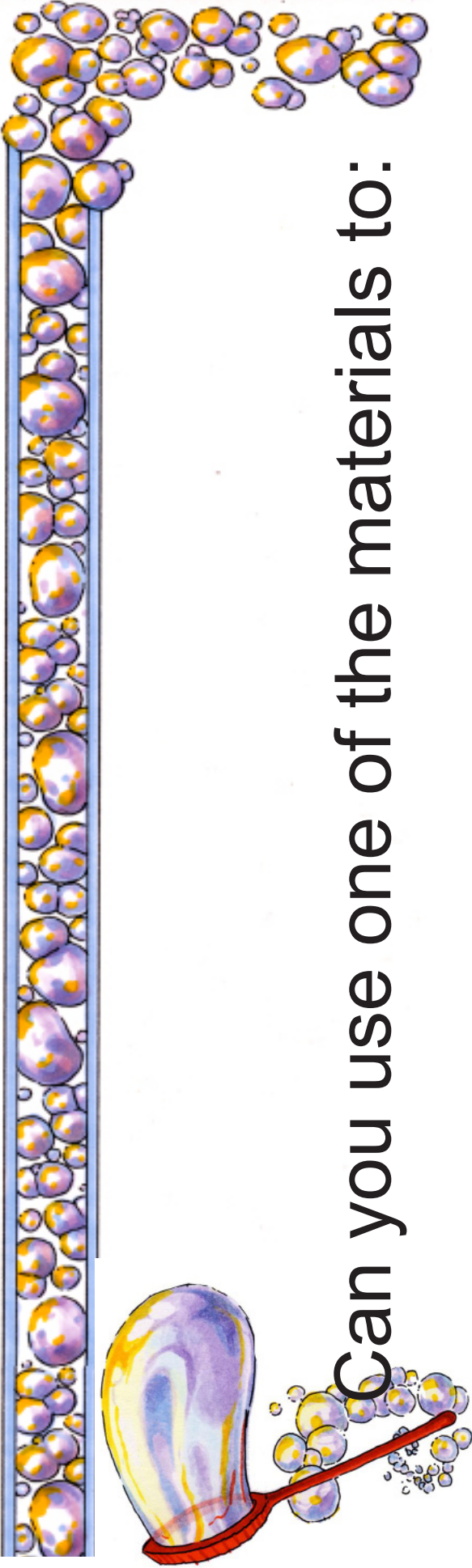
Can you use one of the materials to:

**Make at least ten bubbles with
just one blow!**

How did you do it?

(write below)



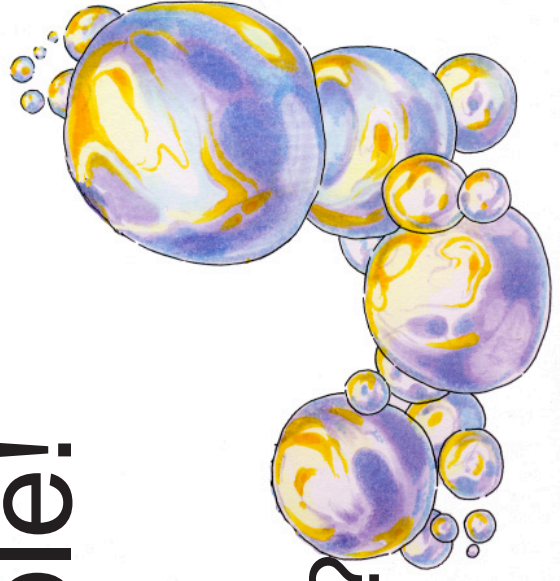


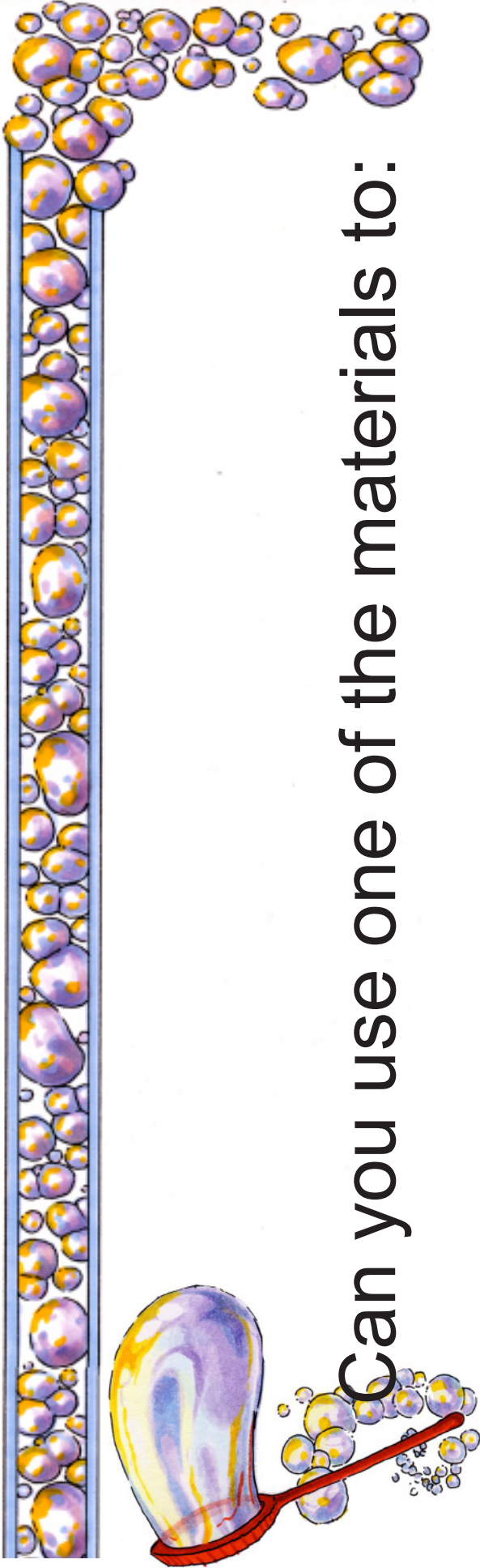
Can you use one of the materials to:

**Make just one
teeny, tiny bubble!**

How did you do it?

(write below)





Can you use one of the materials to:

Make bubbles bounce!

How did you do it?

(write below)



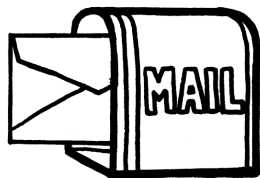
Adventure 4 Creating Bubble Wands

Overview: Groups decide what type of wand they will engineer. They plan two designs, using at least three different materials in each, and begin to create their wands.

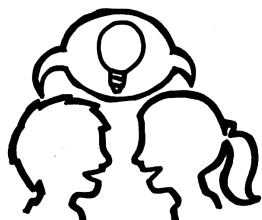
Note to Educator: Kids have explored several different types of bubble wands during the unit, and have used a variety of different materials to make bubbles. In this activity, encourage kids to apply what they have learned to engineer a bubble wand that uses materials in new ways and combines materials.

Be sure to save the wands kids create for use in Adventures 5 and 6!

Duo Update (5 min)



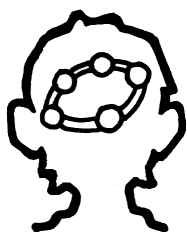
Set the Stage (5 min)



Activity (30 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 7 or *Engineering Journal* p. 18
- EDP poster
- Challenge of the Day*, this guide p. 65

Materials Store

- roll of string
- spool of wire
- 4 pans of bubble solution
- 8 pieces of screen
- 10 balloons
- 10 paper towel tubes
- 10 plastic tubes
- 10 transparency sheets

- 15 paper cups

- 30 straws

- 30 twist ties

- 35 rubber bands

- 50 craft sticks

- 50 pipe cleaners

- 50 sheets construction paper

- optional: newsprint

- optional: plastic mesh

- berry baskets

For each group of 3-5 kids:

- scissors

For each kid:

- Engineering Journal*

Preparation

Time Required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. Set up a Materials Store with all of the materials and supplies kids will have available for engineering their bubble wands.
3. Set up a testing station with four pans of bubble solution in a central location where groups can test their bubble wands. You may want to cover the workspace with newsprint.
4. Post the *Challenge of the Day*.



Journal Pages for Adventure 4

Message From the Duo, p. 18

Adventure 4 **Message From the Duo**

reply forward archive delete

from: engineeringadventures@mos.org
 subject: Engineering a Tower
 to: You 4:32 PM

Hi everyone,

Wow! You've done some great engineering so far! We've asked lots of questions about bubbles and saw what bubbles can and can't do. We've also asked good questions about the materials we can use to make our bubble wands. Now it's time to engineer our wands!

We want our bubble wand technologies to show people some of the amazing things that bubbles can do. First we need to Imagine some different ways to combine materials. Then we can Plan out our wand and work as an engineering team to Create it. The Engineering Design Process will help us engineer the best wands for the Bubble Bonanza show!

Jacob

Engineering Adventures: Engineering Journal 18 © Museum of Science, 2012

Imagine and Plan, p. 19

Adventure 4 **Imagine and Plan**

Choose your goal, then draw some ideas for your bubble wand. Be sure to label what supplies you will need!

Our Goal
 Our bubble wand will:

make lots of bubbles make small bubbles
 make huge bubbles _____

Idea #1

Idea #2

Engineering Adventures: Engineering Journal 19 © Museum of Science, 2012

My Ideas About My Wand, p. 20

Adventure 4 **My Ideas About My Wand**

Draw what your wand looks like. Circle the parts you would like to improve for next time.

What are the materials you used to make your wand?

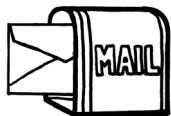
Engineering Adventures: Engineering Journal 20 © Museum of Science, 2012

Adventure 4 Creating Bubble Wands

Educator Page: Adventure Guide

Kids will learn:

- following the steps of the Engineering Design Process will help them Imagine, Plan, and Create bubble wands for the Bubble Bonanza.



Present the Message From the Duo (5 min)

- Have kids open their Engineering Journals to *Message From the Duo*, p. 18 to read the challenge Jacob presents about making bubble wands out of different materials (track 7). To check for understanding, ask:
 - What technology do India and Jacob want us to engineer?** *Bubble wands.*
 - What process did Jacob say would help us?** *The Engineering Design Process.*
- Show students the Engineering Design Process poster and let them know you will have it posted so they can look at it as they are designing.

See It! To see a real bubble festival, visit our website and click on “Bubble Festival.”



Set the Stage: What is the Goal? (5 min)

- Tell kids that today they will get the chance to use all that they have learned about wand materials to design a wand that can be used in the Bubble Bonanza.
- Explain that their design **MUST** include at least three of the bubble wand materials on the table.
- Show kids the new materials that have been added to the Materials Store—craft sticks, paper cups, construction paper, plastic tubes, transparency sheets, and (optionally) berry baskets. Ask:
 - How are these materials similar to other things you’ve tested?**
- Tell kids they can choose their goal for their bubble wand. Possible goals include engineering a wand that makes lots of bubbles, big bubbles, small bubbles, etc.
- Point out the *Challenge of the Day* and encourage kids to refer back to it as they work.



Plan a Bubble Wand (10 min)

- Have each group use *Imagine and Plan*, p. 19, to choose a goal for their bubble wand and sketch out two ideas they have.

Tip: You can set up the testing station before this adventure starts, but encourage kids to Plan and Create (build) for at least 10 minutes before they start testing.



2. Explain that drawing the plans for their wands is an important step that engineers use to make sure they don't waste time and materials figuring out what they want to do.
3. Once teams have picked one idea they want to create, they can get supplies from the Materials Store.

Create! (20 min)

1. Give kids plenty of time to Create and test their wand designs. As they are building, ask questions like:
 - **How will your wand meet your goal?**
 - **Why did you choose those materials?**
2. When kids bring their wands to the bubble solution pans for testing, ask questions like:
 - **What parts of your wand are working well?**
 - **What parts of your wand are not working well?**
 - **How could you improve your wand?**
3. Use the Engineering Design Process Poster to guide conversations and encourage students to use the names for the steps of the Engineering Design Process to describe what they are doing.

Tip: Be sure to keep the bubble wands for Adventures 5 and 6!



Reflect (10 min)

1. Gather kids together and have them put all materials down on the tables. Assure them that they will have more time to work on their designs during the next adventure.
2. Have groups share their work so far. Ask:
 - **What materials are working the best for your designs? Why do you think so?**
3. Show kids the Engineering Design Process poster. Ask:
 - **How did we use the Engineering Design Process today?**
 - **What did we Create?**
 - **How did we Plan?**
 - **Did anyone Imagine or Improve today? How?**
4. Give kids time to record thoughts using *My Ideas About My Wand*, p. 20, which guides them to think about any improvements they might want to make during the next adventure.

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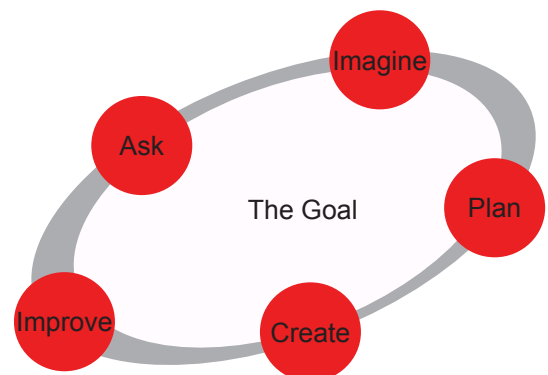
from engineeringadventures@mos.org
subject Creating Bubble Wands
to You
4:32 PM

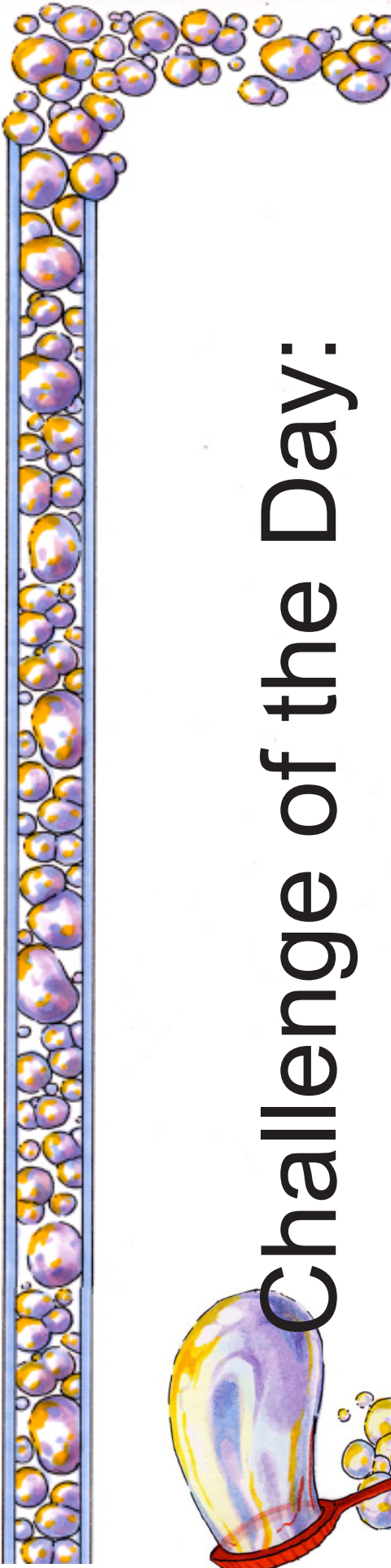
Hi everyone,

Wow! You've done some great engineering so far! We've asked lots of questions about bubbles and saw what bubbles can and can't do. We've also asked good questions about the materials we can use to make our bubble wands. Now it's time to engineer our wands!

We want our bubble wand technologies to show people some of the amazing things that bubbles can do. First we need to Imagine some different ways to combine materials. Then we can Plan out our wand and work as an engineering team to Create it. The Engineering Design Process will help us engineer the best wands for the Bubble Bonanza show!

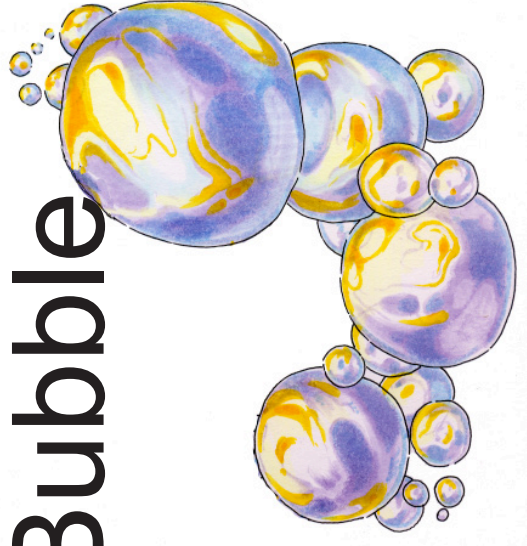
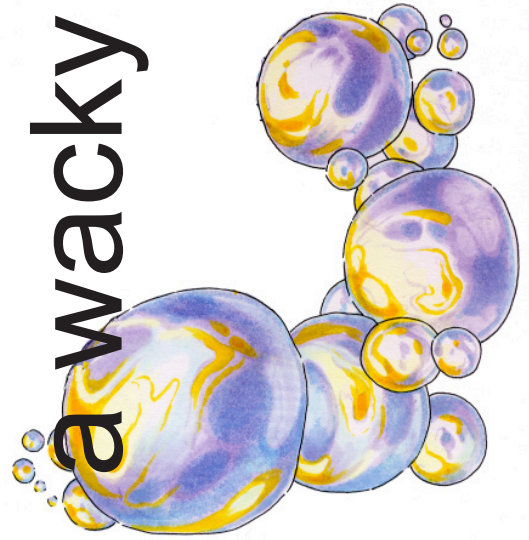
Jacob





Challenge of the Day:

Can you put **THREE** different materials together to engineer a wacky wand for our Bubble Bonanza?



Adventure 5 Improving Bubble Wands

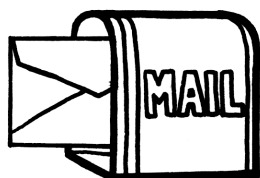
Educator Page: Preview

Overview: Kids focus on the Improve step of the Engineering Design Process as they continue working on their wands, testing, and Improving their designs.

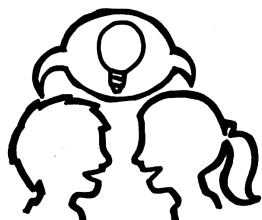
Note to Educator: The goal of this lesson is for kids to improve upon their original wand designs. Kids are also given small fans that they can use to blow bubbles through their wands.

Be sure to keep the improved bubble wands for Adventure 6!

Duo Update (5 min)



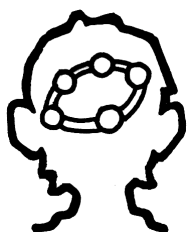
Set the Stage (5 min)



Activity (25 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 8 or Engineering Journal p. 21
- EDP poster
- Challenge of the Day*, this guide p. 73

Materials Store (remaining materials from Adv. 4):

- roll of string
- spool of wire
- 2 small fans
- 4 pans of bubble solution
- 8 pieces of screen
- 10 balloons
- 10 paper towel tubes

- 10 plastic tubes
- 10 transparency sheets
- 15 paper cups
- 30 straws
- 30 twist ties
- 35 rubber bands
- 50 craft sticks
- 50 pipe cleaners
- 50 sheets construction paper
- optional: newsprint
- optional: mesh berry baskets

For each group of 3-5 kids:

- scissors

For each kid:

- Engineering Journal

Preparation

Time Required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. Set up a testing station with four pans of bubble solution in a central location where groups can test their bubble wands. You may want to cover the workspace with newsprint.
3. Set up a Materials Store with all the materials left over from Adventure 4.
4. Post the *Challenge of the Day*.



Journal Pages for Adventure 5

Message From the Duo, p. 21

Adventure 5 **Message From the Duo**

reply forward archive delete

from: engineeringadventures@mos.org
subject: Engineering a Tower
to: You 2:15 PM

Hi everyone,

Jacob and I are so impressed with the wands you engineered. They are great technologies! We know you're using the Engineering Design Process to make these wands the best they can be.

Share your ideas with each other and try to Improve your wands even more! If your goal is to make big bubbles, can you Improve your wand so the bubbles it makes are giant? If your goal is to make lots of bubbles, can you Improve your wand so it makes fifty or even one hundred bubbles?

To help you out, we sent you one more special supply to make your wands even more exciting to watch during the Bubble Bonanza. Jacob and I can't wait to see your final designs.

India

Engineering Adventures: Engineering Journal 21 © Museum of Science, 2012

Improving Bubble Wands, p. 22

Adventure 5 **Improving Bubble Wands**

What does your final wand look like? Draw a picture.

What materials did you use to make your wand?

Did you know?
Some scientists think our universe is part of a giant bubble.

Engineering Adventures: Engineering Journal 22 © Museum of Science, 2012

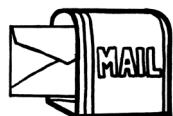
Adventure 5

Improving Bubble Wands

Educator Page: Adventure Guide

Kids will learn:

- they can use the Improve step of the Engineering Design Process to make their technologies even better.



Present the Message From the Duo (5 min)

- Tell kids India sent them a message about the Improve step of the Engineering Design Process.
- Have kids open their Engineering Journals to *Message From the Duo*, p. 21 to follow along with India's message (track 8).



Ask: How Can We Improve Our Designs? (5 min)

- Show kids the new material that Jacob and India sent: small fans. Tell kids that the fans will be near the testing station so groups can try them out after Improving their designs.
- Have kids share some of their experiences from last time. Ask:
 - Which materials are working well in your bubble wand designs?**
 - Are there any materials that are not working well?**
 - What parts of your design do you want to Improve so that you can meet your goal?**
- Some groups may have had difficulty with materials getting soggy. Guide kids to make suggestions for each other based on what is working well in their own designs.
- Have kids look back at *My Ideas About My Design*, p. 20, where they sketched out their bubble wand design in the previous Adventure. Have kids think about parts of their design they would like to improve and possibly draw a new plan.

Tip: If you don't have small fans available, you could substitute a larger fan or a hair dryer.



Let the Improving Begin! (25 min)

- Point out the *Challenge of the Day* and encourage kids to refer back to it as they Improve their first designs. As they are working, ask questions like:
 - Which three materials are you using?**
 - What parts of your wand are working/not working well?**
 - How are you Improving your wand so that you can meet your goal?**
- As teams work, use the Engineering Design Process poster to guide conversations and encourage students to use the names for the steps of the Engineering Design Process to describe what they are doing.



Reflect (10 min)

1. Gather kids together and have them put all materials down on the tables.
2. Show kids the Engineering Design Process poster. Ask:
 - **How did you engineer today? Did anyone use the Improve step while engineering your wands?**
 - **What are some problems you are having? How are you working with your team to solve these problems?**
3. In a dry area of the room, have kids use *Improving Bubble Wands*, p. 22 to draw their final bubble wand design and label the materials they used.
4. Tell kids that the next adventure will be the Engineering Showcase when they will be able to share the wands they engineered for the Bubble Bonanza show. Remind them that the information they have been recording in their Engineering Journals can help them with their presentation.

Extensions: Write to the Duo

1. Consider having kids write a letter or an email to the Duo. By having them explain their designs to the Duo, they'll be preparing for the kind of sharing they will be asked to do during the Bubble Bonanza (Adventure 6).
2. A possible writing prompt includes:
 - **Write a letter to India and Jacob about your final design. Draw a picture of your wacky wand and write down which materials you used to make it.**

Tip: If you have computer access, your kids can email the Duo at EngineeringAdventures@mos.org

reply forward archive delete

from engineeringadventures@mos.org
subject The Best of the Best Bubble Wands
to You
2:15 PM

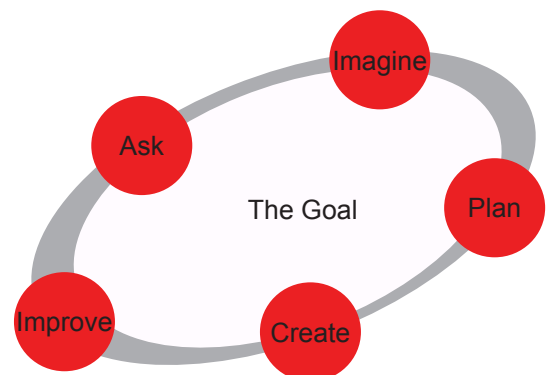
Hi everyone,

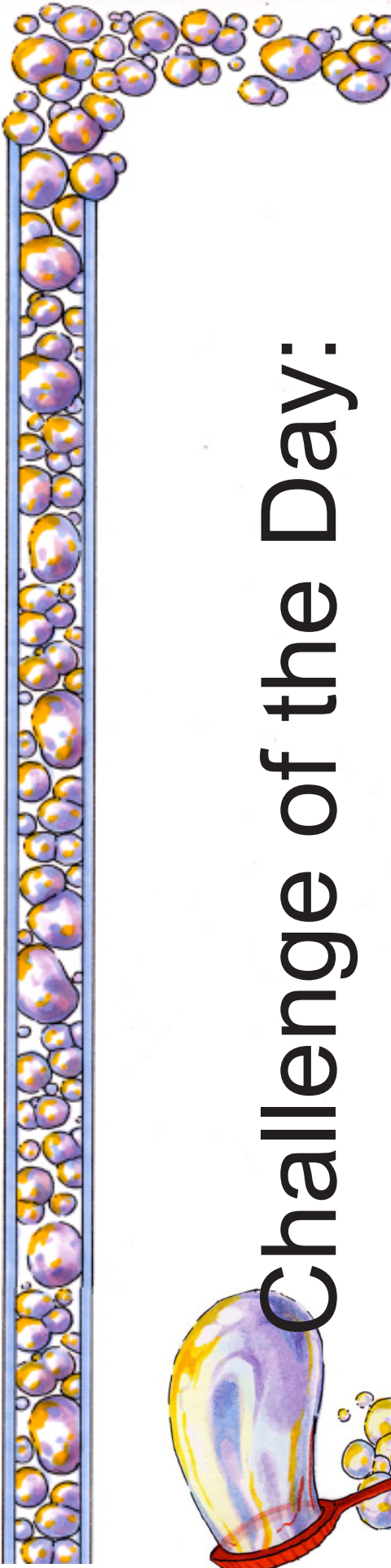
Jacob and I are so impressed with the wacky wands you engineered. They are great technologies! We know you're using the Engineering Design Process to make these wands the best they can be.

Share your ideas with each other and try to Improve your wacky wands even more! If your goal is to make big bubbles, can you Improve your wand so the bubbles it makes are giant? If your goal is to make lots of bubbles, can you Improve your wand so it makes fifty or even one hundred bubbles?

To help you out, we sent you one more special supply to make your wands even more exciting to watch during the Bubble Bonanza. Jacob and I can't wait to see your final designs.

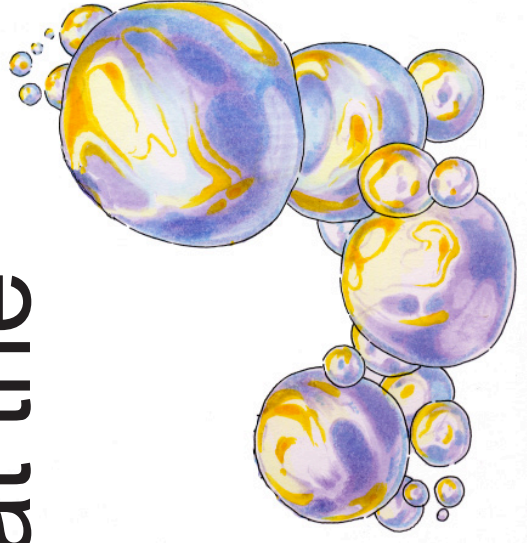
India





Challenge of the Day:

Can you Improve your bubble wand so it meets your goal, and will be exciting to show at the Bubble Bonanza?

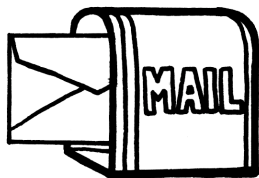


Engineering Showcase: Bubble Bonanza

Overview: During this activity, kids show their wands and their knowledge of the Engineering Design Process in a Bubble Bonanza show.

Note to Educator: The Bubble Bonanza provides the chance for all groups to share the wands they engineered. You should choose a presentation format that is best for your kids. You could set it up like a fair, with each group standing at their own station and explaining their bubble wands. Or, you could actually create a show set to music where each group has an allotted time to be on stage and show the wands they engineered.

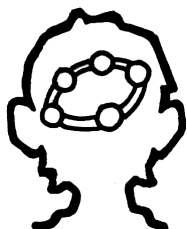
Duo Update (5 min)



Activity (30 min)



Reflect (10 min)



Materials

For the entire group:

- Message from the Duo*, track 9 or Engineering Journal p. 23
- EDP poster
- Challenge of the Day*, this guide p. 81
- markers
- paper
- 2 hand-held fans
- 4 pans of bubble solution
- optional: newsprint

For each group of 3-5 kids:

- final wand designs from Adventure 5

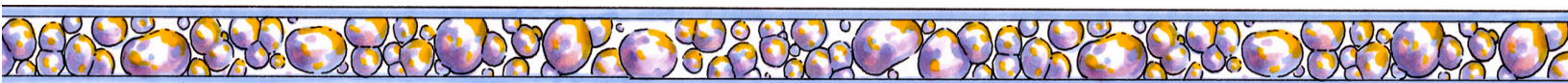
For each kid:

- Engineering Journal

Preparation

Time Required: 5 minutes

1. Have the *Message from the Duo* ready to share.
2. Post the *Challenge of the Day*.
3. Decide how you will format the Bubble Bonanza.
4. Prepare one pan of bubble solution for each group.
5. You may want to cover tables and the floor with newsprint.
6. If possible, arrange to record or photograph this activity!



Journal Pages for Adventure 6

Message From the Duo, p. 23

Adventure 5 **Message From the Duo**

reply forward archive delete

from engineeringadventures@mos.org
subject Engineering a Tower
to You 2:15 PM

Hi everyone,

Jacob and I are so impressed with the wands you engineered. They are great technologies! We know you're using the Engineering Design Process to make these wands the best they can be.

Share your ideas with each other and try to Improve your wands even more! If your goal is to make big bubbles, can you Improve your wand so the bubbles it makes are giant? If your goal is to make lots of bubbles, can you Improve your wand so it makes fifty or even one hundred bubbles?

To help you out, we sent you one more special supply to make your wands even more exciting to watch during the Bubble Bonanza. Jacob and I can't wait to see your final designs.

India

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Bubble Bonanza, p. 24

Adventure 6 **Bubble Bonanza**

Plan your Bubble Bonanza presentation with your group.

- What does your bubble wand do?
- How is your bubble wand a technology?
- What materials did you choose? Why?
- What steps of the Engineering Design Process did you use to help you create your bubble wand?

Engineering Adventures: Engineering Journal 24 © Museum of Science, 2012

My Ideas About Engineering, p. 25

Adventure 6 **My Ideas About Engineering**

What was your favorite part about engineering your bubble wand?

Circle the step of the Engineering Design Process that helped you the most.

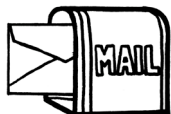
For the Record
I think engineering is:

- more fun than I thought it would be.
- harder than I thought it would be.
- _____ than I thought it would be.

Engineering Adventures: Engineering Journal 25 © Museum of Science, 2012

Kids will learn:

- to describe how they used the steps of the Engineering Design Process to help them Ask, Imagine, Plan, Create, and Improve their wand design.



Present the Message From the Duo (5 min)

- Have kids open their Engineering Journals to *Message From the Duo*, p. 23 to read how India and Jacob would like them to share the great engineering they did (track 9).
- Post the *Challenge of the Day*. To check for understanding, ask:
 - What do India and Jacob want us to do?** *They want us to show others our wacky wands and tell them how we used the Engineering Design Process to create them.*



Plan the Bonanza (10 min)

- Tell kids about the format for the Bubble Bonanza that you decided on (a fair, a show, etc.). Groups can create spoken presentations, visual displays, or anything that you think your group will enjoy.
- Have kids fill out *Bubble Bonanza*, p. 24, to help them prepare for their presentation.
- Circulate and help kids write down or think about their responses to the questions:
 - How does your wand meet your goal?**
 - How is your wand a technology?**
 - What materials did you choose? Why?**
 - What steps of the Engineering Design Process did you use to help you create your wand?**

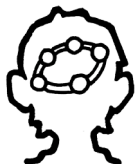
Tip: If you are having visitors come to the final presentation, you may want to have extra wand materials available so that groups can lead them through engineering their own wands.

Share (20 min)

- Allow each group to share their wands with everyone by demonstrating how they work
- Have each child talk about their design, or ask them to respond to each question on *Bubble Bonanza*, p. 24.

Reflect (10 min)

- Guide kids to look back at the Engineering Design Process poster. Ask:
 - Which step helped you most when you were creating your wand?**
- Have groups make their final entry in their Engineering Journals, on *My Ideas About Engineering*, p. 25.





reply



forward



archive



delete

from

engineeringadventures@mos.org

subject

Bubble Bonanza

to

You

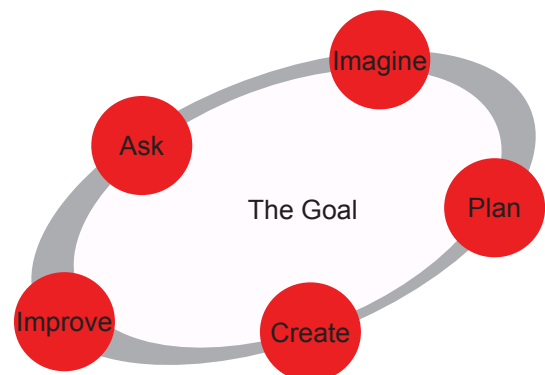
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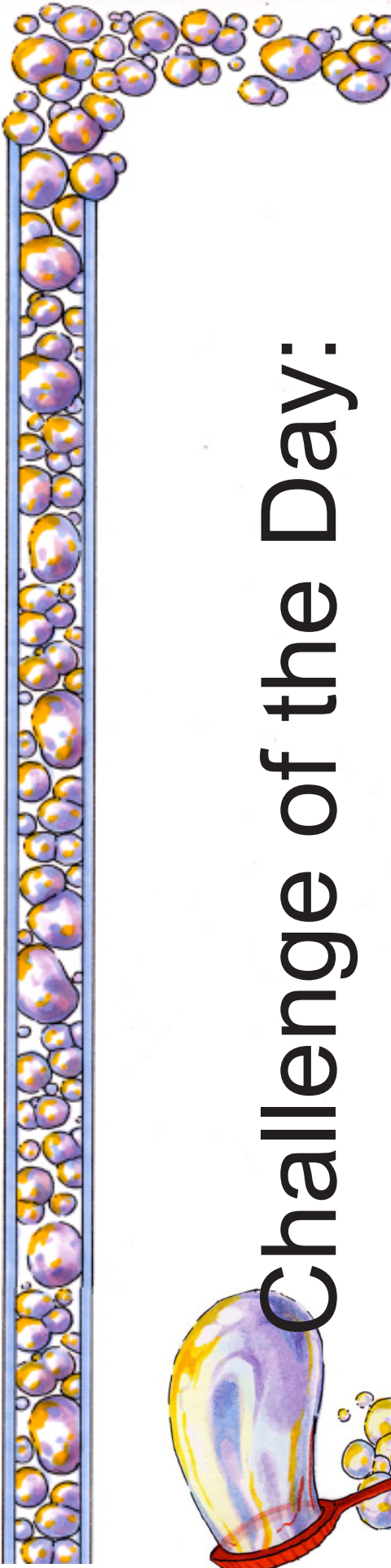
Hi everyone,

Thank you for all of your great engineering! Who knew there were so many ways to make bubbles? The wands you engineered are amazing! We can't wait for you to share your designs with other people. Miguel thinks the amusement park will be really impressed.

We think you should do a test run of the Bubble Bonanza to show people the wand technologies that you engineered. Be sure to tell people your goal and show everyone what your wands can do. Don't forget to tell people how you used the Engineering Design Process to create your designs!

We'll be in touch,
India and Jacob, the Duo





Challenge of the Day:

Can you share how you
used the Engineering Design
Process to engineer your
bubble wand?

