Engineering Adventures

In Good Hands: Engineering Space Gloves

Materials Engineering for Out-of-School Time • Grades 3–5

Written by the EiE® Team
Illustrated by Ross Sullivan-Wiley
and the EiE Team®

EiE

EiE
Museum of Science
1 Science Park
Boston, MA 02114

eie@mos.org

Written by the EiE team:

Project Director:
Christine Cunningham

Curriculum Development:
Owen Berliner
Martha Davis
Marisa Garcia
Katherine Katzer
Katy Laguzza
Mary Eileen McDonnell
Natacha Meyer
Bekka Nolan
Leandra Rizzo
Kate Sokol

Research and Evaluation:
Christine Gentry
Jonathan Hertel
Cathy Lachapelle
Christopher San Antonio-Tunis

Operations:
Jack Payette
Vince Sbarra

Professional Development:
Chantal Balesdent
Mary Dzaugis
Marlene Guay
Elissa Jordan
Nia Keith
Stacy Klein-Gardner
Karen Saur

Marketing and Communications:
Hannah Erb
Amielle Major
Corey Niemann
Melissa Rousselle
Robin Staley
Annie Whitehouse

Sales and Customer Relations:
Kate Asquith
Chuy Garcia
Heather Gunsalles
Sean McLaughlin
Courtney Quarterman
Jill Olson
Jeremy Pinson
Jay Santos
Erin Scroggins
Pete Sobel
Merrick Teti
Renee Venegas

Multimedia:
Alex Hennessy
Richard Sutton

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Pilot Sites for In Good Hands:

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

A.C. Whelan Elementary School Revere, MA
Beeman Memorial School Gloucester, MA
Boys and Girls Club of Dorchester Dorchester, MA
Boys and Girls Club of Flagstaff Flagstaff, AZ
Boys and Girls Club of Greater Salem Salem, MA
Bridges After-School Program Carmichael, CA
Cambridge Camping Association Cambridge, MA
East Prairie Middle School Tuscola, IL
Flagstaff Family YMCA Flagstaff, AZ
Flagstaff Junior Academy Flagstaff, AZ
FUSD FACTS Camp Iwannago Flagstaff, AZ
Gregg Neighborhood House Lynn, MA
Havelock Elementary School Havelock, NC
JerseySTEM South Orange, NJ
Killip Elementary School Flagstaff, AZ
Knoles Elementary School Flagstaff, AZ
Leupp Public School Flagstaff, AZ
Magnolia School Orlando, FL
Museum at Prairiefire Overland Park, KS
Project Access Charter Court Apartments San Jose, CA
Project Access Villa Monterey Apartments San Jose, CA
QRSD Fun Frontier Hubbardston, MA
Reformation Lutheran Church Philadelphia, PA

PLANETS

Planetary Learning that Advances the Nexus of Engineering, Technology, and Science (*PLANETS*) is an interdisciplinary and cross-institutional partnership that integrates planetary science, education, technology, and engineering (NASA #NNX16AC53A).

The Center for Science Teaching and Learning at Northern Arizona University (NAU), the U.S. Geological Survey (USGS) Astrogeology Science Center, and the Museum of Science, Boston have partnered to develop, pilot, and research the impact of three curriculum units and related professional development resources (http://planets-stem.org).

The purpose of *PLANETS* is to increase public awareness and use of NASA resources by highlighting the relationship between science, technology, engineering, and mathematics in the context of planetary science in out-of-school time settings.

NAU Collaborators:
Haylee Archer Graduate student
Nadine Barlow Professor, Department of Physics and Astronomy
Amy Beeler Undergraduate student
Mindy Bell Flagstaff STEM City
Christopher Benson Graduate student
Nena Bloom Evaluation Coordinator and Researcher
Joëlle Clark Principal Investigator
Vanessa Fitz-Kesler Professional Development Associate
Maegan Foltz Undergraduate student
Dane Henderson Graduate student
Elisabeth Roberts Evaluation Coordinator and Researcher
Lori Rubino-Hare Professional Development Coordinator
Sean Ryan Professional Development Associate
Brandon VanBibber Undergraduate student

USGS Collaborators:
Ryan Anderson Research Scientist
Lauren Edgar Research Scientist
Tenielle Gaither Research Scientist
Moses Milazzo Research Scientist
Greg Vaughan Research Scientist

PLANETS Evaluation:
Carol Haden Magnolia Consulting

Unit Map

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

Prep Adventure 1: Tower Power

Kids will engineer an index card tower that can support a stuffed animal.

Prep Adventure 2: Hands-On Technology

Kids will discuss the definition of technology and engineer a solution to solve a problem.

Adventure 1: Everyday Gloves

Kids will explore the features of different gloves and how they perform in a series of challenges. Kids then are introduced to the concept of space hazards and spacesuit design.

Adventure 2: Chilling Out

Kids will test and compare different materials to see which ones work best to protect against cold temperatures.

Adventure 3: Ready for Impact

Kids will test and compare how well different materials protect against impact hazards, specifically damage from heavy moving objects.

Adventure 4: Dangerous Dust

Kids will test and compare how dust resistant different materials are.

Adventure 5: Create a Space Glove

Kids will *plan*, *create,* and test their model space gloves in one of three Mission Simulations to see how well the gloves protect against the hazards of space.

Adventure 6: Improve a Space Glove

Kids will *improve* their model space gloves and test them in a final Mission Simulation.

Adventure 7: Engineering Showcase

Kids will present their designs and share how they used the Engineering Design Process to engineer model space gloves suited for their chosen mission.

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Introduction

Adventures

About EiE®

EiE is a program of the Museum of Science, Boston. Its mission is to create the next generation of problem solvers. EiE curricula are designed to encourage all children, including those from underrepresented groups, to envision themselves as engineers.

The EiE team creates and supports a range of curricula. Each curriculum product has been created using rigorous, research-based design principles. In addition to introducing children to the excitement of engineering, EiE units foster valuable cognitive skills such as critical thinking, collaboration, communication, creativity, flexibility, persistence, and learning from failure.

The table below provides an overview of EiE's curriculum products.

Curriculum Product	Classroom Type	Grade Level
Wee Engineer®	Preschool and Pre-K classrooms	Ages 3-5
EiE® for Kindergarten	Kindergarten classrooms	Kindergarten
Engineering is Elementary®	Elementary school classrooms	Grades 1-5
Engineering Adventures®	Afterschool and Out-of-school settings	Grades 3-5
Engineering Everywhere®	Afterschool and Out-of-school settings	Grades 6-8

For more information about EiE, visit: eie.org.

About the Museum of Science, Boston

The Museum of Science, Boston is the nation's only science museum with a comprehensive strategy and infrastructure to foster engineering and technological literacy in both science museums and schools. The museum develops exhibits, programs, and curricula that empower children to become lifelong STEM learners and passionate problem solvers. Through the advocacy efforts of the NCTL, we inspire to transform STEM education both nationally and internationally. Our engineering curricula (preK-12), resources, and teacher professional development are designed to innovate for the reality of today's educational landscape, combining the best in theory, research, teaching practice, and thought leadership.

About Engineering Adventures

The mission of Engineering Adventures is to create exciting out-of-school-time activities and experiences that allow *all* 3rd–5th grade learners to act as engineers and engage in the Engineering Design Process. Our goal is to positively impact children's attitudes about their ability to engineer by providing materials uniquely appropriate for the varied landscapes of out-of-school-time settings.

The main ideas that guide the developers 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 each unit, 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 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: www.engineeringadventures.org.

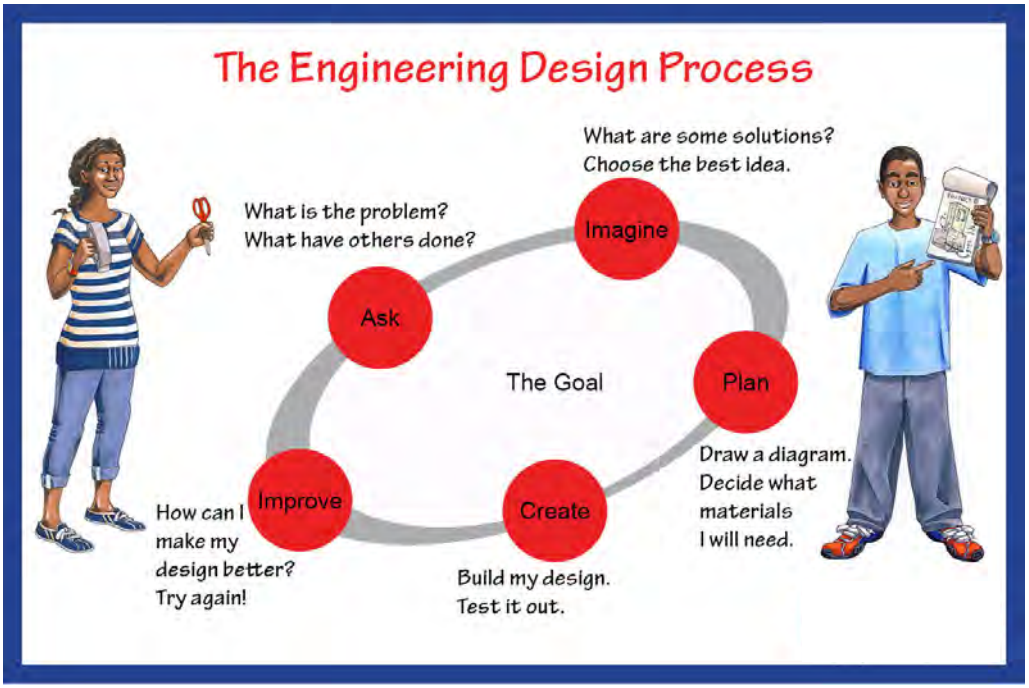
The Engineering Design Process

The Engineering Adventures Engineering Design Process (EDP) is the backbone of each Engineering Adventures unit. It is a five-step process that guides kids in solving engineering challenges. Our goal for each EA unit is for kids to understand the EDP can help them solve problems not only in engineering but also in other areas of their lives.

While there are many other versions of the EDP that are used in academic and professional settings, the EiE team developed a five-step process that is accessible for elementary school kids. India and Jacob, a fictional world-traveling brother and sister duo, introduce and guide kids through the EDP in each unit. There are also questions for the educator to ask and sections in the Engineering Journal to provide an opportunity for kids to reflect on and discuss the process.

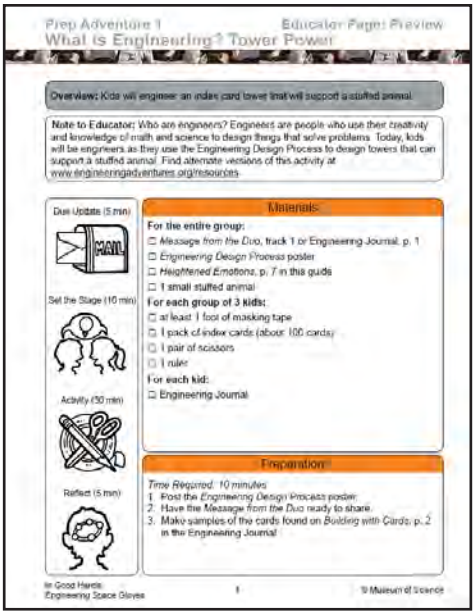
The EDP begins with the goal: the engineering challenge kids are asked to solve. The process is cyclical and flexible; kids can start a challenge at any step and may jump around to steps as they are engineering. For example, it is very common for kids to begin *creating* their technology, but then *ask* questions about materials and *imagine* new ways to *improve* their design. In Enginering Adventures units, kids generally start with the *ask* step, then have time to *imagine* and *plan* their designs, and *create* and *improve* their technologies.

To further highlight the EDP throughout the unit, the steps are italicized in this guide. Below is the EDP used in Engineering Adventures units.



Each Engineering Adventure Includes

Preview pages with relevant background information, materials list, preparatory instructions, and a preview of the journal pages needed.


Prep Adventure 1 Educator Page: Preview
What is Engineering? Tower Power

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

Note to Educator: Who are engineers? Engineers are people who use their creativity and knowledge of math and science to design things that solve problems. Today, kids will be engineers as they use the Engineering Design Process to design towers that can support a stuffed animal. Find alternate versions of this activity at www.engineeringadventures.org/resources.

Due Update (5 min)
Set the Stage (10 min)
Activity (50 min)
Reflect (5 min)

Materials:
For the entire group:
- Message from the Duo, track 1 or Engineering Journal, p. 1
- Engineering Design Process poster
- Heightened Emotions, p. 7 in this guide
- 1 small stuffed animal

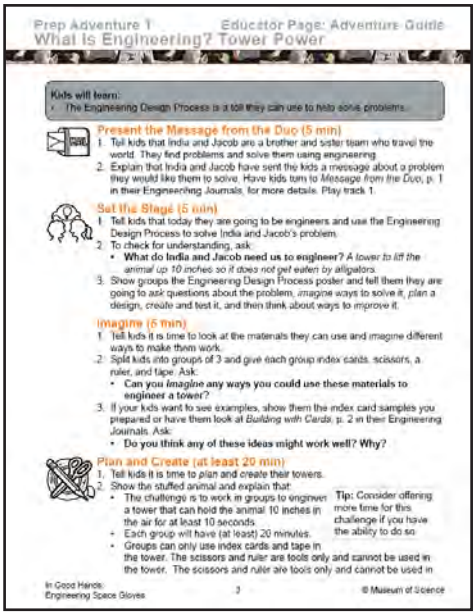
For each group of 3 kids:
- at least 1 foot of masking tape
- 1 pack of index cards (about 100 cards)
- 1 pair of scissors
- 1 ruler

For each kid:
- Engineering Journal

Preparation:
Time Required: 10 minutes
1. Post the Engineering Design Process poster.
2. Have the Message from the Duo ready to share.
3. Make samples of the cards found on Building with Cards, p. 2 in the Engineering Journal.

In Good Hands: Engineering Space Gloves 1 © Museum of Science

An **Adventure Guide** with step-by-step instructions, including discussion questions, extension ideas, and tips.


Prep Adventure 1 Educator Page: Adventure Guide
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)
1. Tell kids that India and Jacob are a brother and sister team who travel the world. They find problems and solve them using engineering.
2. Explain that India and Jacob have sent the kids a message about a problem they would like them to solve. Have kids turn to Message from the Duo, p. 1 in their Engineering Journals, for more details. Play track 1.

Set the Stage (5 min)
1. Tell kids that today they are going to be engineers and use the Engineering Design Process to solve India and Jacob's problem.
2. 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 does not get eaten by alligators.
3. 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.

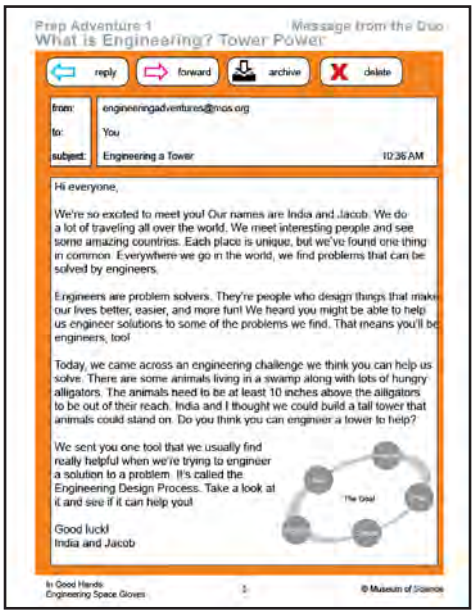
Imagine (5 min)
1. Tell kids it is time to look at the materials they can use and imagine different ways to make them work.
2. Split kids into groups of 3 and give each group index cards, scissors, a ruler, and tape. Ask:
   - Can you imagine any ways you could use these materials to engineer a tower?
3. 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 in their Engineering Journals. Ask:
   - Do you think any of these ideas might work well? Why?

Plan and Create (at least 20 min)
1. Tell kids it is time to plan and create their towers.
2. 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.
   - Groups can only use index cards and tape in the tower. The scissors and ruler are tools only and cannot be used in the tower. The scissors and ruler are tools only and cannot be used in

Tip: Consider offering more time for this challenge if you have the ability to do so.

In Good Hands: Engineering Space Gloves 3 © Museum of Science

A **Message from the Duo**, India and Jacob, with information about the day's activity.


Prep Adventure 1 Message from the Duo
What is Engineering? Tower Power

reply forward archive delete

from: engineeringadventures@mos.org
to: You
subject: Engineering a Tower 10:36 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!

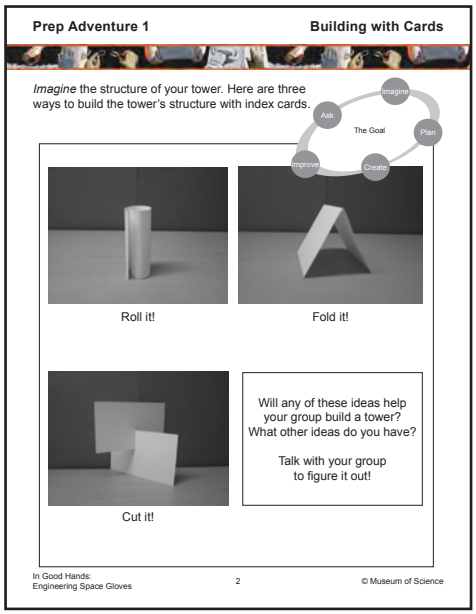
Today, we came across an engineering challenge we think you can help us solve. There are some animals living in a swamp along with lots of hungry alligators. The animals need to be at least 10 inches above the alligators to be out of their reach. India and I thought we could build a tall tower that animals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

In Good Hands: Engineering Space Gloves 1 © Museum of Science

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


Prep Adventure 1 Building with Cards

Imagine the structure of your tower. Here are three ways to build the tower's structure with index cards.

Roll it!

Fold it!

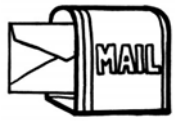
Cut it!

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!

In Good Hands: Engineering Space Gloves 2 © Museum of Science

The Sections of the Adventures



Messages from the Duo

Messages from India and Jacob, a fictional world-traveling sister and brother 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 player, MP3 player, or iOS device, we strongly suggest using the audio recordings, although reading the emails aloud will convey the same information.

Set the Stage (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 5–10 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 Journals.

Engineering Journals

Make a copy of the Engineering Journal for each kid as you begin working on this unit. 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.

There are a few ways you can use the Engineering Journal. You may want to have groups share one Engineering Journal as a central recording spot for all group data and findings. This allows group members who enjoy writing and recording to do so. You may also encourage groups to share the responsibility by having group members rotate who records for each adventure.

The back page of each Engineering Journal is a passport page from the location 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 have completed.

Alternate Prep Adventures

The two prep adventures, “What is Engineering?” and “What is Technology?,” introduce kids to engineering and technology. “What is Engineering?” gives kids the chance to collaborate, experience a mini hands-on engineering challenge, share their designs, and learn about the Engineering Design Process. This adventure sets the stage for what kids can expect in the rest of the unit.

“What is Technology?” has kids interact with technologies, working with the definition that a technology is anything designed by humans to help solve a problem. Most kids think of technology as things that can be plugged into the wall. They do not realize that the items that they interact with every day—including pencils, paper, and water bottles—are also technologies. This adventure introduces the definition of technology that the kids will refer to as they engineer their own technologies to solve the problem presented in the unit.

There are alternate activities for both of these adventures available online in the Resources section at www.engineeringadventures.org/resources. If kids complete multiple units, you may want to use an alternate activity to refresh the concepts in these activities. There may also be an activity that is more active or would be a better fit for the kids in your program. If you have questions about these activities, please email engineeringadventures@mos.org.

What You Need to Know Before Teaching the Unit

Engineering is Fun

The EiE team hears this from many educators and kids. Engineering is a way of problem solving—a way of thinking about the world—that is very fun and creative. Any time you design something 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, it is a good life lesson for the kids in your program.

It Is 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 Adventures

Each adventure requires 45–60 minutes of teaching time. We recommend that you budget at least 8–9 hours in order to complete this unit, as some adventures may 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.

Prep Adventure 1: What is Engineering? Prep Adventure 2: What is Technology?	2–3 hours
Adventure 1: Everyday Gloves	1 hour
Adventure 2: Chilling Out Adventure 3: Ready for Impact	2 3 hours
Adventure 4: Dangerous Dust	1 hour
Adventure 5: Create a Space Glove Adventure 6: Improve a Space Glove	2–3 hours
Adventure 7: Engineering Showcase	1 hour

Tips and Tricks 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 who struggle with teamwork. Possible roles include: the recorder, the materials gatherer, the tester, and the presenter.

Timing

As groups are working, call out regular time intervals so kids know how much time they have left to complete their task. This is especially helpful if kids have more than 20 minutes to work on a task. Letting them know when 5-minute increments have passed will allow them to budget their time and reassess where they are in their design.

Invite Others to the Engineering Showcase

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

Mobile Apps

Mobile apps can be a fun way to engage kids in out-of-school-time environments. The Engineering Adventures team has created iOS apps (compatible with most iPhones, iPod Touches, and iPads) that are designed to supplement the hands-on engineering experiences that your program provides.

You can download the Engineering Adventures apps onto your personal device or the devices that belong to your site. You may also choose to encourage kids to download the apps onto their devices so they may continue to practice their engineering skills on their own time. Encourage them to receive permission from their parents before doing so.

Technology Flashcards

The Technology Flashcards app is designed to be used in conjunction with Prep Adventure 2. The app features a flashcard game that reinforces the idea that a technology is anything designed by a human to help solve a problem. The game allows kids to learn from their misconceptions in real time by providing them with instant feedback on why selected items are classified as technologies or not.

Search for “Technology Flashcards” in the App Store or visit: www.tinyurl.com/flashcardsapp.

Messages from the Duo

The Messages from the Duo app is a new way for kids to listen to the audio communications from India and Jacob at the beginning of each adventure. Kids can use the scanner function in the app to scan the QR code at the top of each Message from the Duo page in the Engineering Journal. The audio of the message will play automatically as if India and Jacob are communicating directly to the kids over a walkie-talkie! The app gives kids an opportunity to listen to the messages on their own for enhanced comprehension or to share them with others. Educators may also choose to use the app as an alternative to a CD player or to reading the messages aloud.

Search for “Messages from the Duo” in the App Store or visit: www.tinyurl.com/MFTDapp.

Background

Materials Engineering

Materials engineering is an interdisciplinary field that draws upon physics, chemistry, and engineering to understand how materials behave. Materials engineers may combine existing materials such as metals, ceramics, and textiles to see how they perform under different conditions or design entirely new materials to meet the growing technological needs of society. All materials have distinct properties, such as strength, flexibility, and resistance to hot or cold temperatures, that can help determine how they can be used in a specific technology, from snowboards to spaceships.

Space Hazards

Astronauts are exposed to some of the most extreme conditions in space, including high levels of radiation and changes in pressure, oxygen, and gravity. In this unit, groups focus on protecting against three space hazards in their glove designs: cold temperatures, impact, and dangerous dust.

- To protect against cold temperatures, materials engineers use thermal insulators materials that slow the transfer of heat from one place to another. These materials are designed to prevent heat from moving from warm to cold areas.
- In addition to the hazards posed by working with heavy machinery, astronauts also need to avoid collisions with heavy, moving space debris. NASA estimates that there are over 500,000 pieces of space debris, such as nonfunctioning satellites and fragments of other spacecraft, currently being tracked as they orbit Earth at up to 17,500 miles per hour. The growing volume of space debris increases the chances of impact and damage.
- In space exploration, dust can be dangerous. It is abrasive to materials, gets stuck in the joints of spacesuits, and compromises sterile environments. Astronauts work hard to keep dust out of their equipment and spacecraft.

Analog Sites

Analog sites are research facilities that are similar in some way to the environmental conditions found on other planets or moons. Testing at analog sites helps astronauts prepare for space missions in a safe but realistic environment before they leave Earth.

Educator Resources

For a list of online resources about space gloves and materials engineering, visit: http://www.engineeringadventures.org.

Vocabulary

Dust: A mixture of different ingredients, such as grains of sand, dead skin cells, tiny hairs and threads, animal dander, pollen, human-made pollutants, dust mites, and even minerals from outer space.

Dust resistant: A quality or treatment of a material that prevents dust from sticking to it.

Engineer: Someone who uses 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.

Hazard: A source of danger.

Impact: The act of one thing hitting another.

Insulator: A material that does not allow heat to move through it quickly.

Material: What something is made of.

Materials engineer: A person who uses creativity and knowledge of science and math to solve problems related to materials and their specific properties.

Simulation: An imitation of a real situation or process for the purpose of learning.

Space debris: Scattered natural and human-made debris, such as broken bits of meteorites, old satellites, and pieces of spacecraft.

Technology: Any thing designed by humans to help solve a problem.

Temperature: A measurement of how hot or cold something is.

Materials List

This kit is prepared for 12 groups of 2 kids.

Quantity	Part Description
Non-Consumable Items	
1	*Engineering Design Process* poster
1	*Messages from the Duo* audio file or access to a computer
1	measuring cup, 2 cups
1	permanent marker
1	tablespoon measure
2	black lights, handheld, *AA batteries included*
2	buckets, 5 liters
2	calculators
2 pairs	dish gloves
2 pairs	garden gloves
2	hand lenses
2 pairs	oven mitts
2	plastic bags, resealable, gallon size
2	skewers
2	stuffed animals
2	thermometers, digital
2 pairs	winter gloves
4	cups, plastic, 16 oz.
4	jars, with twist lids, 12 oz.
6	aluminum trays, 12” x 10” x 2.5”
8	stopwatches
12	rulers
60	beads
160	paper clips
210	metal washers, 1 1/4” in diameter
Consumable Items	
1 roll	aluminum foil
1 bottle	dish soap
1 box	food-safe gloves, adult, 100 count
1 bottle	UV glow powder, white, 4 oz.
1 box	vinyl gloves, adult, 100 count*
2 sheets	cardboard, thin, 8.5” x 11”
2 cups	gravel

2 boxes	spaghetti†
6	deli containers, round, with lids, 16 oz.
6 cups	sand
12 rolls	tape, masking
24	plastic bags, resealable, quart size
30 sheets	felt, 8.5” x 11”
30 sheets	transparency, 8.5” x 11”
32 sheets	craft foam, green, 8.5” x 11”
36	sponges
50 sq. ft.	cheesecloth, 8.5” x 11”
125	pipe cleaners
300	cotton balls
350	straws, regular
1200	index cards
NOT INCLUDED IN KIT	
1 pad	chart paper
1	clock/timepiece for scheduling
1 sheet	copy paper
1	device to play mp3 files
1 roll	duct tape
2	craft sticks, jumbo
2 rolls	paper towels
8	pens or pencils
12 pairs	scissors
24	Engineering Journals
36 cups	ice cubes‡
	access to water

***** The vinyl glove should be at least 3 mil thickness to prevent tearing during glove construction.

† The spaghetti used in Adventure 3 should be standard, No. 5 size, spaghetti. Using thin spaghetti or angel hair pasta will be too fragile for this activity.

‡ You will need 36 cups of ice cubes for 3 activities. Please ensure that you have access to a freezer.

National Education Standards

Engineering Adventures units are written with the goal of teaching engineering skills and critical thinking practices. Many Engineering Adventures units also touch upon a variety of science topics and principles. The engineering standards taught in this unit and the science topic links in this unit are noted below.

		Prep Adventure 1: What is Engineering?	Prep Adventure 2: What is Technology?	Adventure 1: Everyday Gloves	Adventure 2: Chilling Out	Adventure 3: Ready for Impact	Adventure 4: Dangerous Dust	Adventure 5: Create a Space Glove	Adventure 6: Improve a Space Glove	Adventure 7: Engineering Showcase
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			✓	✓	✓	✓			

		Prep Adventure 1: What is Engineering?	Prep Adventure 2: What is Technology?	Adventure 1: Everyday Gloves	Adventure 2: Chilling Out	Adventure 3: Ready for Impact	Adventure 4: Dangerous Dust	Adventure 5: Create a Space Glove	Adventure 6: Improve a Space Glove	Adventure 7: Engineering Showcase
	3-ESS3-1. Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard.							✓	✓	
Next Generation Science Standards	4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.				✓			✓	✓	
	4-PS3-3. Ask questions and predict outcomes about the changes in energy that occur when objects collide.					✓		✓	✓	
	5-PS1-3. Make observations and measurements to identify materials based on their properties.			✓	✓	✓	✓	✓	✓	
	3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.	✓	✓					✓	✓	✓
	3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	✓						✓	✓	✓
	3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.	✓	✓	✓				✓	✓	✓

How to Recognize Success Rubric

How do you know if you are leading an Engineering Adventures activity successfully? This tool will help you keep track of your kids' successful moments and will ask you to identify how your own actions enabled your kids to succeed.

Elements of success	What does this look like?	How does the guide help me facilitate this?
Kids are engaged and challenged by the activity. They persist through difficulties.	• Kids are on task. • Kids are trying out their ideas. • Kids identify what is working well in their designs. • Kids troubleshoot their own work. • Kids *improve* their designs.	• Use the Message from the Duo to **set a real-world context** that will engage kids in the activity. • Use the bold prompts to **ask open-ended questions** to help kids troubleshoot their work. • Use the bold prompts to **ask kids about what they think is working well** in their designs and what they would like to *improve*. This will help kids feel more confident about their problem-solving abilities.
Kids do most of the talking, sharing their ideas with each other during the entire activity.	• Kids bring their own ideas to the activity and are comfortable sharing them. • Kids brainstorm and debate within their groups. • Kids share their designs with others. • Kids talk about how their ideas are changing over time.	• Use the bold prompts in the guide to **encourage kids to share and explain their thinking**. • Have kids **work in groups** so they can brainstorm and *create* a design together. • Use the bold prompts in the Reflect section to **help kids share their new ideas about designs.**
Kids value their engineering work as a process, not just as the end result.	• Kids go beyond talking about their design to talking about how they thought of it and why they designed it. • Kids use the Engineering Design Process to describe their actions.	• Use the bold prompts in the guide to **ask kids how they use the Engineering Design Process.** Spending time talking and thinking about their process will help kids see the value in it. • Use the bold prompts to **ask kids about *improving*** their designs, even if their designs are working well. • **Encourage kids to reflect individually** in their Engineering Journals to give them time for their experiences to sink in and be remembered.

How to Recognize Success Rubric Template

How do you know if you are leading an Engineering Adventures activity successfully? This tool will help you keep track of your kids' successful moments and will ask you to identify how your own actions enabled your kids to succeed.

Date: Adventure:

Elements of success	Evidence: Did I see this during the activity?	What was my role in making this happen?
Kids are engaged and challenged by the activity. They persist through difficulties.		
Kids do most of the talking, sharing their ideas with each other during the entire activity.		
Kids value their engineering work as a process, not just as the end result.		

Dear Family, Date: _____

We are beginning an engineering unit called *In Good Hands: Engineering Space Gloves*, which is part of the Engineering Adventures curriculum developed by the Museum of Science, Boston. Engineering Adventures is a curricular program that introduces kids to engineering and the Engineering Design Process. Throughout this unit, kids will learn about materials engineering and work to engineer a model space glove that protects against the hazards of space. There are many reasons to introduce kids to engineering:

- **Engineering projects reinforce topics children are learning in school.** Engaging kids 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 alternative solutions.
- **Kids 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 kids 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, space exploration, 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!

_____ _____

_____ _____

_____ _____