Engineering Adventures

Hop to It:
Safe Removal of Invasive Species

Mechanical Engineering for Kids
in Out-of-School Time

EiE Engineering is Elementary®
Developed by the Museum of Science, Boston

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Pilot Sites for Hop to It:

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

21st Century Community Learning Cummings School, Winthrop, MA
Boys and Girls Club of Greater Sacramento, Sacramento, CA
Cambridge Community Center, Cambridge, MA
Columbus Elementary Afterschool, Medford, MA
Condon Boys and Girls Club, Boston, MA
Cummings Elementary 21st Century Afterschool, Winthrop, MA
Garden City Salvation Army, Houston, TX
Gerald and Darlene Jordan Boys and Girls Club, Chelsea, MA
Girls, Inc., Lynn, MA
Henrico County Public Schools, Henrico, VA
High Rocks Educational Corporation, Hillsboro, WV
Hoosier Uplands Health, Education and Aging, Mitchell, IN
Huntington Avenue YMCA, Boston, MA
Imaginarium Science Center, Fort Myers, FL
International Spanish Language Academy, Minnetonka, MN
Jackson-Mann Elementary, Boston, MA
Jenny Lind School, Minneapolis, MN
Manatee County School District, Bradenton, FL
McCarthy-Towne School, Acton, MA
McNeal Elementary Afterschool, Bradenton, FL
Meadowvale Elementary School, Havre de Grace, MD
Metrowest YMCA School's Out Program, Framingham, MA
Missouri River Education Cooperative Extended School Program, Mandan, ND
Natick School District, Natick, MA
North Suburban YMCA, Woburn, MA
Resurrection Lutheran Church, Roxbury, MA
Roberts Elementary Afterschool, Medford, MA
Samuel Kennedy Elementary, Sacramento, CA
Sierra Madre School, Sierra Madre, CA
Silvia Elementary, Fall River, MA
Sitton SUN Community School, Portland, OR
Springfield Dept. of Recreation 21st Century Afterschool, Springfield, MA
Sumner Boys and Girls Club, Roslindale, MA
The Salvation Army, Boston, MA
Tully Elementary, Louisville, KY
Wang YMCA of Chinatown, Boston, MA
Wendell P. Clark Memorial YMCA, Winchendon, MA
Woodlake Elementary Afterschool, Sacramento, CA
Woodrow Wilson 21st Century Afterschool, Framingham, MA

Unit Map

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

Prep Adventure 1: What is Engineering?
Kids engineer a tower and are introduced to the Engineering Design Process as a problem solving tool.

→

Prep Adventure 2: What is Technology?
Kids explore the idea that they, as engineers, can design and improve technology.

↓

Adventure 1: Cane Toad Invasion
Kids are introduced to the problem: engineering a trap to catch invasive cane toads. They will also build some traps that need improvement in order to be successful.

↓

Adventure 2: Creating a Cane Toad Trap
Using their knowledge of the cane toad problem, kids will use the steps of the Engineering Design Process to engineer their own cane toad traps.

→

Adventure 3: Improving a Cane Toad Trap
Kids continue using the steps of the Engineering Design Process as they create their cane toad traps, test them, and improve their designs.

↓

Adventure 4: Engineering Showcase
Kids present their cane toad traps and knowledge of the Engineering Design Process by creating Public Service Announcements that tell others about the dangers of cane toads.

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Introduction

Adventures

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:

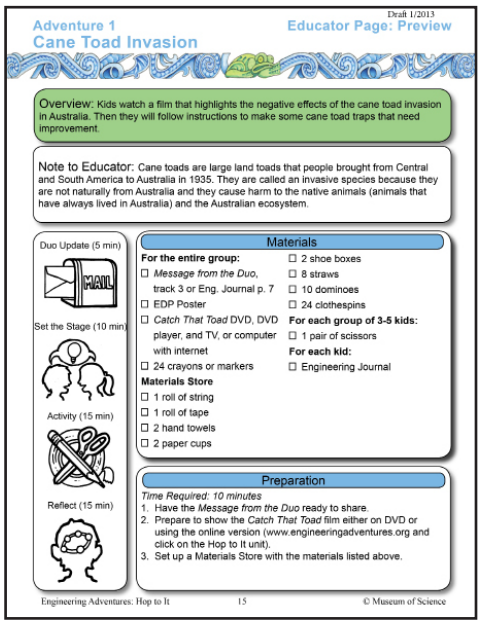
- they can use the Engineering Design Process to help solve problems.
- engineers design technologies to help people and solve problems.
- they have talent and potential for designing and improving technologies.
- they, too, are engineers.

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.


Draft 1/2013

Adventure 1
Cane Toad Invasion

Educator Page: Preview

Overview: Kids watch a film that highlights the negative effects of the cane toad invasion in Australia. Then they will follow instructions to make some cane toad traps that need improvement.

Note to Educator: Cane toads are large land toads that people brought from Central and South America to Australia in 1935. They are called an invasive species because they are not naturally from Australia and they cause harm to the native animals (animals that have always lived in Australia) and the Australian ecosystem.

Duo Update (5 min)

Set the Stage (10 min)

Activity (15 min)

Reflect (15 min)

Materials

For the entire group:
- ☐ *Message from the Duo*, track 3 or Eng. Journal p. 7
- ☐ EDP Poster
- ☐ *Catch That Toad* DVD, DVD player, and TV, or computer with internet
- ☐ 24 crayons or markers

Materials Store
- ☐ 1 roll of string
- ☐ 1 roll of tape
- ☐ 2 hand towels
- ☐ 2 paper cups
- ☐ 2 shoe boxes
- ☐ 8 straws
- ☐ 10 dominoes
- ☐ 24 clothespins

For each group of 3-5 kids:
- ☐ 1 pair of scissors

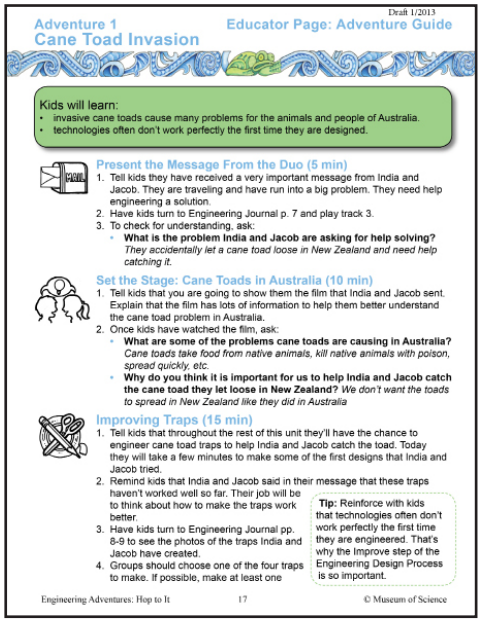
For each kid:
- ☐ Engineering Journal

Preparation

Time Required: 10 minutes
1. Have the *Message from the Duo* ready to share.
2. Prepare to show the *Catch That Toad* film either on DVD or using the online version (www.engineeringadventures.org and click on the Hop to It unit).
3. Set up a Materials Store with the materials listed above.

Engineering Adventures: Hop to It 15 © Museum of Science

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


Draft 1/2013

Adventure 1
Cane Toad Invasion

Educator Page: Adventure Guide

Kids will learn:
- invasive cane toads cause many problems for the animals and people of Australia.
- technologies often don't work perfectly the first time they are designed.

Present the Message From the Duo (5 min)
1. Tell kids they have received a very important message from India and Jacob. They are traveling and have run into a big problem. They need help engineering a solution.
2. Have kids turn to Engineering Journal p. 7 and play track 3.
3. To check for understanding, ask:
   - **What is the problem India and Jacob are asking for help solving?** *They accidentally let a cane toad loose in New Zealand and need help catching it.*

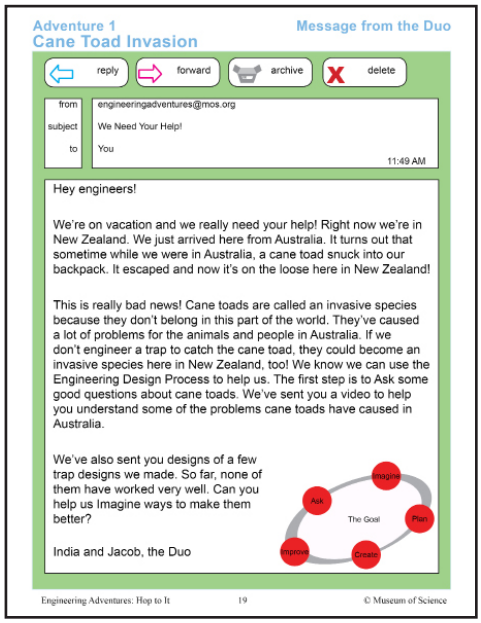
Set the Stage: Cane Toads in Australia (10 min)
1. Tell kids that you are going to show them the film that India and Jacob sent. Explain that the film has lots of information to help them better understand the cane toad problem in Australia.
2. Once kids have watched the film, ask:
   - **What are some of the problems cane toads are causing in Australia?** *Cane toads take food from native animals, kill native animals with poison, spread quickly, etc.*
   - **Why do you think it is important for us to help India and Jacob catch the cane toad they let loose in New Zealand?** *We don't want the toads to spread in New Zealand like they did in Australia*

Improving Traps (15 min)
1. Tell kids that throughout the rest of this unit they'll have the chance to engineer cane toad traps to help India and Jacob catch the toad. Today they will take a few minutes to make some of the first designs that India and Jacob tried.
2. Remind kids that India and Jacob said in their message that these traps haven't worked well so far. Their job will be to think about how to make the traps work better.
3. Have kids turn to Engineering Journal pp. 8-9 to see the photos of the traps India and Jacob have created.
4. Groups should choose one of the four traps to make. If possible, make at least one

Tip: Reinforce with kids that technologies often don't work perfectly the first time they are engineered. That's why the Improve step of the Engineering Design Process is so important.

Engineering Adventures: Hop to It 17 © Museum of Science

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.


Adventure 1
Cane Toad Invasion

Message from the Duo

reply | forward | archive | delete

from: engineeringadventures@mos.org
subject: We Need Your Help!
to: You
11:49 AM

Hey engineers!

We're on vacation and we really need your help! Right now we're in New Zealand. We just arrived here from Australia. It turns out that sometime while we were in Australia, a cane toad snuck into our backpack. It escaped and now it's on the loose here in New Zealand!

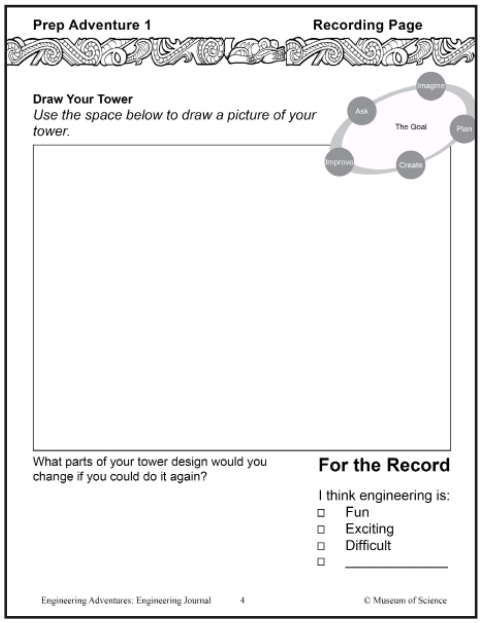
This is really bad news! Cane toads are called an invasive species because they don't belong in this part of the world. They've caused a lot of problems for the animals and people in Australia. If we don't engineer a trap to catch the cane toad, they could become an invasive species here in New Zealand, too! We know we can use the Engineering Design Process to help us. The first step is to Ask some good questions about cane toads. We've sent you a video to help you understand some of the problems cane toads have caused in Australia.

We've also sent you designs of a few trap designs we made. So far, none of them have worked very well. Can you help us Imagine ways to make them better?

India and Jacob, the Duo

Engineering Adventures: Hop to It 19 © Museum of Science

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


Prep Adventure 1

Recording Page

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

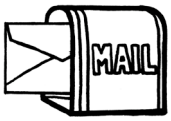
What parts of your tower design would you change if you could do it again?

For the Record

I think engineering is:
- ☐ Fun
- ☐ Exciting
- ☐ Difficult
- ☐ _____

Engineering Adventures: Engineering Journal 4 © Museum of Science

The Sections of the Adventures



Messages from the Duo

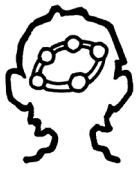
Messages from India and Jacob, a world-traveling brother and sister Duo, are provided as a quick, exciting way to present the real-world context for the unit's engineering challenge. Providing a context helps kids to understand the challenge and motivates them to find solutions. If you have access to 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.



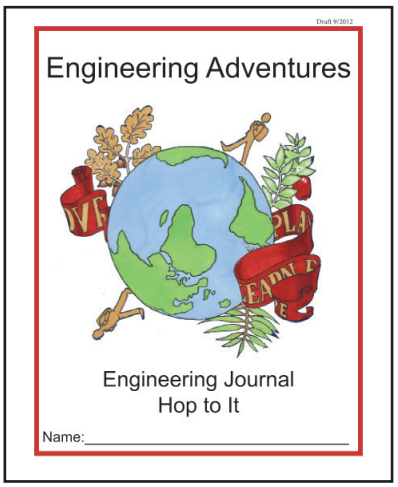
Reflect

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/eie/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 Adventures

Each adventure requires 45-60 minutes of teaching time. We recommend that you budget at least 6-10 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 Technology? Stepping Into Technology Prep Adventure 2: What is Engineering? Tower Power	2-3 hours
Day 2	Adventure 1: Cane Toad Invasion	1 hour
Day 3	Adventure 2: Creating a Cane Toad Trap Adventure 3: Improving a Cane Toad Trap	2-3 hours
Day 4	Adventure 4: Engineering Showcase	1-1.5 hours

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 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.

Background

Mechanical Engineering

Mechanical engineering is one of the largest and most diverse areas of engineering. Mechanical engineers are people who use their creativity and knowledge of science and math to solve problems related to various kinds of machines.

If you take a look around, chances are that mechanical engineers have had a hand in nearly every technology around you. It is a common misconception that mechanical engineers only work on large-scale, complex machines, such as airplanes, cars, and robots. In fact, mechanical engineers may work on even small machines, such as staplers or coffee makers. With whatever machines mechanical engineers work on, they need to think about how the parts of the machines move, whether heat and/or friction are created, and all the forces that act on the machine. All of those factors are important to making sure the machine will work safely, efficiently, and reliably.

In this unit, kids are asked to act as mechanical engineers designing a trap to catch a cane toad. They will be given simple materials they to use in creative ways to engineer a machine that works. Because a criterion for their machine is that the starting point must be at least four feet away from the part of the machine that catches the toad, kids will need to think about how all of the parts of their machine interact with each other to ultimately activate the part of the machine that catches the toad.

Invasive Species and Cane Toads

An invasive species is a species that is not native to an ecosystem and is harmful to either the ecosystem, the economy, or human health. Invasive species can be plants, animals, or other organisms. Many invasive species have been accidentally introduced to new ecosystems by hitching a ride on a cargo plane, on the bottom of a row boat, or even within the baggage of an unsuspecting traveler. Often times, however, an invasive species is intentionally introduced by people in the hopes that the benefits of the species will outweigh the negatives. This is not always the reality.

People introduced cane toads to Australia hoping the cane toads would eat beetles that were destroying sugar cane crops. The cane toads, however, quickly spread and multiplied. The cane toad has few natural predators in Australia and most native animals have not yet adapted to avoid the cane toad, which is poisonous when eaten. This has resulted in a decimation of the population of certain native species and an alteration of the food chain. To this day, cane toads are still considered to be a threat to the ecosystem of Australia, and there are many organizations working to remove cane toads from the country.

Materials List

(This kit is prepared for 8 groups of 3 children)

Quantity	Item
Non-consumable Items	
1	Duo audio CD or access to a computer
1	*Catch That Toad* movie on DVD or access to a computer
1	EDP Poster
1	stuffed toy
2	wind-up toy toads
8	rulers
8	scissors
10	dowels, approx. ¼" x 12"
24	table tennis balls
30	clothespins
55	dominoes
Consumable Items	
1	aluminum foil roll
1	cellophane tape, roll
4	string, rolls
8	boxes
8	hand towels or pieces of cloth
8	masking tape, rolls
16	cardboard sheets
30	cups, paper, 10 oz.
30	paper towel tubes
30	rubber bands
60	craft sticks
60	paper clips
60	straws, plastic
100	pipe cleaners
800	index cards, 3" x 5"
NOT INCLUDED IN KIT	
1	CD player
1	chart paper
1	timer or clock
1	DVD player/TV
8	paper sheets

Vocabulary

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

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

Habitat: The environment where an animal or plant normally lives.

Invasive species: An animal that does not naturally live in an area and whose introduction is likely to cause harm to the environment or human health.

Machine: An object that has parts that work together to complete a task.

Mechanical engineer: The type of engineer who designs parts of machines so they work together to solve a problem.

Native species: An animal that naturally lives in an area.

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 Adventure 2: What is Technology? Technology Detectives	Adventure 1: Cane Toad Invasion	Adventure 2:Creating a Cane Toad Trap	Adventure 3: Improving a Cane Toad Trap	Adventure 4: 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						

Dear Family, Date: _____

We are beginning an engineering unit called Hop to It: Safe Removal of Invasive Species, 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 engineering and the engineering design process. Throughout this unit, children will learn about mechanical engineering and work to engineer traps for cane toads. The unit is set in a real-world context: children will learn about the invasive cane toad species in Australia and why it is important to stop the spread of cane toads to other areas, such as New Zealand.

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 mechanical engineering, Australia, or New Zealand, 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!

_____ _____
_____ _____
_____ _____

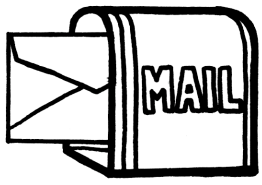
Prep Adventure 1 Educator Page: Preview

What is Engineering? Tower Power

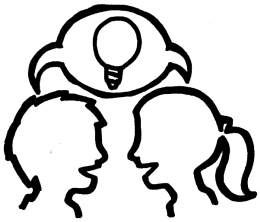
Overview: Kids will engineer an index card tower that will support a stuffed animal.

Note to Educator: Who are engineers? Engineers are people who use 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)

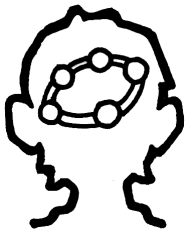


Set the Stage (10 min)



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,

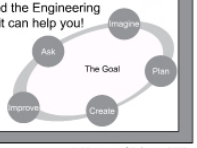
We're so excited to meet you! Our names are India and Jacob. We do a lot of traveling all over the world. We meet interesting people and see some amazing countries. Each place is unique, but we've found one thing in common. Everywhere we go in the world, we find problems that can be solved by engineers.

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



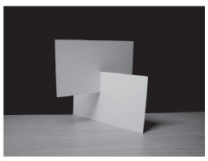
Building with Cards, p. 2

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?

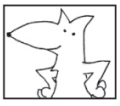
Talk with your group to figure it out!

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

PANIC!

Recording Page, p. 4

Prep Adventure 1 **Recording Page**

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

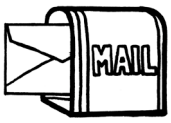
What parts of your tower design would you change if you could do it again?

For the Record

I think engineering is:
- ☐ Fun
- ☐ Exciting
- ☐ Difficult
- ☐ _____

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 who travel the world. They find problems and solve them using engineering.
2. 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)

1. Tell kids that today they are going 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 doesn't 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's time to look at the materials they can use and Imagine different ways to make them work.
2. 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?**
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. 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.
   - You can only use index cards and tape in the tower. The scissors are a tool only and cannot be used in the tower.

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.

- 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 remember what they learned.

What is Engineering? Tower Power

reply | forward | archive | delete

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

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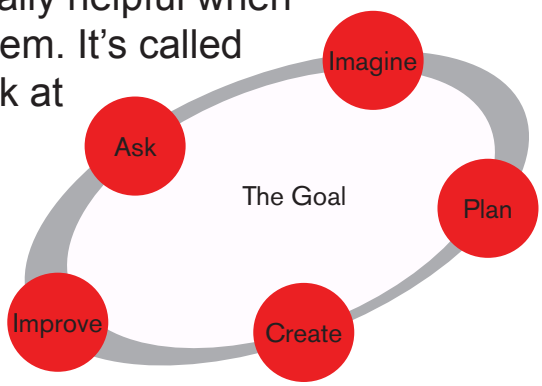
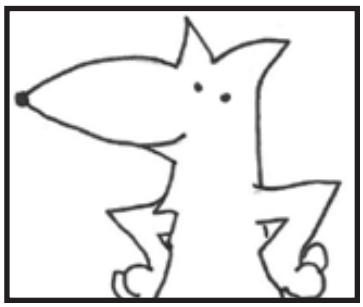


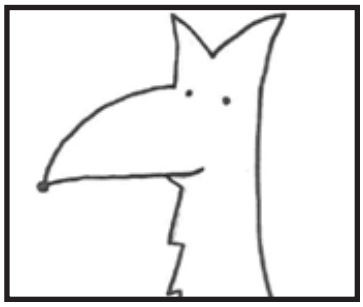
Good luck!
India and Jacob

Fearless
8 inches and up

Confident
6-8 inches



Calm
4-6 inches



Nervous
2-4 inches

Terrified
0-2 inches

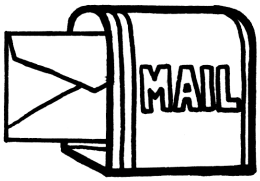
PANIC!

Prep Adventure 2 Educator Page: Preview
What is Technology? Technology Detectives

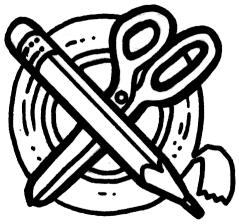
Overview: Kids will examine some technologies and imagine ways to improve them.

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.

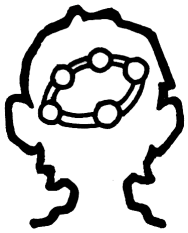
Duo Update (5 min)



Activity (15 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):

- ☐ electronic device, like a cell phone or calculator
- ☐ water bottle
- ☐ roll of tape
- ☐ ruler
- ☐ construction paper
- ☐ stuffed animal
- ☐ hat
- ☐ scissors
- ☐ sweater
- ☐ dice
- ☐ juicebox
- ☐ bag
- ☐ hair clip
- ☐ button
- ☐ spoon
- ☐ key
- ☐ book
- ☐ stapler
- ☐ glue stick

For each kid:

- ☐ Engineering Journal

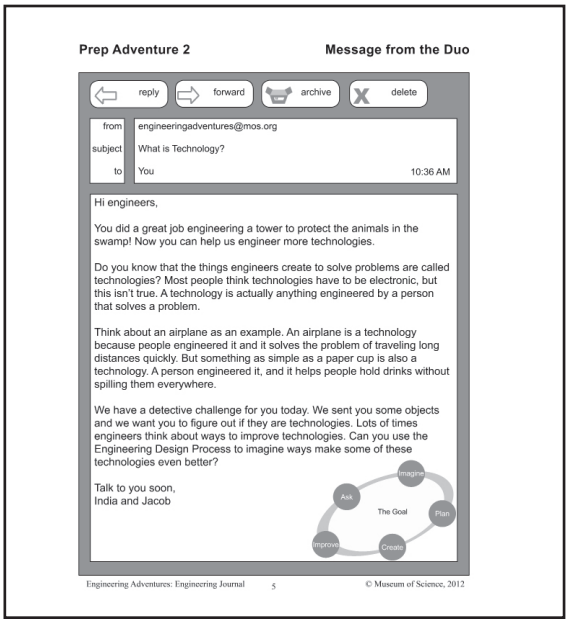
Preparation

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.

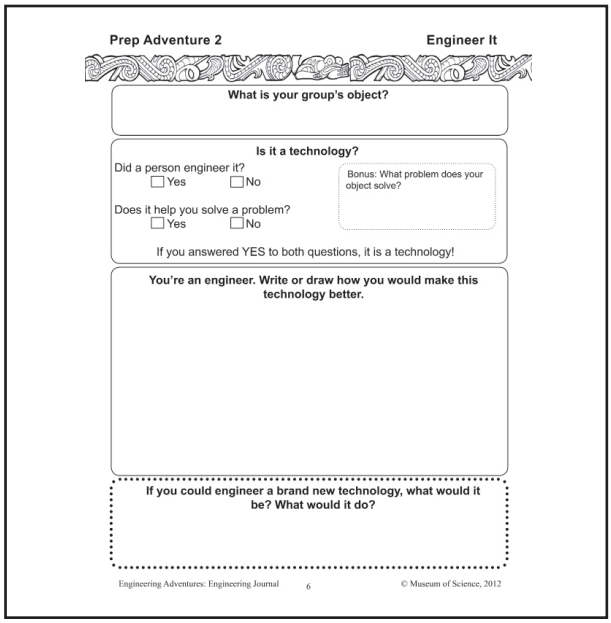
Do you know that the things engineers create to solve problems are called technologies? Most people think technologies have to be electronic, but this isn't true. A technology is actually anything engineered by a person that solves a problem.

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

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.

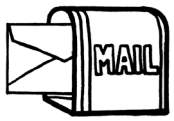
If you could engineer a brand new technology, what would it be? What would it do?

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!

Prep Adventure 2 Educator Page: Adventure Guide
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.

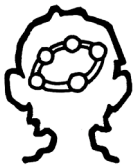
Tip: You may want to write down what the kids say is technology, so you can refer back to it at the end of the adventure.

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 other natural objects 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

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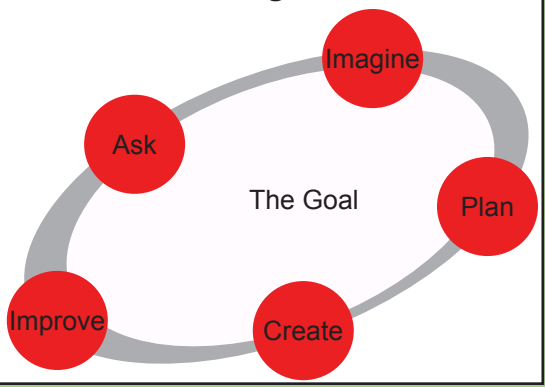


Talk to you soon,
India and Jacob

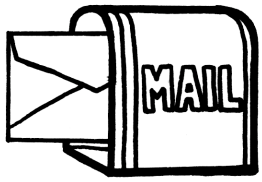
Adventure 1
Cane Toad Invasion

Educator Page: Preview

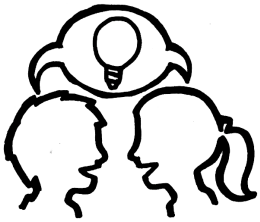
Overview: Kids watch a film that highlights the negative effects of the cane toad invasion in Australia. Then they will follow instructions to make some cane toad traps that need improvement.

Note to Educator: Cane toads are large land toads that people brought from Central and South America to Australia in 1935. They are called an invasive species because they are not naturally from Australia and they cause harm to the native animals (animals that have always lived in Australia) and the Australian ecosystem.

Duo Update (5 min)

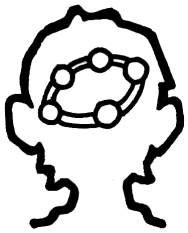


Set the Stage (10 min)



Activity (15 min)

Reflect (15 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 3 or Eng. Journal p. 7
- ☐ EDP Poster
- ☐ *Catch That Toad* DVD, DVD player, and TV, or computer with internet
- ☐ 24 crayons or markers

Materials Store

- ☐ 1 roll of string
- ☐ 1 roll of tape
- ☐ 2 hand towels
- ☐ 2 paper cups
- ☐ 2 shoe boxes
- ☐ 8 straws
- ☐ 10 dominoes
- ☐ 24 clothespins

For each group of 3-5 kids:

- ☐ 1 pair of scissors

For each kid:

- ☐ Engineering Journal

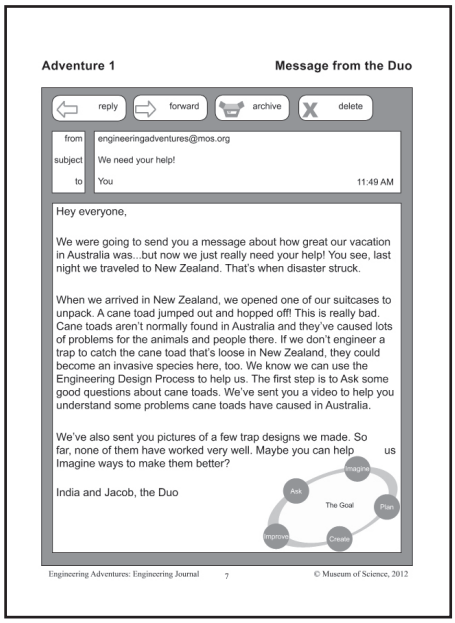
Preparation

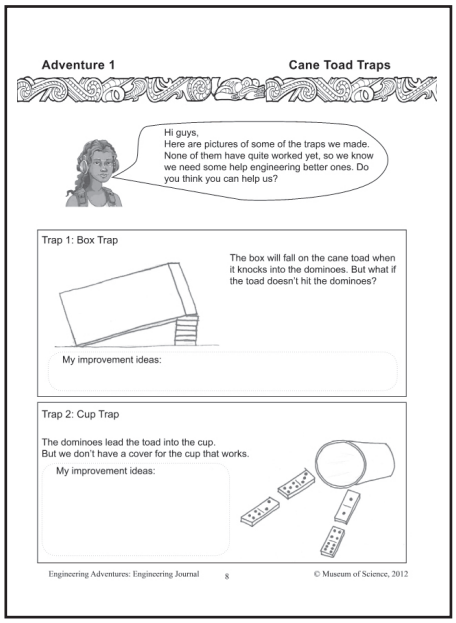
Time Required: 10 minutes

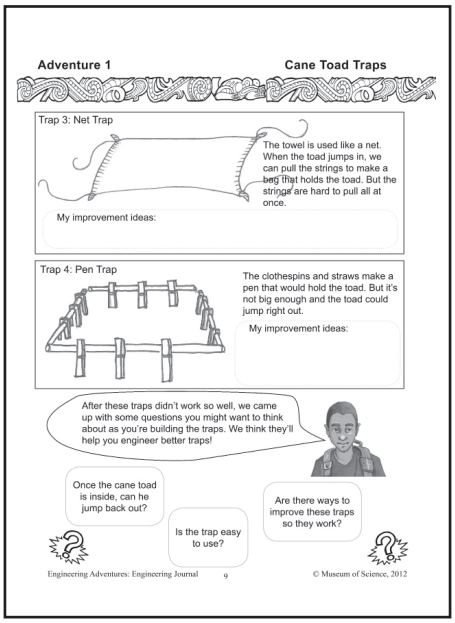
1. Have the *Message from the Duo* ready to share.
2. Prepare to show the *Catch That Toad* film either on DVD or using the online version (www.engineeringadventures.org and click on the *Hop to It* unit).
3. Set up a Materials Store with the materials listed above.

Journal Pages for Adventure 1

Message From the Duo, p. 7 *Cane Toad Traps*, p. 8 *Cane Toad Traps*, p. 9







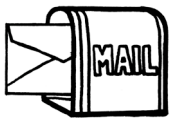
DVD Notes

The *Catch That Toad* DVD gives kids some background information to understand the cane toad problem in Australia. Below are some notes about important ideas or facts covered in the DVD. Note that the entire film is just over six minutes long.

Minutes	Summary
50 seconds	Explains the problem the Duo has (that they accidentally brought a cane toad to New Zealand)
1:55	Describes some characteristics of cane toads
2:20	Explains why cane toads were originally brought to Australia
3:35	Scientist discuss what happens when native animals try to eat cane toads
5:00	Scientist explains why it's so important to stop cane toads from entering New Zealand
5:20	How the Engineering Design Process can help you catch the cane toad

Adventure 1
Cane Toad Invasion

Kids will learn:
- invasive cane toads cause many problems for the animals and people of Australia.
- technologies often don't work perfectly the first time they are designed.



Present the Message From the Duo (5 min)

1. Tell kids they have received a very important message from India and Jacob. They are traveling and have run into a big problem. They need help engineering a solution.
2. Have kids turn to Engineering Journal p. 7 and play track 3.
3. To check for understanding, ask:
   - **What is the problem India and Jacob are asking for help solving?** *They accidentally let a cane toad loose in New Zealand and need help engineering a trap to catch it.*

Set the Stage: Cane Toads in Australia (10 min)

1. Tell kids that you are going to show them the film that India and Jacob sent. Explain that the film has lots of information to help them better understand the cane toad problem in Australia.
2. Once kids have watched the film, ask:
   - **What are some of the problems cane toads are causing in Australia?** *Cane toads take food from native animals, kill native animals with poison, spread quickly, etc.*
   - **Why do you think it is important for us to help India and Jacob catch the cane toad they let loose in New Zealand?** *We don't want the toads to spread in New Zealand like they did in Australia*

Improving Traps (15 min)

1. Tell kids that throughout the rest of this unit they'll have the chance to engineer cane toad traps to help India and Jacob catch the toad. Today they will take a few minutes to make some of the first designs that India and Jacob tried.
2. Remind kids that India and Jacob said in their message that these traps haven't worked well so far. Their job will be to think about how to make the traps work better.
3. Have kids turn to Engineering Journal pp. 8-9 to see the photos of the traps India and Jacob have created.
4. Groups should choose one of the four traps to make. If possible, make at least one

Tip: Reinforce with kids that technologies often don't work perfectly the first time they are engineered. That's why the Improve step of the Engineering Design Process is so important.

example of each trap.

5. Each group should send one member up to the store to gather the materials needed for their trap.
6. Groups should follow the directions in their Engineering Journals to create and test their trap.
7. Remind kids that they will get the chance to create their own improved traps during the next adventure, so imagining ways to improve these traps will give them a head start.

Tip: If groups finish early, they can fill out *Cane Toad Problems*, pp. 18-19 in their Engineering Journals.

Reflect (15 min)

1. Have each group share what they created. Ask:
   - **How does your group's trap work?**
   - **How do you think you could make this trap better?**
2. Show kids the Engineering Design Process poster. Ask:
   - **Do you think we used any steps of the Engineering Design Process today? How?** *We Asked about why cane toads are a problem in Australia and Asked and Imagined about how we could Improve the traps India and Jacob tried.*
3. Give kids time to record some of their improvement ideas on *Cane Toad Traps*, pp. 8-9. Recording their ideas will help them prepare for engineering new traps in the next adventure.

Extension: Invasive Species Near You?

Find out if there are any invasive species that live in your area. Have a discussion with kids about the impact that invasive species have on the local ecosystem.

Message from the Duo

reply | forward | archive | delete

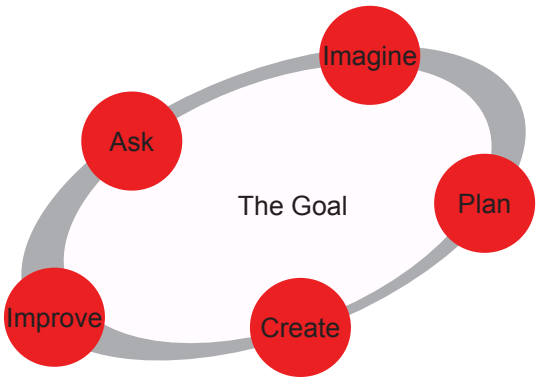
from	engineeringadventures@mos.org
subject	We Need Your Help!
to	You
	11:49 AM

Hey engineers!

We're on vacation and we really need your help! Right now we're in New Zealand. We just arrived here from Australia. It turns out that sometime while we were in Australia, a cane toad snuck into our backpack. It escaped and now it's on the loose here in New Zealand!

This is really bad news! Cane toads are called an invasive species because they don't belong in this part of the world. They've caused a lot of problems for the animals and people in Australia. If we don't engineer a trap to catch the cane toad, they could become an invasive species here in New Zealand, too! We know we can use the Engineering Design Process to help us. The first step is to Ask some good questions about cane toads. We've sent you a video to help you understand some of the problems cane toads have caused in Australia.

We've also sent you designs of a few traps we made. So far, none of them have worked very well. Can you help us Imagine ways to make them better?



India and Jacob, the Duo

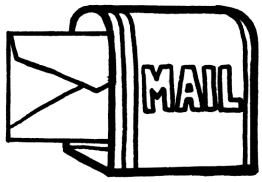
Adventure 2
Creating a Cane Toad Trap

Educator Page: Preview

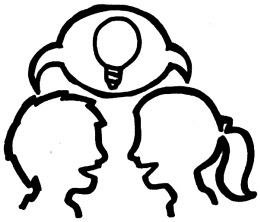
Overview: Kids will use the steps of the Engineering Design Process to Imagine, Plan, Create, and Improve their own cane toad traps.

Note for Educator: Kids will either improve on the traps they created in Adventure 1, or engineer their own new traps. Let kids know it is okay if they do not complete their designs today, as they will be able to continue working during the next Adventure.
Be sure to keep the traps groups build today for use in Adventures 3 and 4.

Duo Update (5 min)

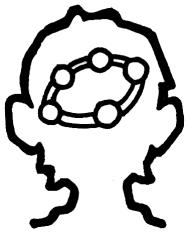


Set the Stage (5 min)



Activity (25 min)

Reflect (10 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 4 or Eng. Journal p. 10
- ☐ EDP Poster
- ☐ 1 roll of foil
- ☐ 2 wind-up toad toys

Materials Store

- ☐ 4 rolls of string
- ☐ 8 empty boxes (pasta or shoe boxes work well)
- ☐ 8 hand towels or small pieces of fabric
- ☐ 8 pairs of scissors
- ☐ 8 rolls of masking tape
- ☐ 8 rulers or meter sticks
- ☐ 10 dowels, ¼" diameter
- ☐ 16 paper/cardboard sheets
- ☐ 24 table tennis balls
- ☐ 30 clothespins
- ☐ 30 paper cups
- ☐ 30 paper towel tubes
- ☐ 30 rubber bands
- ☐ 55 dominoes
- ☐ 60 craft sticks
- ☐ 60 paper clips
- ☐ 60 straws
- ☐ 100 pipe cleaners

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 the materials kids will have available for designing their traps.

Journal Pages for Adventure 2

Message From the Duo, p. 10

Adventure 2 **Message from the Duo**

reply | forward | archive | delete

from	engineeringadventures@mos.org
subject	Engineering a better trap
to	You 12:09 PM

Hi everyone,

We're ready to start engineering a better trap to catch the cane toad. The ideas you had for improving our first designs were great. India and I are sure you'll be able to engineer a trap that works.

We've already started using the Ask step of the Engineering Design Process to help us solve the problem. We Asked some good questions about the problems cane toads cause. Now we need to Imagine some ways to trap the toad and make a Plan. Then we can Create and test our trap designs. If they doesn't work quite right the first time, we can always Improve.

Cane toads can shoot poison up to three feet away, so we should make sure our trap is easy to activate when the cane toad is at least four feet away. Can you use what you know about technology, engineering, and the Engineering Design Process to help us design a trap that's four feet long? We sent you a special wind-up toad toy to help you test the cane toad traps you engineer.

We can't wait to see what you come up with!

Jacob

Engineering a Trap, p. 11

Adventure 2 **Enginering a Trap**

Draw a picture of the trap you engineered. Circle any parts you want to improve next time.

Test Results

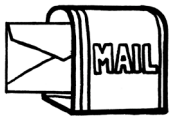
How much space is there between where you activate your trap and where the toad gets caught?

☐ 4 feet or more ☐ Less than 4 feet

Try 1	Try 2
☐ Caught the cane toad	☐ Caught the cane toad
☐ Did not catch the cane toad	☐ Did not catch the cane toad

Adventure 2 Educator Page: Adventure Guide
Creating a Cane Toad Trap

Kids will learn:
- the Engineering Design Process is a tool they can use to help engineer solutions to problems.



Present the Message From the Duo (5 min)

1. Tell kids that today they'll begin engineering their cane toad traps. Jacob sent them a message with more details.
2. Have kids turn to Engineering Journal p. 10 and play track 4.
3. To check for understanding, ask:
   - **What is the technology that Jacob is asking you to help engineer?** *A trap to catch the cane toad.*
   - **How far away from the part of the trap that catches the toad does the starting point need to be? Why?** *At least 4 feet, because the cane toads can shoot poison up to 3 feet away.*
   - **Which steps of the Engineering Design Process do you think will help you the most?**

Set the Stage (5 min)

1. Show kids the model cane toad (the wind-up toy) that India and Jacob sent so they can understand how it will interact with their trap. Wind up the toy so they can see how it moves.
2. Ask a volunteer to help you test the toad. Prop a piece of cardboard or paper up using a domino. Have the volunteer test whether the toad can go up the ramp, or whether it can turn corners. Encourage kids to think about how this might affect their designs!
3. Show them the materials they'll have available for designing their traps. Tell them that the rules are:
   - They need to be able to activate their trap four feet away from where the cane toad will be caught.
   - They need to try their trap at least twice and record whether it works each time.

See It!: To see examples of machines made using simple materials, visit: http://www.mos.org/eie/engineeringadventures/hoptoitvideos

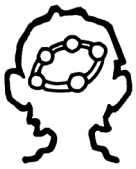
Let the Building Begin! (25 min)

1. Kids will work in groups to build a trap to catch the cane toad. They might choose to improve some of the traps that India and Jacob started with, or they might engineer something completely different. Once a group has

agreed upon a plan, they may get materials from the Materials Store and begin to build.

2. As groups are building, encourage them to think creatively, and to move back and forth between the steps of the Engineering Design Process. Use the poster to guide conversations and encourage groups to use the names for the steps of the Engineering Design Process to describe what they are doing.
3. As groups build, ask questions like:
   - **How will your trap work?**
   - **What steps of the Engineering Design Process have you used so far?**
4. When a group is ready to test their trap, have them measure the distance between the starting point of the trap and where the toad will be caught. Make sure the distance is at least four feet. Then allow them to test twice with the wind-up toad and record results in their Engineering Journals.
5. As groups test, ask questions like:
   - **What works well in your trap?**
   - **What does not work well in your trap?**
   - **How could you improve your trap?**

Tip: Some groups may not be ready to test today. They will have more time to test during Adventure 3.



Reflect (10 min)

1. Remind kids they will get more time to work on their traps during the next adventure.
2. If some groups would like, let them share their traps with the whole group. Before groups activate their traps, have them review the Engineering Design Process poster. Ask:
   - **Which step of the Engineering Design Process helped you the most today? Why?**
   - **How will you Improve your trap next time?**
3. Be sure to save the traps teams build today for use in Adventures 3 and 4.
4. Give kids time to record thoughts in their Engineering Journals on *Engineering a Trap*, p. 11. Recording the results of their testing and ideas they have for improvements will help prepare kids for the next adventure.

Message from the Duo

reply | forward | archive | delete

from	engineeringadventures@mos.org
subject	Engineering a Better Trap
to	You
	12:09 PM

Hi everyone,

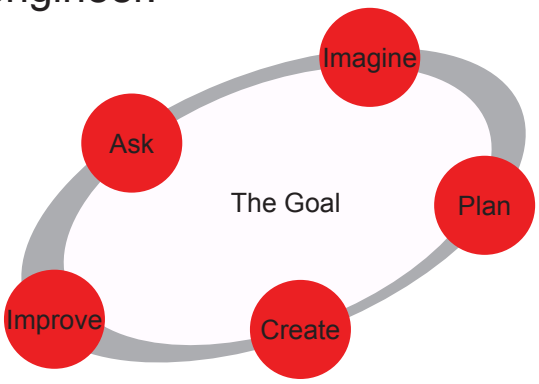
We're ready to start engineering a better trap to catch the cane toad. The ideas you had for improving our first designs were great. India and I are sure you'll be able to engineer a trap that works.

We've already started using the Ask step of the Engineering Design Process to help us solve the problem. We Asked some good questions about the problems cane toads cause. Now we need to Imagine some ways to trap the toad and make a Plan. Then we can Create and test our trap designs. If they don't work quite right the first time, we can always Improve.

Cane toads can shoot poison up to three feet away, so we should make sure our trap is easy to activate when the cane toad is at least four feet away. Can you use what you know about technology, engineering, and the Engineering Design Process to help us design a trap that's four feet long? We sent you a special wind-up toad toy to help you test the cane toad traps you engineer.

We can't wait to see what you come up with!

Jacob



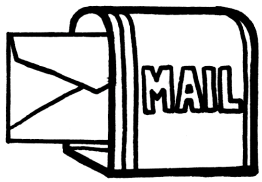
Adventure 3
Improving a Cane Toad Trap

Educator Page: Preview

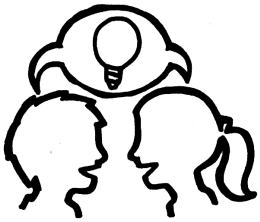
Overview: Kids continue using the steps of the Engineering Design Process as they Create their cane toad traps, test them, and Improve their designs.

Note to Educator: Allow groups to move through the Improve step at their own pace, and continue this activity on another day if necessary.

Duo Update (5 min)

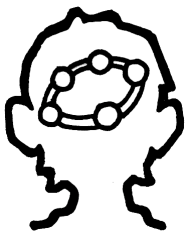


Set the Stage (5 min)



Activity (25 min)

Reflect (10 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 5 or Eng. Journal p. 12
- ☐ EDP Poster
- ☐ 2 wind-up cane toads
- ☐ Materials Store

Materials Store (remaining materials from Adv. 2):

- ☐ 1 roll of foil
- ☐ 4 rolls of string
- ☐ 8 empty boxes (pasta or shoe boxes work well)
- ☐ 8 hand towels or small pieces of fabric
- ☐ 8 pairs of scissors
- ☐ 8 rolls of masking tape
- ☐ 8 rulers
- ☐ 10 dowels, ¼" diameter
- ☐ 16 paper/cardboard sheets
- ☐ 24 table tennis balls
- ☐ 30 clothespins
- ☐ 30 paper cups
- ☐ 30 paper towel tubes
- ☐ 30 rubber bands
- ☐ 55 dominoes
- ☐ 60 craft sticks
- ☐ 60 paper clips
- ☐ 60 straws
- ☐ 100 pipe cleaners

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 the materials left over from Adventure 2.

Journal Pages for Adventure 3

Message From the Duo, p. 12

Adventure 3 **Message from the Duo**

reply | forward | archive | delete

from	engineeringadventures@mos.org
subject	Time is almost up!
to	You 2:45 PM

Hi everyone,

The technologies you engineered to trap the cane toad are looking great. We are leaving early tomorrow morning to go back home, and we need to have the traps ready to go so we can catch the cane toad before we leave!

We need the final traps to be the best they can be. Share your ideas with each other and try to Improve your traps even more! Use the steps of the Engineering Design Process to help you. This is what engineers do all of the time.

If you have time, think about some ways to camoflauge your trap—make it blend in to what's around it so the cane toad will not see it. You could also think about putting some bait inside to attract the toad.

We're counting on you...and so are New Zealand's native animals!

India

Improve, p. 13

Adventure 3 **Improve**

Dear India and Jacob,
Here are the results of our improved cane toad trap testing:

Test Results

How much space is there between where you activate your trap and where the toad gets caught?

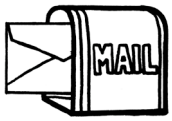
☐ 4 feet or more ☐ Less than 4 feet

Try 1	Try 2
☐ Caught the cane toad	☐ Caught the cane toad
☐ Did not catch the cane toad	☐ Did not catch the cane toad

Below is a picture of our improved trap.

Adventure 3 Educator Page: Adventure Guide
Improving a Cane Toad Trap

Kids will learn:
- that the Improve step of the Engineering Design Process is important for perfecting a design.



Present the Message From the Duo (5 min)

1. Tell kids that today they will Improve their cane toad traps so they are they best they can be. India has sent them a message with more details.
2. Have kids turn to Engineering Journal p. 12 and play track 5.
3. To check for understanding, ask:
   - **What kind of technology are we engineering?** *A cane toad trap.*
   - **Do you remember how far away the starting point of your trap needs to be from where the toad is caught? Why?** *The trap needs to be activated from a spot at least 4 feet away from where the toad will be caught because the cane toad can shoot poison 3 feet!*

Set the Stage (5 min)

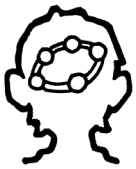
1. Explain to kids that they can all learn from each others' first trap designs and testing. Have some groups share what they've done so far. Ask:
   - **What worked well in your first design? What didn't work well?**
2. Encourage groups to learn from what worked well and what didn't work well in other groups' designs. Explain that engineers learn from each other all of the time!

Let the Creativity Begin! (25 min)

1. Give groups time to improve their traps. They may need to gather new materials from the Materials Store.
2. Have groups measure the length of their designs, and then test their designs at least twice using the wind-up toad.
3. As groups build and test, ask questions like:
   - **Did your group successfully trap the cane toad?**
   - **How have you improved your trap?**
   - **What parts in your new design work well?**
4. If kids get frustrated working on their traps, remind them that engineers often come up with many designs that don't work before they are able to engineer a design that does work.

Tip: If groups are stuck, encourage them to talk to other groups and ask if they have ideas on how to solve certain design problems.

Tip: If groups finish early, they can use markers and paper to camouflage their traps. For fun, you might also encourage them to perfect the way they will "hide" from the cane toad when activating their trap.



Reflect (10 min)

1. Show kids the Engineering Design Process poster. Ask:
   - **Which steps did you use most today?**
   - **Which step was the most fun for your group? Why do you think engineers use this step?**
   - **If you could improve your trap again, what parts would you change?**
2. Tell kids that during the next session, they will get the chance to show the great engineering they've been doing. If you would like kids to invite their families or friends, let them know.
3. Give kids time to record their thoughts in their Engineering Journals on *Improve*, p. 13. Recording the results of their testing will help prepare kids for the next adventure, when they will share the traps they engineered.

Tip: If groups finish early, they can fill out *Cane Toad Problems*, pp. 18-19 in their Engineering Journals.

Improving a Cane Toad Trap

reply | forward | archive | delete

from	engineeringadventures@mos.org
subject	Time is Almost Up!
to	You
	2:45 PM

Hi everyone,

The technologies you engineered to trap the cane toad are looking great. We are leaving early tomorrow morning to go back home, and we need to have the traps ready to go so we can catch the cane toad before we leave!

We need the final traps to be the best they can be. Remember that you need to be able to activate the traps from at least four feet away from where the toad will be caught. Share your ideas with each other and try to Improve your traps even more! Use the steps of the Engineering Design Process to help you. This is what engineers do all of the time.

If you have time, think about some ways to camouflage your trap—make it blend in to what's around it so the cane toad will not see it. You could also think about putting some bait inside to attract the toad.

We're counting on you... and so are New Zealand's native animals!

India

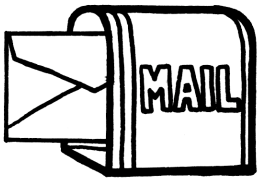
Adventure 4
Engineering Showcase

Educator Page: Preview

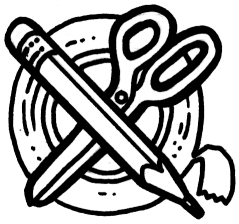
Overview: Kids present their cane toad traps and knowledge of the Engineering Design Process by creating a Public Service Announcement that tells others about the dangers of cane toads.

Note to Educator: It may take some groups extra time to prepare their PSA. Consider spreading this adventure over the course of two sessions.
You may want to invite guests, such as other kids from your program, parents, friends, or even professional mechanical engineers to come see the showcase! During the showcase, encourage kids to take ownership of their designs, feel proud of the work they have done, and show off their new skills and knowledge.

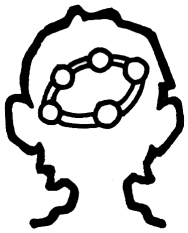
Duo Update (5 min)



Activity (35 min)



Reflect (5 min)



Materials

For the entire group:

- ☐ *Message from the Duo*, track 6 or Engineering Journal p. 14
- ☐ EDP poster
- ☐ wind-up cane toad
- ☐ optional: camera or video camera

For each group of 3-5 kids:

- ☐ markers or crayons
- ☐ paper
- ☐ traps from Adventure 3

For each kid:

- ☐ Engineering Journal

Preparation

Time Required: 10 minutes

1. Have the *Message from the Duo* ready to share.
2. If possible, plan to video record or take pictures of this adventure!

Journal Pages for Adventure 4

Message From the Duo, p. 14

Adventure 4 **Message from the Duo**

reply | forward | archive | delete

from	engineeringadventures@mos.org
subject	One more thing
to	You
	9:25 AM

Hi everyone,

Good news. With your hard work, your creativity, and the Engineering Design Process, we caught the cane toad!

Cane toads are still a big problem in Australia, though. In fact, the problem there is getting worse every day. Luckily, there is more we can do to help. When we were in Australia, we saw lots of Public Service Announcements—PSAs—about cane toads on TV. A PSA is like a commercial, except instead of advertising something you give information. In one of the Australian PSAs, a park ranger gave some great information about cane toads and what to do if you see one. We think you should make PSAs about the cane toad traps you engineered!

Think about it. At first, you probably didn't know very much about cane toads, but now you are experts. You have even engineered technologies to trap them! Do you think you could teach other people about cane toads and how to engineer technologies to trap them?

Do your best! Be sure to tell everyone how you used the Engineering Design Process to help you solve this problem.

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

Engineering Showcase PSA, p. 15

Adveture 4 **Engineering Showcase PSA**

Plan your presentation with your group.

How does your trap work? What are some improvements you made to your trap?

What steps of the Engineering Design Process did you use to help you design your trap?

What is the most important reason why people should help try to catch cane toads?

My Next Engineering Adventure, p. 16

Adventure 4 **My Next Engineering Adventure**

What do you want to engineer next?

_____

Draw your technology here!

What materials do you want to use?

_____
_____
_____
_____
_____
_____
_____

My engineering checklist:

- ☐ Find friends to work with.
- ☐ **Ask** questions about how to start.
- ☐ **Imagine** lots of ideas.
- ☐ Make a **Plan**.
- ☐ **Create** and test the plan.
- ☐ **Improve** until you think it is ready.

Use the next page to keep track of your work!

My Next Engineering Adventure, p. 17

Adventure 4 **My Next Engineering Adventure**

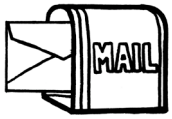
How is your engineering project going? Keep track of what you do on this page.

Adventure 4 Engineering Showcase

Educator Page: Adventure Guide

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 cane toad trap technologies.



Present the Message From the Duo (5 min)

1. Tell kids that today they'll get the chance to share all of their great engineering work with others. The Duo sent them a message with some details.
2. Have kids turn to Engineering Journal p. 14 and play track 6.
3. To check for understanding, ask:
   - **What do India and Jacob want us to do?** *They want us to make a PSA to tell people about why cane toads are dangerous and how we engineered our traps.*
   - **Why do they want us to do this?** *If we teach people about what we did to help solve the cane toad problem, maybe other people will try to solve the problem, too.*

Let the Creativity Begin! (15 min)

1. Have groups think about how they will present their PSA. They may want to record ideas in their Engineering Journals on *Engineering Showcase PSA*, p. 15. Encourage groups to think about how they used the Engineering Design Process throughout the adventures.
2. Remind kids that they will share their presentations with the entire group when they are done.

Tip: If you have time, show kids a few PSAs from the Internet. Talk about what each is trying to say and what makes it effective.

Share (20 min)

1. Have each group present their PSA to everyone. Have the wind-up toad toy available so groups can show how their traps work. If possible, record the PSAs or take pictures.
2. After groups present, ask:
   - **Which parts of your trap work the best?**
   - **Which parts of your trap would you still like to improve?**
   - **What step of the Engineering Design Process helped you most to engineer your trap?**

Reflect (5 min)

1. Gather kids together to wrap up their engineering experience. Ask:
   - **What would you say to someone who is about to bring an invasive species to an area? Why would you say that?**

- **Do you think engineers can help take care of the environment? Why?**

2. Give kids time to record thoughts on *My Next Engineering Adventure*, pp. 16-17 in their Engineering Journals. Encourage kids to continue engineering!

Message from the Duo

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from: engineeringadventures@mos.org
subject: One More Thing...
to: You
9:25 AM

Hi everyone,

Good news. With your hard work, your creativity, and the Engineering Design Process, we caught the cane toad!

Cane toads are still a big problem in Australia, though. In fact, the problem there is getting worse every day. Luckily, there is more we can do to help. When we were in Australia, we saw lots of Public Service Announcements—PSAs—about cane toads on TV. A PSA is like a commercial, except instead of advertising something you give information. In one of the Australian PSAs, a park ranger gave some great information about cane toads and what to do if you see one. We think you should make PSAs about the cane toad traps you engineered!

Think about it. At first, you probably didn't know very much about cane toads, but now you are experts. You have even engineered technologies to trap them! Do you think you could teach other people about cane toads and how to engineer technologies to trap them?

Do your best! Be sure to tell everyone how you used the Engineering Design Process to help you solve this problem.

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

