

Activity Guide

Includes Activities for all ages

CHALLENGE LEVEL 1

Explore STEM with

NC STATE Engineering

WARNING: These STEM activities have been known to cause extreme excitement. Some have even reported increased brain activity and a new love for Engineering!

This adventurous guide was brought to you
by North Carolina State University Engineering.

*Activities in this guide will require materials and supervision.



Parental Authorization

(Parent/Guardian must complete and give to the accompanying adult if it is not the parent or some school systems require them to be turned into home room teacher.)

I/We, the undersigned, grant our son/daughter _____ permission
(Name of Student)

to participate in an out-of-school educational activity as part of the **Take Our Daughters and Sons to Work® Day**.

Should a medical emergency arise while my son/daughter is participating in this field trip, the accompanying adult or I will be responsible for initiating medical treatment. I give permission for immediate treatment as required in the judgment of the attending physician.

If there are any changes to the information provided herein, it is the parent's responsibility to provide the updated information.

Signature of Parent or Guardian

Signature of Parent or Guardian

Date

Special Note:

Parents/Guardians of students that are participating in the Take Our Daughters and Sons to Work® Day event should fill-in an Excused Absence Form if your school needs.

What is Engineering?

Have you ever solved a problem? Maybe you have solved a homework problem in math or science. But what about a problem like how to do your chores faster or how to reach something on a tall shelf? Engineers solve society's problems, and their work is all around you!

*Name Something Engineers
Help to Create*

E— Earphones

N—

G—

I—

N—

E—

E—

R—



GETTING AROUND – Take a look at your tennis shoes — what do you use them for? Can you list all of the materials in your shoe? Can you find different kinds of tennis shoes and compare their features and tread? How are they different? Engineers develop lighter and stronger materials that allow your feet to breath and design shoes to perform the best for different types of activities like running, basketball and skateboarding.

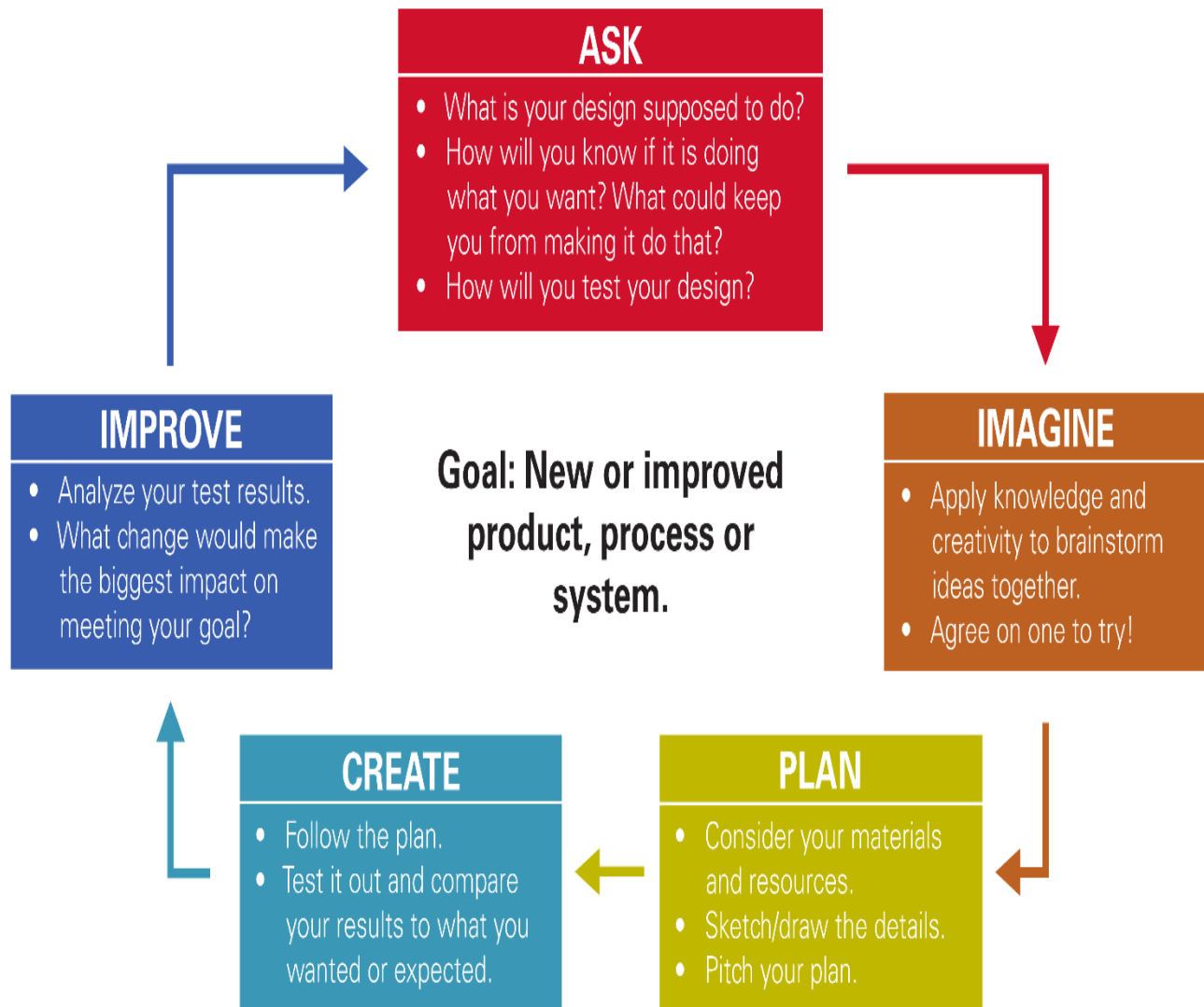
STAYING WELL – Have you ever had an x-ray at the doctor's office or dentist? You probably got to see your tissue and bones! Lots of engineers work to develop the machines that take these images. Engineers also design things like electronic thermometers, hearing aids and tiny robots so small that they can be used for surgery!

YUMMY ON THE TUMMY – We all love a great candy bar or piece of chocolate, but where and how are they made? Engineers design equipment to make your favorite candies and foods, as well as design processes that don't waste ingredients and produce the freshest, best-tasting treats! They might also be involved in developing the packaging that your candy is wrapped in — from the materials to the shape and design!

CHEMICALS AT WORK – Have you ever wondered how that sticker on your apple stays on during shipping and at the store but comes off so easily when you are ready to eat it? Engineers develop new chemicals and materials that make our lives easier — like the stuff in diapers which makes them absorb liquids, glue that can be used on your skin instead of stitches and solar cells that can collect the sun's energy.

GAMES, GAMES AND MORE GAMES – Have you ever played games on a Nintendo Wii™ or a Playstation®? Engineers and Computer Scientists not only designed the box, the guts and the handsets, but they also designed all of the software tools for the graphics, menus, sounds and actions! Next time you play, thank an engineer!

The Engineering Design Process



- The engineering design process is a series of steps that you repeat to develop or improve a product, process or system. You can start anywhere in the process, however, most engineers begin at **ASK** or **IMPROVE**.
- Failure is always a part of the process ... so is learning from failure!

Design process adapted from the Museum of Science Boston "Engineering is Elementary" program.



the engineering place

Castle Challenge

Objective: Use teamwork and creativity to construct a castle out of hula hoops. Defend it from incoming balls while trying to knock the other teams castles down. The team with the last castle standing is the winner.



Materials:

- Hula Hoops
- Cones
- Balls

Constraints:

1. Teams will get 2 minutes to construct all 3 castles.
2. At least one hula hoop must be flat on the ground.
3. One hula hoop must be completely off the ground.
4. All 6 hula hoops must be used.
5. Teams must remain inside their boundary.

Winning teams will play the counselors.

Assessment:

What would you do differently if you had to do this activity again?

Human Rube Goldberg

Objective: Using at least 5 of the materials listed, each team must transfer the whiffle ball from the ground to the bucket...without actually touching it.

Materials:

- Foam noodle
- Toilet Paper
- Diaper
- Turkey Baster
- Foam Plate
- CD
- Elastic Band
- Plastic Container
- Paper Clips
- Bungee Cord

Tools:

- e Ball
- Tape Measure
- Bucket
- Stop Watch



Activity Details: Using only the materials listed above, each team has to move the whiffle ball in to the bucket that it comes in. The ball should be placed on the ground and the bucket 10 feet away and 5 feet higher. At least 5 of the materials have to be used to complete this process and all actions have to be initiated by a team member (volunteers from the audience can be taken if necessary).

Test Process: Once the process has been designed and tested, each team will get 3 tries to complete the task and their fastest time will be recorded.

Human Rube Goldberg

ENGINEERING DESIGN CYCLE

ASK: What are the different mechanical devices to make objects move?
What materials will you use?

IMAGINE: What ideas do you have for reaching your goal of making the fastest human Rube Goldberg machine? What is your best idea?

PLAN: Draw a diagram of your design below. What are the roles of everyone in your group? What is your plan for finishing in the time allotted?

CREATE: Carry out your plan and test your design. Was it successful?
Why or why not?

How fast was the task completed?

IMPROVE: What was good about your design? What can you make better?

Sweet Feet

Take a look at your shoes.

Are they designed for running, skateboarding, protecting your feet from the cold, or looking stylish?



Engineers design and create shoes that best serve different purposes. In order to design successful shoes, they must take into account durability, scuff-resistance, comfort, traction, and flexibility.



Adding a heel to a shoe adds a challenge to the design, because it shifts the wearer's weight forward, affecting his or her comfort and balance.

Sweet Feet - continued

Objective: To design and create a pair of shoes with a 2-inch heel that can successfully undergo several challenges. Remember that heeled shoes are not only worn by women! Boots and dress shoes that are worn by both men and women have heels.

Materials:

- Corrugated Plastic Board
- Foam Sheet
- Duct Tape (2 meters)
- Decorating Materials
 - String and Ribbon
 - Markers
 - Stickers

Tools:

- Pipe Cleaners
- Cotton Balls
- Glue Guns
- Colored Cellophane
- Xacto Knives
- Miscellaneous Materials
- Rulers



Activity Details: Use the listed materials to create a pair of shoes with a heel of at least 2 inches. The heel must also measure at least 2 inches both before and after standing in the shoes. One member

of your group will wear the shoes to complete all of the challenges.

Test Process: The shoes will be tested for comfort and efficiency and will also undergo 3 challenge zones: Jumping, Walking, and Stair Climbing. Each test and challenge has a point system, and the goal is to achieve the most points.

Sweet Feet - continued

ENGINEERING DESIGN CYCLE

ASK: How does the test process affect your design?

IMAGINE: What ideas do you have for reaching your goal? What methods will you use to make a comfortable shoe? Take a look at the comfort scoring for ideas, and think about how the shoe will feel when you put it on. How will you make an efficient shoe? Look at the efficiency scoring for ideas.

PLAN: Draw a diagram of your design below. Don't forget the 2-inch heel! What materials will you use? Who will wear the shoes?

Sweet Feet - Continued

CREATE: Carry out your plan and test your design.

TESTING

Comfort

Shoe Status	Points	Check Point Earned
No prodding of residue/staples etc.	5	
Small amounts of residue	3	
Residue components jab into feet	1	

Efficiency

Shoe Status	Points	Check Point Earned
Shoe can be put on and off with ease, shoe fits and heel stays 2 inches	8	
Shoe is complicated to put on, shoe fits but heel compresses	5	
Shoe does not go on without ripping. No heel.	1	

CHALLENGE ZONES

Zone 1: Jumping --Jump in your shoes 5 times

Zone 2: Walking - Walk down the hall and back in your shoes

Shoe Status	Points	Check Point Earned
Shoe stayed intact	5	
Shoe Slightly Damaged	3	
Shoe Completely Damaged	1	

Shoe Status	Points	Check Point Earned
Shoe stayed intact	7	
Shoe Slightly Damaged	4	
Shoe Completely Damaged	1	

Zone 3: Stair Climbing - Walk down and back up the stairs once

Add the number of points you have received for each of your challenges, and write the results on the total bar.

Shoe Status	Points	Check Point Earned
Shoe stayed intact	8	
Shoe Slightly Damaged	5	
Shoe Completely Damaged	1	

Challenge/Task	Points Received
Jumping	
Walking	
Stairs	
Comfort	
Efficiency	

Total _____

IMPROVE: Consider the comfort, efficiency, and performance of your shoes. How could you improve these characteristics?

Diaper Dissection

Objective: To explore the absorption capabilities and material makeup of a diaper.

Materials:

- 1 Diaper
- Colored Water

Tools:

- Plastic Gloves
- Measuring Cup
- Aluminum Pan



Background and Activity Details: **Did you know that Americans use about 18 billion disposable diapers per year?**

Today you will measure how much water a diaper can hold and what materials a diaper consists of.

Procedure:

ENGINEERING DESIGN CYCLE

ASK: What does a diaper do? What makes a good diaper?

IMAGINE: How could you measure the amount of water a diaper can hold?

Diaper Dissection - Continued

PLAN: Look at and touch the diaper. How much water do you think it will absorb?

CREATE: Place the diaper in the pan and pour water from the measuring cup into the diaper until it is full. How will you be able to tell when the diaper is full?

How much water did the diaper hold?

Wearing gloves, cut the diaper open and look at what parts of the diaper absorbed the water. What does the material on the inside of the diaper feel like?

IMPROVE: Diapers take up as much as 1% of all landfills in our country. How could you design the diaper to be more friendly to the environment?

It's Time For the ICE CREAM CHALLENGE!



Purpose: To Make Ice Cream

Materials:

- 1 quart size Ziploc bag
- 1 gallon size Ziploc bag
- 1 $\frac{1}{2}$ cups whole milk
- 4 handfuls ice cubes
- $\frac{1}{4}$ cup coarse (rock) salt
- 2 clean plastic spoons
- $\frac{1}{2}$ tsp. Vanilla extract (flavoring)
- paper towels
- 2-3 cups for final product
- Condiment cup of sugar or $\frac{1}{8}$ cup
- Clean pair of scissors

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Procedure:

1. Work with a partner
2. Place ice cubes in gallon Ziploc bag
3. Place milk in second Ziploc bag. Add sugar and Vanilla extract.
4. Add coarse salt in the bag with ice. Seal and shake for 20 seconds.
5. Empty most of the air from the bag with the milk in it. **MAKE SURE THE BAG IS SEALED** and place it inside the bag with the ice mixture.
6. GENTLY shake the sealed bags back and forth in your hands to make sure the ice mixture coats the milk. Shake for 3 to 10 minutes until the milk is an ice cream consistency.
7. Carefully remove the inner bag and place on the paper towels. Wipe the salty water off the ice cream bag.
8. Cut with clean scissors and pour into your cups.
9. Clean up and ENJOY!

Are You Ready to Become an Engineer Today?



(n) Engineering involves the application of creativity in partnership with math, science, social studies, language arts and fine arts to search for quicker, better and less expensive ways to use the forces and materials of nature to meet today's challenges. Engineers are problem solvers who use every resource possible to bring into existence things and ideas they imagine.

Finish These Phrases to learn more about Engineers

1. Engineers work to solve _____ such as _____, clean water, protecting the environment and improving the quality of everyday life.
2. Engineering allows you to use your _____ every day.
3. _____ have the opportunity for rapid advancement in their companies.
4. Engineering _____ remain high.
5. Engineering has more impact on the _____ than any other profession.

PHRASE BANK

Engineers

salaries

national

global problems

world hunger

local

creativity

world

Are You Ready to Become an Engineer Today? - Continued

ANSWER SHEET



1. Engineers work to solve global problems such as world hunger, clean water, protecting the environment and improving the quality of everyday life.
2. Engineering allows you to use your creativity every day.
3. Engineers have the opportunity for rapid advancement in their companies.
4. Engineering salaries remain high.
5. Engineering has more impact on the world than any other profession.

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Directions for Completing the Take Our Daughters And Sons To Work[®] Day Assignment

Please use the forms (Take Our Daughters and Sons to Work[®] Day Activity Log and the Post-Take Our Daughter And Sons To Work Day Evaluation Form) to document the activities that you participated in on Take Our Daughters And Sons To Work[®] Day. Include the time, activity and the adult who supervised you while involved in the activity. A sample has been completed for you.

Activity Log

Student Name _____

School Grade _____

Workplace _____

TIME	ACTIVITY	RESPONSIBLE ADULT
8:00-8:30	Tour of OFFICE BUILDING	

* (Use if the group leader asks you to).

Evaluation Form

Your Name _____ Date _____

Name of Company _____

Fill in the blanks. Share your answers at home with your family.

1. This is the most unusual or surprising thing I saw:

2. One job I saw was:

3. The job helps people because:

4. The following school work will help in doing this job:

5. This is an example of an important work habit:

6. This is an example of a team project I learned about at the work-site visit:

7. Of all the jobs I saw, I think I would be best at:

Program Form

Let us know what you think about the Take Our Daughters And Sons To Work ® program and you may appear on our Web site. Please answer the following questions and mail this form to the address below.

1. What did you learn on Take Our Daughters And Sons To Work Day?
2. Finish this sentence: I love Take Our Daughters And Sons To Work Day because...
3. What did you learn about your parent/sponsor?
4. Finish these sentences:
My future work...

My future family...

My future community...
5. What do you think it would be like to work and take care of a family?
6. What company or organization did you attend and what did you learn about the workplace?

Full Name _____
Parent/Sponsor Name _____
Parent/Sponsor Phone Number _____
E-mail Address _____

Email To: **todastw@mindspring.com**