



NSDL/NSTA Web Seminar
Teach Engineering: Because Dreams Need Doing



Thursday, February 19, 2009

Who's presenting today



Mindy Zarske

K-12 Engineering Coordinator
Integrated Teaching and Learning Program
University of Colorado at Boulder
Boulder, CO

"Nobody ever suggested engineering to me."



Mike Mooney

Associate Professor of Engineering
Colorado School of Mines
Golden, CO

"a high school guidance counselor told me I
wasn't *smart enough* to be an engineer"



<http://nsdl.org>





<http://nsdl.org>



- NSDL Pathways for specific content & audience
- NSDL Engineering Pathway: K-Gray
- Rich variety of materials found in one place

<http://engineeringpathway.org>



<http://nsdl.org>





Goal: Use of Engineering Design to Engage Students in Learning

TEACH Engineering *Resources for K-12*

A collection of high-quality curriculum within the NSDL Engineering Pathway

<http://teachengineering.org>



<http://nsdl.org>





Outline:

- ✓ What do engineers do?
- ✓ What is the engineering design process?
- ✓ What are types of engineering?
- ✓ What are some engineering activities that I can use with my students?



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What do Engineers Do?





Stamp all the ones you think apply

Fix Broken Cars	Design Medical Equipment	Build new wind turbines	Design sport shoes	Create a sculpture

What do Engineers Do?



Fix Broken Cars	Design Medical Equipment	Build new wind turbines	Design sport shoes	Create a sculpture
technician		technician		artisan



Engineers *design* everything...

- ✓ Medical devices
- ✓ Roller coasters
- ✓ Computer games
- ✓ Music studio technology
- ✓ iPods, cell phones
- ✓ Alternative energy technologies
- ✓ Water filtration systems
- ✓ Hybrid cars





Grand Challenges for Engineering

- ✓ Make solar energy economical
- ✓ Provide energy from fusion
- ✓ Develop carbon sequestration methods
- ✓ Manage the nitrogen cycle
- ✓ Provide access to clean water
- ✓ Restore and improve urban infrastructure
- ✓ Advance health informatics
- ✓ Engineer better medicines
- ✓ Reverse-engineer the brain
- ✓ Prevent nuclear terror
- ✓ Secure cyberspace
- ✓ Enhance virtual reality
- ✓ Advance personalized learning
- ✓ Engineer the tools of scientific discovery

...awaiting
engineering solutions
in the 21st century!



*As determined by a committee of the
National Academy of Engineering.
<http://www.engineeringchallenges.org/>


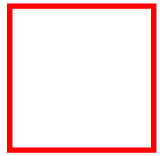
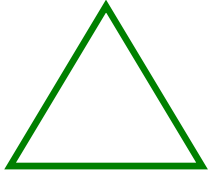
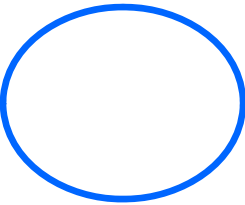
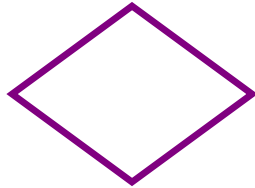
Engineering Design Process

common to all designed items

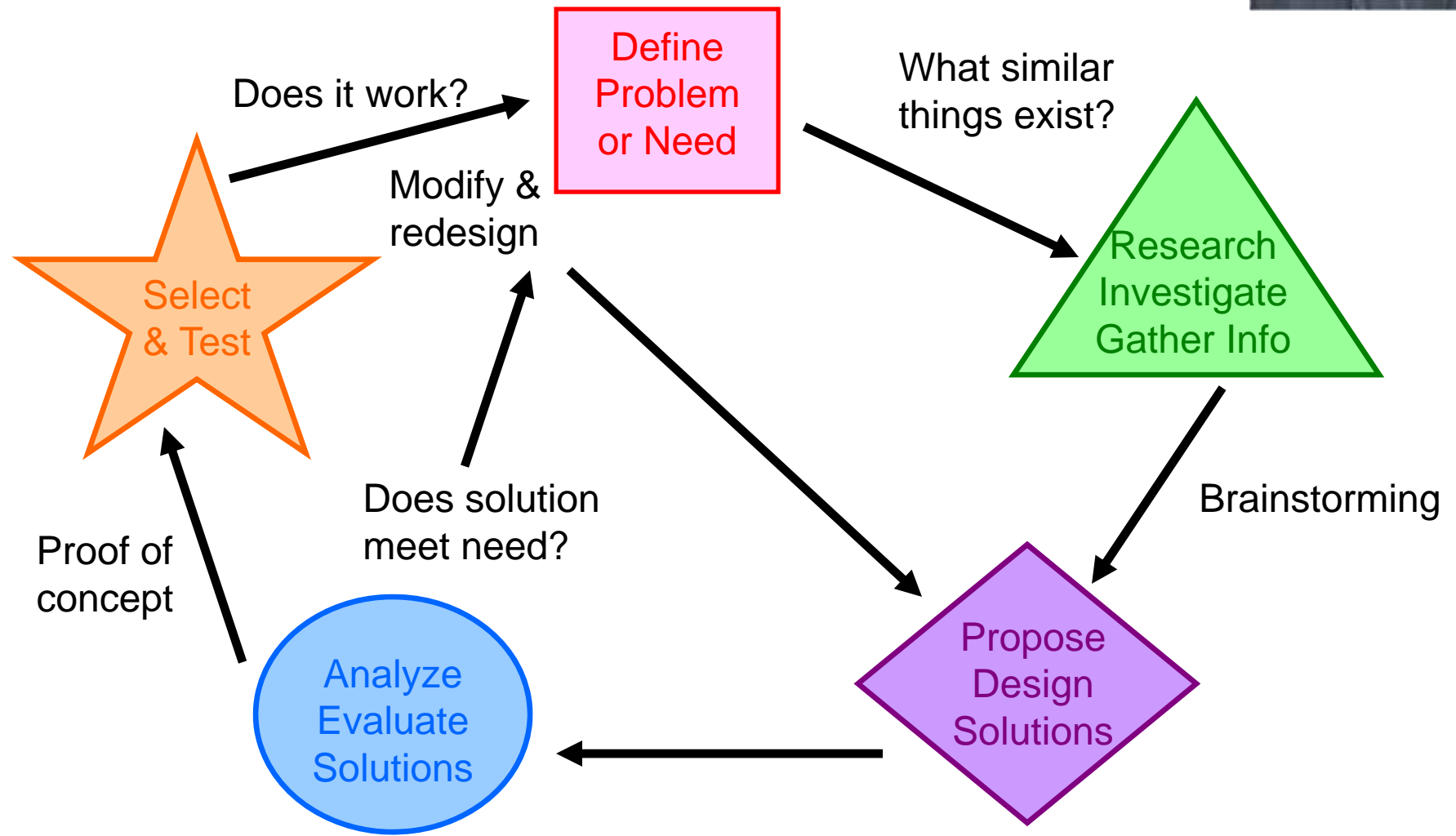


What order is typically followed?

Order the steps below from 1 to 5...

 Select & Test	 Define Problem or Need	 Research Investigate Gather Info	 Analyze Evaluate Solutions	 Propose Design Solutions

Engineering Design Process



Engineering Design Process



Define
Problem
or Need

What is the problem? What do we want to accomplish? What are the project requirements? What are the limitations? Who is the customer? What is our goal?

Gather information and conduct research - talking to people from many different backgrounds.

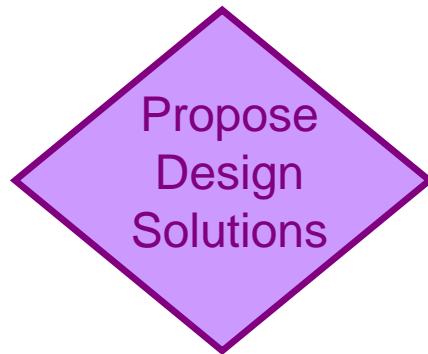
Research
Investigate
Gather Info



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Engineering Design Process



There is always more than one possible way to solve a problem lots of brainstorming involved. This is where really creative ideas come from.

Engineers evaluate multiple design solutions to determine if and how well they meet the design criteria.



Per qualitative or quantitative rating system, a final design is selected. The final design is then thoroughly tested.

What are the different types of engineers?

What are some types of engineers that you are familiar with?

1	2	3
4	5	6
7	8	9

Type your answers in the boxes



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There are many types of engineering

Here are some of them...

- **Aerospace**
- **Agricultural**
- **Biological**
- **Biomedical**
- **Chemical**
- **Civil**
- **Computer Science**
- **Electrical**
- **Environmental**
- **Geotechnical**
- **Industrial and Systems**
- **Material Science**
- **Mechanical**
- **Metallurgical**
- **Nuclear**
- **Petroleum**
- **Software**





TEACH Engineering Resources for K-12

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News and Events

March is Women's History Month! Check out our [Gender Equity and Women in Information Technology](#) resources. Read and comment on the [National Academies' Beyond Bias and Barriers report](#).

[ASEE's Engineering Research Council Summit](#) is March 11-13.

[The National Collegiate Inventors and Innovators Alliance Meeting](#) is March 22-23.

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Welcome to the world of K-12 engineering!

Engineers have a hand in designing, creating or modifying nearly everything we touch, wear, eat, see and hear. Introducing engineering into the K-12 classroom connects science and math concepts to the everyday engineering that surrounds us. This teacher resource, *TeachEngineering.com*, helps teachers enhance learning, excite students and stimulate interest in science and math through the use of hands-on engineering.

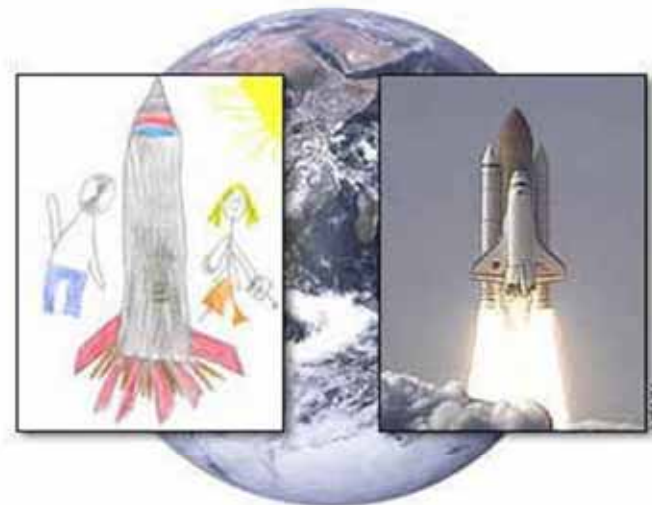
The *TeachEngineering* digital library provides teacher-tested, standards-based engineering content for K-12 teachers to use in science and math classrooms. Engineering lessons connect real-world experiences with curricular content already taught in K-12 classrooms. Mapped to educational content standards, *TeachEngineering's* comprehensive curricula are hands-on, inexpensive, and relevant to children's daily lives.

There are many ways to access the materials in this collection:

- ◆ [Search](#) the collection by specifying keywords, grade levels, educational standards, or other criteria
- ◆ [Browse](#) curricular contents by subject area, curricular units, lessons or activities
- ◆ Access your favorite items and submit reviews in your own personalized [MyTE](#) area

And remember — you don't need knowledge of engineering to use these curricula!

Just a cute kid with a great imagination...
or an aspiring engineer who will shape our world?





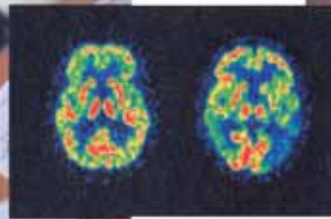
Biomedical engineering

What is it?

Biomedical engineering applies the engineering design process to the medical and biological sciences to improve health care and people's quality of life.

What K-12 science does it relate to?

Biology, life science, human body





Example TeachEngineering Activities for Biomedical Engineering



Prosthetic party

Student teams investigate biomedical engineering and the technology of prosthetics. Students create a model prosthetic lower leg using various materials. Each team demonstrates its prosthesis' strength and consider its pros and cons, giving insight into the characteristics and materials biomedical engineers consider in designing artificial limbs.

No Valve in Vain

In this activity, students will design and create their own heart valves out of a variety of materials. This activity will not only test their understanding of how a one-way valve works and its purpose, but will also allow them a chance to think outside of the box and practice engineering problem-solving.



Let's go check it out!

TEACHEngineering Resources for K-12

Curriculum Search

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Premier Curriculum Award for K-12 Engineering
Funded by:
NSDL
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Current curricula contents:
436 hands-on activities
240 lessons
36 units



<http://nsdl.org>

<http://teachengineering.org>





Environmental engineering

What is it?

Environmental engineering applies the engineering design process to air, water and land resources to improve the quality of human life and other organisms, and to remediate pollution.

What K-12 science does it relate to?

Life science, ecology, water, geology



<http://nsdl.org>





Example TeachEngineering Activities for Environmental Engineering

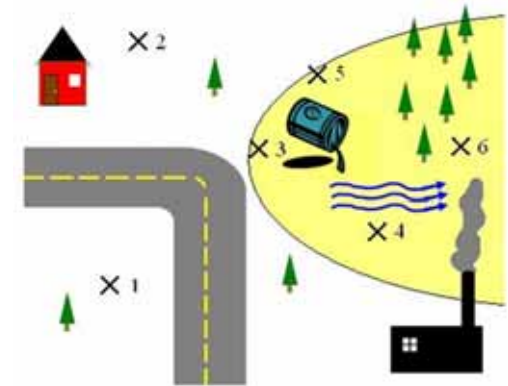
Engineers Speak for the Trees



Students begin by reading Dr. Seuss' *The Lorax* as an example of how overdevelopment can cause long-lasting environmental destruction. Student teams are asked to serve as natural resource engineers, city planning engineers and civil engineers with the task to replant the nearly destroyed forest and develop a sustainable community design that can co-exist with the re-established natural area.

Groundwater Detectives

Student teams locate a contaminant spill in a hypothetical site by measuring the pH of soil samples. Then they predict the direction of groundwater flow using mathematical modeling. They also use the engineering design process to come up with alternative treatments for the contaminated water.



How engaging do you think these types of activities are for girls?



- (A) Very engaging
- (B) Somewhat engaging
- (C) Definitely engaging

How engaging do you think these types of activities are for girls?

Girls want a career that *makes a difference*. Engineering design activities give young women an opportunity to be creative and a context for how they can help improve the *health, happiness and safety of others*.





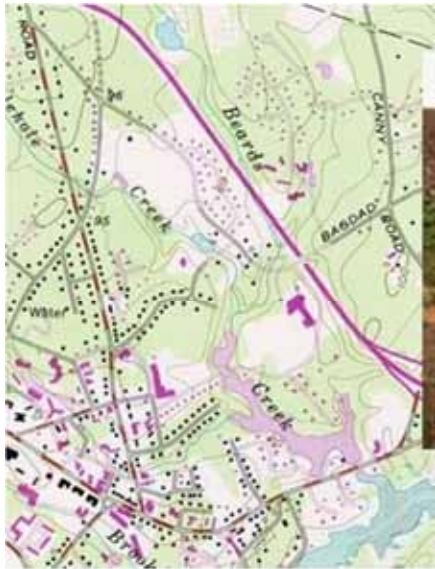
Geotechnical engineering

What is it?

Geotechnical engineering applies the engineering design process to subsurface conditions and materials to determine physical and chemical properties of an area.

What K-12 science does it relate to?

earth science, rocks & minerals, geological processes





Example TeachEngineering Activities for Geotechnical Engineering

**ADVENTURE
ENGINEERING**

Asteroid Impact



Asteroid Impact unit

An asteroid is on a collision course with earth; it is projected to impact somewhere in North America. The surface of the earth will be uninhabitable for one year. Your engineering team must design underground caverns to house the 10 million people of Alabraska for one year.

Unit Summary

- 8 lessons
- 450 to 550 minutes

TEACH Engineering *Resources for K-12*



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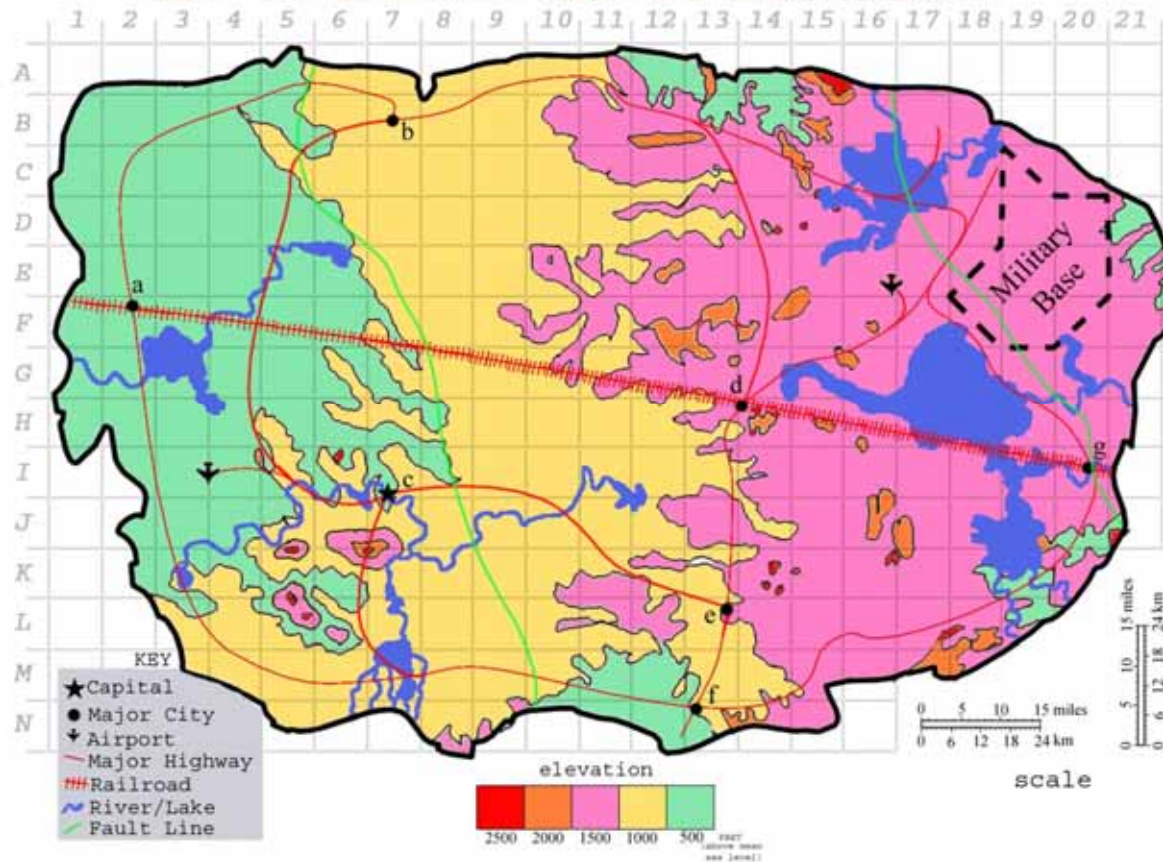


NSTA WEB SEMINARS

ADVENTURE ENGINEERING Asteroid Impact



MAP A: GENERAL MAP OF ALABRASKA

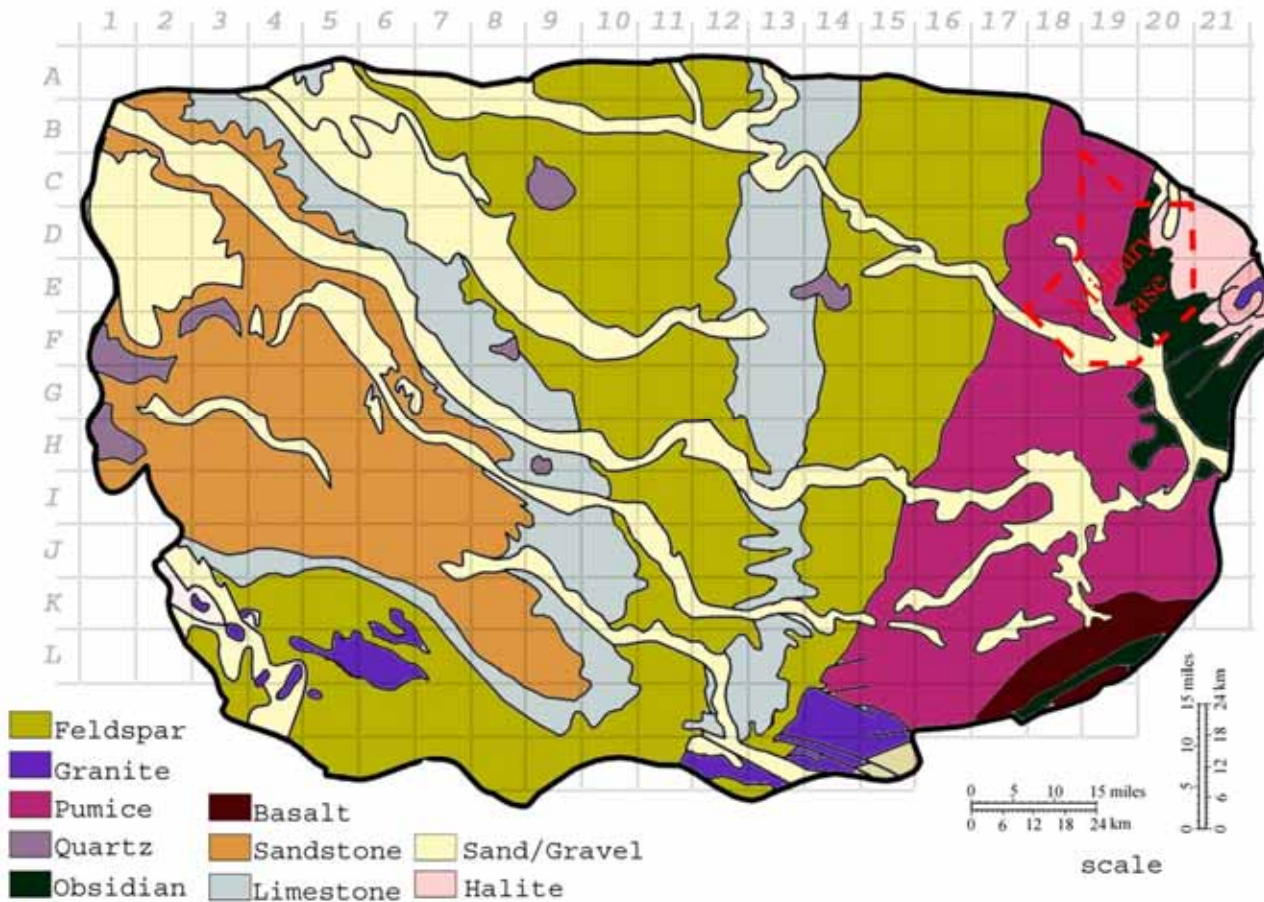


Student teams:

- (1) explore general and geological maps
- (2) determine the area of their classroom to help determine the cavern size
- (3) learn about map scales

ADVENTURE ENGINEERING Asteroid Impact

MAP B: GEOLOGY MAP OF ALABRASKA



Student teams:

- (4) test and classify rocks
- (5) identify important rock properties for underground caverns
- (6) choose a final location and size

In what rock type would you build caverns?

How likely are you to try an engineering activity in your classroom?



- (A) Not very likely
- (B) I might give one a try
- (C) I definitely want to try one
- (D) I already do engineering activities.



<http://engineeringpathway.org>

<http://teachengineering.org>

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**THANK
YOU!**

Resources from this seminar:

<http://www.diigo.com/list/nsdlworkshops/web-sem-engineering>

Search for “diigo nsdl workshops engineering”

Learn about new tools and resources, discuss issues related to science education, find out about ways to enhance your teaching at:

<http://expertvoices.nsdl.org/learningdigitalK12>



<http://nsdl.org>





<http://www.illuminate.com>



Welcome to Your Professional Development

The Learning Center is NSTA's e-professional development portal to help you address your classroom needs and busy schedule. You can gain access to more than 2,600 different resources that cater to your preference for learning. Over 700 hundred resources, such as journal articles, science objects and web seminars are available **for free**. A suite of practical tools such as My Library, My Transcript, and My Professional Development Plan and Portfolio tool help you organize, personalize, and document your growth over time.



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By State Standards

Many resources now permit you to select your grade, standard document, and state to view the standards that align to the resource you've selected.

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Learn at your own pace online with these 1-2 or 6-10 hour interactive activities.

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Learn online from certified instructors with your colleagues. 1-2 hour seminars, week and month long courses are available. Earn state and university credit.

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In Person Experiences

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2 hr
Do-It-Yourself
Science Object

[Oceans Effect on Climate and Weather: Global](#)

Science OBJECTS

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