



Tested & Approved STEM Activities

Engineering & Technology Programming

Teacher's Guide

Collaborate with us!

- Send students home with flyers or link to the library from your classroom website.
- Plan an event with us, or encourage students to volunteer!

Please contact _____ at _____ to discuss
how we can work together to increase the community's STEM engagement!

Classroom Connections

There are a variety of websites with engineering and technology activities for different grade levels:

- **Design Squad**
This PBS site has lessons, resources, and teachers guides to engage students in hands-on engineering.
<http://pbskids.org/designsquad/parentseducators/>
- **Engineering is Elementary**
This site includes free curriculum for grades 3-5 (Engineering Adventures) and middle school (Engineering Everywhere) in out of school time.
<http://www.eie.org>
- **NASA Beginning Engineering, Science and Technology (BEST)**
These activity guides help teach students the engineering design process.
<http://www.nasa.gov/audience/foreducators/best/>
- **TryEngineering**
This site features a variety of lesson plans allowing teachers to apply engineering principles in the classroom.
www.tryengineering.org
- **eGFI: Dream up the Future**
Tools include engineering lesson plans, class activities, outreach programs, and more.
<http://teachers.egfi-k12.org/>

Younger elementary students (K-2)

These students are introduced to engineering problems as situations that people want to change:

- Students can define engineering problems, such as designing boats that can float, lights that can turn on, and instruments that can make music.
- Students can compare solutions, such as lamps with on/off switches and lamps that turn on or off when touched, and test and evaluate them.
- Students can convey solutions through representations, such as a drawing or a physical model.

Older elementary students (grades 3-5)

These students are more formally problem-solving as part of engineering design:

- Students can specify the criteria and constraints that a possible solution to a simple problem must meet, such as limiting materials for designing the tallest model tower to straws, tape, and scissors.
- Students can improve solutions based on simple tests, such as building a model of a pinwheel then testing it and determining ways to make it move more easily.
- Students can explore multiple solutions to a problem, such as testing different types of paper airplanes for how far they fly.

Middle school students (grades 6-8)

These students can focus on the engineering solutions within the larger context of the problem:

- Students can consider limitations to possible solutions, such as expense, the location it must be built, and whether the solution is acceptable to the local people.
- Students can systematically test and refine a solution, such as developing strategies for measuring how effective a solar cell is: how long it holds its charge compared to how long it takes to charge and how bright it can make a light bulb glow.
- Students can combine parts of different solutions to create new solutions, such as combining multiple strategies to filter dirty water.

Connections to Science Standards

The concepts and activities within STAR_Net engineering and technology exhibits and library programming resources connect to a variety of the Next Generation Science Standards.

Disciplinary Core Ideas

- ETS1.A: Defining and Delimiting Engineering Problems
- ETS1.B: Developing Possible Solutions
- ETS1.C: Optimizing the Design Solution

Science and Engineering Practices

- Defining problems
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Designing solutions for engineering
- Engaging in Argument from Evidence to determine best solution to a problem
- Obtaining, evaluating, and communicating information

Crosscutting Concepts

Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.

Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.

Systems and system models. Defining the system under study—specifying its boundaries and making explicit a model of that system—provides tools for understanding and testing ideas that are applicable throughout science and engineering.

Energy and matter: Flows, cycles, and conservation. Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.



Credit: Engineers without Borders



Credit: WaterAid, Juthika Howlader



Credit: NASA



Credit: National Guard

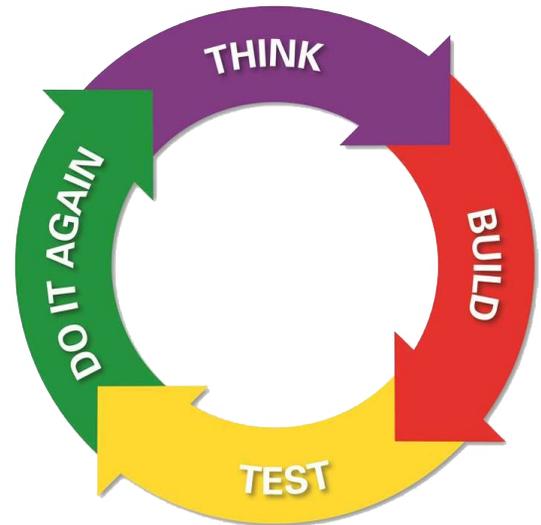
Key Engineering Concepts

Engineers Design and Support the Systems (Infrastructure) that Support the Way We Live Today

- Engineers solve problems that improve lives, like how to get clean water to rural communities.
- They help humanity face the known and unknown needs of our communities and the planet — using the finite resources available.
- Engineers solve problems that make life more fun, like planning, designing, and building community parks.

Engineering Process

- Engineers think about a problem and factors they have to consider to solve it.
- They come up with an idea and build a prototype.
- They test the prototype.
- Then they repeat the process to improve their results.



Low Tech High-Impact Technology

Even simple technologies have the power to improve lives. Some of the simplest machines have been around for centuries, and continue to be central to engineering:

- Inclined planes and screws
- Wedges
- Levers

Engineering is a Social Endeavor

- Engineers often work in teams, with different people contributing in different ways, to take on a challenge.
- Engineers build on the ideas of others.

Grand Challenges for Engineering

To help engineers focus on our planet's most pressing engineering and technology issues, the National Academy of Engineering developed The Grand Challenges For Engineering, 14 initiatives related to health, security, sustainability, and the joy of living.

