

Selecting Natural Phenomena to Drive Engineering Instruction and Assessment

1. How are natural phenomena in engineering different from science?

In science lessons students construct explanations for natural phenomena to better understand the natural world. In engineering lessons students consider **natural phenomena that we want or need to change**. This requires an understanding of the natural world: students first investigate what may cause the undesired phenomenon and define the engineering problem that addresses the most likely cause(s). Students then develop (and test) possible solutions and optimize the most promising solution (Figure 1).

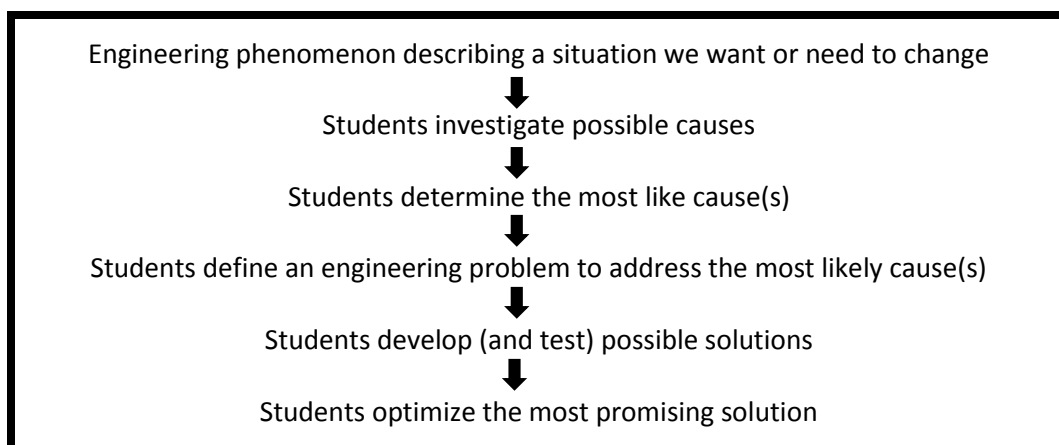


Figure 1. The engineering design process beginning with an engineering phenomenon

2. What makes a good natural phenomenon for engineering lessons?

Phenomena should be **SPECIFIC, OBSERVABLE, GRADE-APPROPRIATE, and RELEVANT (SOAR)**

a. Engineering phenomena should be **SPECIFIC**

Natural phenomenon should be as specific as possible so that students can collect data and obtain information about the undesired phenomenon to determine what causes it.

Non-specific engineering phenomena	Specific engineering phenomena
Bees	The honeybee population is declining.
Hurricane Sandy	Hurricane Sandy damaged many houses along the New Jersey shore.
Sweat sometimes smells.	The classroom smells bad after students come back from gym which is unpleasant to the teacher.

b. Engineering phenomena should be **OBSERVABLE**

Observable through	Example engineering phenomenon
Direct observations of naturally occurring events	Halfway through our summer pool party all the ice for our drinks has melted.
Observations related to technologies	Our cell phone stops working after we use it to make several long phone calls.
Situations we want to change related to natural phenomena	Looking directly at the Sun during a solar eclipse can damage our eyes.

REMEMBER: PHENOMENA DO NOT NEED TO BE PHENOMENAL!

c. Engineering phenomena should be GRADE-APPROPRIATE

Grade-appropriate engineering phenomena require students to use Core Ideas to define engineering problems and to develop and optimize solutions. This may include Core Ideas that are introduced for the first time, were introduced earlier in the grade or in previous grades. These Core Ideas can be found in the Core Ideas Matrix or on the NGSS standard pages and are related to the topics listed below.

Grades K-5	Grades 6-12
<p>Grade K: Pushes & Pulls; Ecosystems; Weather & Climate</p> <p>Grade 1: Light & Sound; Structure and Function of Living Things; Patterns and Cycles of Sun, Moon, and Stars</p> <p>Grade 2: Structure and Properties of Matter: Heating & Cooling; Ecosystems; Processes that Shape the Earth</p> <p>Grade 3: Force & Motion; Ecosystems; Life Cycles; Weather & Climate</p> <p>Grade 4: Energy; Waves; Structure and Function of Living Things; Processes that Shape the Earth</p> <p>Grade 5: Structure and Properties of Matter: Mixtures & Solutions; Ecosystems; Earth Systems; Solar System</p>	<p>Physical Science: Structure of Matter; Chemical Reactions; Force & Motion; Energy; Waves</p> <p>Life Science: Structure and Processes in Living Things; Ecosystems; Heredity; Evolution</p> <p>Earth and Space Science: Earth Systems; Weather & Climate; Human Impacts; Earth, Sun, Moon System; Solar System; Galaxies and the Universe</p>

d. Engineering Phenomena should be RELEVANT

Selecting engineering phenomena that students find interesting, relevant, and consequential helps support their engagement. A good engineering phenomenon builds on every day or family experiences: who students are, what they do, where they came from. Such phenomena highlight how science ideas help us define engineering problems and develop and optimize solutions for aspects of the world that matter to students, their communities, and society. Below are some example for students in urban or suburban/rural schools.

Urban schools	Suburban or rural schools
During July and August it is extremely hot and unpleasant on subway platforms.	I don't like going up to my attic in the summer, because it is so hot up there.
After they started construction next door we see an increasing number of mice in our neighborhood.	There have been an increased number of bear sightings in our town over the past two years.

References and Resources

NGSS Phenomena (ngssphenomena.com)

STEM Teaching Tools 42 - Using Phenomena in NGSS-Designed Lessons and Units (STEMteachingtools.org/brief/42)

Teaching Science is Phenomenal: Using Phenomena to Engage Students in Three-dimensional Science Performances Consistent with the NRC Framework and the NGSS (teachingscienceisphenomenal.org)

HO L4.1 – Selecting Natural Phenomena to Drive Science Instruction and Assessment

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