Topic: Engineering and Design

EQ: What ways can we use engineering design in our classroom?

Engineering and Design

- Think about a problem in the world today: Chances are, there is an engineer who is trying to solve that problem
    - Examples like: How do we build smarter and safer cars? How can we use the power of the sun for energy? How can we fight and eliminate cancer?
- These are all problems that could be potentially solved through engineering

Engineering and Design

- Engineering - Using science and math to solve a problem and improve the world around us
- Design - Creating a plan or drawing to show how something will look or work
- These two things work together and we will be using both processes throughout the year

Some of Engineering's Greatest Challenges

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

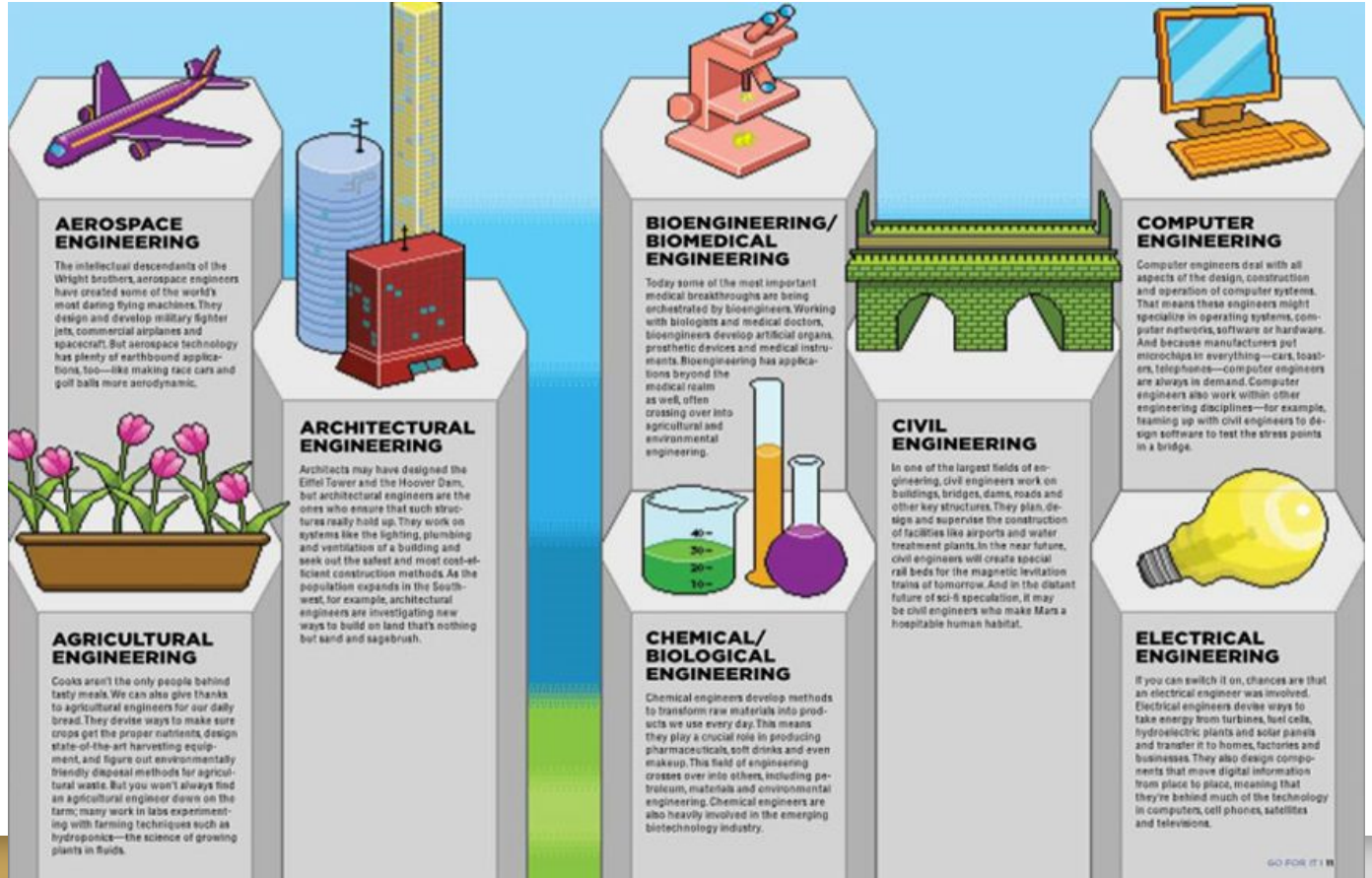
Enhance virtual reality

Advance personalized learning

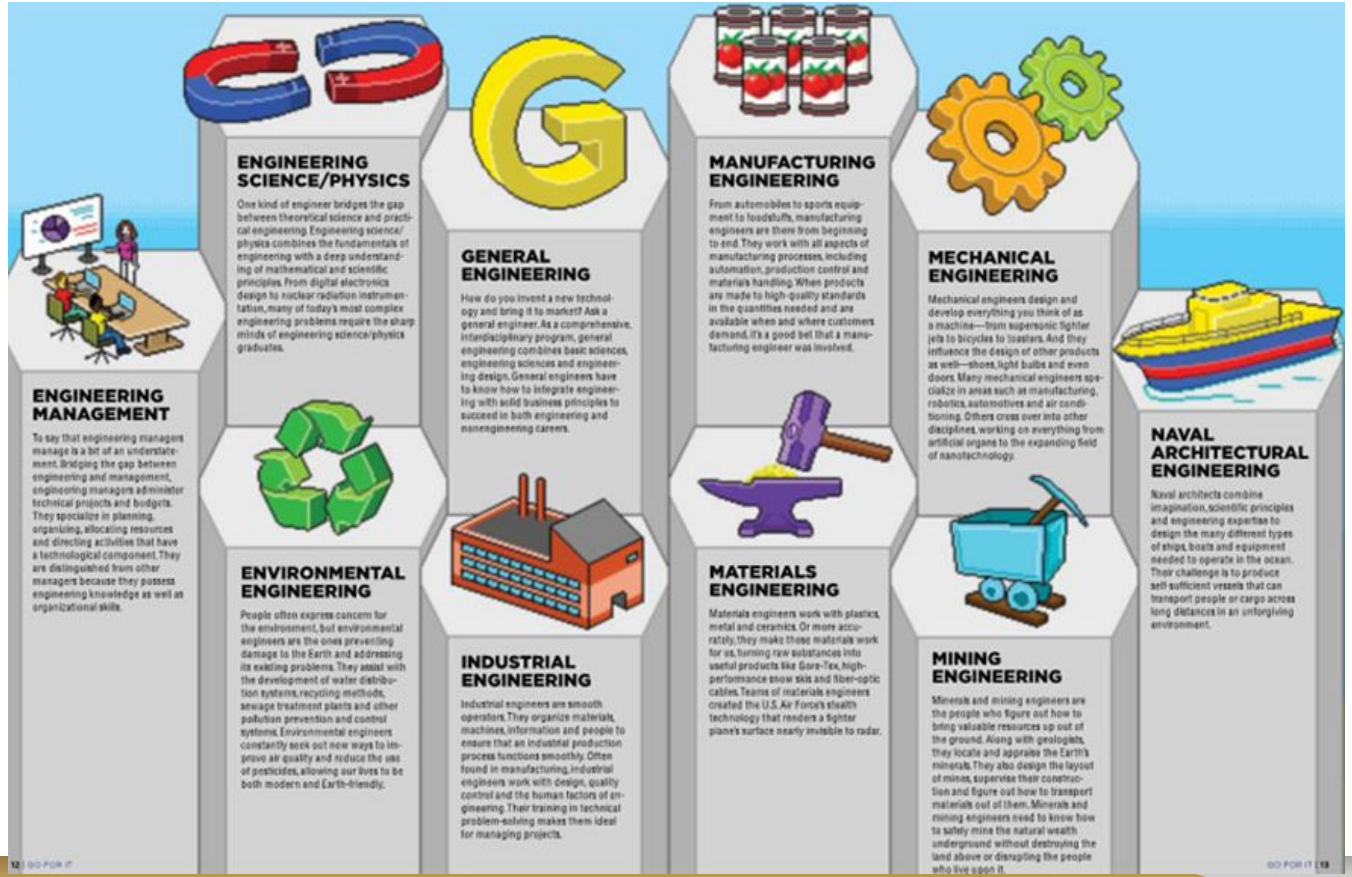
Engineer the tools of scientific discovery

Let’s take a closer look at engineering

Types of Engineering



Even More Types of Engineering!



ENGINEERING MANAGEMENT

To say that engineering managers manage is a bit of an understatement. Bridging the gap between engineering and management, engineering managers administer technical projects and budgets. They specialize in planning, organizing, allocating resources and directing activities that have a technological component. They are distinguished from other managers because they possess engineering knowledge as well as organizational skills.

ENGINEERING SCIENCE/PHYSICS

One kind of engineer bridges the gap between theoretical science and practical engineering. Engineering science/physics combines the fundamentals of engineering with a deep understanding of mathematical and scientific principles. From digital electronics design to nuclear radiation instrumentation, many of today's most complex engineering problems require the sharp minds of engineering science/physics graduates.

ENVIRONMENTAL ENGINEERING

People often express concern for the environment, but environmental engineers are the ones preventing damage to the Earth and addressing its existing problems. They assist with the development of water distribution systems, recycling methods, sewage treatment plants and other pollution prevention and control systems. Environmental engineers constantly seek out new ways to improve air quality and reduce the use of pesticides, allowing our lives to be both modern and Earth-friendly.

GENERAL ENGINEERING

How do you invent a new technology and bring it to market? Ask a general engineer. As a comprehensive, interdisciplinary program, general engineering combines basic sciences, engineering sciences and engineering design. General engineers have to know how to integrate engineering with solid business principles to succeed in both engineering and nonengineering careers.

INDUSTRIAL ENGINEERING

Industrial engineers are smooth operators. They organize materials, machines, information and people to ensure that an industrial production process functions smoothly. Often found in manufacturing, industrial engineers work with design, quality control and the human factors of engineering. Their training in technical problem-solving makes them ideal for managing projects.

MANUFACTURING ENGINEERING

From automobiles to sports equipment to foodstuffs, manufacturing engineers are there from beginning to end. They work with all aspects of manufacturing processes, including automation, production control and materials handling. When products are made to high-quality standards in the quantities needed and are available when and where customers demand, it's a good bet that a manufacturing engineer was involved.

MATERIALS ENGINEERING

Materials engineers work with plastics, metal and ceramics. Or more accurately, they make those materials work for us, turning raw substances into useful products like Gore-Tex, high-performance snow skis and fiber-optic cables. Teams of materials engineers created the U.S. Air Force's stealth technology that renders a fighter plane's surface nearly invisible to radar.

MECHANICAL ENGINEERING

Mechanical engineers design and develop everything you think of as a machine—from supersonic fighter jets to bicycles to toasters. And they influence the design of other products as well—shoes, light bulbs and even doors. Many mechanical engineers specialize in areas such as manufacturing, robotics, automotives and air conditioning. Others cross over into other disciplines, working on everything from artificial organs to the expanding field of nanotechnology.

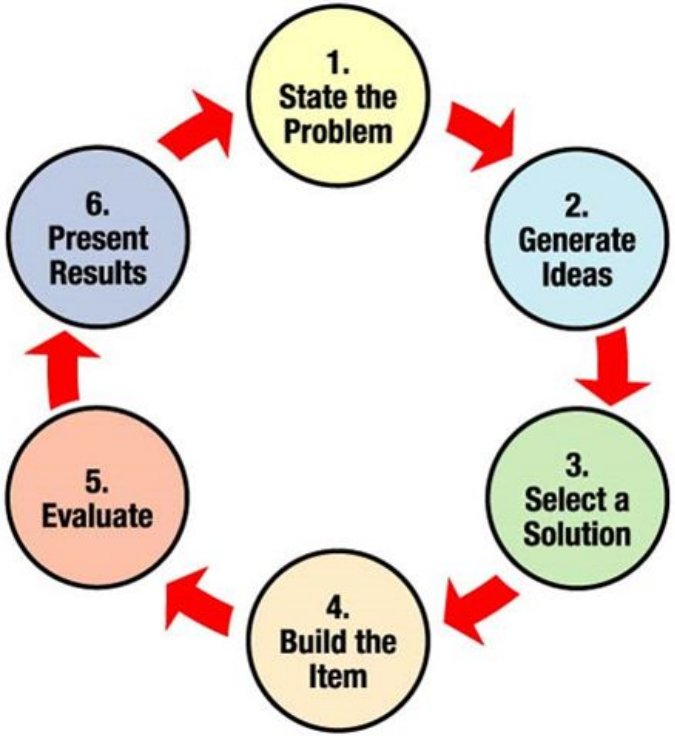
MINING ENGINEERING

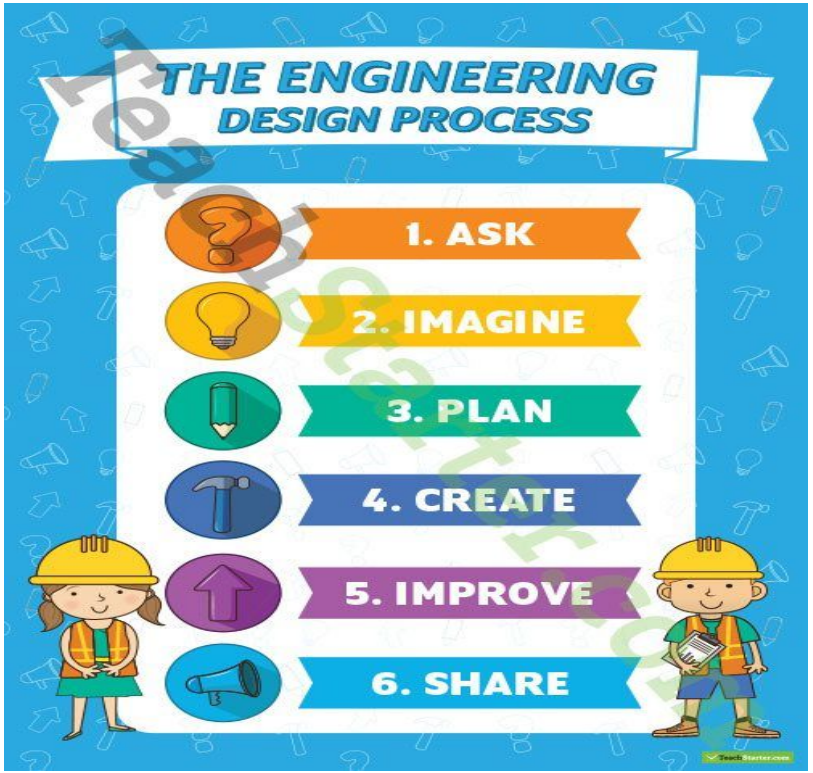
Minerals and mining engineers are the people who figure out how to bring valuable resources up out of the ground. Along with geologists, they locate and appraise the Earth's minerals. They also design the layout of mines, supervise their construction and figure out how to transport materials out of them. Minerals and mining engineers need to know how to safely mine the natural wealth underground without destroying the land above or disrupting the people who live upon it.

NAVAL ARCHITECTURAL ENGINEERING

Naval architects combine imagination, scientific principles and engineering expertise to design the many different types of ships, boats and equipment needed to operate in the ocean. Their challenge is to produce self-sufficient vessels that can transport people or cargo across long distances in an unforgiving environment.

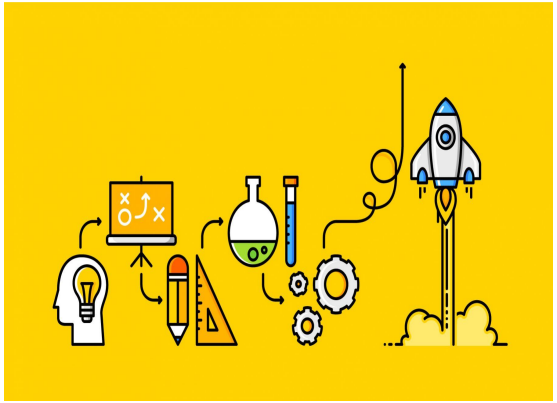
The Design Process





The Design Process

1) Identify - What is the problem? What is my goal?
2) Imagine - What could be a solution?
   –> Brainstorm, agree on one idea
3) Plan - Draw a diagram; what materials will I need? How will I test it?
4) Create - Build it!
5) Test- What works? What does not work?
6) Improve - how could you change/improve your design?
7) Present- Present your idea to others



Criteria and Constraints

- These help to define the problem
- **Criteria** are the “wants”: What are you trying to achieve? How will you know when the solution is acceptable? They should be specific and measurable.
- **Constraints** are the limitations. Common constraints are time, money, size, available materials, and compatibility.

  Think of a decision you had to make: What limited your options?

Science vs Engineering

- Are scientists and engineers the same?
- No, they are not. Even though engineers need to be good at science the goals of each are different.
- The goal of a scientists is to learn new things about the world, to expand our knowledge.
- The goal of an engineer is to take that knowledge and make a product to solve a problem.