# 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



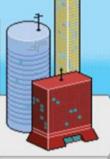
### **AEROSPACE ENGINEERING**

The intellectual descendants of the Wright brothers, acrospace engineers, have created some of the world's most daring styling machines. They design and develop military fighter jets, commercial airplanes and spacecraft. But aerospace technology has plenty of earthbound applications, too—like making size cars and golf balls more aerodynamic.



### AGRICULTURAL ENGINEERING

Cooks aren't the only people ballind tally meals. We can also give thanks to agricultural engineers for our daily bread. They devise ways to make sure crops get the proper patients, design ment, and figure out environmentally mend, and figure out environmentally threadly disposal methods the agricultural water. But you won't always find an agricultural engineer devin on the tarm; many work in labs experimenting with terming techniques such as hydropoeks—the science of growing plants in fluid.

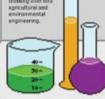


### ARCHITECTURAL ENGINEERING

Architectum may have designed the Ethelia Tower and the Hoover Cham, but architectural engineers are the ones who ensure that such structures ready holds up. They work or systems like the lightim, plumbing and ventilation of a building and seek out the adest and most cost-elticient construction methods. As the population expends in the South west, for example, architectural engineers are investigating new ways to build on land that's nothing but and an asperbush.



### BIOENGINEERING/ BIOMEDICAL ENGINEERING



### CHEMICAL/ BIOLOGICAL ENGINEERING

Chemical engineers develop methods to transform raw materials into producing to the producing we use every day. This means they play a crucial role in producing pharmaceuticals, soft dinha and even makeup. This field of engineering crosses over into others, including petroleum, materials and environmental engineering. Chemical engineers are also heavily involved in the emerging bitechnology industry.



### CIVIL ENGINEERING

In one of the largest fields of enclineering, civil engineers work on buildings, bridges, dams, noads and other key structures. They plan, design and supervise the construction of facilities like airports and water treatment plants. In the near future, ovil engineers will crists special rail beds for the magnetic levitation trains of tomorrow. And in the distant future of sci-f specialism, it may be obli engineers who make Mars a frosoitiable human habitat.



### COMPUTER ENGINEERING

Computer engineers draf with all aspects of the design, construction and operation of consputer systems. That means that engineers might specialize in operating systems, computer networks, software or hardware. And because manufactures or entitled in the systems of the encountry of the engineers also work within other engineers also work within other engineers (and the construction of engineers) with ovid engineers to design software to test the stress points in a bridge.



### ELECTRICAL ENGINEERING

If you can switch it on, thances are that, an electrical requirer was involved. Electrical engineer was involved. Electrical engineers as involved. Electrical engineers device ways to take energy from turkines, but cells, hydroelectric plants and soler panels and transfer to homes, factoriers and businesses. They also design components that make digital information from place to place, meaning that they're behind much of the schoology in computers, cell phones, safelities and television.

# Even More Types of Engineering!



### ENGINEERING SCIENCE/PHYSICS One kind of engineer bridges the gap between theoretical science and practi-

One kind of engineer bridges the gap between the ordinal sidence 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 resiliation instrumentation, many of tradey's most compilex engineering problems require the deap missist of engineering science/shysics graduates.



### ENVIRONMENTAL ENGINEERING

Propie often express concern for the environment, for environmental engineers are the ones preventing damage to the Parth and adversed in the damage to the Parth and adversed in the development of water distribution systems, recycling methods, asways treatment plants and other pollution prevention and control systems, recycling methods, swayson for the pollution prevention and control systems, reviewmental engineers constantly seek out new ways to inspect of the proposal and pushing and enduce the soft produced produced and participations.



### GENERAL ENGINEERING

Haw do you inwent a new inchmolopy and bring it to market? Ank a operant lengineer. As a comprehensive, interdesighterary program, general engineering sciences and engineering sciences and engineering ing design. General engineer have to know how to infigurate engineering with selfd business principles to aucoced in buth engineering and namenglamening careers.



### INDUSTRIAL ENGINEERING

Industrial engineers are smooth operators. This organism This operators. This operators and people to ensure that an industrial production process tractions smoothly. Other found in examination industrial engineers work with design, qualify control and the human factors of engineering. Their training in behand problem-dolling makes them ideal for managing problem.



### MANUFACTURING ENGINEERING

Farm automobiles to sports equivment to foodfalfs, manufacturingengineers are three from beginningto end. They work with all appeals to end. They woodcoling control and materials handling. When products and materials handling within products are made to high-quality standards in the quantities needed and are available when and where customers demand. It is good lest that a manutationing materials with the second



### MATERIALS ENGINEERING

Materials engineers work with plastics, metal and ceramics. Or more accurately, they make those realersals work for ss. turning raw substances into westful products. Sile Geor-Exc. highperformance soos soils and fiber-optic cables. Teams of materials engineers created the U.S.Air Forces shallow technology that readed a Sighter plane's warders easily invisible to rader.



### MECHANICAL ENGINEERING

Mechanical engineers design and develop energhing you think of as a machine—burs supersoin lighter (et a lo locycles to lossions. And they instrumed the design of other products as well—shoes, light builts and even doors. Many mechanical engineers specialty in areas such as mentifacturing, reducing, and the second tooling, others cross over sale other distiplines, working on encything from stifficial organs to the expanding field of nanofacturing.



### MINING ENGINEERING

Minerals and mining engineers are the propile who figure and how to bring valuable resources up out of the ground. Name of the propile the ground. Short with ground the ground. Short with a ground the ground. Short 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 have to assist you must be to ask to be and reground without destroying the land above or disrupting the people who live used.



### NAVAL ARCHITECTURAL ENGINEERING

Naval architects condine imagination, scientific principles and engineering experties to design the many different types of shopt, boats and equipment needed to operate in the ocean horic challenges is to produce act sufficient vessels that can transport people or carpo acrees long distances in an unforgliving servironment.

**ENGINEERING** 

MANAGEMENT

To say that engineering managers

manage is a bit of an understate-

ment. Bridging the gap between

engineering and management, engineering managers administer

technical projects and budgets.

organizing, allocating resources

and directing activities that have

a technological component. They

managers because they possess

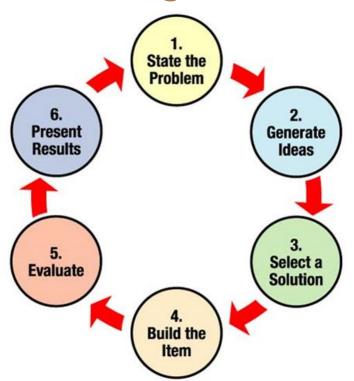
engineering knowledge as well as

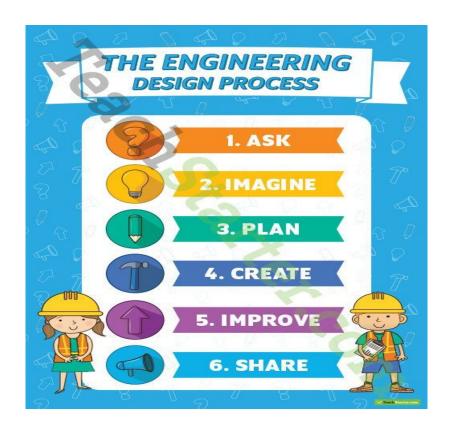
are distinguished from other

arganizational skills.

They specialize in planning.

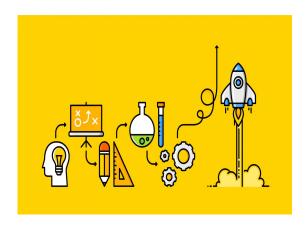
# The Design Process





# 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.

