M.Ed. Teacher Leadership Special Studies in STEM Education – Professional Development Activity

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By the end of this presentation, you should...

- gain a better understanding of what it means to “do” engineering
- have a sample engineering design process to use in your classroom
- have an example of an engineering activity to do with your students

What is Engineering?

- Think About:
  - What is your own personal definition?
  - How would you evaluate your experience with engineering design?

Three Principles for Engineering Education

"1. Engineering education should emphasize engineering design

- the design process, the engineering approach to identifying and solving problems, is highly iterative; open to the idea that a problem may have many possible solutions; a meaningful context for learning scientific, mathematical, and technological concepts; and a stimulus to systems thinking, modeling, and analysis. In all of these ways, engineering design is a potentially useful pedagogical strategy.

2. Engineering education should incorporate appropriate mathematics, science, and technology knowledge and skills

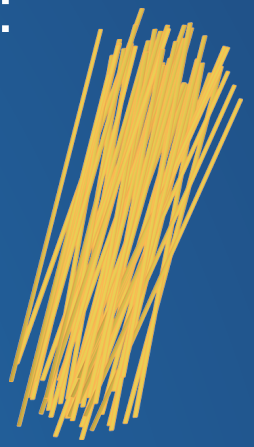
3. Engineering design should promote engineering habits of mind.

- Engineering 'habits of mind' align with what many believe are essential skills for citizens in the 21st century.
  - system thinking
  - creativity
  - optimism
  - collaboration
  - communication
  - attention to ethical considerations (Katehi, et. al., 2009, pg. 4-5)"

Model Engineering Activity

Now, you will have an opportunity to experience the engineering design process. First, you will need:

- 20 dry spaghetti pieces
- string the length of a meter
- masking tape the length of a meter
- one large marshmallow
- scissors
- at least three other people (for two teams of two)



Once you have gathered your materials, move on to the next slide.

Task Directions

The task is simple:

-in eighteen minutes, teams must build the tallest free-standing structure out of 20 sticks of spaghetti, one yard of tape, one yard of string, and one marshmallow. The marshmallow needs to be on top and fully intact.

Comparing Teams

-Who do you think tends to do the worst in this activity? Why?

-Who do you think tends to do the best in this activity? Why?

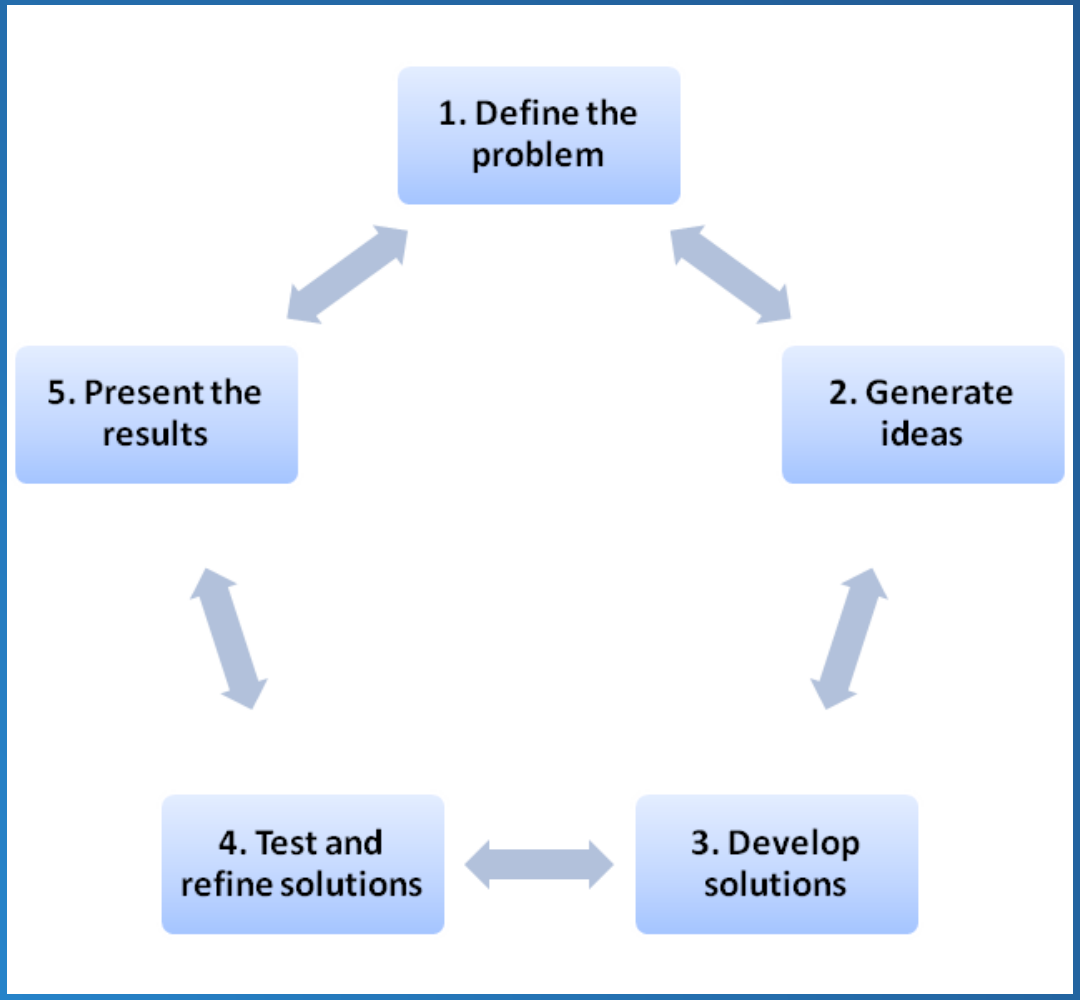
-What improves performance?

-What kills it?

Engineering Design Process Models

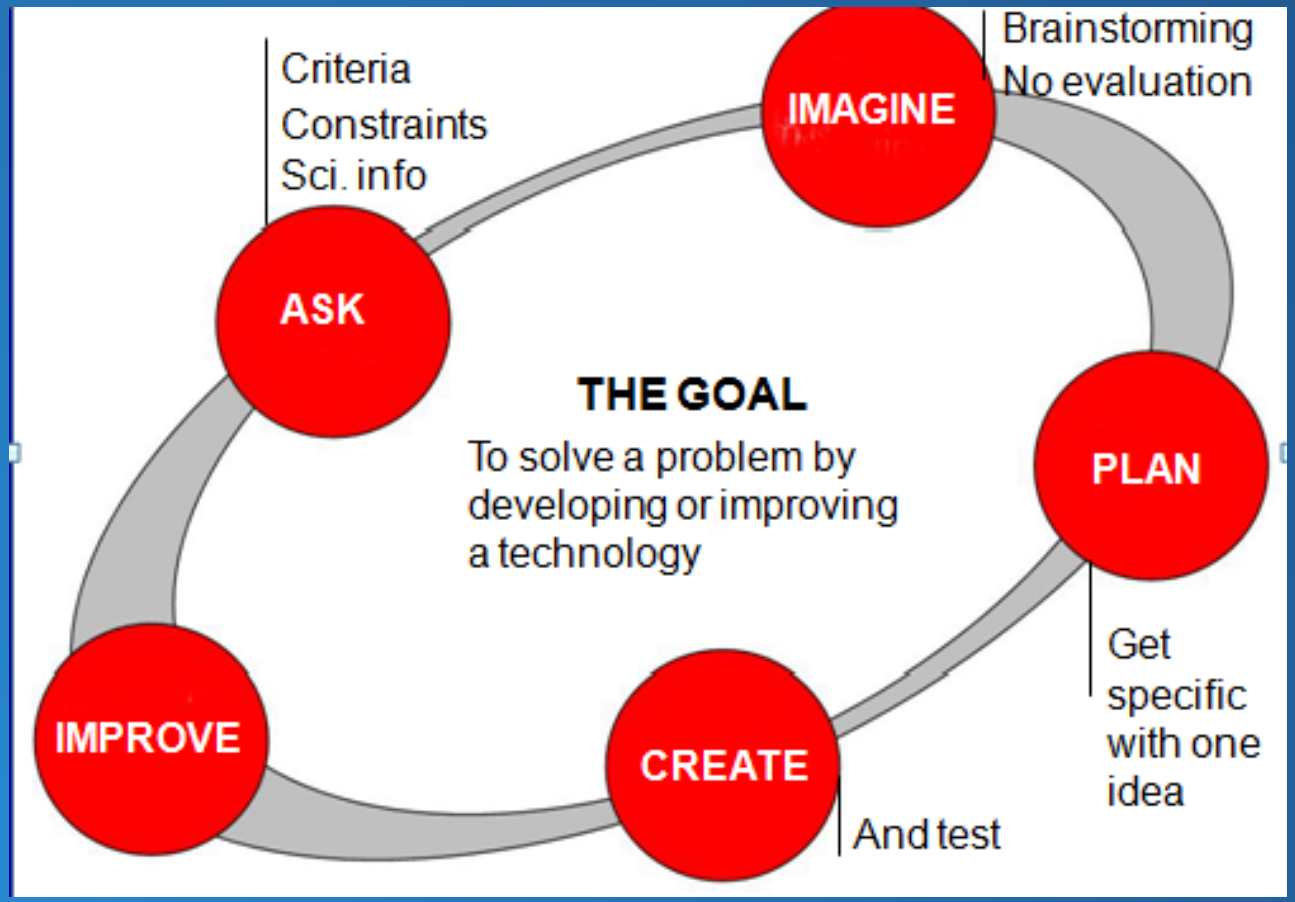
In the next five slides, you will see different examples of engineering design process models. Take a look at them and decide which process best fits the steps you took to complete the marshmallow challenge.

MCPS Provided Engineering Design Process



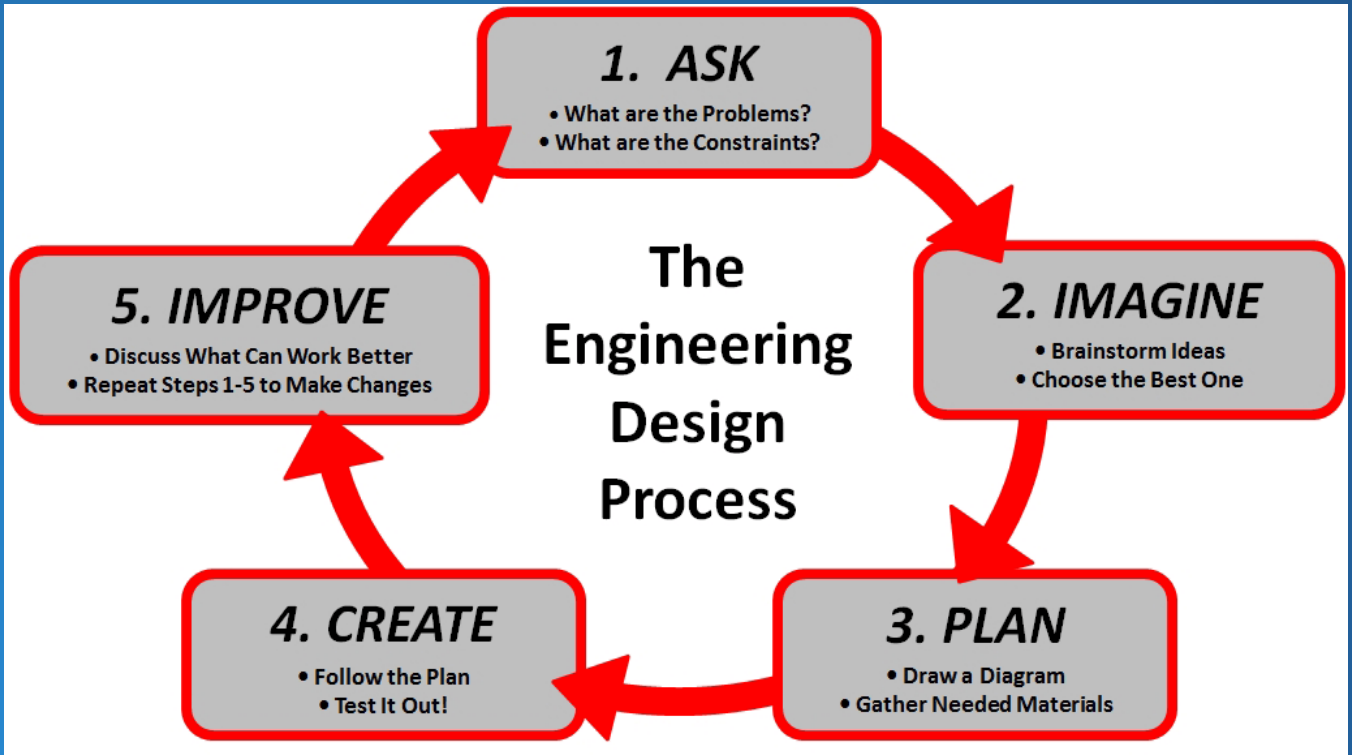
Examples of Engineering Design Process

Image source: http://www.eie.org/engineering-elementary/resources/engineering-design-process-hi-res-image



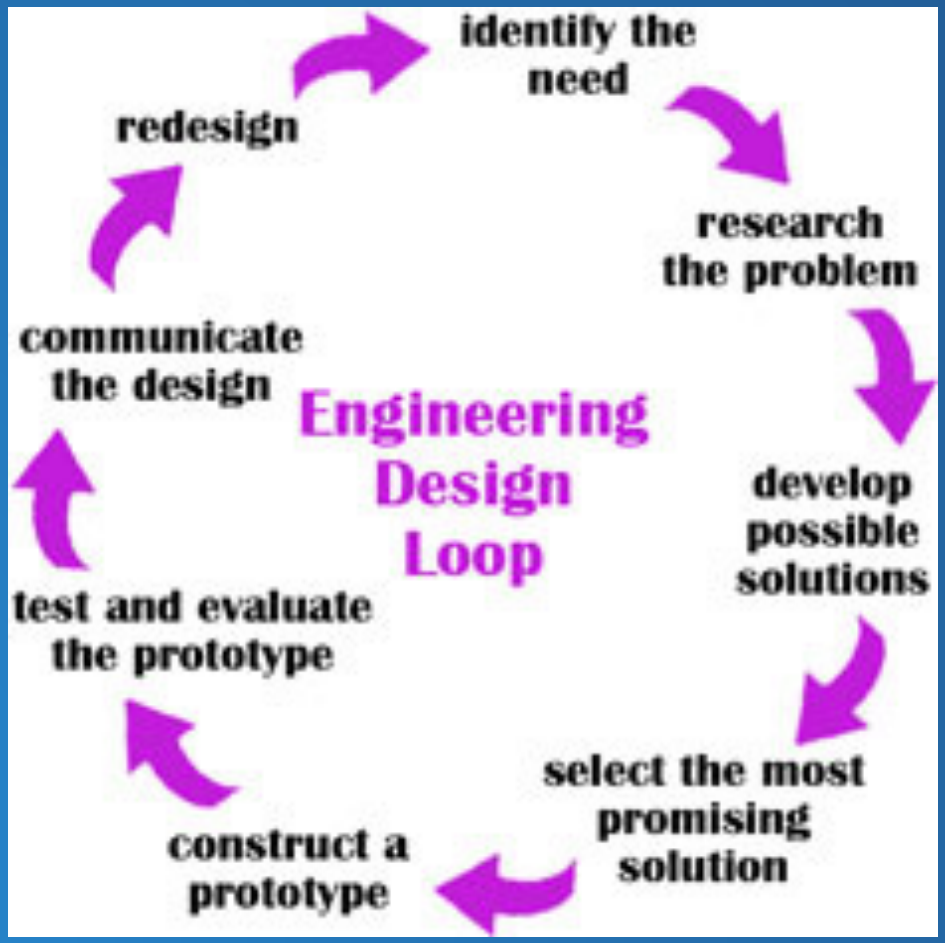
Examples of Engineering Design Process

Image source: www.engr.ncsu.edu



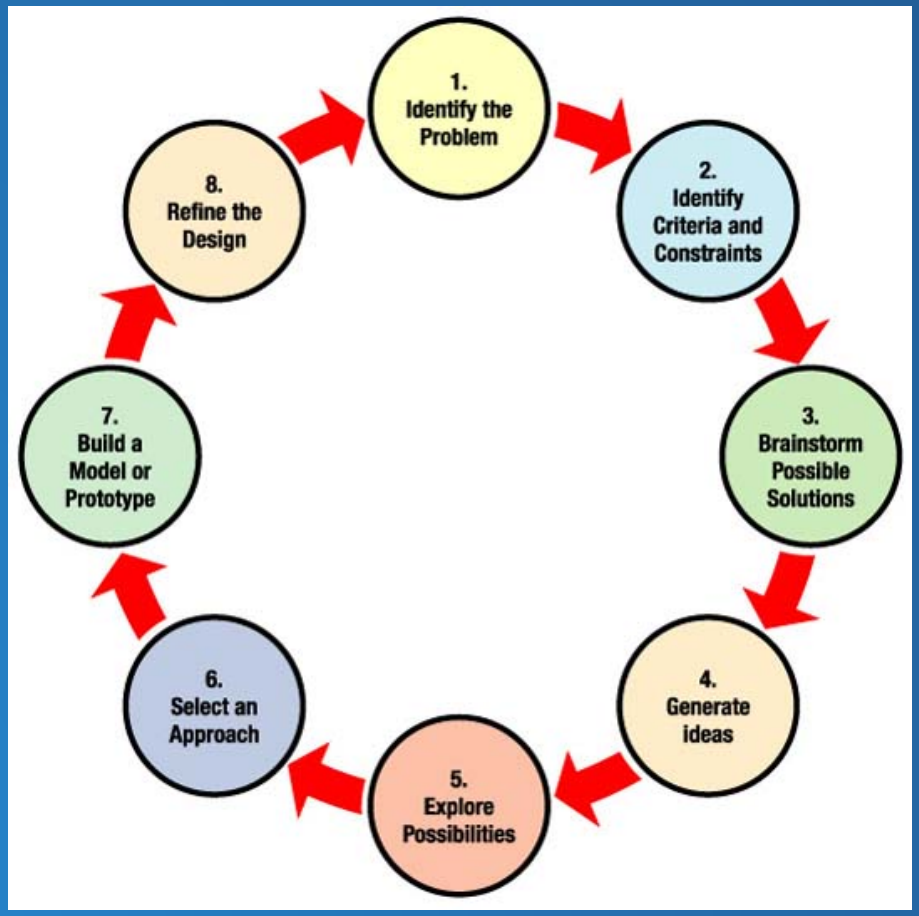
Examples of Engineering Design Process

Image source: http://engineeringdesignprocessdbryson.weebly.com/



Examples of Engineering Design Process

Image source: www.nasa.gov



Real-Life Engineering Connections

As a teacher, you can also use the design process in your everyday work.

For example, a good classroom lesson requires planning out the objective (need/problem) to be addressed. During the testing process (teaching the lesson), the teacher will observe areas in need of improvement. The chance for re-design will be necessary in order to best suit the needs of learners.

Understanding engineering and the design process gives us an outlet to better problem solve the challenges we face in our careers and everyday life.

How does this relate to STEM?

Science- City planners must work in conjunction with environmentalist groups to ensure minimal damage to the environment when building a tower.

Technology- A building in the modern age will need to be outfitted with wi-fi technology to support the growth of business.

Engineering- The structural design of a building that needs to support a certain load on top is something architects must consider when building city skyscrapers.

Mathematics- Construction workers must calculate and measure the proper amount of materials to be used when designing a real-life structure similar to the marshmallow tower.

Next Generation Science Standards (NGSS)

- K-2
  - Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

  - Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

  - Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

- 3-5
  - Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

  - Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

  - Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Survey

Thank you for participating in this professional development opportunity. Please take a moment to fill out our survey by clicking here. The results of this survey will be used to help us better serve your needs in our next professional development session. Any of your personal information will be kept confidential.

References

- Katehi, L. (2009). *Engineering in K-12 education understanding the status and improving the prospects*. Washington, DC: National Academies Press.

- NGSS Lead States. 2013. *Next Generation Science Standards: For States, By States*. Washington, DC: The National Academies Press.