Engineer’s have to…

- "apply their scientific and engineering knowledge to the solution of technical problems, and then optimize those solutions within the requirements and constraints set by the material, technological, economic, legal, environmental and human-related considerations" (p. 41).

  Lewis (2005) quotes Pahl and Beitz

Engineering a solution

Koen defines the engineering method as:

- ". . .the strategy for causing the best change in a poorly understood situation within the available resources" (p. 7).

What do engineers do?

Engineers. . .

- “scope,
- generate,
- evaluate,
- and realize ideas”.

Dym, at al, 2005, p. 104 quoting Sheppard,

What Makes Engineering Unique?

- Design is the basic activity that differentiates engineering from science and is the one activity found in every field of engineering.

Engineering Design

- Engineering design is a systematic, intelligent process in which designers generate, evaluate, and specify concepts for devices, systems, or processes whose form and function achieve clients' objectives or users' needs while satisfying a specified set of constraints.

  Dym, et al. 2005, p. 104.

  Edie, Jenison, Mashaw, and Northup simply stated: "Engineering Design is a systematic process by which solutions to the needs of humankind are obtained" (2001, p. 79).

Essential features of design

- Design problems reflect the fact that the designer has a client (or customer) who, in turn, has in mind a set of users (or customers) for whose benefit the designed artifact is being developed. The design process is itself a complex cognitive process.

7 Essential Features of Engineering Design-Based Science

- Client Driven and Goal Oriented
- Authentic Context
- Includes constraints
- Materials, tools, and equipment familiar to students
- Yields a product (prototype) or process
- Yields multiple solutions
- Requires teamwork

Design Thinking

- Design thinking reflects the complex processes of inquiry and learning that designers perform in a systems context, making decisions as they proceed, often working collaboratively on teams in a social process, and “speaking” several languages with each other (and to themselves).

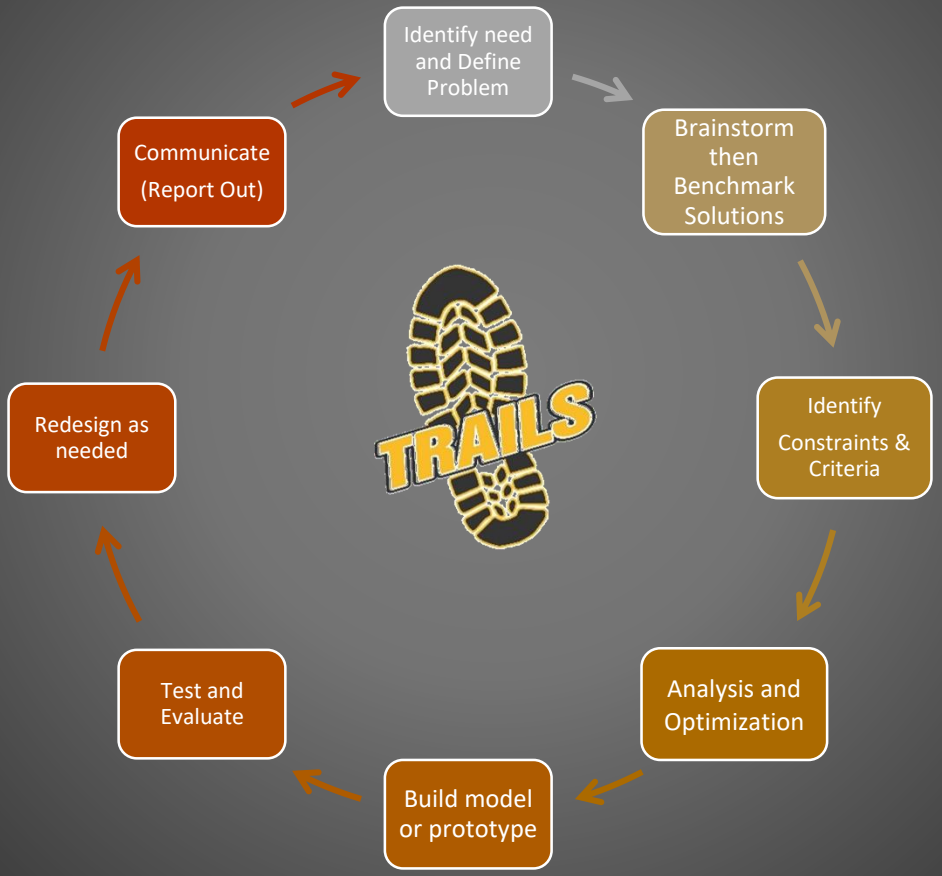
  Dym et al. 2005, p. 104

Technological Design and Engineering Design

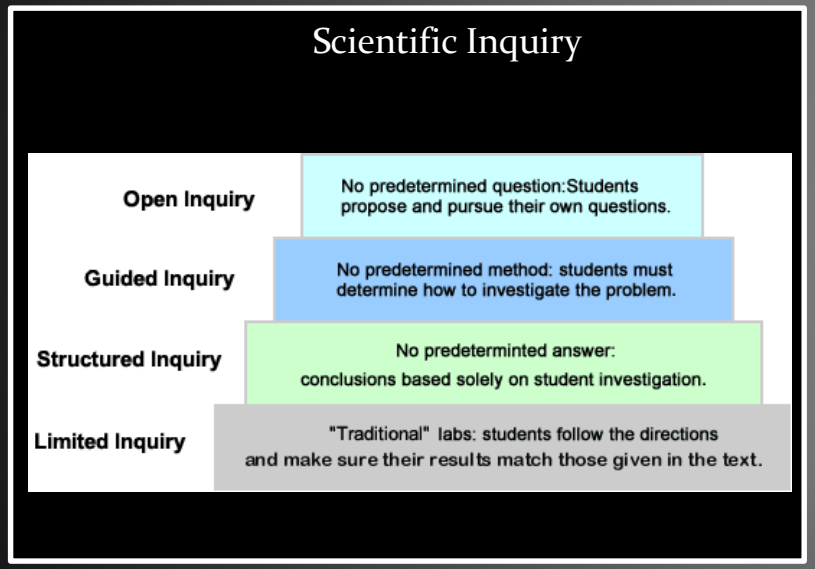
Table 1: Comparision of Technological Design and Engineering Design

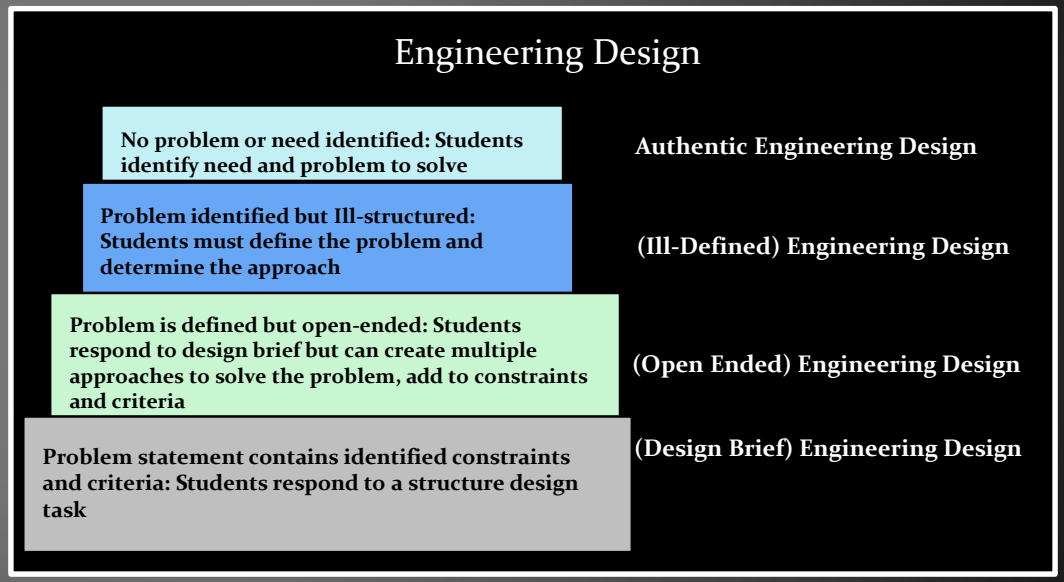
Technology Education Design Process (Standards for Technological Literacy, 2000)	**Engineering Design Process** (Eide, Jenison, Mashaw, Northup, 2001)
Defining a Problem	Identify the Need
Brainstorming	Define Problem
Researching & Generating Ideas	Search for Solutions
Identifying Criteria	Identify Constraints
Specifying Constraints	Specify Evaluation Criteria
Exploring Possibilities	Generate Alternative Solutions
Selecting an Approach and Develop a Design Proposal	Analysis
Building a Model or Prototype	Mathematical Predictions
Testing & Evaluating the Design	Optimization
Refining the Design	Decision
Communicating Results	Design Specifications
	Communicating to Technicians

TRAILS Design Model



Levels of Science Inquiry and Engineering Design





Kelley, SLED, 2015

The model presented here is a modified version used by one of our MWM teachers, Renee DeWald of Evanston Township High School of Illinois
http://www.materialsworldmodules.org/pedagogy/inquiry_continuum.shtml?vm=r&s=1