

# STEM Fundamentals



← The Model #302 telephone was the standard for forty years.



How long will this one last?

## Foundation Concepts for Teaching Problem Solving

# Engineering Design

- “Design” is to Technology what “Inquiry” is to Science and “Reading/Writing” are to Language Arts
- Design is the core problem solving process
- Design problem solving extends learning beyond the classroom

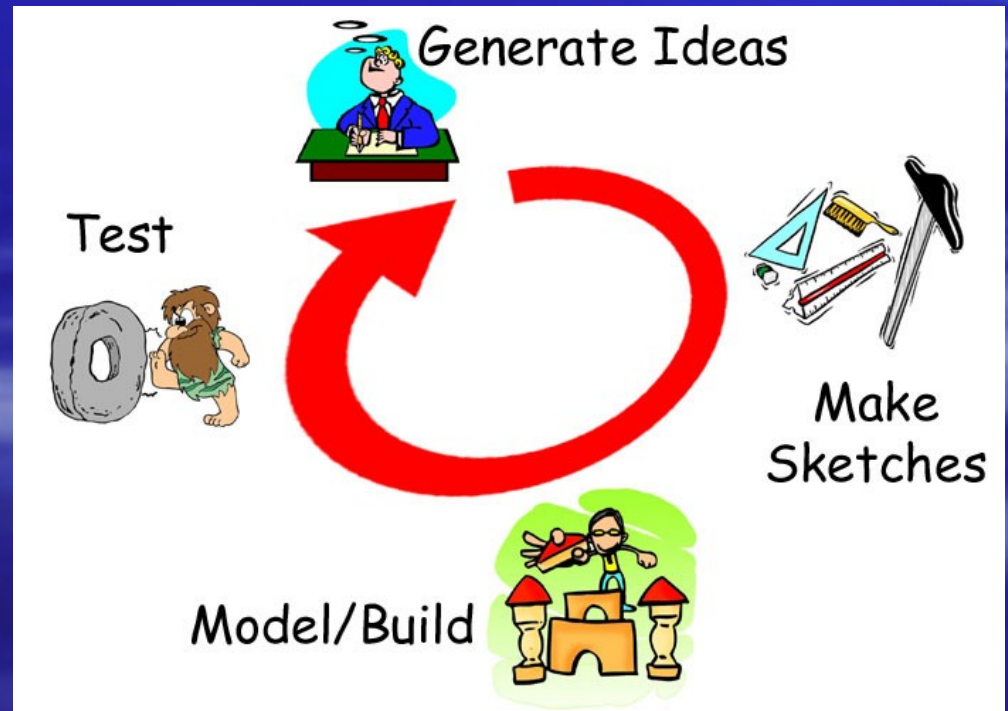


# The Design Loop

## Different tasks to be completed

– Suggested, rather than prescriptive

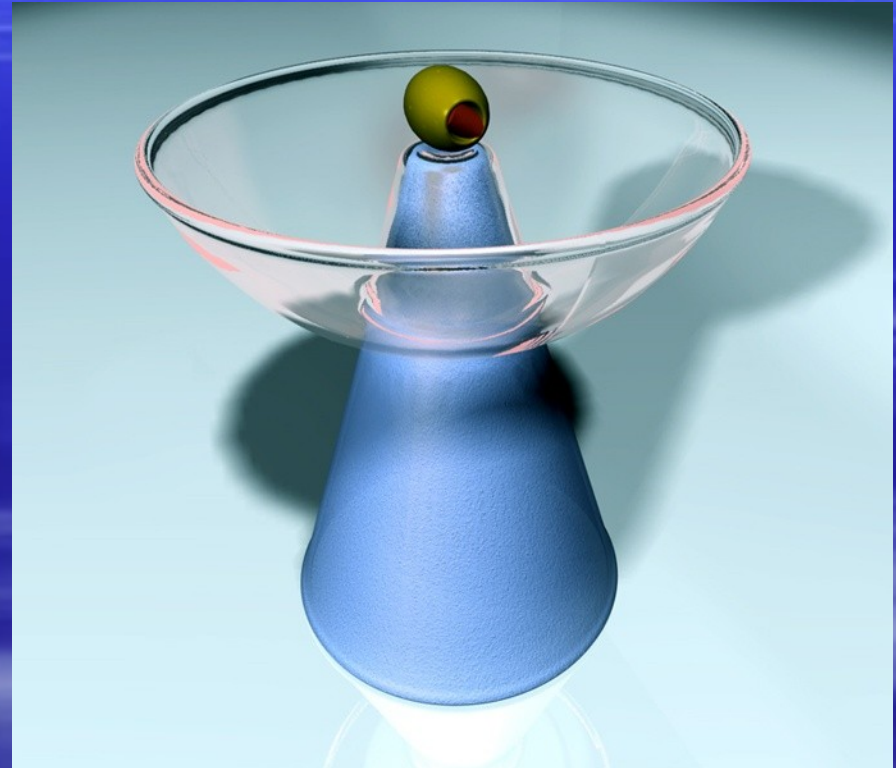
1. Identify the problem
2. Investigating
3. Developing ideas
4. Refining the idea
5. Modeling/prototyping
6. Evaluating/assessing
7. Communicating





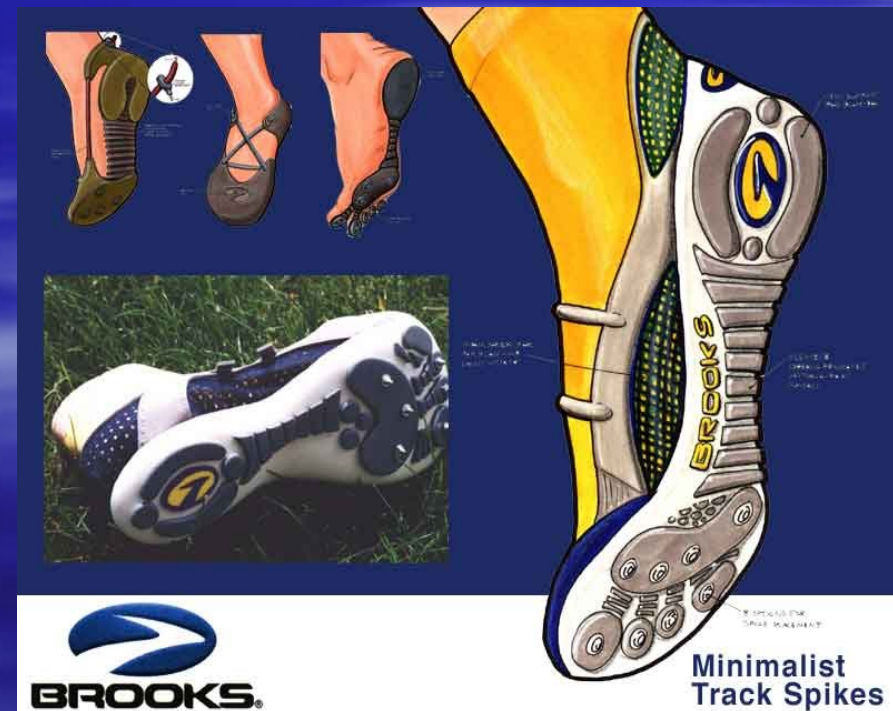
# 1. Understand the Problem

- Before attempting to solve the problem, we must:
  - Analyze the situation
  - Determine “what is the actual problem?”
  - Define the problem
  - Understand the problem



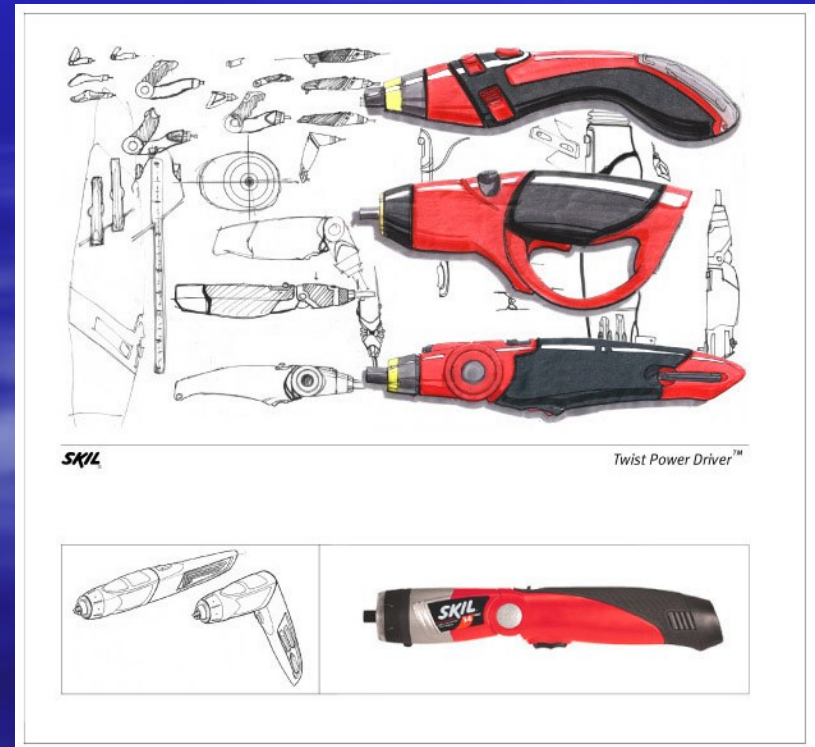
# 2. Investigate the Problem

- Explore possible alternative solutions
  - Conduct research
    - Past experiences and knowledge
    - Observations (examine similar problems/solutions)
    - Discussions with people who have faced similar problems (interviews, telephone calls, e-mail)
    - Search for new information (books, Internet, search of similar products)
    - Explore community resources (shops, businesses, museums, industries)



# 3. Develop Ideas & Potential Solutions

- Designers must ask questions
  - Brainstorm
  - Generate multiple ideas
  - Consequences (intended and unintended)
  - Identify alternatives
  - Consider constraints
  - Consider limits
  - Consider specifications
  - Consider risks/benefits





# 4. Refine & Detail Ideas

- Sketches and drawings
- Combining/separating ideas
- Assessing the potential of various ideas
- Generating specifications
- Idea selection
- Creating working and final drawings



# 5. Mock-ups, Models & Prototypes

- Planning (tools, energy, time, money)
- Gathering materials and resources
- Fabrication (models, prototypes)
- Refinement
- Testing





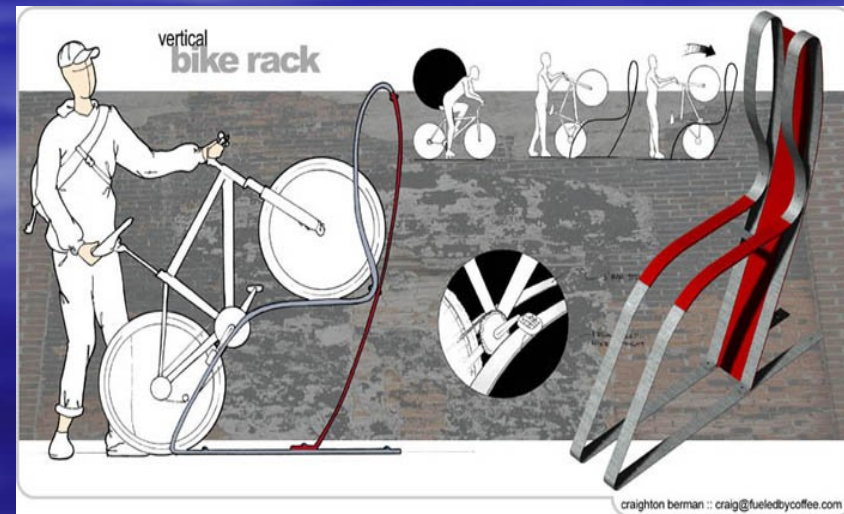
# 6. Evaluation & Assessment

- Testing the solution
  - Did the product/system solve the problem?
- Evaluating the process
- What could be changed in the future?
- Is the proposed solution the simplest possible?



# 7. Communication

- Recording and presenting the idea
  - Drawings, sketches, graphs, materials lists
- Documentation of:
  - Major steps
  - Materials/techniques used
  - Discarded ideas
- Demonstration of proposed solution
- Future changes/ideas



# Applying Proven Solutions

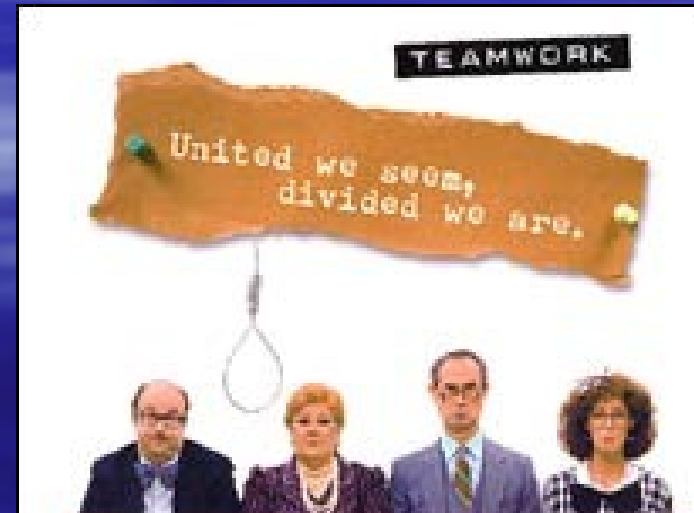
- We call it “problem solving,” but it is really a process of applying proven solutions from our memory of experiences!
  - Allows the student to begin building that mental warehouse!





# What do students learn by solving STEM problems?

- Contributing to the team
- Strategies for conducting research and solving problems
- Techniques for making models and prototypes
- Methods for assessing their own work
- Techniques for communicating team process and results



# Methods Used to Deliver Engineering Design

- Engineering design is delivered in the classroom using technological problem solving.
  - Invention/Innovation
  - Research and Development
  - Experimentation
  - Troubleshooting
  - Design Problem Solving



# **Why use STEM Activities?**

- Reinforces course content
- Forces students to apply recently learned information (to solve a real problem)
- Requires clear written/oral communication
- Requires team work (cooperation)
- Welcomes curiosity/rewards creativity
- Does not emphasize memorization



# Role of the Instructor During Stem Activities



- Providing the foundation for learning
- Determining content
- Developing design problems for solving
- Asking probing questions
- Serving as a resource person
- Facilitating cooperation among teams

# The Progression of Design





# Toasters of the Future?



**Western BRASS MILLS**

*When it's TOASTERS instead of torpedoes*

As the pendulum of war swings on toward peace and reconversion, Western brass will again be used in products designed for service — utility — convenience — beauty — and comfort.

Post-war industry will want Western brass — in sheet or strip, drawn or stamped parts — because it is easy to form, draw, buff and plate, and because it will be "tailored" to meet exacting specifications.

That's the way we like to do the job . . . as we are now doing it to meet war requirements. Western mills at East Alton, Ill., and New Haven, Conn., are experienced in producing non-ferrous metals to exactly suit the job. We will welcome the opportunity to demonstrate our ability to meet your specifications . . . now or post-war.

**Western BRASS MILLS**

**1944 SEPTEMBER 1944**

SUN	MON	TUE	WED	THU	FRI	SAT
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DIVISION OF  
WESTERN CARTRIDGE CO.  
EAST ALTON, ILLINOIS





# Limits on Design

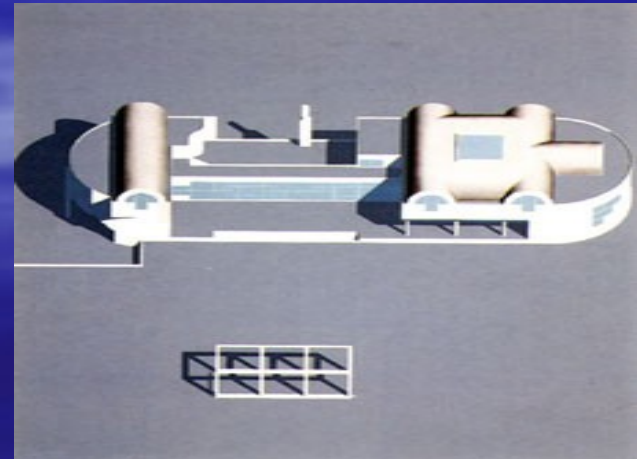


*Ask the family who lives in one*  
**THE BEAVER**  
Buckeye's beautiful CUSTOM BUILT Model 28-T will be on display at the Oklahoma Outdoor Show, Oklahoma City, March 12 to 22.



The 28-foot "Beaver" has handcrafted interior, heat piped to bedroom, automatic hot water heater, apartment size range, inlaid or plastic linoleum, Int'l. or Duo-Therm stove, Sanitary or Marvel refrigerator, your choice of exterior color.

**BUCKEYE COACH & MFG. CO.**  
ROUTE 30N BEAVERDAM, OHIO



# Form Follows Function!



*It only takes one horsepower to pull a Shurtz*

# Design Reflects the Era

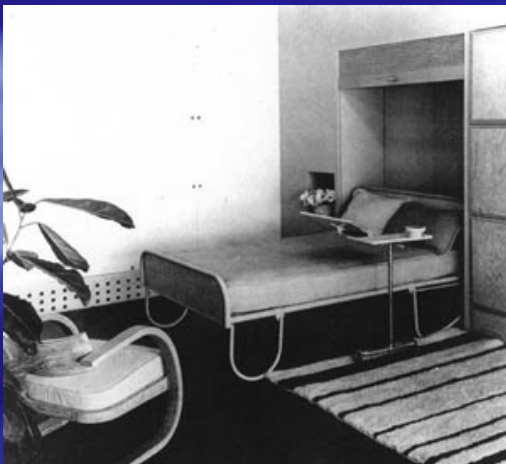
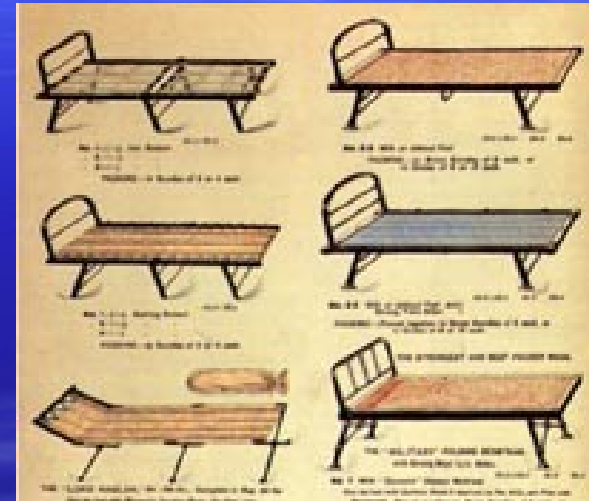




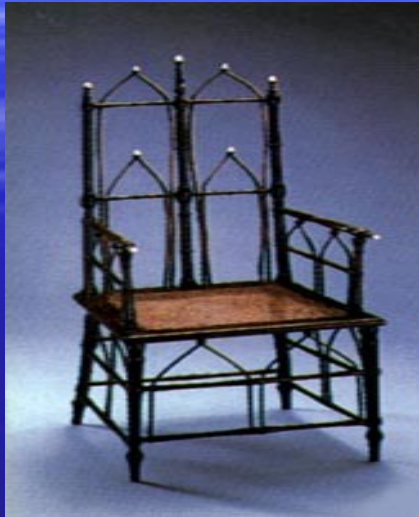
# Design Reflects Changes in Technology



# Design Reflects Changes in Culture



# Design Reflects Changes in Consumer Expectations





# Some Design Changes Aren't Accepted!



# Which of these Concept Cars will be Accepted?

