SCIENCE FAIR SERIES:
LET'S GET STARTED

Engineering Design Project

Types of Projects

- Inquiry Based Experiment.
  - Inquiry based experiment is the science experiment we are all familiar with the incorporates the scientific method.

- The Engineering/ Design Project.
  - An engineering design project is an innovation (invention) or design improvement.
  - ISEF Definition: Projects that directly apply scientific principles to manufacturing and practical uses--civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc.

Parallel Process

Computer Programming		Math Projects
Engineering Process	**Scientific Method**	**Mathematical Reasoning/**
Define a need	State a question	Define what is known
Do background research	Do background research	Do background research and define all terminology
Establish design criteria	Formulate your hypothesis, identify variables	Make a conjecture/ assumption based on what you know
Prepare preliminary designs	Design experiment, establish procedure	Perform calculations
Build and test prototype	Test hypothesis by doing experiment	Look for counter examples
Test and redesign as necessary	Analyze your results and draw conclusions	Recalculate and write up steps to the conclusion
Present results.		

Scientific Method and Engineering Process comparison used with permission by Science Buddies.

Engineering Design Process

- Define a need
- Do background research
- Establish design criteria
- Prepare preliminary designs
- Build and test prototype
- Test and redesign as necessary

Define a need

- Define a problem to be solved.
  - Engineering Design is really based on consumerism as an application of science.
- Define a need not currently met.
  - An innovation.
- Define a need in a product that can be improved
  - Some aspect of the current design has the un-intended result of not appealing to consumer. (too heavy, to hard to use, to hard to move)
  - Current design has a flaw or bug.
  - Current design can be improved since the technology, materials, etc have been improved.

Define a customer

- A need is defined by a customer.
- Customers may express needs by describing a product
  - *I need a car.*
- Customers may express needs as a functional requirement .
  - *I need a way to get to school.*

“Need” statement

- The need should be described in a simple statement that includes
  - What you are designing (the product),
  - Who it is for (customer),
  - What need does it satisfy (problem to solve),
  - And how does it improve previous designs (easier to use, less expensive, more efficient, safer).

Examples of “Need”

- Design a hearing aid that will improve hearing capacity of hearing-impaired people by lowering the frequency of sound in real time.
- Design a software program for STEM project fair participants to evaluate the performance of an engineering design or determine if the hypothesis has been validated.

Research desired functionality

- Research desired functionality so that you understand the need.
- Determine limiting factors and criteria for success or meeting the design (ex. cost)
- Research materials and processes to used in your proposed solution.

Research similar ideas

- Research current similar designs
- Evaluate the designs
  - Evaluate strength and weaknesses
  - Analyze and compare them

Generate ideas

- Combine some components of the researched designs
- Change some components of the researched designs
- Add an original component
- Generate 2 or 3 separate design ideas
- After research you should be able to write a design statement.

Test criteria

- Determine test criteria to evaluate the solution.
- Apply to generated ideas to evaluate which approach is best to continue project.

Identify baseline for testing

- Develop Test Cases
  - Safety mode,
  - Manual mode, and
  - Normal user mode.
- Test Baseline
  - Testing should show improvement in speed. (be specific: ex 5%)
  - Compare performance to Version 2.5

Create design statement

- A design statement expands the need into an intended solution.
- Format: The (product) shall provide (user) with (functionality requirements) using (materials/ tools).
  - Product can be hardware software or combination
  - User must be defined
  - Materials are components of solution.
  - Tools are apparatus for building and/ or testing product.
- Establish evaluation criteria for project success.
- Establish mitigation (alternative design plans) for any limiting factors that may come up.

Design statement example

The water filter (product) shall provide victims of flood (user) with a way to clean and filter water for drinking (functionality requirements).

Next Step..

- Designing your project to validate the functionality…
- Watch September 23 (or catch the recording after if you can’t make it)

Visit NEOHSTEM Alliance Website

- For more project information
- http://neohstem.org/