SCIENCE FAIR SERIES:
LET'S GET STARTED

Science Inquiry Project

Types of Projects

- Inquiry Based Experiment.
  - Inquiry based is the familiar science experiment that 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.

Scientific Method

- State a question
- Do background research
- Formulate hypothesis and identify variables
- Design experiment, establish procedure
- Test hypothesis by doing the experiment
- Analyze your results and draw conclusions

State a question

- Your question is the beginning of your investigation.
- Start with words that create wonder.
  - How?
  - What?
  - When?
  - Which?
  - Why?
  - Where?
- The answer cannot be a yes or not answer.
  - For example, “How does salt affect the freezing point of water?” is a better question than, “Does salt affect the freezing point of water

Question examples

- How does water purity affect surface tension?
- When is the best time to plant soybeans?
- Which material is the best insulator?
- How does arch curvature affect load carrying strength?
- How do different foundations stand up to earthquakes?
- What sugars do yeast use?

Topics to avoid

- Any topic that boils down to a simple preference or taste comparison. For example, "Which tastes better: Coke or Pepsi?“
- Most consumer product testing of the "Which is best?" type. This includes comparisons of popcorn, bubblegum, make-up, detergents, cleaning products, and paper towels.
- Any topic that requires people to recall things they did in the past.
- Effect of colored light or music on plants, not original.
- Any topic that requires measurements that will be extremely difficult to make or repeat, given your equipment.
- Any topic that is more of a demonstration such as a volcano.

Research

- Research your question...
- When does it happen?
- Why does it happen?
- Under what circumstances does it happen?

Generate ideas

- During research ask questions like:
  - Why does that happen?
  - Can I make it stop happening?
  - Can I make it happen faster?
  - Can I change the way it happens?

Formulate your hypothesis

- Understanding Cause and Effect
  - A cause is something that makes something else happen. Out of two events, it is the event that happens first.
  - To determine cause ask the question:
    - Why did “it” happen?
  - An effect is what happens as a result of the cause. Of two related events, it’s the one that happens second or last.
  - To determine the effect, ask the question:
    - What happened?

Examples

Cause	Effect
The boy kicked the ball	The ball rolled
The girl teased the dog.	The dog growled.
Sally studies hard for a test.	Sally earned an A on her test.
Ashley adds red food coloring to frosting.	The frosting turns red.
Helena added baking soda to vinegar. (chemistry)	The mixture created foam.
Daniel increased the length of the string on a pendulum . (physics)	The swing time increased.
Can you think of others?	

Format of a hypothesis

- If [cause / independent variable]
- Then [effect/ dependent variable]
- Because [principle of science tested]

Example hypothesis

- "Raising the temperature of a cup of water [temperature is the independent variable] will increase the amount of sugar that dissolves [the amount of sugar is the dependent variable]. Because chemical reactions increase with heat [principle of science tested]"

Project variables

- Scientists use an experiment to search for **cause and effect** relationships in nature. In other words, they design an experiment so that changes to one item cause something else to vary in a predictable way.
- These changing quantities are called **variables**. A variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled

Independent variable

- The **independent variable** is the one that is changed by the scientist. To insure a fair test, a good experiment has only one independent variable. As the scientist changes the independent variable, he or she **observes** what happens.
- For a fair test, you can change one factor at a time while keeping all other conditions the same

Dependent variable

- The scientist focuses his or her observations on the **dependent variable** to see how it responds to the change made to the independent variable. The new value of the dependent variable is caused by and depends on the value of the independent variable.
- For example, if you open a faucet (the independent variable), the quantity of water flowing (dependent variable) changes in response--you observe that the water flow increases.

Controlled variables

- Controlled variables are quantities that need to remain constant.
  - Note: the controlled variables must be noted in the lab notebook during the experiment as carefully as the dependent variables.
- Think of all the items that can affect your dependent variable and hold all of them constant.
  - For example, if we want to measure how much water flow (dependent variable) increases when we open a faucet,
  - And there are two (or more) variables that can affect the water flow, (size of opening, pressure)
  - Choose one as the independent variable,
  - Hold the other variables constant.
- If you change more than the independent variable, you are not in control of your experiment.

Variable example

- Question:
  - How does heating a cup of water change the amount of sugar it dissolves?
- Independent Variable
  - Temperature of the water measured in Centigrade.
- Dependent Variable:
  - Amount of sugar that dissolves completely measured in grams.
- Controlled Variables:
  - Type of sugar.
  - Amount of stirring.

Time as the independent variable

- Question:
  - How fast does a candle burn?
- Independent Variable
  - Time measured in minutes.
- Dependent Variable:
  - Height of candle measured in centimeters at regular intervals of time (ex. Every 5 minutes)
- Controlled Variables:
  - Use the same type of candle.
  - Wind.

Measurement

- In a good experiment, the scientist must be able to **measure** the values for each variable. Weight or mass is an example of a variable that is very easy to measure.
- However, imagine trying to do an experiment where one of the variables is love. There is no such thing as a "love-meter." Love is not measurable in a scientific sense; therefore, it would be a poor variable to use in an experiment.

Next Step..

- Designing your experiment to prove your hypothesis...
- 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/