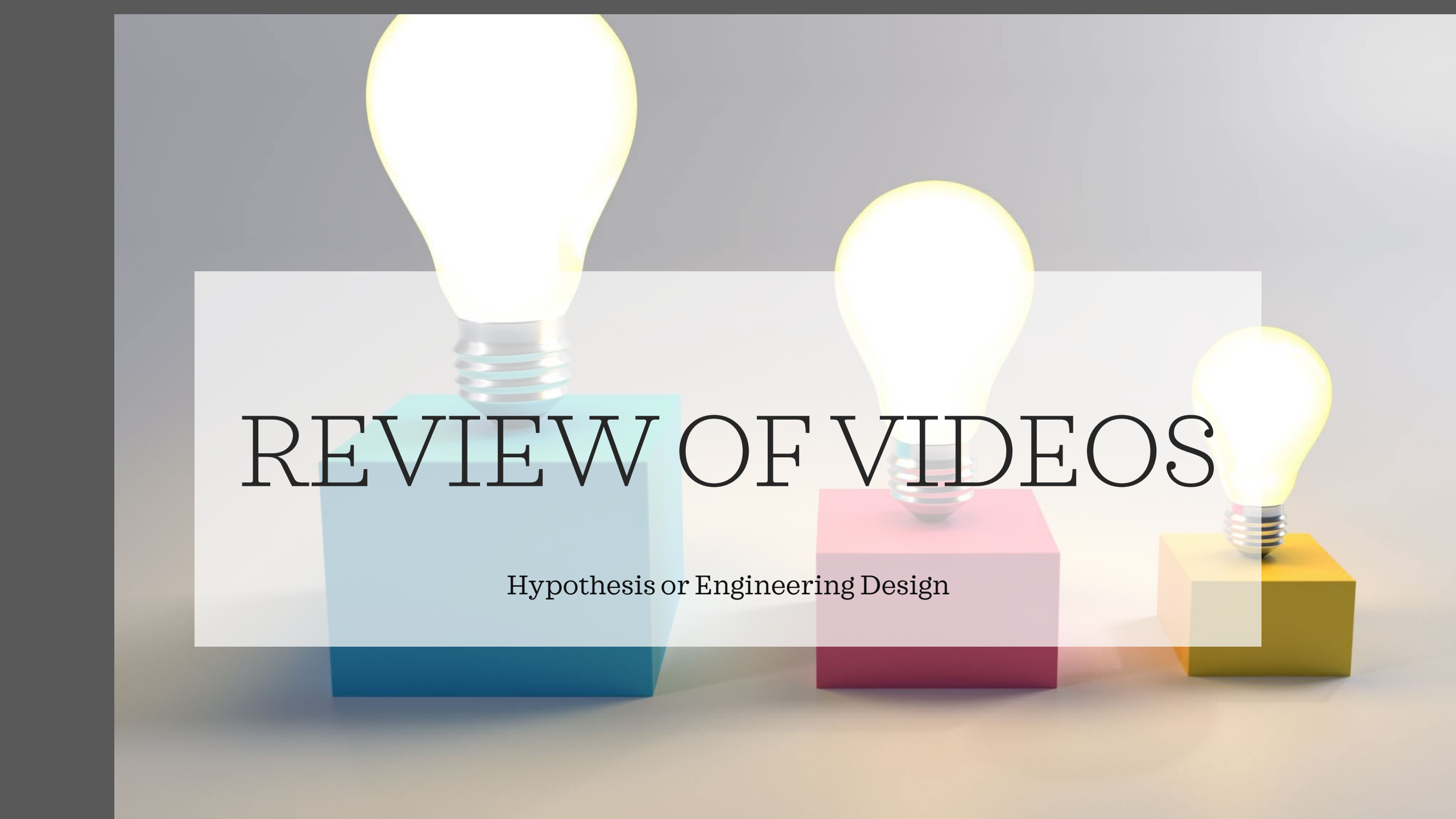
SCIENCE FAIR SERIES:
LET'S GET STARTED

Creating Project Plan



REVIEW OF VIDEOS

Hypothesis or Engineering Design

Types of Projects

- Inquiry Based Experiment.
  - Inquiry based is the familiar 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

Types of Projects

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.		

Library Research

- Using Akron Summit County Public Library for your research:
- https://www.youtube.com/watch?v=LXyGdgK-KEI&feature=youtu.be

Notebook Entry for Research

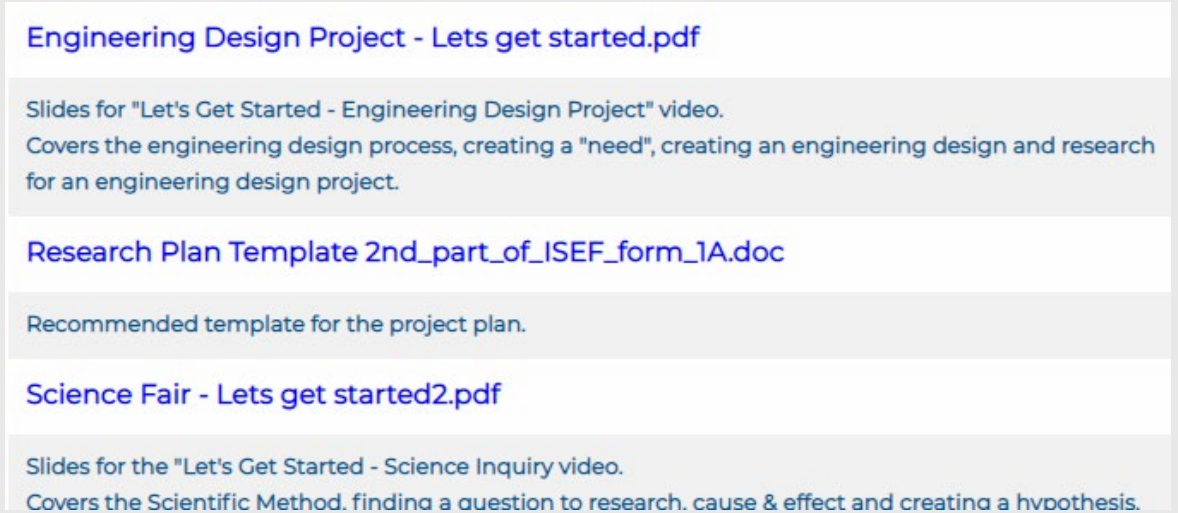
- Date:
- Source:
- Notes & Comments:

Creating hypothesis or engineering design statement

- Creating an Engineering Design Statement
- https://www.youtube.com/watch?v=ZZTLVass3dI&feature=youtu.be
- Creating a Hypothesis
- https://www.youtube.com/watch?v=MgLH3HPjP7c&feature=youtu.be

Review Part 1 Slide Stacks

- **Hypothesis and Design Statement Video Materials:**
  - http://www.neohstem.org/?Program=ScienceProjectSeries&subpage=331



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

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?

Format of a hypothesis

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

Notebook Entry - for Hypothesis

- Date:
- Hypothesis
- Notes from discussion with scientist or teacher:

Engineering Design Process

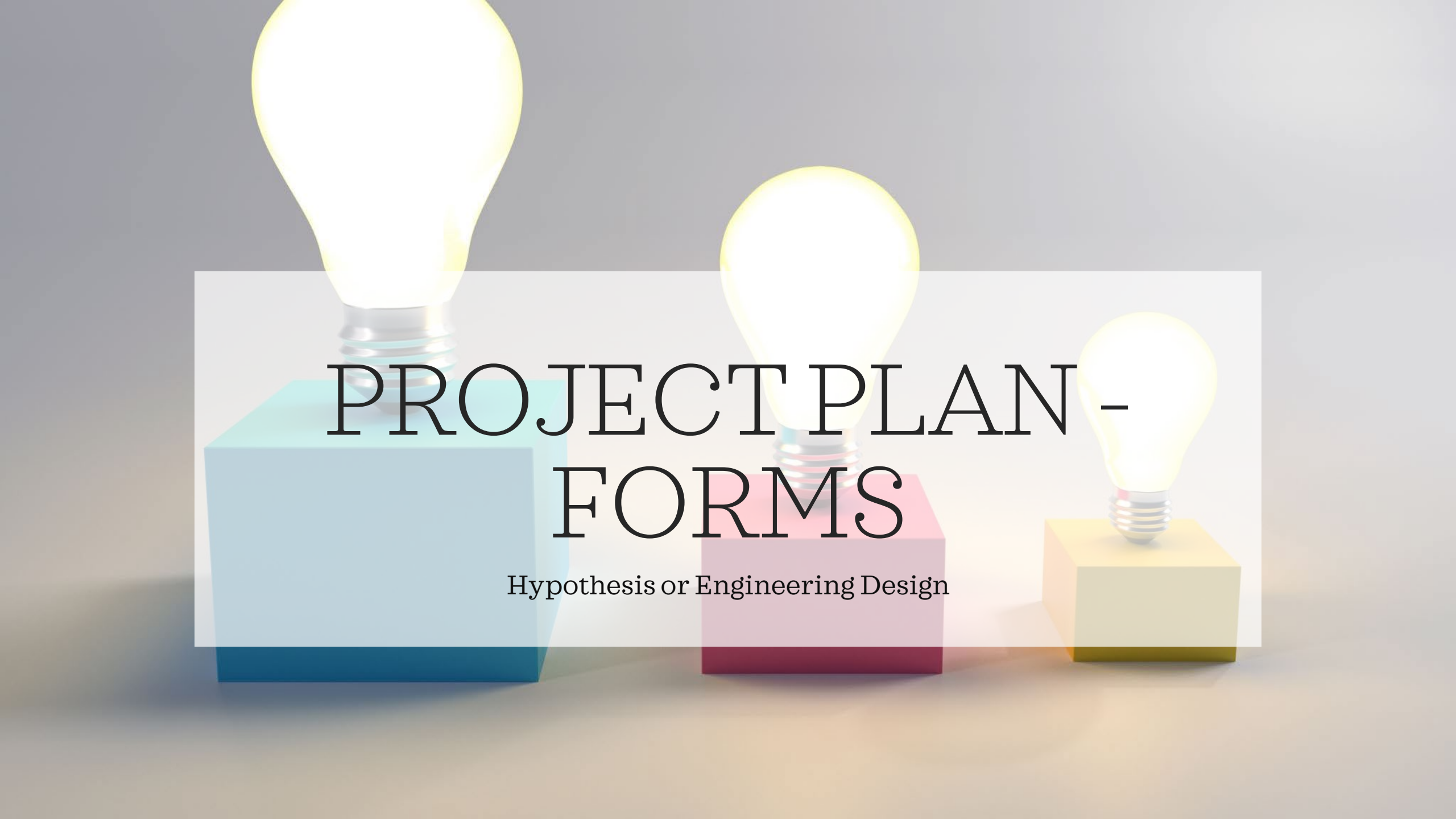
- Define a need
- Do background research
- Establish design criteria
- Prepare preliminary designs
- Build and test prototype
- Test and redesign as necessary

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.

Notebook Entry - for Design Statement

- Date:
- Design Statement
- Notes from discussion with scientist or teacher:



PROJECT PLAN - FORMS

Hypothesis or Engineering Design

Recommended Schedule

Month of September
- Pick a project idea.

Month of October
- Determine Project Plan, and Data Test Strategy

Month of November
- Perform Experiment

Month of December
- Perform Data Analysis and Conclusion

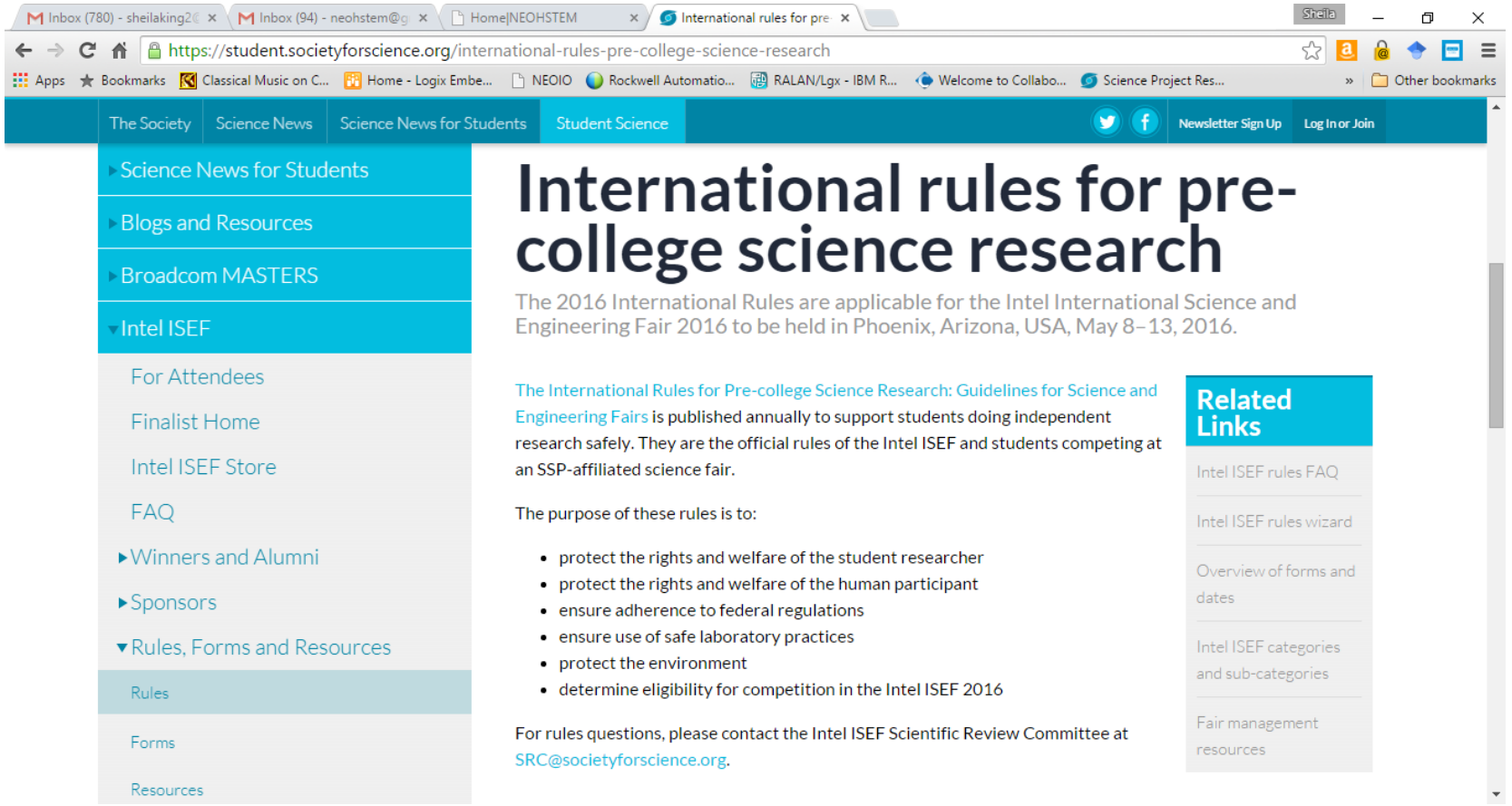
Month of January
- Write Oral and Written Presentations, Make Display, Practice Presentation

Before you begin

- Understand the policies and rules of Science Day (Ohio Academy of Science)
- Review the judging criteria

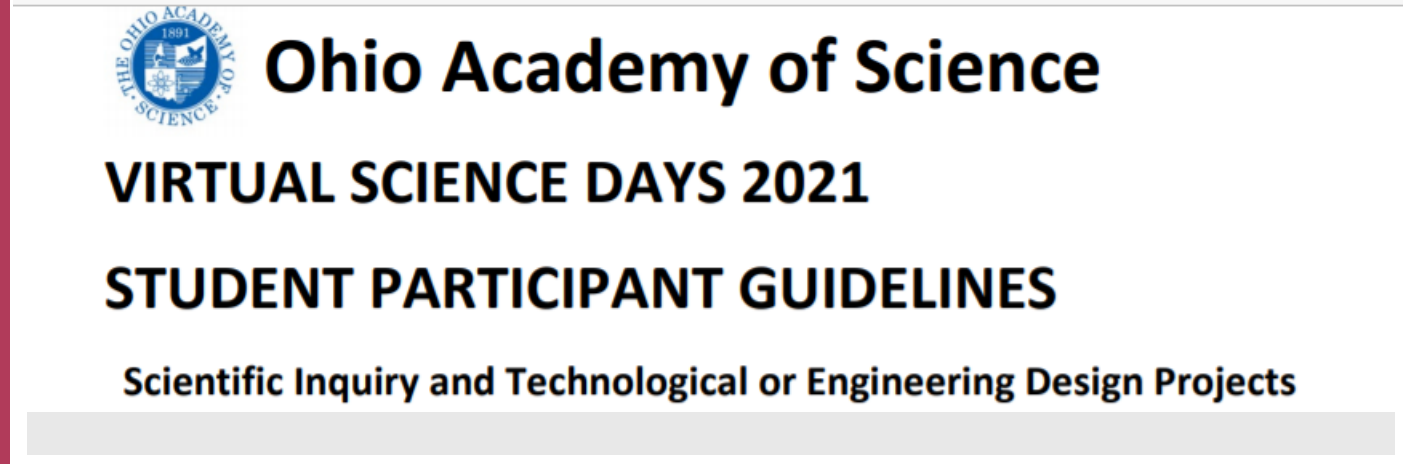
Rules

- Ohio Academy of Science uses ISEF Rules – as it is the standard for undergraduate research.



Understand policies and rules

- Become familiar with the Ohio Academy of Science and the Science Day Standards,
  - https://www.ohiosci.org/students
  - https://static1.squarespace.com/static/545d32b5e4b0719cb5aae580/t/5f594245549d39585c3450f1/1599685191002/Student+Guide++to+Virtual+SSD+with+Appendices+9-9-2020.pdf



Review judging criteria

- **Get Judging Cards and resources from:**
  - http://www.neohstem.org/?Program=ScienceProjectSeries&subpage=331

Create a project plan

- Forms First – for safety
- Research Plan

Where to get forms

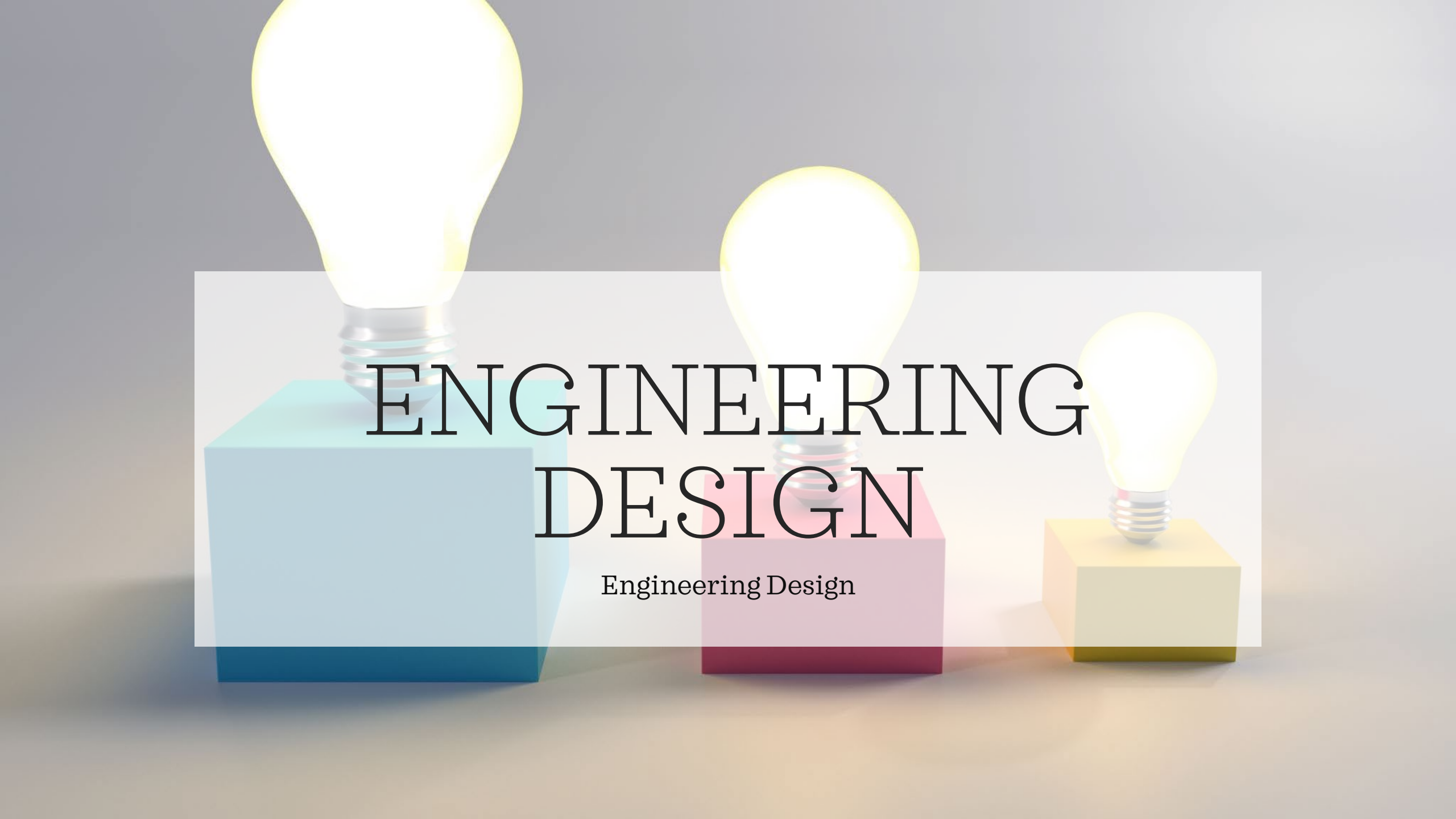
- **Get forms and resources from:**
  - http://www.neohstem.org/?Program=ScienceProjectSeries&subpage=332
  - https://www.societyforscience.org/isef/forms/

Where to Research Plan Template

- **Get research plan template:**
  - http://www.neohstem.org/?Program=ScienceProjectSeries&subpage=332

Notebook Entry – Plan for Forms

- Date:
- What forms do I need?
- Who needs to sign the forms?



ENGINEERING DESIGN

Engineering Design

Prepare preliminary drawings

- Sketch drawing of your design include materials, colors, etc.
- Create a state, sequence, class, or flow chart of functionality.
- Assure you have met all the design criteria in your design (even reference the design criteria you are addressing in the design)
- Make a materials list.

Notebook Entry – Sketches of all preliminary designs

- Date:
- Name of preliminary design
- Description of preliminary design
- Version of design

Prepare assembly procedure

- List the steps in detail.
- Listing will help work out some of the possible problems before the building process begins.
- Include tools needed for each step.

Notebook Entry –Assembly instructions for preliminary design (name of design)

- Date:
- Name of preliminary design
- Assembly steps to build

Develop test plan

- You should develop a test plan describing what you will test, how you will test, and how you'll perform analysis.
- You must test your prototype under actual or simulated operating conditions.

Notebook Entry – Test Plan

- Date:
- Name of preliminary design
- Preliminary tests for design / version

Assemble design

- Use your drawings for assembly to make sure the design is correct.
- Take notes to improve design. (ex. Switch steps for ease of assembly)

Notebook Entry – Assembly notes

- Date:
- Name of preliminary design
- Preliminary tests for design / version
- Assembly Instructions Used
- Notes on instructions – changes needed to instructions

Test design

- Run tests to determine if the design meets the criteria.
- Run other tests for product quality assurance.

Notebook Entry – Design Tests

	Date:		
	Test Name:		
	Variable Under Test	Test Notes	Observations (anything you notice)
1			
2			
3			
4			

Analysis

- Examine and evaluate prototype
- Use test criteria to determine if design meets design statement

Notebook Entry – Evaluation of Design

- Date:
- Name of design
- Summary of Tests:
- Evaluation if design meets design criteria:
- Changes/ refinements needed to meeting criteria:
- Changes/ refinements needed to improve the design:

Notebook Entry – Description of Changes/ Refinements

- Date:
- Issue to be addressed:
- Description of changes:

Notebook Entry – New Evaluation of Design

- Date:
- Name of design
- Summary of Tests:
- Evaluation if design meets design criteria:

SCIENTIFIC INQUIRY

Project Plan

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, dependent, and controlled variables

- The **independent variable** is the one that is changed by the scientist.
- 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.
- **Controlled variables** are quantities that need to remain constant.

Notebook Entry – Specification of Variables

- Date:
- Independent Variable (units of measure)
- Dependent Variable (units of measure)
- Controlled Variables
  - Plan to control each variable

Design Experiment

- **The first step of designing your experimental procedure involves planning how you will:**
  - change your independent variable.
  - measure the impact that this change has on the dependent variable.

Fair Test

- **To guarantee a fair test when you are conducting your experiment, you need to:**
  - make sure that the only thing you change is the independent variable.
  - all the controlled variables must remain constant.

Notebook Entry – Plan to Validate Hypothesis

- Date:
- Log/ Journal Entry on brainstorming for how to validate hypothesis.

Write the procedure

- Write the **experimental procedure** like a step-by-step recipe for your science experiment.
  - (Again) A good procedure is so detailed and complete that it lets someone else duplicate your experiment exactly!

Determine number of repetitions

- **Repeating a science experiment is an important step** to verify that your results.
  - For a typical experiment, you should plan to repeat it at least 3-5 times (more is better).
  - If you are planning to take your experiment to District/ Regional you should plan on using statistics which means repetition should be 15.
  - If you are doing something like growing plants, then you should do the experiment on at least three plants in separate pots (that's the same as doing the experiment three times).

Notebook Entry – Write out Procedure

- Date:
- Procedure
- Notes from discussion with scientist or teacher:

Execute the procedure

- **Data is the storyteller of your project.**
  - Accurate
  - Precise
  - Clean
  - Noisy
  - Variance
  - Outliers

Execute the procedure

- **Data is the storyteller of your project.**
  - Accurate
  - Precise
  - Clean
  - Noisy
  - Variance
  - Outliers

Notebook Entry – Test Data Log

	Date:				
	Independent Variable (unit)	Dependent Variable (unit)	Controlled Variables (unit)	Process Notes (confirmation of controlled variables, including mistakes)	Observations (anything you notice)
1					
2					
3					
4					

Notebook Entry – Analysis of Tests

- Date:
- Summary of Tests:
- Conclusions: (did results validate or invalidate hypothesis)
- Thoughts on repetition
  - Do I need to repeat any part of the experiment to clarify test information.

Notebook Entry – Repeated Tests Summary

- Date:
- Summary of Tests:
- Conclusions: (did results validate or invalidate hypothesis)

NEXT STEPS

Mentor Help

Hypothesis or Engineering Design Statement Workshop & Discussion

- **Write your hypothesis or engineering design statement**
- October 8, 9 or 10, 4-5 PM:
  - Hypothesis Workshop
  - Submit your hypothesis or design statements for recommendations from science panel.

  - *Note: submissions can be anonymous*
  - *Attendees can ask questions in the panel discussion*

Project Plan Workshop & Discussion

- **Develop your Project Plan**
- October 21, 22 or 23:
  - Project Plan Review
  - Submit your project plan for recommendations and discussion with science panel.

  - *Note: submissions can be anonymous*
  - *Attendees can ask questions in the panel discussion*

Submit your Hypothesis, Design Statements, and Research Plans to:

stdiv@akronlibrary.org

Visit NEOHSTEM Alliance Website

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