



SCIENCE FAIR SERIES: LET'S GET STARTED

Creating Project Plan



The image features three glowing yellow lightbulbs, each resting on a pedestal of a different color and height. The tallest pedestal is blue, the middle one is pink, and the shortest is yellow. The lightbulbs are arranged in a descending line from left to right. A semi-transparent white rectangular box is centered over the scene, containing the main title and subtitle.

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.		
<i>Scientific Method and Engineering Process comparison used with permission by Science Buddies.</i>		

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=Mg LH3HPjP7c&feature=youtu.be>

Review Part 1 Slide Stacks

- **Hypothesis and Design Statement Video Materials:**

- <http://www.neohstem.org/?Program=ScienceProjectSeries&subpage=331>

[Engineering Design Project - Lets get started.pdf](#)

Slides for "Let's Get Started - Engineering Design Project" video.

Covers the engineering design process, creating a "need", creating an engineering design and research for an engineering design project.

[Research Plan Template 2nd_part_of_ISEF_form_1A.doc](#)

Recommended template for the project plan.

[Science Fair - Lets get started2.pdf](#)

Slides for the "Let's Get Started - Science Inquiry" video.

Covers the Scientific Method, finding a question to research, cause & effect and creating a hypothesis.

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:

The image features three glowing lightbulbs of varying sizes, each resting on a small, colored rectangular block. The largest lightbulb is on a blue block on the left, the medium-sized one is on a pink block in the center, and the smallest one is on a yellow block on the right. The background is a soft, light gray gradient. A semi-transparent white rectangular box is overlaid in the center, containing the text.

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.

The screenshot shows a web browser window with the URL <https://student.societyscience.org/international-rules-pre-college-science-research>. The page features a teal navigation bar with links for 'The Society', 'Science News', 'Science News for Students', and 'Student Science'. A sidebar on the left contains a menu with 'Intel ISEF' expanded, showing options like 'For Attendees', 'Finalist Home', 'Intel ISEF Store', 'FAQ', 'Winners and Alumni', 'Sponsors', and 'Rules, Forms and Resources'. The main content area has the title 'International rules for pre-college science research' and a sub-header: 'The 2016 International Rules are applicable for the Intel International Science and Engineering Fair 2016 to be held in Phoenix, Arizona, USA, May 8–13, 2016.' Below this, a paragraph states: 'The International Rules for Pre-college Science Research: Guidelines for Science and Engineering Fairs is published annually to support students doing independent research safely. They are the official rules of the Intel ISEF and students competing at an SSP-affiliated science fair.' A section titled 'The purpose of these rules is to:' is followed by a bulleted list: 'protect the rights and welfare of the student researcher', 'protect the rights and welfare of the human participant', 'ensure adherence to federal regulations', 'ensure use of safe laboratory practices', 'protect the environment', and 'determine eligibility for competition in the Intel ISEF 2016'. At the bottom, it says 'For rules questions, please contact the Intel ISEF Scientific Review Committee at SRC@societyscience.org.' A 'Related Links' sidebar on the right includes 'Intel ISEF rules FAQ', 'Intel ISEF rules wizard', 'Overview of forms and dates', 'Intel ISEF categories and sub-categories', and 'Fair management resources'.

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>



Ohio Academy of Science

VIRTUAL SCIENCE DAYS 2021

STUDENT PARTICIPANT GUIDELINES

Scientific Inquiry and Technological or Engineering Design Projects

Review judging criteria

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

Reference Materials

[Individual Engineering Design Scorecard.pdf](#)

[Individual Science Inquiry Scorecard.pdf](#)

[Science Project Goals and Scoring.pdf](#)

Slides for "Goals and Scoring"

Covers the goals to be successful in a science project by understanding the scoring.

This is the material covered in the September 9 zoom meeting.

[Team Engineering Design Scorecard.pdf](#)

[Team Science Inquiry Scorecard.pdf](#)

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/>

Reference Materials

[1-Checklist-for-Adult-Sponsor.pdf](#)

ISEF Form - Mandatory for all projects.

[1A-Student-Checklist-Research-Plan-Instructions.pdf](#)

ISEF Form - Mandatory for all projects

[1B-Approval-Form.pdf](#)

Where to Research Plan Template

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

[Research Plan Template 2nd_part_of_ISEF_form_1A.doc](#)

Recommended template for the project plan.

Notebook Entry – Plan for Forms

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

The image features three glowing yellow lightbulbs, each resting on a different colored rectangular block. The blocks are blue, pink, and yellow, arranged from left to right. The lightbulbs are illuminated, casting a soft glow. The background is a light, neutral color. A semi-transparent white rectangular area is overlaid on the center of the image, containing the text.

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:

The image features three glowing yellow lightbulbs, each resting on a different colored rectangular block. The largest lightbulb is on a light blue block on the left. The medium-sized lightbulb is on a pink block in the center. The smallest lightbulb is on a yellow block on the right. The background is a soft, light gray gradient. A semi-transparent white rectangular area is overlaid in the center, containing the text.

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)

The image features three glowing lightbulbs, each resting on a colored rectangular block. The blocks decrease in height from left to right: a tall light blue block on the left, a medium-height pink block in the center, and a short yellow block on the right. The lightbulbs are illuminated with a warm yellow glow. The background is a soft, light gray gradient. A semi-transparent white rectangular area is overlaid on the center of the image, containing the text.

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/>