# MENDOCINO COUNTY STUDENT SCIENCE & ENGINEERING PROJECT HANDBOOK

## 35th Annual Mendocino County Science Fair

March 20, 2021

*Updated December 2020*

## TABLE OF CONTENTS



**Dear Students,**

This handbook was designed to provide assistance and guidelines when working on a science or engineering project. It includes project ideas, research methods, and instructions for creating your display. This year our Virtual Science Fair will take place on zFairs! Use this link: ca-mendocino.zfairs.com to create a profile, submit your project, participate in your judging interview, and to attend the virtual fair on March 20th.

This handbook also goes over the scientific and engineering process that is outlined in the Next Generation Science Standards (NGSS).

A science or engineering project can be a fun way to explore a subject that interests you. Science requires research, study, and is a logical sequence of investigative events that can be as creative as the investigator's mind.

Science and engineering projects have changed the lives and begun careers for many young people, so let this be an opportunity for you to have a positive impact on your life and future!

**Dear Parents/Guardians,**

The main purpose of the science project is to give your child experience in applying the scientific method, to explore areas of their interest and to learn to do research.

This handbook also goes over the scientific and engineering process that is outlined in the Next Generation Science Standards (NGSS).

While general methods and procedures will probably be discussed in the classrooms, most of the work for individual projects will be done at home. Your suggestions and encouragement will be of great value. This handbook will teach students how to do projects that require *hands-on* experimentation and use of the scientific method or engineering process rather than descriptive projects, models, or collections.

Please review this handbook with your child. This is a very exciting part of our program. We believe you will enjoy and take great pride in the creative and unique science or engineering projects developed by your child.

# What is a Science or Engineering Project?

A science project or engineering Is an attempt to answer a question by creating and conducting an experiment or addressing a design problem. This handbook will teach you how to do projects that require *hands-on* experimentation and use of the processes of scientific method and engineering design.

While a science or engineering project may include any or all of the elements listed below, you should keep in mind that it is more than just descriptive projects, models, or collections. For instance, a display of plants is not considered a science project but asking a question such as, *What is the effect of light on the germination of radish seeds,* can be a science project.

- ✓ Diagram
- ✓ Copy
- ✓ Illustration
- ✓ Table
- ✓ Chart
- ✓ Model
- ✓ Collection
- ✓ Specimen
- ✓ Working Model


## Selecting Your Project Topic

For many students, one of the most difficult parts of a science project is selecting a topic. A sample list of ideas is provided in this handbook. You are encouraged to research additional ideas, as well. Before deciding on a specific topic or project title, keep in mind that your project should be one that:

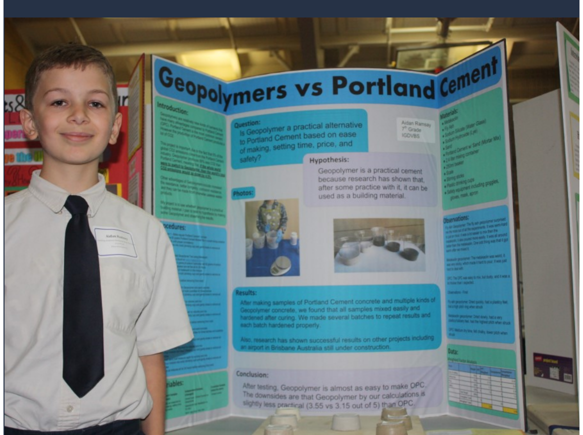
- ✓ You are really interested in researching;
- ✓ You are motivated to do;
- ✓ You have information available;
- ✓ You can get the materials and equipment needed;
- ✓ You can actually perform the experiment;
- ✓ You have enough time to work on and complete;
- ✓ And you can do by yourself or with very little help from others except for possible teammates (maximum 3 per team).

# How to Do a Science or Engineering Project

You should first begin a log to record everything about your project including all of the different topics you considered before selecting your science or engineering project. The log book is a dated record of all work done on a project. It is generally hand-written, start to finish, with all pages numbered in the top right corner. You may also create a log book digitally so long as it is accessible to judges. You may also use a Logbook template via Google docs.

The log book contains detailed notes of every step of the project from beginning to end—all notes on background information, all observations, all plans and actions, all data, and all thoughts, reflections and conclusion. You may acknowledge those who helped you but refer to them as "teacher," "parent," etc.

**Do not include the names of people in your log book or on your project display.**




## The Log Book

**The log book is the single most valued piece of work in your project.** Keep your log book with you whenever you work on your project. It is your personal record of your science project and includes:

- ✓ **Reading notes, articles, and data**
  - ✓ "I've researched my topic in (specify location of article, etc.)"
- ✓ **Decisions**
  - ✓ "I've decided to experiment with plants" or state the reason why you decided to experiment on your subject.
- ✓ **Actions**
  - ✓ "I've gone to the library to find books on my topic. I found a lot of books on… I set up my planters and grow lights, and took pictures of them to show my progress."
- ✓ **Observations**
  - ✓ "I've noticed that the plants are starting to wilt, so I need to water them more. The crystals are very fragile, so I can't put them on my display. I will need to take lots of pictures."
- ✓ **Thoughts and reflections**
  - ✓ "I've noticed that many of the seedlings are dying. I wish I had used more seeds. I'm worried that all my plants will be dead before the experiment is finished. I wonder why they are dying?"

# Reference List of Science & Engineering Project Vocabulary

**Accuracy** - The quality of being near to the true or desired value

**Analysis** - Breaking an object or process into smaller parts to examine or evaluate systematically

**Argument** - A persuasive defense for an explanation or solution based on evidence and reasoning

**Assessment** - An evaluation of the cost, quality and/or ability of someone or something

**Causation** - The relationship between cause and effect

**Claim** - A response made to a question and in the process of answering that question

**Communicate** - To share information orally, in written form and/or graphically through various forms of media

**Constraints** - A limitation or condition that must be satisfied by a design, including materials, cost, size, labor, etc.

**Control** - A variable that is kept the same across all tests for use as the comparison standard

**Correlation** - A predictive dependent relationship between variables that may be positive or negative. Changing a variable creates a corresponding change in another but does not imply causation.

**Criteria** - Attributes of a design that can be measured; a set of standards upon which a decision is based

**Design (v.)** - To generate or to propose a possible solution; to create, fashion, execute, or construct

**Diagram (n.)** - A visual representation of data or information

**Effectiveness** - A determination of how well a solution meets the criteria

**Efficiency** - The measurable relationship between a solution and the amount of resources it requires

**Error** - The difference between a measured value and its true or accepted value; important types include:

**Random Error** - An unpredictable result from a consistent measurement process

**Systematic Error** - A predictable and consistent deviation from a value (true or accepted) or a process

**Evaluate** - To determine significance

**Evidence** - Data used to support a claim

**Failure** - The inability of a device, process, or system to perform a required function

**Function** - A specific task that a system or part of a system performs or is intended to perform

**Hypothesis** - A possible explanation that can be tested with an experiment

**Impact (n.)** - A strong effect or influence on someone or something

**Implication** - A suggestion about or connection to a future outcome that is not stated directly

**Inference** - Forming an opinion based on known facts or evidence

**Investigate** - The process of gathering or examining information systematically; generating data to provide evidence to support a claim based on a stated goal, predicted outcome, and planned course of action

**Limit** - The minimum or maximum permissible value

**Model** - A diagram, replica, mathematical representation, analogy, or computer simulation used to analyze a system for condition flaws, test a solution, visualize or refine a design, and/or communicate design features

## Reference List of Science & Engineering Project Vocabulary

**Observation** - To become aware of an occurrence using the senses

**Parallax** - A perceived line of sight displacement while viewing an object

**Patterns** - Significant predictive features identified through analysis

**Performance** - The required action of a device, process or system

**Plan (n.)** - A systematic approach to solving a problem

**Precision** - The quality of being reproducible in amount or performance

**Predict** - To determine a future outcome

**Problem** - A situation to be changed; a question raised for inquiry, consideration, or solution

**Process** - A series of steps that form a pathway to a solution

**Prototype** - A model that tests design performance

**Qualitative** - Non-measurable and described through observation; subjective

**Quantitative** - Measurable and can be represented in numeric form; objective

**Reasoning** - A logical, objective thought process based on data, information, and evidence to form a conclusion or judgement

**Refine** - To improve through small changes

**Reflect** - Analyze a past course of action, process, or experience in order to generate a future improvement or modification

**Relevance** - The capability of someone or something to help solve a problem

**Reliability** - The ability of a device, process or system to perform an intended function without failure for a given time under specified operating conditions

**Repeatability** - Consistently repeating the same measurement procedure on a system or part of a system with the same tool used under the same conditions by the same person

**Reproducibility** - The consistent ability of a tool to reproduce the same measurement on a system under the same conditions no matter who operates the tool

**Requirements** - What the design must do; may be used in place of criteria

**Scale** - The relationship between the size of an accurate representation of an object and the actual object itself

**Simulation** - The use of a model to learn how a device, process or system will behave

**Specifications (Specs)** - A detailed written record specific to the criteria needed to solve the problem; the technical information about “what” is needed to solve the problem but not “how” to solve it

**Test (v.)** - To determine whether or not a design, model, process, system or theory meets the criteria as a possible solution

**Theory** - An idea or set of ideas used to explain a fact or event

**Trade-Off** - An exchange of one idea for another that may involve losing a quality or aspect of a design

**Trueness** - The closeness between the average value of a large series of measurements results and the true or reference value; quantitative

**Uncertainty** - Quantifiable doubt about a measurement result

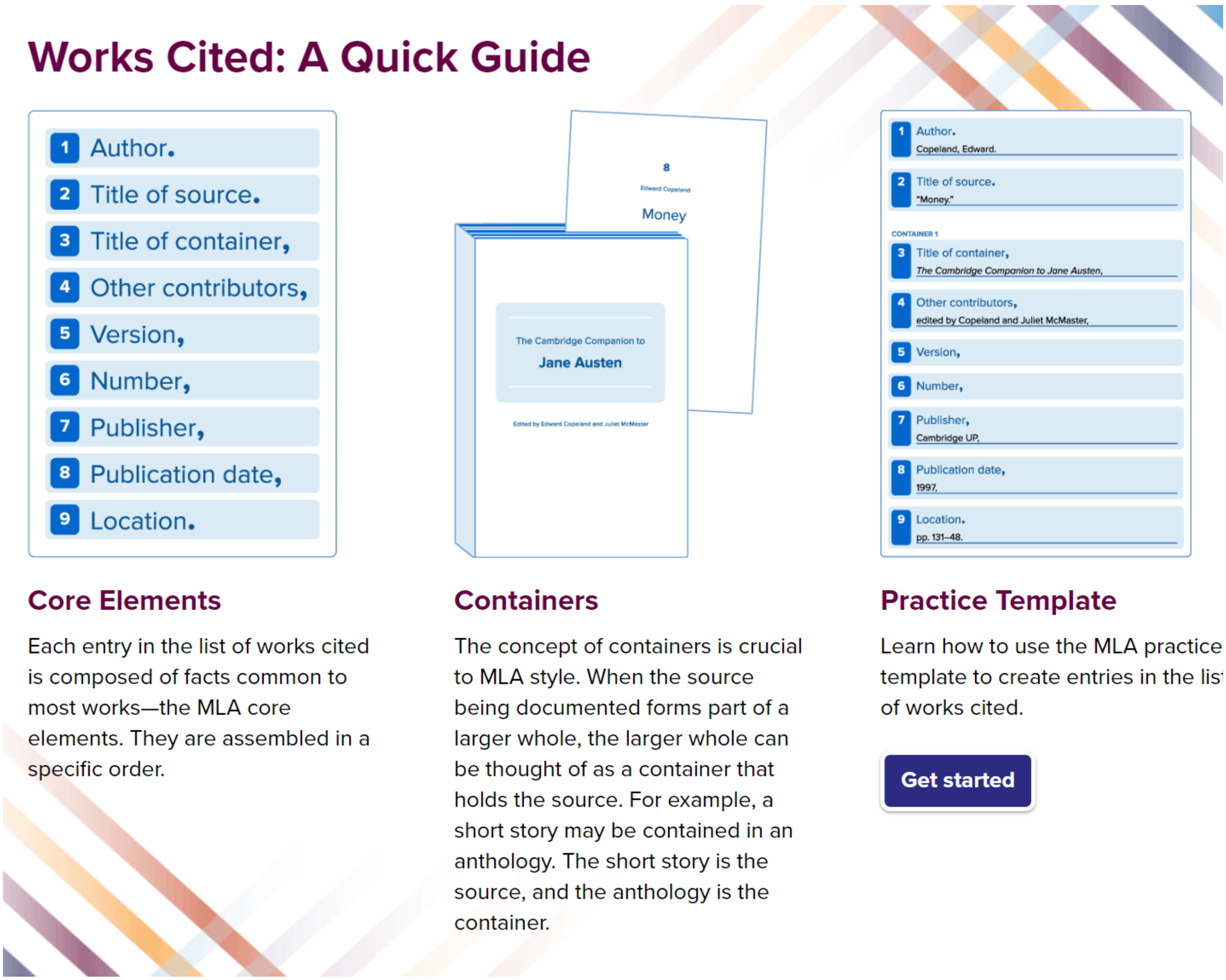
**Variability** - The extent to which data points differ from each other; how far apart or how close together

# Examples of Citing References

The MLA Style Center is a great resource to learn how to cite sources using the MLA formatting style. Depending on what and where your cite is, the formatting and style guide changes. To access this site, please see the following link: https://style.mla.org/

Below is the beginning of a step by step guide in MLA and how to properly cite any documents that you gather research and information from.

The link below is: https://style.mla.org/works-cited-a-quick-guide/




## Core Elements

Each entry in the list of works cited is composed of facts common to most works—the MLA core elements. They are assembled in a specific order.

## Containers

The concept of containers is crucial to MLA style. When the source being documented forms part of a larger whole, the larger whole can be thought of as a container that holds the source. For example, a short story may be contained in an anthology. The short story is the source, and the anthology is the container.

## Practice Template

Learn how to use the MLA practice template to create entries in the list of works cited.

# The Science & Engineering Process

Aligned with the new Next Generation Science Standards, the following outlines the steps for both:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

## Asking Questions & Defining Problems

"Students at any grade level should be able to ask questions of each other about the texts they read, the features of the phenomena they observe, and the conclusions they draw from their models or scientific investigations. For engineering, they should ask questions to define the problem to be solved and to elicit ideas that lead to the constraints and specifications for its solution (NRC Framework 2012, p. 56)"

Scientific questions arise in a variety of ways. They can be driven by curiosity about the world, inspired by the predictions of a model, theory, or findings from previous investigations, or they can be stimulated by the need to solve a problem. Scientific questions are distinguished from other types of questions in that the answers lie in explanations supported by empirical evidence, including evidence gathered by others or through investigation.

While science begins with questions, engineering begins with defining a problem to solve. However, engineering may also involve asking questions to define a problem, such as: What is the need or desire that underlies the problem? What are the criteria for a successful solution? Other questions arise when generating ideas, or testing possible solutions, such as: What are the possible trade-offs? What evidence is necessary to determine which solution is best?

## Developing & Using Models

Models include diagrams, physical replicas, mathematical representations, analogies, and computer simulations. Although models do not correspond exactly to the real world, they bring certain features into focus while obscuring others. All models contain approximations and assumptions that limit the range of validity and predictive power, so it is important for students to recognize their limitations.

In science, models are used to represent a system (or parts of a system) under study, to aid in the development of questions and explanations, to generate data that can be used to make predictions, and to communicate ideas to others. Students can be expected to evaluate and refine models through an iterative cycle of comparing their predictions with the real world and then adjusting them to gain insights into the phenomenon being modeled. As such, models are based upon evidence. When new evidence is uncovered that the models can't explain, models are modified.

In engineering, models may be used to analyze a system to see where or under what conditions flaws might develop, or to test possible solutions to a problem. Models can also be used to visualize and refine a design, to communicate a design's features to others, and as prototypes for testing design performance.

# The Science & Engineering Process

Aligned with the new Next Generation Science Standards, the following outlines the steps for both:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

## Planning & Carrying Out Investigations

Scientific investigations may be undertaken to describe a phenomenon, or to test a theory or model for how the world works. The purpose of engineering investigations might be to find out how to fix or improve the functioning of a technological system or to compare different solutions to see which best solves a problem. Whether students are doing science or engineering, it is always important for them to state the goal of an investigation, predict outcomes, and plan a course of action that will provide the best evidence to support their conclusions. Students should design investigations that generate data to provide evidence to support claims they make about phenomena. Data are not evidence until used in the process of supporting a claim. Students should use reasoning and scientific ideas, principles, and theories to show why data can be considered evidence.

## Analyzing & Interpreting Data

Once collected, data must be presented in a form that can reveal any patterns and relationships and that allows results to be communicated to others. Because raw data as such have little meaning, a major practice of scientists is to organize and interpret data through tabulating, graphing, or statistical analysis. Such analysis can bring out the meaning of data—and their relevance—so that they may be used as evidence.

Engineers, too, make decisions based on evidence that a given design will work; they rarely rely on trial and error. Engineers often analyze a design by creating a model or prototype and collecting extensive data on how it performs, including under extreme conditions. Analysis of this kind of data not only informs design decisions and enables the prediction or assessment of performance but also helps define or clarify problems, determine economic feasibility, evaluate alternatives, and investigate failures. (NRC Framework, 2012, p. 61-62)

## Using Mathematics & Computational Thinking

Although there are differences in how mathematics and computational thinking are applied in science and in engineering, mathematics often brings these two fields together by enabling engineers to apply the mathematical form of scientific theories and by enabling scientists to use powerful information technologies designed by engineers. Both kinds of professionals can thereby accomplish investigations and analyses and build complex models, which might otherwise be out of the question. (NRC Framework, 2012, p. 65)

# The Science & Engineering Process

Aligned with the new Next Generation Science Standards, the following outlines the steps for both:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

### *Using Mathematics & Computational Thinking Continued...*

Students are expected to use mathematics to represent physical variables and their relationships, and to make quantitative predictions. Other applications of mathematics in science and engineering include logic, geometry, and at the highest levels, calculus. Computers and digital tools can enhance the power of mathematics by automating calculations, approximating solutions to problems that cannot be calculated precisely, and analyzing large data sets available to identify meaningful patterns. Students are expected to use laboratory tools connected to computers for observing, measuring, recording, and processing data. Students are also expected to engage in computational thinking, which involves strategies for organizing and searching data, creating sequences of steps called algorithms, and using and developing new simulations of natural and designed systems. Mathematics is a tool that is key to understanding science. As such, classroom instruction must include critical skills of mathematics.

## Constructing Explanations & Designing Solutions

The goal of science is to construct explanations for the causes of phenomena. Students are expected to construct their own explanations, as well as apply standard explanations they learn about from their teachers or reading.

An explanation includes a claim that relates how a variable or variables relate to another variable or a set of variables. A claim is often made in response to a question and in the process of answering the question, scientists often design investigations to generate data.

In engineering, the goal is a design rather than an explanation. The process of developing a design is iterative and systematic, as is the process of developing an explanation or a theory in science. Engineers' activities, however, have elements that are distinct from those of scientists. These elements include specifying constraints and criteria for desired qualities of the solution, developing a design plan, producing and testing models or prototypes, selecting among alternative design features to optimize the achievement of design criteria, and refining design ideas based on the performance of a prototype or simulation. (NRC Framework, 2012, p. 68-69)

# The Science & Engineering Process

Aligned with the new Next Generation Science Standards, the following outlines the steps for both:

- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

## Engaging in Argument from Evidence

Argumentation is a process for reaching agreements about explanations and design solutions. In science, reasoning and argument based on evidence are essential in identifying the best explanation for a natural phenomenon. In engineering, reasoning and argument are needed to identify the best solution to a design problem. Student engagement in scientific argumentation is critical if students are to understand the culture in which scientists live, and how to apply science and engineering for the benefit of society. As such, argument is a process based on evidence and reasoning that leads to explanations acceptable by the scientific community and design solutions acceptable by the engineering community.

Argument in science goes beyond reaching agreements in explanations and design solutions. Whether investigating a phenomenon, testing a design, or constructing a model to provide a mechanism for an explanation, students are expected to use argumentation to listen to, compare, and evaluate competing ideas and methods based on their merits. Scientists and engineers engage in argumentation when investigating a phenomenon, testing a design solution, resolving questions about measurements, building data models, and using evidence to evaluate claims.

## Obtaining, Evaluating, & Communicating Information

Being able to read, interpret, and produce scientific and technical text are fundamental practices of science and engineering, as is the ability to communicate clearly and persuasively. Being a critical consumer of information about science and engineering requires the ability to read or view reports of scientific or technological advances or applications (whether found in the press, the Internet, or in a town meeting) and to recognize the salient ideas, identify sources of error and methodological flaws, distinguish observations from inferences, arguments from explanations, and claims from evidence. Scientists and engineers employ multiple sources to obtain information used to evaluate the merit and validity of claims, methods, and designs. Communicating information, evidence, and ideas can be done in multiple ways: using tables, diagrams, graphs, models, interactive displays, and equations as well as orally, in writing, and through extended discussions.

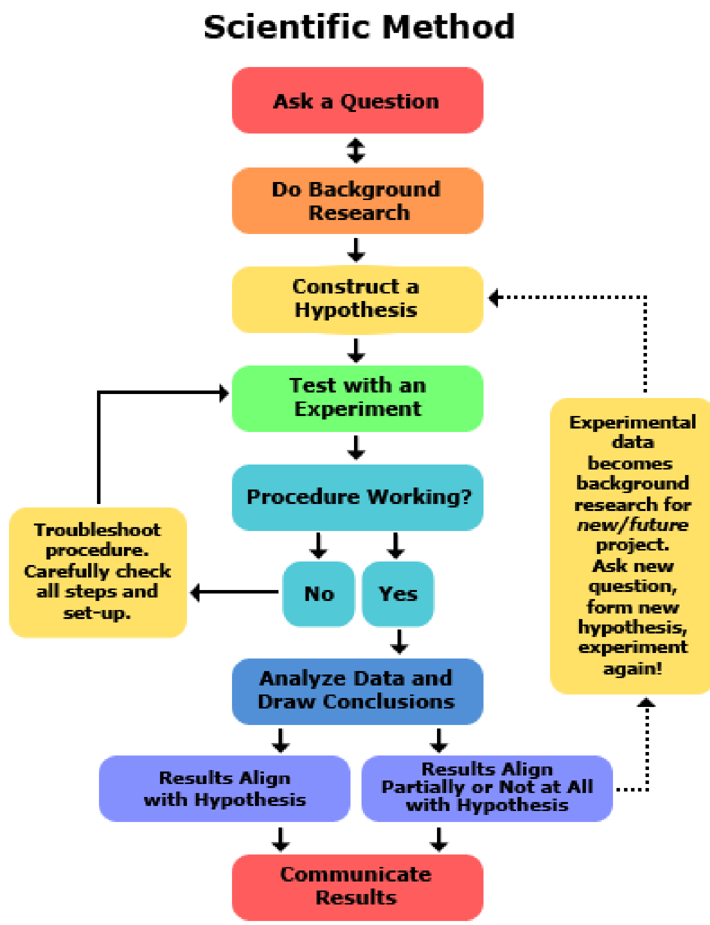
# Comparing Scientific Method & Engineering Method

**WHAT IS THE SCIENTIFIC METHOD?**

The scientific method is a process for experimentation that is used to explore observations and answer questions. Does this mean all scientists follow exactly this process? No. Some areas of science can be more easily tested than others. For example, scientists studying how stars change as they age or how dinosaurs digested their food cannot fast-forward a star's life by a million years or run medical exams on feeding dinosaurs to test their hypotheses. When direct experimentation is not possible, scientists modify the scientific method. In fact, there are probably as many versions of the scientific method as there are scientists! But even when modified, the goal remains the same: to discover cause and effect relationships by asking questions, carefully gathering and examining the evidence, and seeing if all the available information can be combined in to a logical answer.

Even though we show the scientific method as a series of steps, keep in mind that new information or thinking might cause a scientist to back up and repeat steps at any point during the process. A process like the scientific method that involves such backing up and repeating is called an iterative process.

Whether you are doing a science fair project, a classroom science activity, independent research, or any other hands-on science inquiry understanding the steps of the scientific method will help you focus your scientific question and work through your observations and data to answer the question as well as possible.




*Science Buddies (2018). Comparing the Engineering Design Process and the Scientific Method. Retrieved from: https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-compare-scientific-method*

# Comparing Scientific Method & Engineering Method

| Steps of the Scientific Method | Detailed Help for Each Step |
|---|---|
| **Ask a Question:** The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where? For a science fair project some teachers require that the question be something you can measure, preferably with a number. | Your Question |
| **Do Background Research:** Rather than starting from scratch in putting together a plan for answering your question, you want to be a savvy scientist using library and Internet research to help you find the best way to do things and insure that you don't repeat mistakes from the past. | Background Research Plan<br>Finding Information<br>Bibliography<br>Research Paper |
| **Construct a Hypothesis:** A hypothesis is an educated guess about how things work. It is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction:<br>"If _____*[I do this]* _____, then _____*[this]*_____ will happen."<br><br>State both your hypothesis and the resulting prediction you will be testing. Predictions must be easy to measure. | Variables<br>Variables for Beginners<br>Hypothesis |
| **Test Your Hypothesis by Doing an Experiment:** Your experiment tests whether your prediction is accurate and thus your hypothesis is supported or not. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all other conditions the same.<br><br>You should also repeat your experiments several times to make sure that the first results weren't just an accident. | Experimental Procedure<br>Materials List<br>Conducting an Experiment |
| **Analyze Your Data and Draw a Conclusion:** Once your experiment is complete, you collect your measurements and analyze them to see if they support your hypothesis or not.<br><br>Scientists often find that their predictions were not accurate and their hypothesis was not supported, and in such cases they will communicate the results of their experiment and then go back and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again. Even if they find that their hypothesis was supported, they may want to test it again in a new way. | Data Analysis & Graphs<br>Conclusions |
| **Communicate Your Results:** To complete your science fair project you will communicate your results to others in a final report and/or a display board. Professional scientists do almost exactly the same thing by publishing their final report in a scientific journal or by presenting their results on a poster or during a talk at a scientific meeting. In a science fair, judges are interested in your findings regardless of whether or not they support your original hypothesis. | Final Report<br>Abstract<br>Display Board<br>Science Fair Judging |

# Comparing Scientific Method & Engineering Method

What is the Engineering Process?

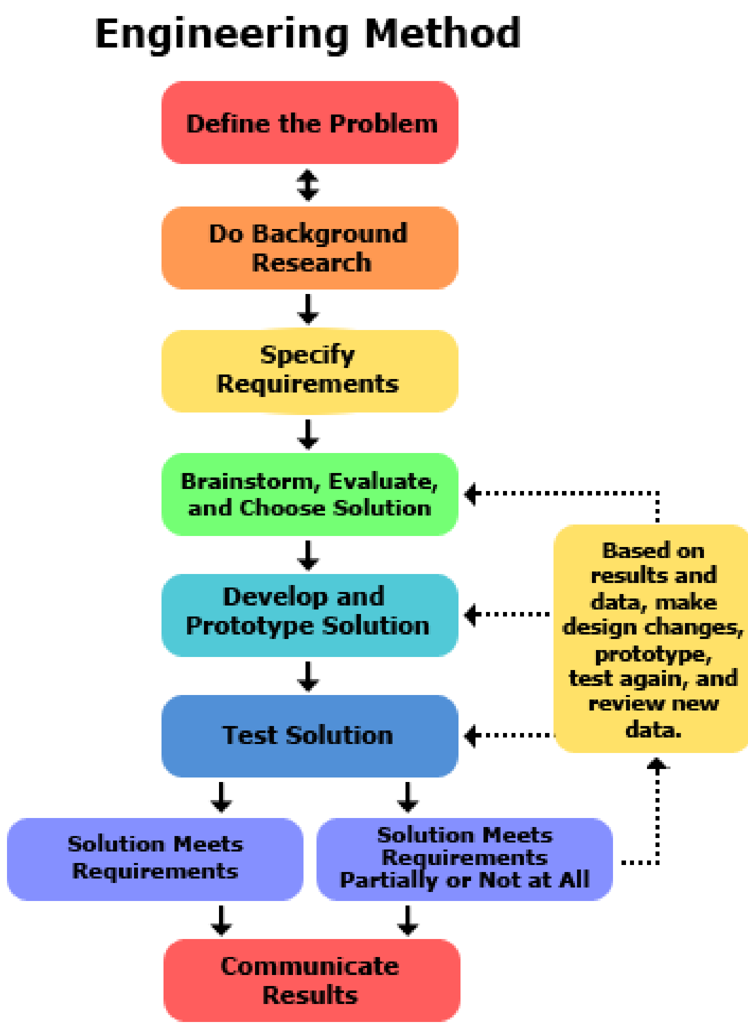
The engineering design process is a series of steps that engineers follow to come up with a solution to a problem. Many times the solution involves designing a product (like a machine or computer code) that meets certain criteria and/or accomplishes a certain task.

This process is different from the Steps of the Scientific Method, which you may be more familiar with. If your project involves making observations and doing experiments, you should probably follow the Scientific Method. If your project involves designing, building, and testing something, you should probably follow the Engineering Design Process. If you still are not sure which process to follow, you should read Comparing the Engineering Design Process and the Scientific Method.

**THE STEPS OF THE ENGINEERING DESIGN PROCESS ARE TO:**

- Define the Problem
- Do Background Research
- Specify Requirements
- Brainstorm Solutions
- Choose the Best Solution
- Do Development Work
- Build a Prototype
- Test and Redesign

Engineers do not always follow the engineering design process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change to your design. This way of working is called iteration, and it is likely that your process will do the same!




*Science Buddies (2018). Comparing the Engineering Design Process and the Scientific Method. Retrieved from: https://www.sciencebuddies.org/science-fair-projects/engineering-design-process/engineering-design-compare-scientific-method*

# Categories / Ideas for Science Fair Projects

**Behavior/Health/Social Sciences (Life Science B: Medicine, Health, Behavior and Social Sciences)**

- Does color have an effect on a person's food choice? How?
- How do sound waves affect your mood?
- Do TV commercials control buying habits?
- Which orange drinks have the highest concentration of Vitamin C?
- How do students communicate non-verbally to their teachers?

**Biological Sciences (Life Sciences A: Biology, Botany, Zoology, Microbiology, Biochemistry)**

- What is the highest temperature at which milk may be stored and not spoil?
- Does gravity affect the direction that a seed grows?
- Does magnetism affect plant growth? How?
- Which fruits contain a large quantity of acid?
- How much salt will a plant tolerate and still grow?

**Earth Science (Geology, Astronomy, Ecology, Atmospheric Science, Environmental Science)**

- What is the rate of absorption of water in different soil types?
- Pick a constellation. Track its movement each night and use that to prove the earth's orbit around the sun.
- At what time during the day does the sun give the most energy?
- Conduct cloud chamber investigations of particles and cloud formation.
- Conduct an analysis of the Mount St. Helen's eruption as compared to the Hawaiian eruptions.

**Engineering**

- Create an original machine that will perform a function. Make modifications and test each model.
- Test the wind resistance of automobile models in a wind tunnel.
- Conduct an analysis of exhaust emissions of cars as related to the size of cars and tune-up conditions.
- Design, construct, and test a mechanical method of separating solid waste for recycling.
- Construct and test a model solar desalination system.

**Physical Sciences (Physics, Chemistry, Aerodynamics, Hydrodynamics, Electronics & Electromagnets, Mathematics, Software, and Computer Science**

- Do metals rust at different rates?
- Does the temperature of the air affect the air pressure?
- Do the different colors in the spectrum have different temperatures?
- What surfaces reflect light best?
- What stain remover will remove the largest percentage of the stain?
- How are Fibonacci numbers and ratios found in nature?
- Providing geometric theorems by using concrete objects.
- Programming computers to perform equations to test mathematical results (i.e., prime factorization, statistics).
- Using probability methods in predicting the future.
- Design a new mathematical system for analyzing solutions.

*For additional ideas, refer to Science Fair link on the Mendocino County Office of Education website [http://www.mcoe.us/District/Department/27-Curriculum-Instruction/Portal/Science-Fair](http://www.mcoe.us/District/Department/27-Curriculum-Instruction/Portal/Science-Fair)*

*or the California State Science Fair webpage [http://www.usc.edu/CSSF/Info_Genl/Categories.html](http://www.usc.edu/CSSF/Info_Genl/Categories.html)*

# Categories / Ideas for Science Fair Projects

### Science Buddies

www.sciencebuddies.org (choose the Project Ideas tab) Science Buddies offers detailed guidance and examples for serious students who want to do the best possible project.

- "How-to" information
- Ask an expert online mentoring
- Teacher resources

### Science Buddies Advanced Project Guide

http://www.sciencebuddies.org/
(choose the Advanced Project Guide tab)

Preparing for Advanced High School Science Competitions

- Overview of the Top Science Competitions
- Nine Reasons to Do a High School Science Project
- How to Be Successful at a Top Science Competition
- Roadmap: How to Get Started On an Advanced Science Project
- How to Find a Mentor
- Mentoring & Coaching Advanced High School Student Research
- Roundtable on Finding an Idea for an Advanced Project
- Sample Projects from Advanced Competitions
- How to Read a Scientific Paper

### What Makes A Good Science Fair Project

www.usc.edu/CSSF/Resources/Good_Project.html

A website from USC that gives a lot of good tips and ideas to think about regarding what makes a good science fair project. Advice for students as well as teachers and parents is included.

### Science Project Ideas

www.scienceproject.com

World's largest web site for Science Project ideas, information and support.

- Middle School project ideas (Intermediate projects)
- High School project ideas (Senior projects)

### Science Fair Adventure

http://www.sciencefairadventure.com/

Science Fair projects ideas by topic.

### Parent Resources to Science Fair Projects

http://school.discoveryeducation.com/sciencefaircentral/Parent- Resources.html

- What is the parent's role?
- How do I help my student come up with a project idea?
- How much time will we need?
- How do I help with the project?
- What are the main sticking points for students?
- What should the final project look like?
- What else can I do to help?
- Where do I get supplies?

### Math Ideas for Science Fair Projects

http://mathforum.org/teachers/mathproject.html

http://mathforum.org/library/drmath/sets/high_projects.html

- Includes tips on finding interesting ideas
- Topics arranged by math subjects

### Science Fair Resource Guide

www.ipl.org/div/projectguide

Resources for science fair projects. Includes tips, explanation of the scientific method, and help choosing a topic.

### Successful Science Fair Projects

http://faculty.washington.edu/chudler/fair.html
Includes an overview of how to do a science fair project and additional science fair websites.

### Science Fairs

https://www.apa.org/education/k12/science-fair.aspx Information about research methods and statistics that is particularly useful for high school students.

*The above information was gathered from the Anne Arundel County Public Schools Science Fair Resource Guide, 2014.*

ANNE ARUNDEL
COUNTY PUBLIC SCHOOLS

# Categories / Ideas for Science Fair Projects

### Students discuss various aspects of a science fair project.

http://www.archimedesinitiative.org/themes.html

Student interviews on an array of insightful projects providing excellent advice from conquering fears to working through unforeseen results

### Agricultural Ideas for Science Projects

www.ars.usda.gov/is/kids/fair/ideasframe.htm

This website offers suggestions for a wide variety of science fair projects with an agricultural theme.

- Botany
- Chemistry
- Environmental Science
- Medicine and Health
- Microbiology
- Zoology

### Virtual Library—Science Fairs

http://physics.usc.edu/%7Egould/ScienceFairs/

A comprehensive list of every science fair accessible through the Web.

### Super Science Fair Projects

www.super-science-fair-projects.com/

Complete Guide to Science Fair Projects, Topics and Experiments

- Steps for Doing a Science Fair Project
- Science Fair Idea: Winning Strategies
- Science Fair: How Judges Think
- School Science Fair Projects: How to keep a Timeline
- Science Project Ideas: Science Category Outline
- Science Fair Project Ideas: Science Topic Outline
- High School Science Fair Projects: How to do Project Research
- Kids Science Fair Projects: How to Write a Project Report
- Middle School Science Fair Projects: How to Do a Presentation
- Cool Science Fair Projects: Day of the Science Fair
- Best Science Fair Projects

### The DuPont Challenge Science Essay Competition

http://thechallenge.dupont.com/

### Google Science Fair

http://www.google.com/events/sciencefair/

- Science Project Resources
- Partner Resources- especially Scientific American

### Science Fair Resource Center

http://homeworkspot.com/sciencefair/

Project ideas, information, books and kits

- General Science Fair Project Ideas
- Ideas by Subject
- Help
- Middle School Science Resources
- High School Science Resources

### Junior Science & Humanities Symposia (JSHS) Program

http://www.jshs.org/

JSHS is sponsored by the research arm of the Department of Defense and administered in cooperation with nationwide colleges and universities. JSHS aims to prepare and support students to contribute as future scientists and engineers -- conducting STEM research on behalf of or directly for the Department of Defense, the Federal research laboratories, or for the greater good in advancing the nation's scientific and technological progress.

Contains a variety of excellent resources including preparation and presentation tips. A list of awards and scholarships is also included.

### Maryland BioGENEius Challenge

http://www.biotechinstitute.org/go.cfm?do=Page.View&pid=71

The premier competition for high school students that recognizes outstanding research in biotechnology.

#### Toshiba ExploraVision

http://www.exploravision.org/

ExploraVision is a science competition that goes beyond the typical student science competition and into what it takes to bring ideas to reality. A teacher will sponsor and lead his/her students as they work in groups of 2 – 4 to simulate real research and development. A teacher will guide his or her students as they pick a current technology, research it, envision what it might look like in 20 years, and describe the development steps, pros & cons, and obstacles.

# Judging Criteria

Judging is based on student work and not that of a professional. Judges use many criteria to assess your project and no two judges will have the same opinion about what constitutes a good science project. However, the following concepts are common to all judges and will help you understand what judges are looking for in evaluating your project.

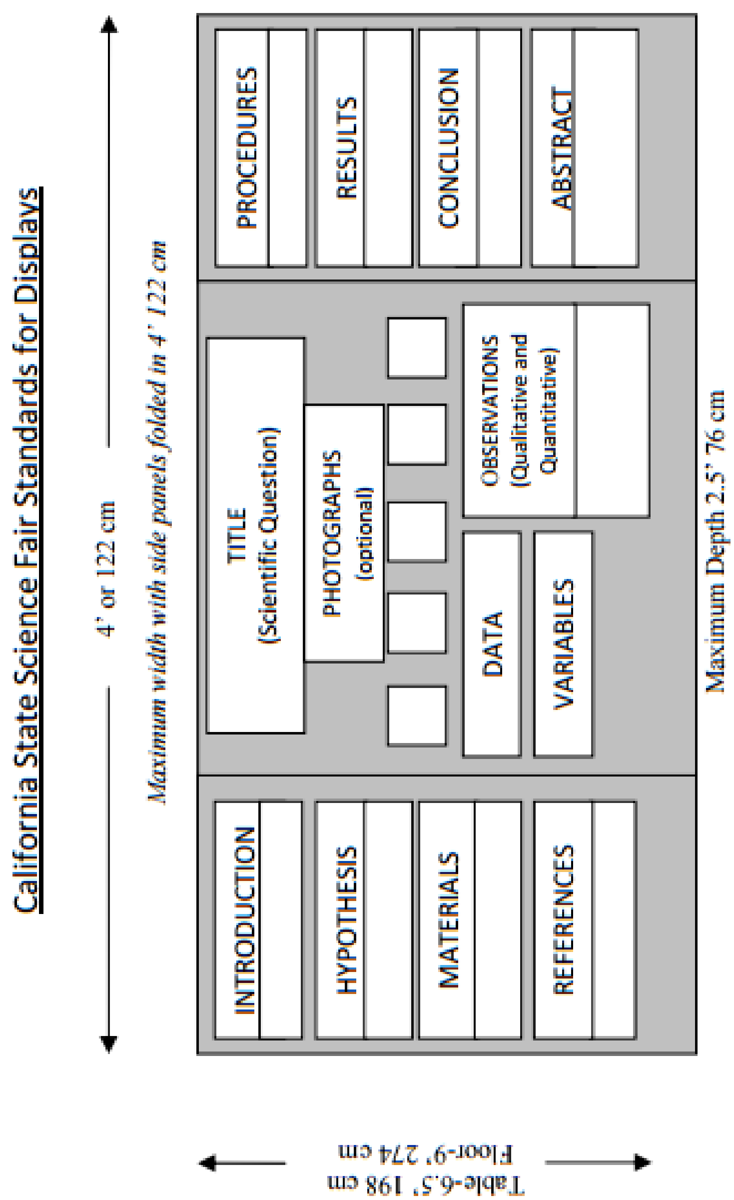
Projects must include a log book, digital display board, or photos of a physical display board, which meet the criteria on the samples provided here (also available on zFairs).


# Display Board Specifications

All projects must be free standing and must have a self-supporting display board. The student's name, school, and grade level should be displayed on the front of the board. Any indication of prizes or awards the project may have won at a local school science fair must be removed for display in the county fair. Listed below is a sample display board format. **Note:** We will not be collecting the physical boards.

**Exhibit size:**

- Maximum Width: 4 feet or 122 cm
- Maximum Depth: 2.5 feet or 76 cm
- Maximum Height: 6.5 feet or 198 cm on table
  OR 9 feet or 274 cm on floor.



# Judging Criteria

Judging is based on student work and not that of a professional. Judges use many criteria to assess your project and no two judges will have the same opinion about what constitutes a good science project. However, the following concepts are common to all judges and will help you understand what judges are looking for in evaluating your project.

## Digital Display Specifications/ How-To

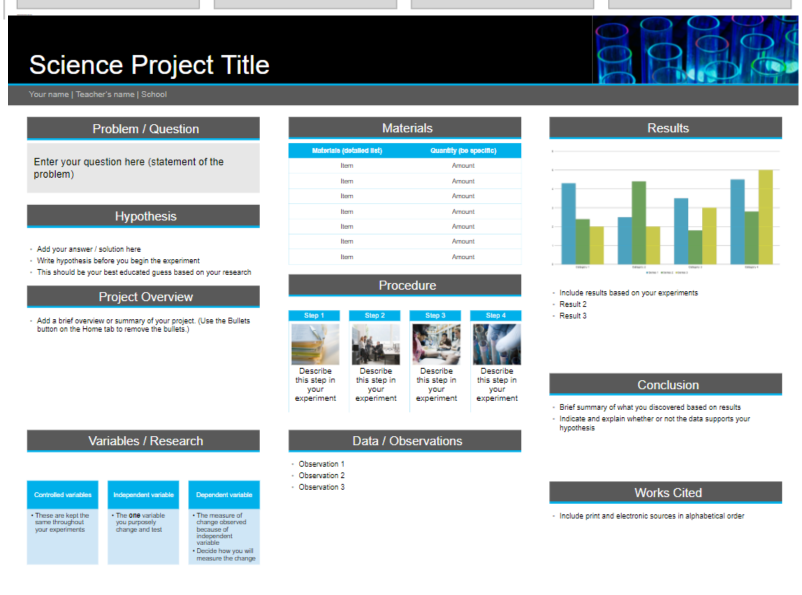
Students have the following options for digitally displaying their project:

- Digital Slideshow (saved as a PDF)
- Digital Poster (saved as a pdf or image file)
- High Quality Digital Photos of a Science Fair Backboard (we will ONLY be accepting digital photos of Backboards, not the physical backboard)
- Please note that zFairs allows for up to six images or PDFs to be uploaded. If the files are too large, you are responsible for shrinking them.

See templates for a digital display board below.

**Digital display board template #1**


**Digital display board template #2**



## Safety Rules

**<u>Anything which could be hazardous to public display is prohibited.</u>**

This includes:

- Live insects, or live disease-causing organisms which are pathogenic to vertebrates.
- Microbial cultures of fungi, alive or dead including unknown specimens.
- Chemicals or substances included on the federal list restricted to experimentation at college level or above.
- Flames, open or concealed, or flammable display materials.
- Caustics, acids, or dangerous chemicals.
- Combustible solids, fluids or gases (inert substitutes may be used for display).
- Tanks which have contained combustible gases, including butane and propane.
- Syringes, pipettes, or similar devices.
- Batteries with open top cells.
- No glass or liquids with display —we suggest drawings or photos.

## Electrical

1. Bare wires and exposed knife switches may be used only on circuits of 12 volts or less; otherwise standard enclosed switches are required.
2. Electrical connections in 110 volt circuits must be soldered or fixed under approved connectors and connecting wires insulated.
3. Safety precautions for substances in the American Chemical Society booklet, *Safety in academic Chemistry Laboratories,* must be followed.
4. Circuits with 110 volts must have a main disconnect switch of a type approved by the National Board of Underwriters. Where high voltage is used (110 or above) must be plainly labeled with a conspicuous sign stating high voltage.
5. Electric heating elements must be mounted on non-combustible supports in such a manner that a fire cannot possibly start in the exhibit, and enclosures must be thoroughly ventilated.
6. Exhibits producing temperatures exceeding 100°C (212° F) must be adequately insulated.

## Suggested List of Invertebrates / Plants for Scientific Investigation

| **ANIMALS**<br>Most of these specimens may be obtained at a pet store, in your own backyard, or may be ordered from a science materials catalog. | | **PLANTS/SEEDS**<br>Most of these seeds/plants are fast growing and may be obtained at a nursery, seed store or a health food store. | |
|---|---|---|---|
| Daphnia (transparent water flea) | Fruit Flies | Corn | Radishes |
| Brine Shrimp | Mealworms | Beans | Peas |
| Snails | Crickets | Lima Beans | Tomatoes |
| Protozoan | Sow bugs | Soy Beans | Duck Weed (aquarium plant) |
| Earthworms | Lady Bird (bugs), etc. | Alfalfa | Other young plants from a nursery, etc. |

**SHANE HILDEBRAND**

Mendocino County
Office of Education

2240 Old River Road

Ukiah, CA 95482

shildebrand@mcoe.us

707-467-5000