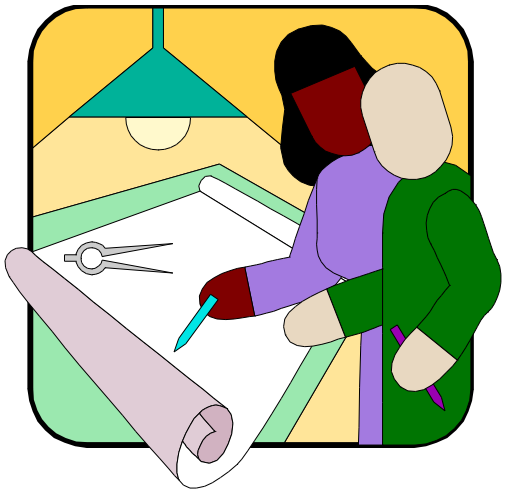
Doing A Meaningful Engineering Design STEM Fair Project

The main purpose of engineering is to design and build a prototype to have it perform by solving a problem, improving a situation, or to use it in a way where a task is easier to do.

Engineering Design Process

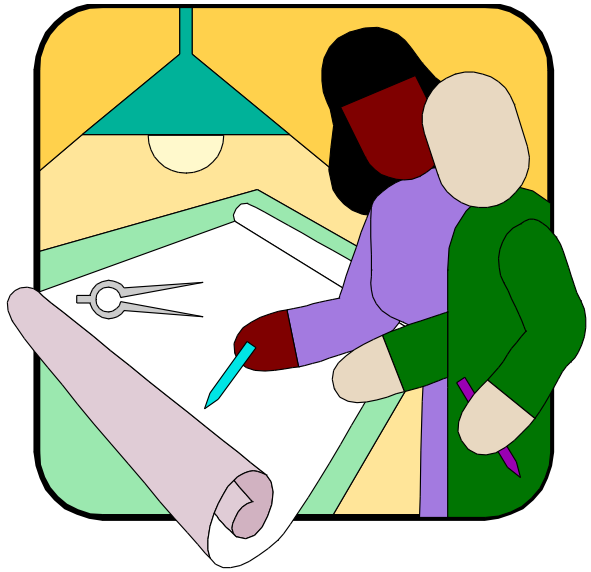
- **Define a Need** for what you want to construct.
- **Research** your idea to learn about your content and what you need to do make a prototype.
- Establish the **Design Requirements** needed for the development of the prototype--shape, size, width, appearance, physical features performance, etc. Include the **criteria** of what you want it to do and the **constraints** of what the limitations are.
- **Design a Plan and Methodology.**
  - Draw the beginning pictures showing what the design of the prototype might look like.
  - Label the parts and put in the measurements of the parts.
  - Many beginning drawings should be drawn. (Brainstorming)
  - Finally, focus on one type of design that you like.
  - Write up a list of materials needed to make it.
  - Make the step-by-step instructions to make it.



Engineering Design Process

Construction and Testing the Prototype

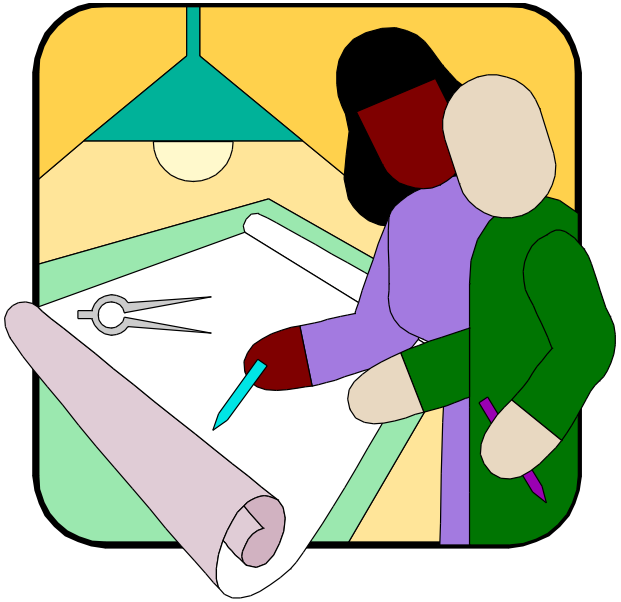
- Build the model with the directions you have planned.
- Test the model and record the results in your journal.
- Analyze the results to see if it follows the criteria and constraints.
- If needed, follow up with redesigning followed with more retesting, recording, and analyzing.
- Keep doing this until you are satisfied that the performance meets the criteria and constraints.
- Testing should be done in multiple conditions and trials.



Engineering Design Process

Reflection

- Write a reflection in your journal of a detailed account of the process involved in creating the prototype.
- Show a strong conclusion of what you found out about building and using the prototype.
- Show a strong application of the knowledge learned to real world applications.
- Your writing should show strong evidence of learning.



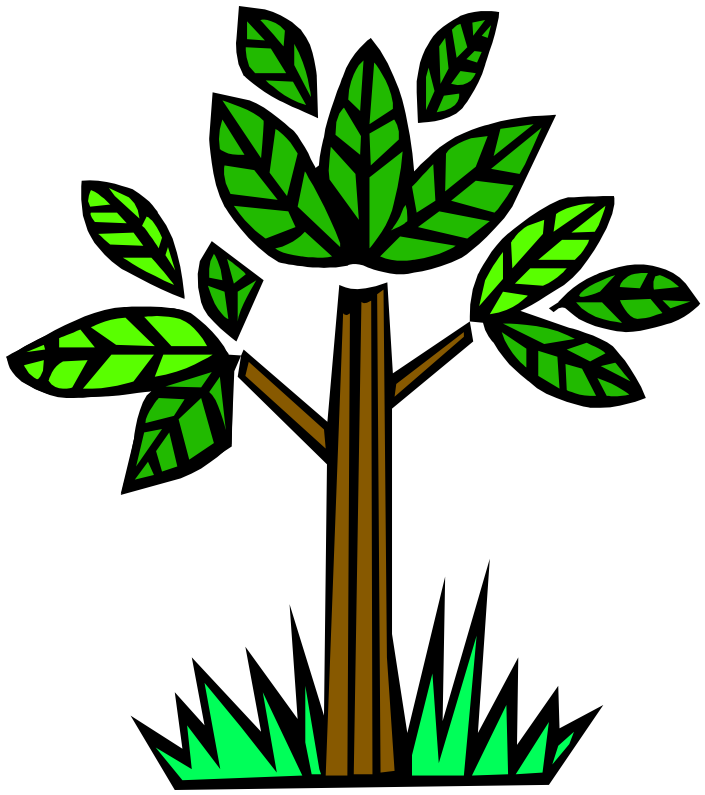
Other Things That are Required When doing a Engineering Design Project

- You need to have a STEM fair journal that shows the work you did and your results following the Engineering Design Process.
- You need a display board that shows all the steps of the engineering design process.
- An interview will be conducted to see if you can explain the engineering design in reference to the project.

How to prepare the journal, display board and for the interview will be shown later in this document.

Engineering Design Process

Choose a Subject You Are Interested In for an Engineering Design Project



Examples of Projects
"What can you do with….?"

balance
floating in water
periscopes
wind power
musical instruments
renewable energy
water flow
weather instruments
batteries
rubber bands power
mechanical power
weather instruments
magnet power
pulleys
laws of motion
things that float
evaporation
solar power
balancing
cold
simple machines
electricity power
gears
solar ovens
floating in air
bridges
reducing friction
catapults
efficient energy
rockets
evaporation
heat
airplanes
chemical change
hot air
insulation

Follow the Engineering Design Process While Doing Your STEM Fair Project

- On the next few slides are the steps of the Engineering Design Process.
- Please follow each step of the Engineering Design Process as completely as you can.
- Be sure to do each step. Do not skip any steps.
- Write everything you do in your journal.

The Engineering Design STEM Journal

Before you begin, you need a journal.

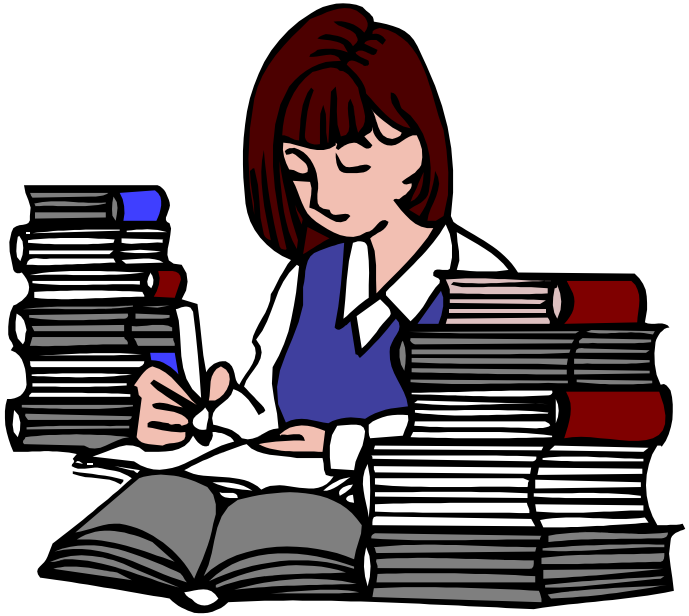
- STEM fair projects need to show a record of everything done by you as an "engineer".
- This record is kept in a journal, recording all the things you do each day you work on your project.
- The journal will have the detailed work you did for each step of the engineering design.
- You need a title page and a table of contents in the journal.
- The table of contents will include all the steps of the Engineering Design Process.
- Be sure you date each day you work on your project.

Define a Need

- Begin by writing a need for something you want to construct. Be sure to have a purpose. It could be to:
  - Solve a problem
  - Improve a situation that needs improvement
  - Making something that will make work easier to do.
- Write it so the need is clearly understood.

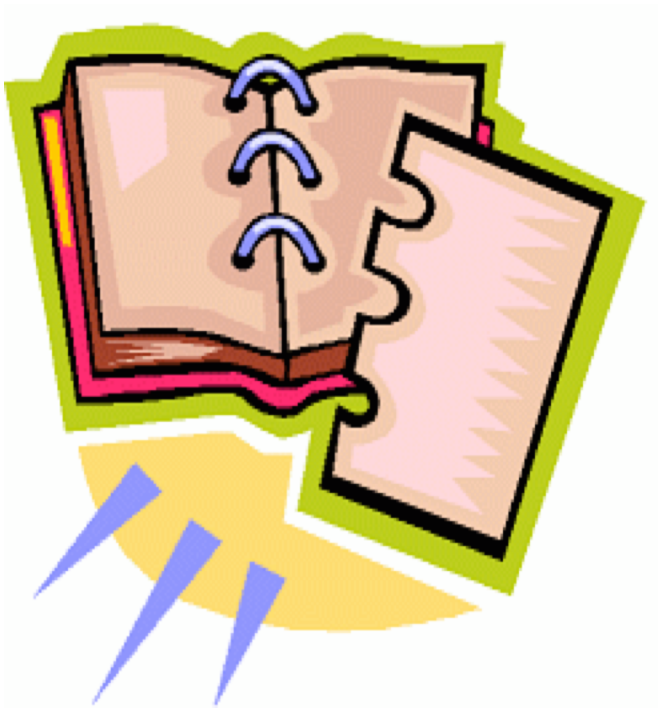
Research Your Type of Design

- Before you begin designing, you need some background information by using some of these resources:
  - Encyclopedias
  - Science Magazines
  - Science Textbooks
  - Library Books
  - Internet
  - Interviews
  - Letters
  - Phone Calls
- You need to research your topic by using at least three sources.
- Record the information you learned in your journal.



Engineering Design Requirements

- Based on your research, you now have an idea of what what your prototype would look like and its importance.
- Establish the design requirements (criteria and constraints) needed of what you expect the prototype to do when it is built and tested.
- The requirements will relate to the size, weight, shape, appearance, and physical features, and the performances (criteria).
- The requirements will also relate to the the cost, time, and effort needed to build the prototype (constraints).



Design Plan and Methodology

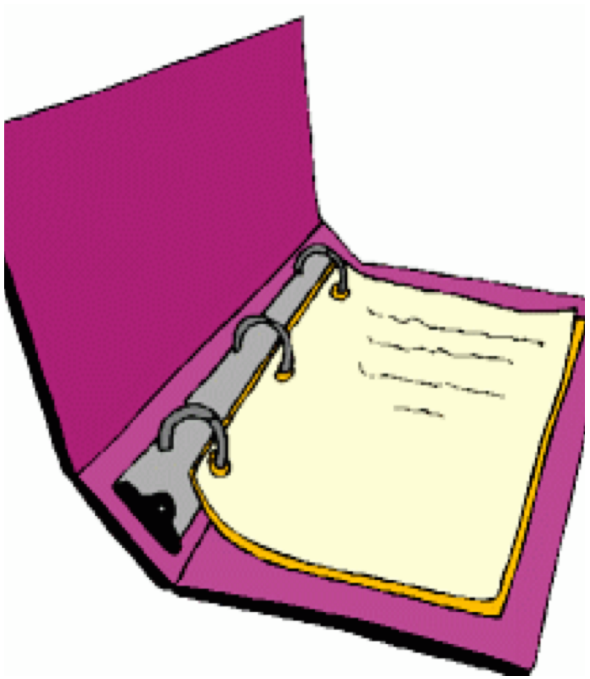
Beginning Designs

- Begin by brainstorming features that would be necessary for your prototype to have to work according to your requirements.
- Make three or four drawings on paper what your design should look for it to achieve the requirements.
- Label the parts on the drawings.

Design Plan and Methodology

Final Design

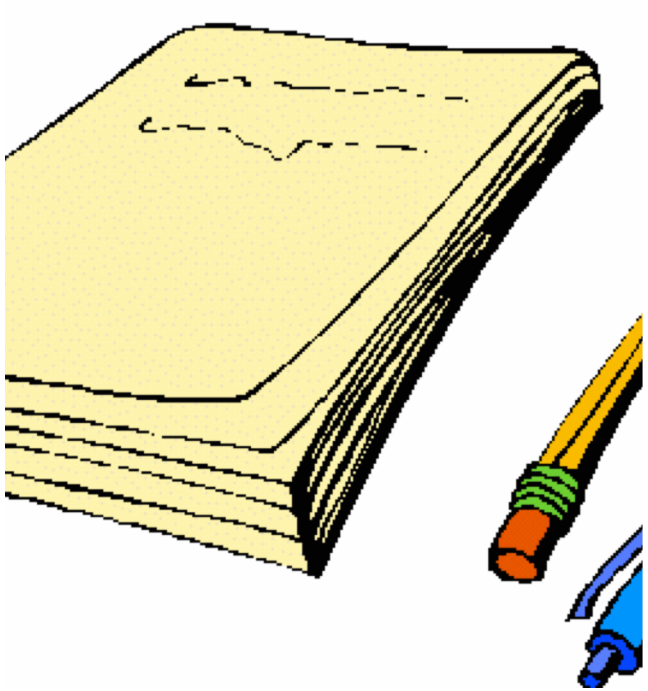
- Focus in on one of the designs that you feel will be the best design for the needed requirements of the prototype.
- Include the criteria (needs) to make the prototype.
- Include the constraints (limitations) of the prototype.
- Continue to change the design to get closer to what you think is the best design for the needed requirements.
- As you work on the changes it should show progress from design to design.
- Label the parts of the designs.



Design and Methodology

Materials

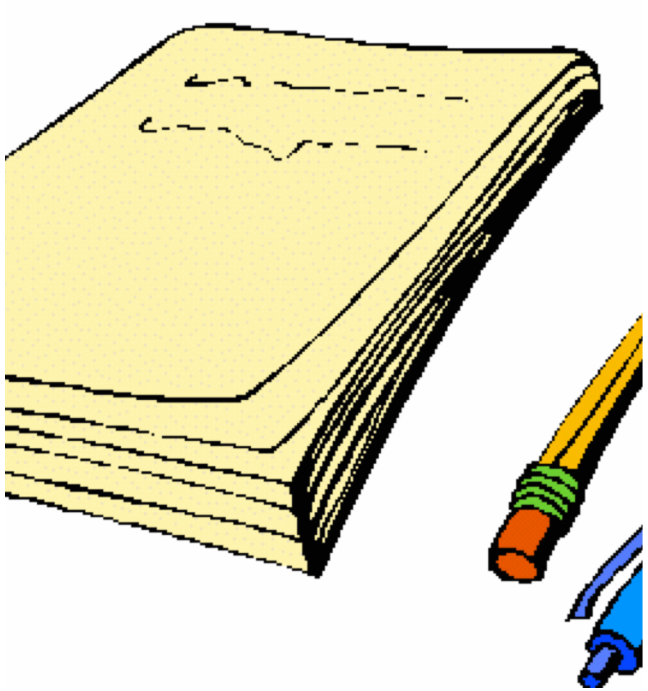
- Make a list of all the materials and equipment you will need to build the prototype.
- Using descriptive words to describe the materials and equipment is important.
- Any materials that are measured should have the measurements included.



Design and Methodology

Step-by-Step Procedure

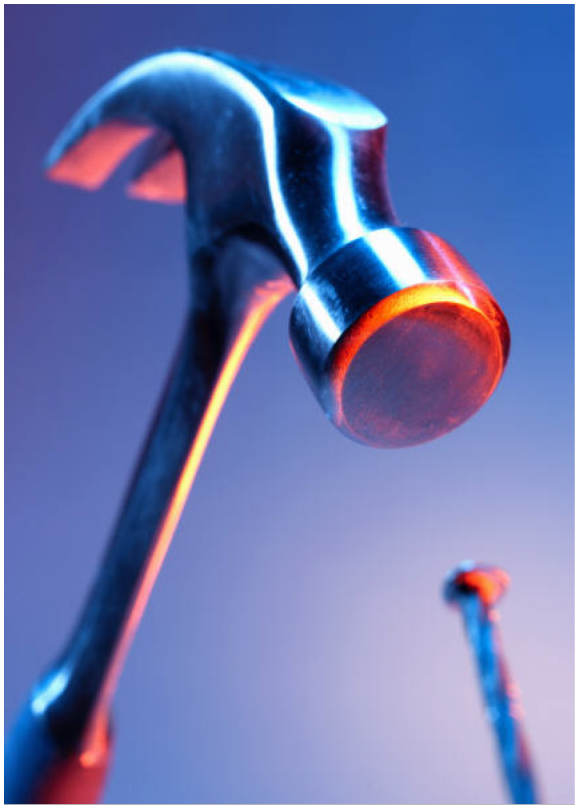
- You need to write the step by step directions you will follow to build the prototype.
- Use numbers in the directions to tell exactly the order you are going to follow to build the prototype.
- As you write your directions in your journal, be very descriptive in your writing so anyone reading it will know exactly what you did.



Constructing, Testing, Recording and Analyzing the Prototype

Building

- Build the prototype according to the design drawings, design requirements, list of supplies, and the step-by-step procedure.
- Be sure it follows the criteria and constraints that were written.



Constructing, **Testing**, **Recording** and Analyzing the Prototype

Testing and Recording

- After the prototype is built, it needs to be field tested to see if it works according to the design requirement.
- Record what is actually happening during testing in your journal.
- Be as descriptive as possible.
- Test it two or three times to get accurate data.

Constructing, Testing, Recording and **Analyzing** the Prototype

Analyzing the Data

- Look at your data carefully so see if the results match the design requirements.
- Write down what you see that is working well and needs no changing.
- Write down what needs to change for the prototype to match the design requirements.

Redesign, Retest, Record And Analyze

If your prototype didn't work exactly to the design requirements, criteria and constraints, you will need to make adjustments.

- Redesign by redrawing the changes needed to meet the requirements.
- Keep accurate notes of the changes you needed to make just in case you need to go back and look.
- Make the changes on your prototype.
- Retest the prototype two or three times and write down what you see happening.
- Analyze the data to see if it matches the design requirements.

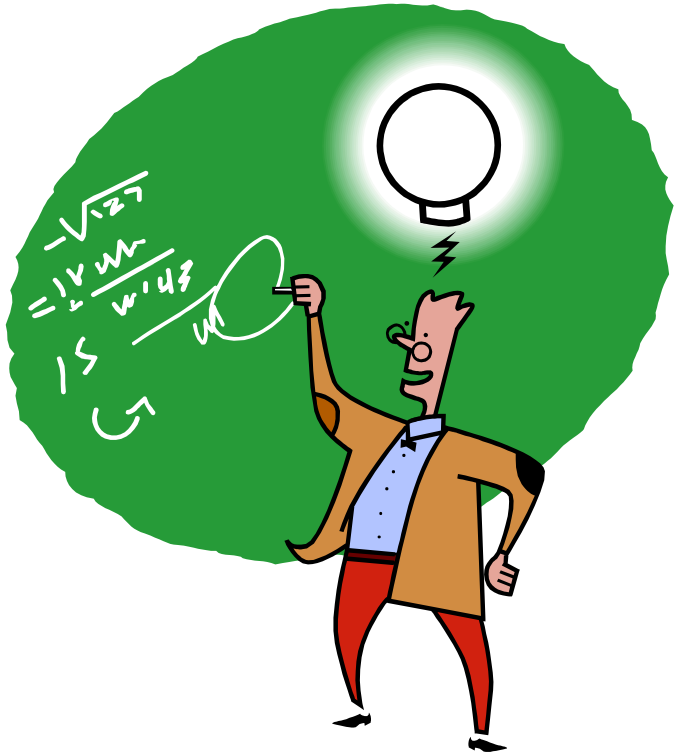
Redesign, Retest, Record And Analyze

- If the data match the design requirements, then you are done.
- If the data doesn't match the design requirements, then redesigning, changes to the prototype, testing and recording and analyzing should continue until you you are satisfied with the testing results.
- Be sure to write down all the changes made and the testing results of each change.

Reflection
What Did You Find Out?

Write about these ideas in your journal and anything else you can think of.

- Write what you learned while doing your project?
- How did the results validate what was expected to happen?
- What did you learn from your project?
- In what ways is your prototype important?
- What are other questions you have now?
- What might you do differently next time if you made one again?
- How can the information you learned be applied to real life.
- Does what you write show evidences of learning?



The Display Board

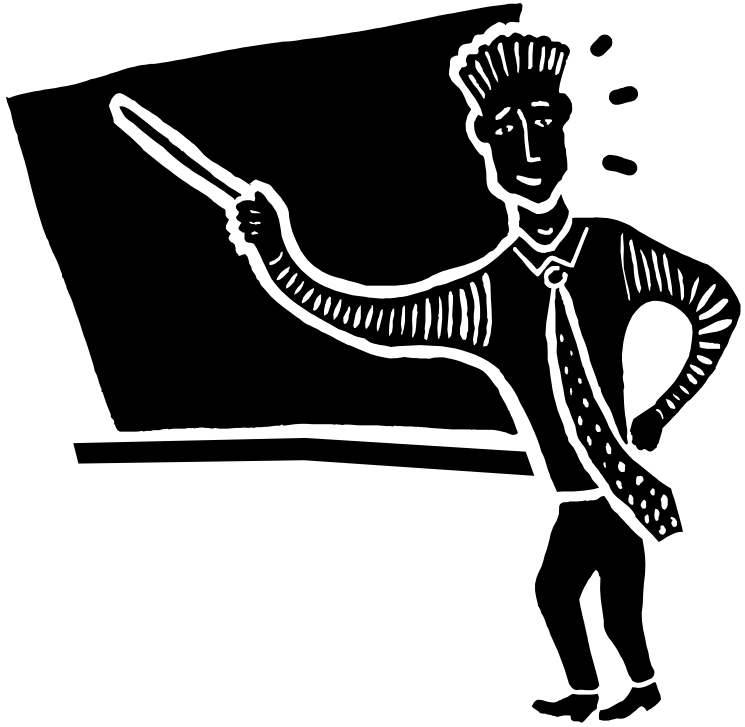
This is your Showcase!

You need a display board.

- All the steps of the Engineering Design should be on the display board except the research.
- Give yourself at least 1 week to make your display board.
- Make it:

  Neat, Creative, Easy to Follow, Errorless (no scribbles), and Informative

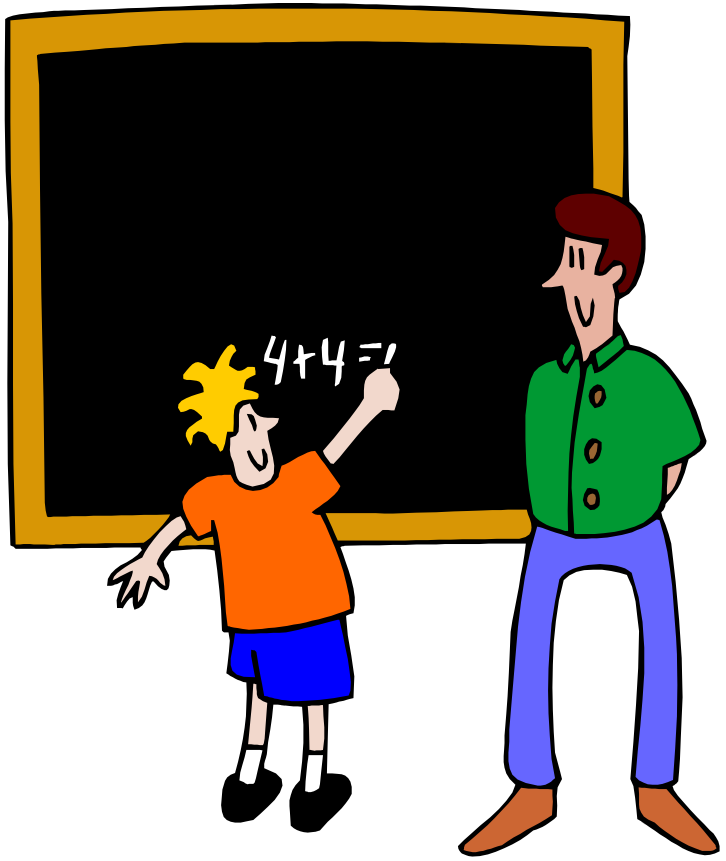
- Your display board should reflect your journal but may not have as much information as your journal.



The Interview

You will be interviewed.

- Know these things:
  - Information you have read about.
  - All the things you did while following the engineering design.
  - What you learned from your project.
  - How the projects has helped you better understanding the world around you.
  - Other questions you now have.
  - What you would change next time if you did the project again.

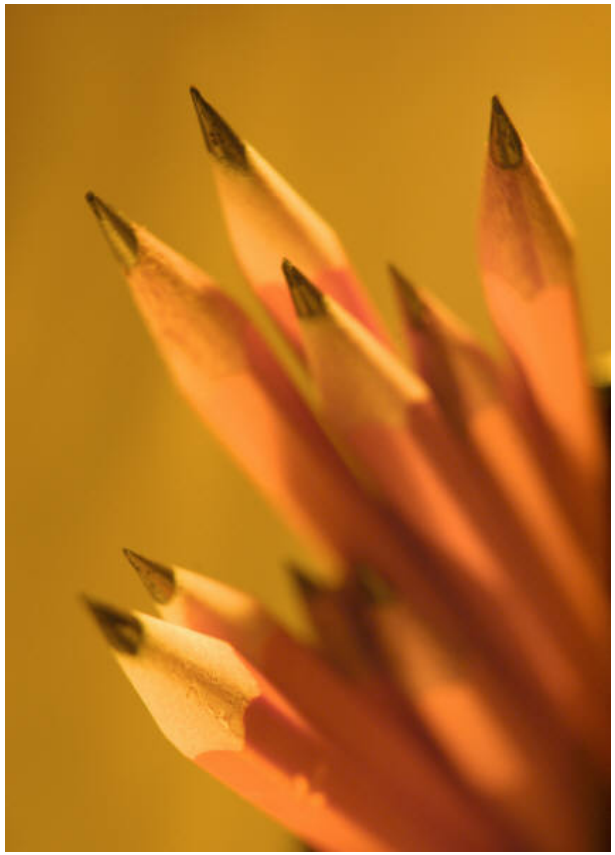


Thoroughness

- Follow through with these ideas:
  - Goals of the project
  - Creativity in the design
  - Clarity
  - Appropriate methods
  - Appropriate equipment
  - Appropriate grade level
  - Knowledge
  - Enthusiasm
  - Individual effort
  - Completed journal
  - Creative display board

2019-20 STEM Fair Entry Form

- Before you begin your project for the school STEM fair, you need to fill out the 2019-20 Central Utah STEM Fair Entry Form.
- Filling out this form helps you know what you need to do to qualify for the school fair, district fair, and the Central Utah STEM Fair.
- It gets you started in the right direction.
- There are three pages to this form that needs to be filled out.
  - Page 1 Student Information and "Special Projects' Signature Page"
  - Page 2 Science Fair Project Research Plan
  - Page 3 Safety Rules and Signatures



STEM Fair Rules

Some STEM fair projects may be dangerous to humans and animals. If your project includes any of the things written below, signatures must be obtained by professionals to make sure it is safe. These rules are set by the International Science Fair committee and need to be followed when doing a STEM fair project. **If these rules are not followed, the project will be disqualified for any science fair competition.**

1. Using Humans
2. Using Vertebrate Animals
3. Using Hazardous Substances or Devices
4. Using Bacteria, Mold, Fungi, Viruses, Parasites, Human or Animal Fresh Tissues, or Body Fluids
5. Using controlled substances

The following slides go into detail of the projects listed above and the signatures that need to be obtained to qualify to be in the school and district STEM fairs. Page one on the CUSF STEM Fair Entry Form is for the signatures needed.

Also note: Growing any microorganisms must be done in a lab. Any microorganisms that are grown at home will disqualify the science fair project for any competition.

Some STEM Fair Projects Need Signatures

If you do a science fair project using humans you need approval and signatures from:

- **Your school science teacher**
- **A school psychologist (from your school), psychiatrist, a medical doctor, physician's assistant, or a registered nurse.**

Note: All people used in the experiment must sign a consent form. If children are used who are under 18, parents must sign a consent form for each of the children used.

Some STEM Fair Projects Need Signatures

If you do a science fair project using vertebrate animals you need approval and signatures from:

- **Your school science teacher**
- **A biomedical/biological scientist (veterinarian in this case)**

Note:

- **Pets can only be used for these experiments and used for observational purposes only for behavioral study.**
- **There can be no pain or discomfort to the animal(s) during the experiment.**
- **Proper care must be provided at all times.**

Some STEM Fair Projects Need Signatures

If you do a science fair project using controlled substances (prescription drugs, tobacco, alcohol) you need approval and signatures from:

- **Your school science teacher**
- **A biomedical/biological scientist**

Note:

- **An adult must directly supervise the experiments.**
- **Students must adhere to all federal, state and local laws when acquiring and handling controlled substances.**

Some STEM Fair Projects Need Signatures

If you do a science fair project using hazardous substances or devices (chemicals, firearms, welders, lasers, radioactive substances, radiation you need approval and signatures from:

- **Your school science teacher**
- **A school administrator from your school**

Note:

- **An adult must directly supervise the experiments.**
- **Adhere to federal and state regulations governing hazardous substances or devices.**
- **Follow proper safety procedures for each chemical or device used in the research.**

Some STEM Fair Projects Need Signatures

If you do a science fair project using bacteria, mold, fungi, viruses, parasites, human or animal fresh tissues, or body fluids you need approval and signatures from:

- **Your school science teacher**
- **A biomedical/biological scientist**

Note:

- **Elementary students cannot use blood in experiments.**
- **Organisms collected in petri dishes must be sealed, grown and stored only in a controlled place like a science lab under the supervision of a scientist. They cannot be grown and stored at home. They will be disqualified if they are grown and stored at home.**
- **Using plant parts, hair, sterilized teeth, and fossilized tissue in experiments need no signatures.**

Using People in Your Experiment

If you use people in your project, you must get proper signatures to use them.

- If they are 18 and over, you need to have them sign a paper saying that it is all right to use them in an experiment.
- If they are under 18, you need to have the parents of these children sign a paper saying that is is all right to use them in an experiment.

For More Information and Help on Putting a STEM Fair Project Together…

You can visit the Central Utah STEM Fair Website at:

http://cusef.byu.edu

Questions or Puzzled?

If you have any questions about the rules or procedures, contact paul.nance@jordandistrict.org or call at 801-244-6479.