

Understanding the Three STEM Fair Project Processes

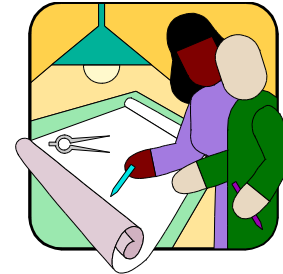


Three Different Types of Processes to Choose From for a STEM Fair Project

The Scientific Method



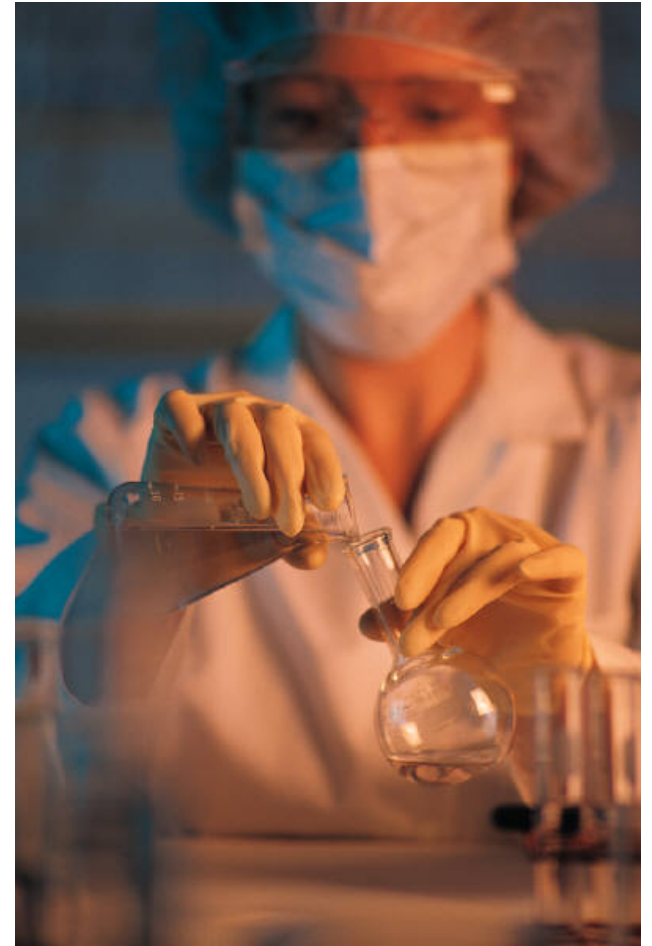
The Engineering Design



The Computer Design



The main purpose of the **Scientific Method Process** is to discover something about nature and connect it to our world. This helps us better understand our world to see why something happens, also to solve or prevent problems.



The main purpose of **The Engineering Design Process** is to design and build a prototype to have it perform to solve a problem, improve a situation, or to use it in a way where a task is easier to do.



The main purpose of the **Computer Design Process** is to program a computer for people to learn about new ideas, learn how to do something, find information that they want to know, or for the computer to perform a useful function.



The Scientific Method Process

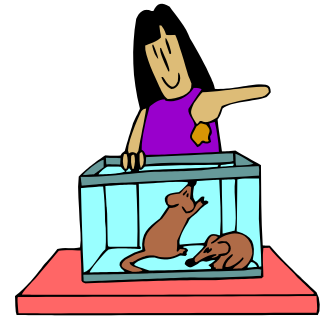
These are the required steps when using the Scientific Method Process.

- Purpose
- Research
- Hypothesis
- Experiment:
 - Write down the materials you will need
 - Write the step-by-step instructions you will follow
 - Write the variables of the experiment
 - Write what you see happening in the experiment (data).
- Analysis
- Conclusion



The Scientific Method Projects

- This scientific method will be used for the following projects:
 - Earth & Environmental Projects
 - Life Science Projects
 - Physics, Astronomy, and Mathematic Projects
 - Chemistry Projects
 - Consumer Science and Product Testing Projects



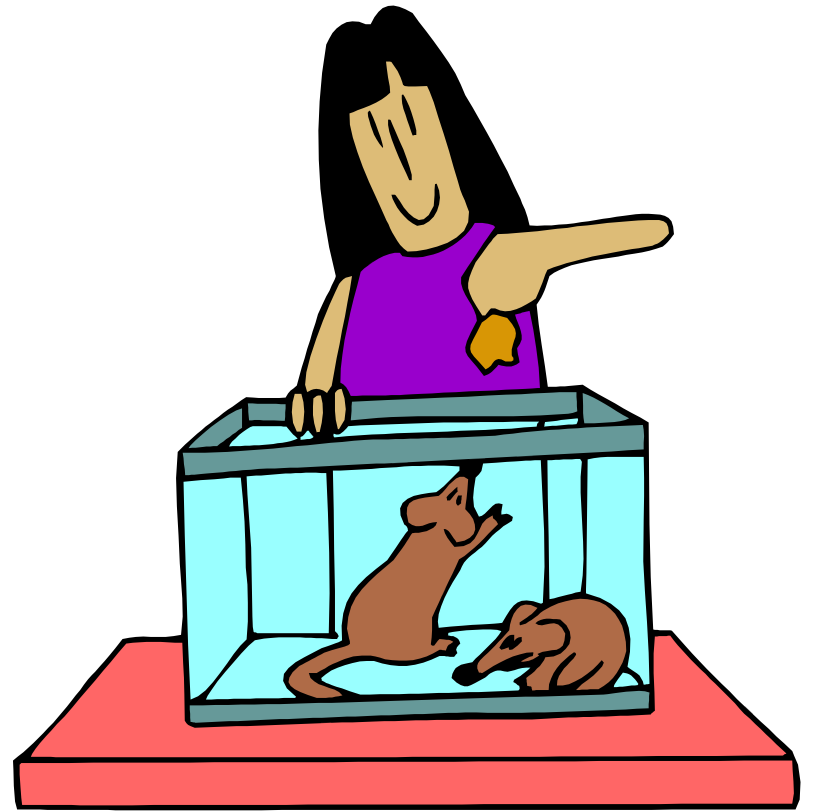
Earth & Environmental Projects

Volcanoes, soil, rocks, minerals, crystals, erosion, weathering, soil deposits, ocean water, earthquakes, fossils, water cycle, weather, air, water, wind, humidity, cold, heat, smog, particles in the water and air, global temperatures, landfills, recycling, composting, any types of pollutants, plant diseases, growing plants organically, and wasting water.



Life Science Experiments

Animal, plant, insect, and human behavior; ecosystems such as forests, deserts, grasslands, and wetlands; food chains, plant cycle, and metamorphosis.



Physics, Astronomy, and Mathematics Projects

Forces in nature — gravity, magnets, centripetal and centrifugal forces, friction, balanced and unbalanced forces; laws of motion; work; simple machines; forces in gases and liquids; pressure, buoyancy, and lift; energy — heat, light, sound, electricity; rotation, revolution, seasons, tides, gravitation pull, brightness/color of stars, space particles, stars, micrometeorites, and asteroids; proof through math, geometric studies, distances in space, math formulas and calculations to prove ideas.



Chemistry Projects

States of Matter--
solids, liquids, and
gases; mixtures,
solutions and
suspensions;
chemical formulas,
reactions, and
equations; chemical
and physical changes.



Consumer Science and Product Testing Projects

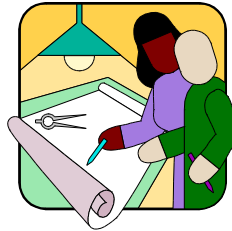
- Testing products you see in advertisements.
- Testing products against each other to see which is the best such as popcorn, diapers, cereals, gum, soda pop, oil in potato chips or French fries, stain removers, soaps, paper towels, and bandages.



The Designing Method*

The designing method will be used for the following projects:

– Engineering Design



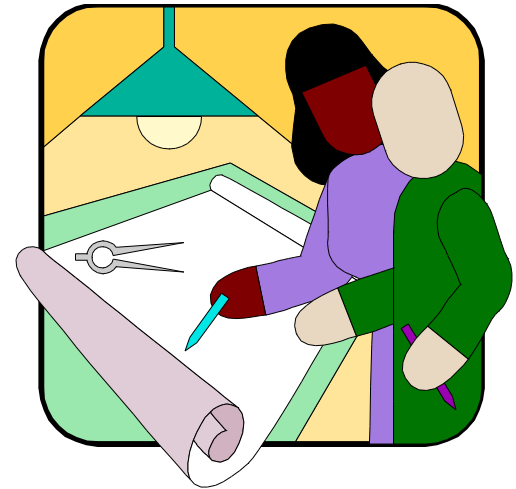
– Computer Science Design



Engineering Design Process

These are the required steps when using the Engineering Design Process.

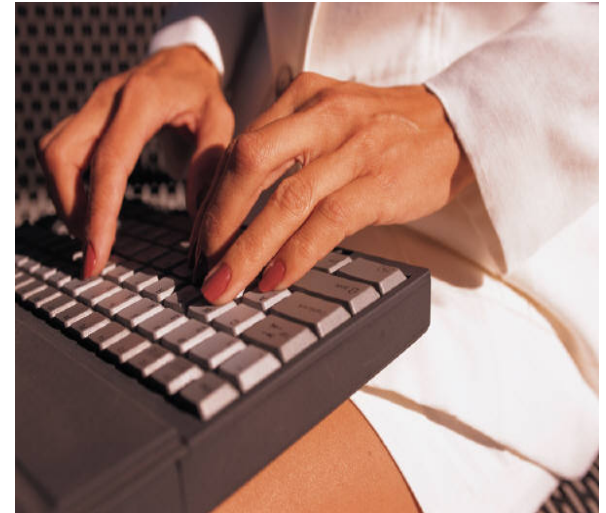
- Define a need for you prototype
- Research your topic
- Establish requirements of what the prototype will do
- Design many drawing of your idea
 - Focus on one drawing for a prototype.
 - Make a list of the materials
 - Plan a step-by-step how it is to be built
- Build the model
- Test the model and analyze the results
- Redesign, test, and analyze if needed
- Write a conclusion what you learned



Computer Design Process

These are the required steps when using the Computer Design Process.

- Define a need for your program
- Research your topic
- Establish requirements of what the program will do
- Design many code ideas
 - Focus on one code for your program
 - Plan the step-by-step process
 - Program your computer with the code.
- Test the model and analyze the results
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- Write a conclusion what you learned



Other Things

That are Required When doing a STEM Fair Project

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

Examples of Projects

“What can you do with....?”

eggs

water

flashlights

balls

straws

concentration

shoes

tastes

balloons

rubber bands

memory

newspaper

magnets

salt

colored paper

things that float

smells

different ages

ice cubes

blindfolding

bubbles

sponges

things that sink

music

coins

soaps

noise

marbles

voices

colors

evaporation

cotton

paper airplanes

dissolving things

animal tricks

small cars

Doing A Meaningful Scientific Method STEM Fair Project



Follow the Scientific Method Process While Doing Your STEM Fair Project

- On the next few slides are the detailed steps of the Scientific Method Process.
- Please follow each step of the Scientific Method 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 Scientific Method Process

These are the required steps when using the Scientific Method Process.

- Purpose
- Research
- Hypothesis
- Experiment:
 - Write down the materials you will need
 - Write the step-by-step instructions you will follow
 - Write the variables of the experiment
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- Analysis
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The STEM Fair

Scientific Method Journal

Before you begin you need a journal.

- STEM fair projects need to show a record of everything done by you as a “scientist” following the Scientific Method.
- You need a title page, table of contents, all parts of the Scientific Method, and a bibliography in the journal.
- The table of contents will include all the steps of the Scientific Method Process.
- Everything you do pertaining to your project will be recorded in your journal including observations and measurements.
- Be sure you date each day you work on your project.



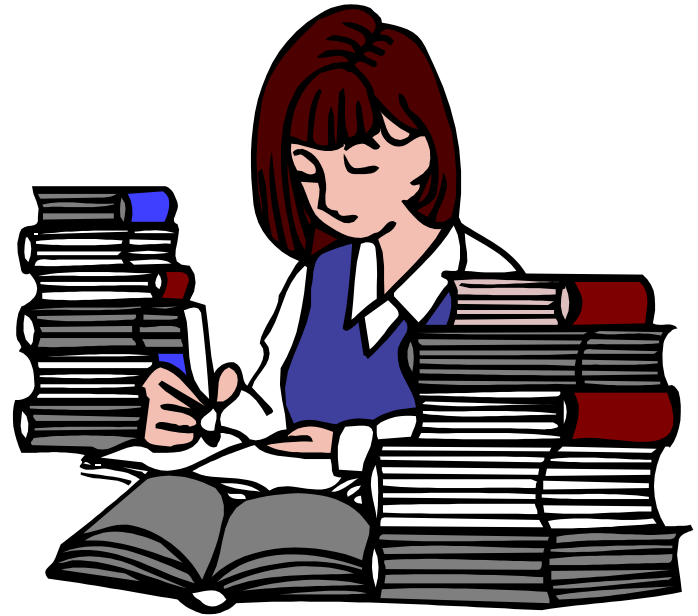
What is Your Purpose?

- The purpose shows that you are going to solve a problem or find out something you don't know. **Write your purpose in the form of a question in your journal.** This is what you want to investigate.



Research Your Topic

- Before you begin experimenting, 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 resources.
- Record the information you learned about in your journal.



Make a Hypothesis

- You are ready to make a prediction of what you think the results of your experiment will be in your journal.
- Based on your research, what do you think will happen when you do your experiment?
- **You also need to put an explanation in your journal as to “why” you chose this hypothesis.**
- **Example:**

Hypothesis:

When light shines on an object, the object will become hotter at a direct angle than on an indirect angle.

Explanation:

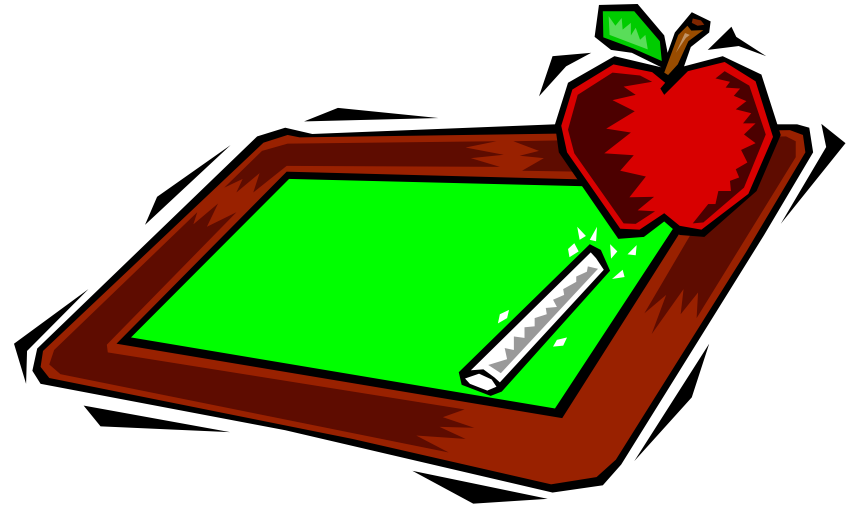
Light shining straight down covers a smaller area than shining on an angle. When on an angle, more heat is spread out causing less heat on the object.



The Experiment

List of Materials

- At this time you need to make a list in your journal of materials you are going to need for your experiment.
- Be sure to make your list very complete with describing words.
- Tell of all measurements and quantities you are going to use.



The Experiment

Step-by-Step Directions

- You need to write the directions of the procedure you are going to follow to do the experiment in your journal.
- These directions tell exactly the process you are going to follow as you do your experiment.
- As you write your directions in your journal, you have to be sure your test is fair. Keep all the conditions the same each time you do the experiment.



The Experiment

Controlled and Experimental Variables

- “**Variable**” means something can change. Everything around us has the possibility of changing so we live among variables. Variables are all the factors that have an effect on your experiment.
- You want to control most of the variable so they are called **controlled variables**.
- You only want to change one variable to have a different outcome each time you do your experiment. This is called the **experimental variable**.
- Write your controlled variables and the one experimental variable in your journal.



The Experiment

Gathering Data

- As you do your experiment, you are going to observe things happening.
 - Be sure to write down the data you are observing in your journal. This is your raw data.
 - Organize your raw data into a table in your journal.
- Be sure to collect sufficient data to make a reasonable conclusion.
- Test your experiment at least twice so it is valid.



Analyzing Your Data

To analyze mean to break something up into parts to be able to examine it. That is what you have to do with the data.

- **The first step in analyzing your data is to make a graph.**
- A graph is a picture of the results of your experiment.
- On a graph the experimental variable is usually written at the bottom.
- The measurements are usually written at the left side.
- The data is the information on the graph.
- **Then write a paragraph describing what the graph is telling you.**
- Be sure to make your graph in your journal with the written analysis.



Bibliography

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 - Page numbers
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The Display Board

This is your Showcase!

You need a display board.

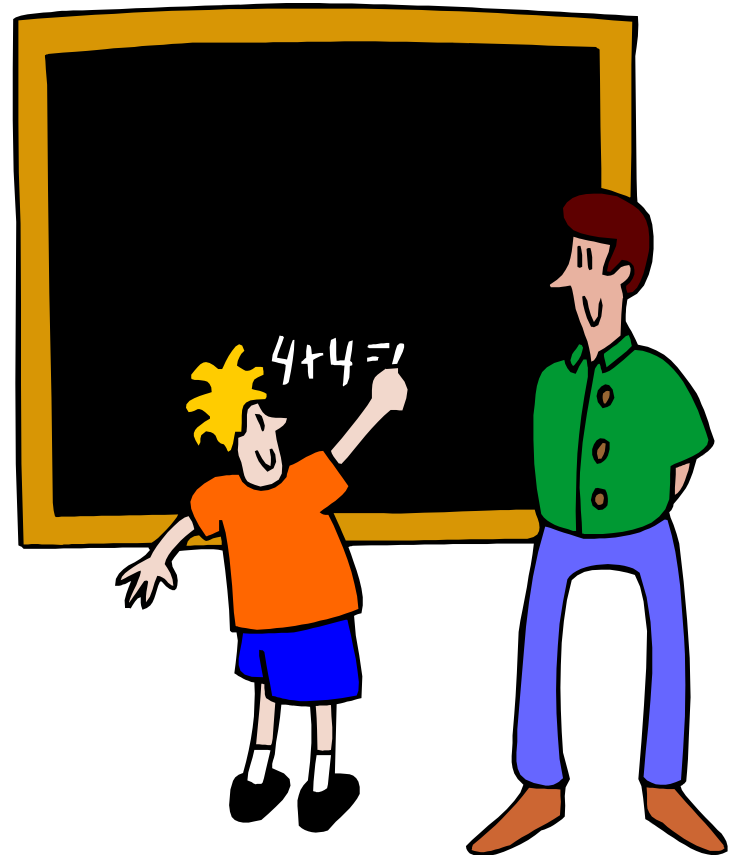
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- Make it:
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The Interview

You will be interviewed.

- Know these things:
 - Information you have read about.
 - All the things you did while following the Scientific Method.
 - What you learned from your project.
 - How the projects has helped you better understanding the world around you.
 - Other questions you now have.
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Doing A Meaningful Engineering Design STEM Fair Project



Follow the Engineering Design Process While Doing Your STEM Fair Project

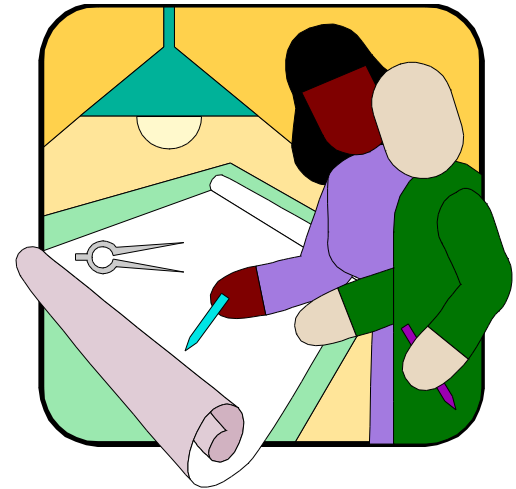
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Engineering Design Process

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- Define a need for you prototype
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 - Focus on one drawing for a prototype.
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The STEM Fair

Engineering Design Journal

Before you begin, you need a journal.

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- You need a title page, table of contents, all parts of the Engineering Design, and a bibliography in the journal.
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- Everything you do pertaining to your project will be recorded in your journal including observations and measurements.
- Be sure you date each day you work on your project.



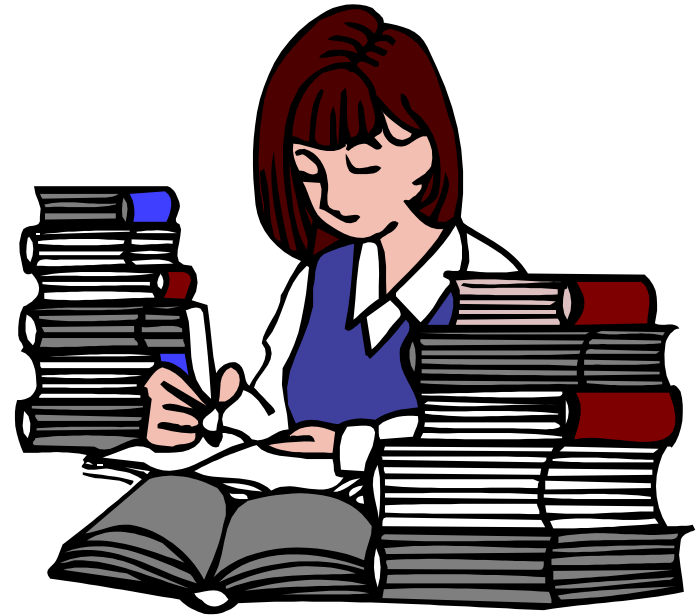
Define a Need

- 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:
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- Record the information you learned in your journal.



Engineering Design Requirements

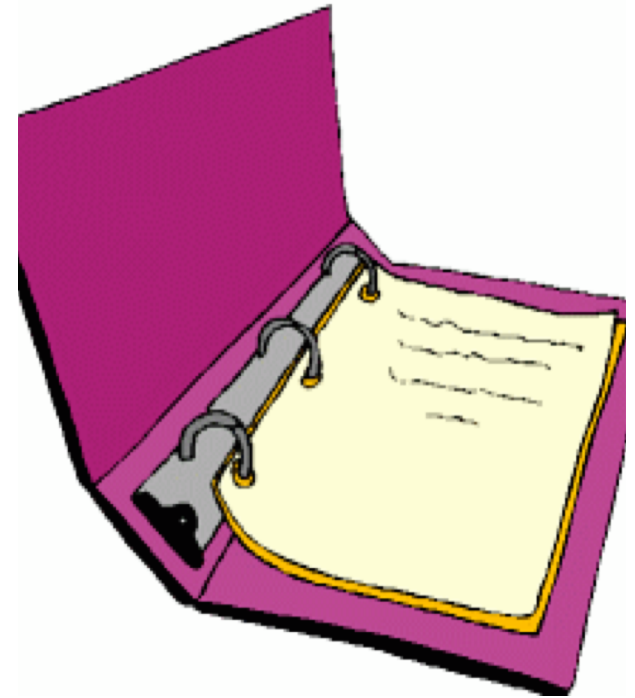
- Based on your research, you now have an idea of what your prototype would look like and its importance.
- Write down the design requirements what you expect the prototype to do when it is built and tested.
- The requirements will relate to the size, weight, shape, appearance, and physical features,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



The Designing of the Prototype

Beginning Designs

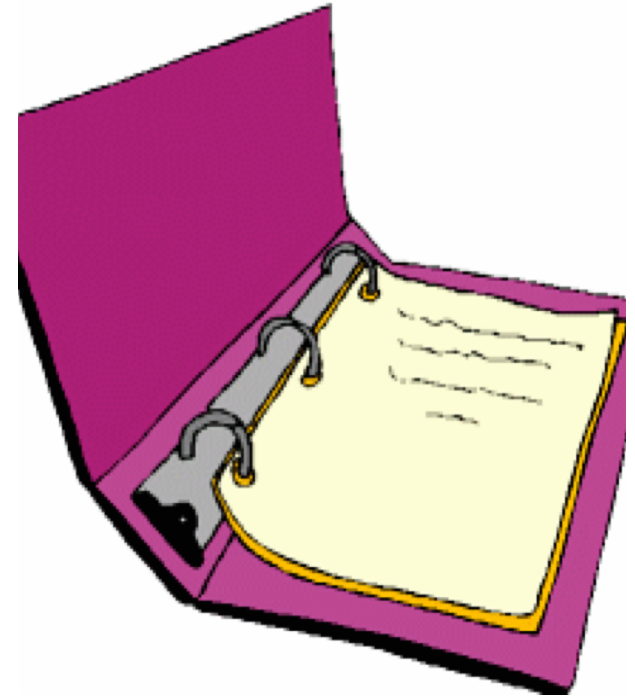
- Begin by brainstorming features that would be necessary for your prototype to have to work according to your requirements.
- Make three or four drawings on paper what your design should look for it to achieve the requirements.
- Label the parts on the drawings.



The Designing of the Prototype

Final Designs

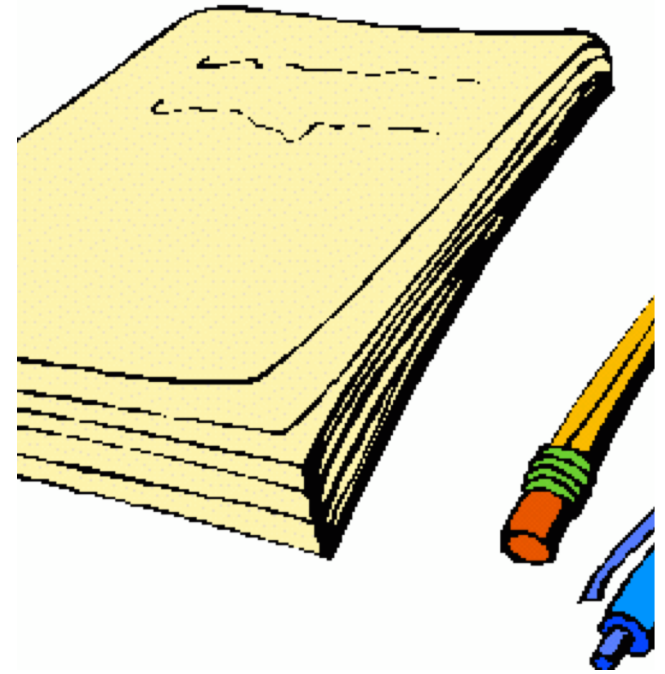
- Focus in on one of the designs that you feel will be the best design for the needed requirements of the prototype.
- Continue to change the design to get closer to what you think is the best design for the needed requirements.
- As you work on the changes it should show progress from design to design.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



Designing of the Prototype

List of Materials

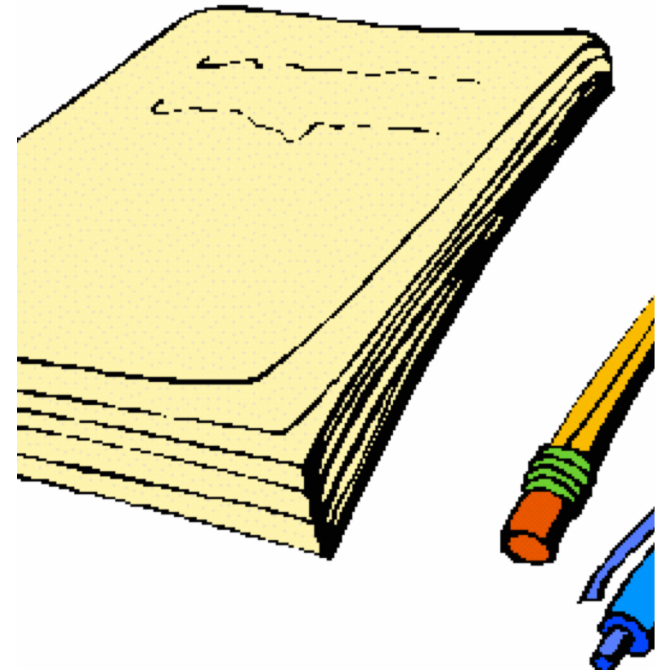
- Make a list of all the materials and equipment you will need to build the prototype.
- Using descriptive words to describe the materials and equipment is important.
- Any materials that are measured should have the measurements included.



Designing of the Prototype

Step by Step Instructions

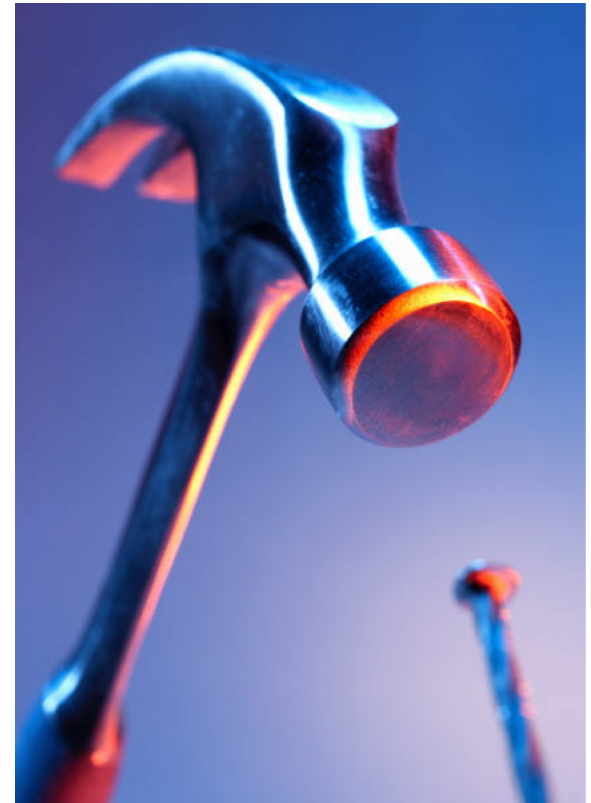
- You need to write the step by step directions you will follow to build the prototype.
- Use numbers in the directions to tell exactly the order you are going to follow to build the prototype.
- As you write your directions in your journal, be very descriptive in your writing so anyone reading it will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



Building, Testing, Recording and Analyzing the Prototype

Building:

- Build a prototype according to the design drawings, design requirements, list of supplies, and the step-by-step procedure.
- Write about your experience building the prototype in your journal.



Building, Testing, Recording and Analyzing the Prototype

Testing and Recording

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



Building, 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

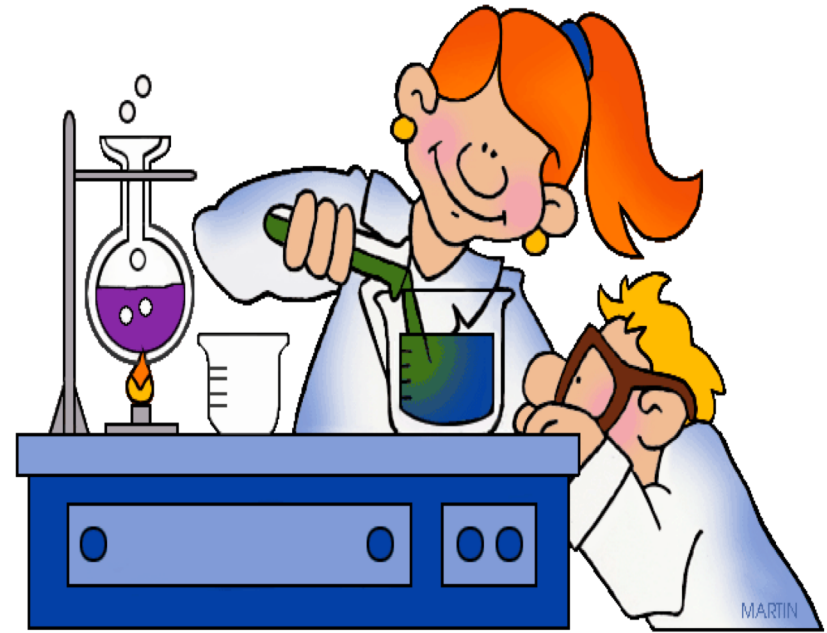
If your prototype didn't work exactly to the design requirements, you will need to make adjustments.

- Redesign in a drawing of what changes you need to make and label the changes.
- 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.



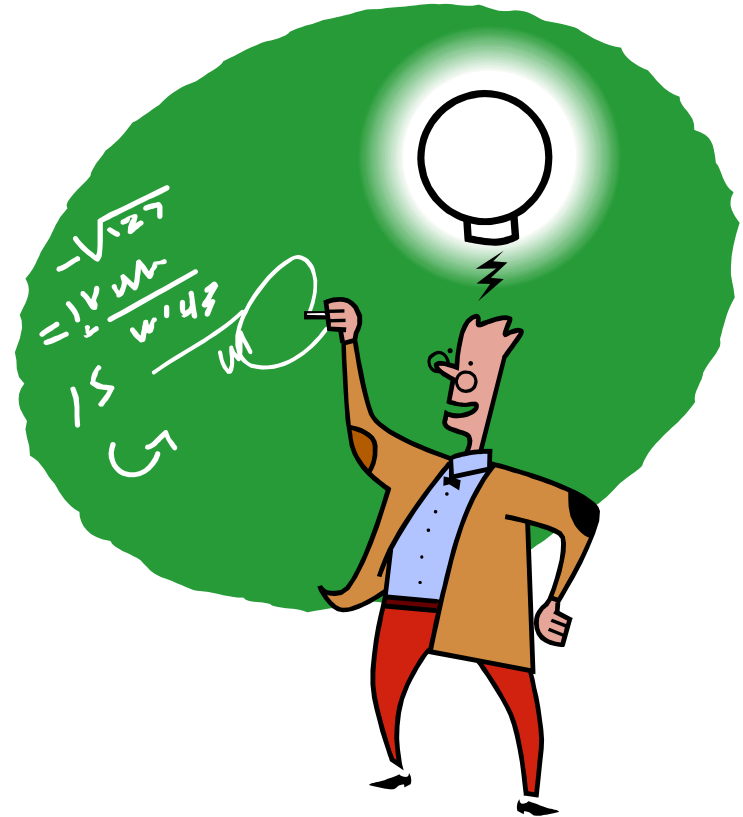
The Conclusion

What Did You Find Out?

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

- Write did you learn while doing your project?
- How did the results validate what was expected to happen?
- What did you learned 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?
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Does what you write show evidences of learning?



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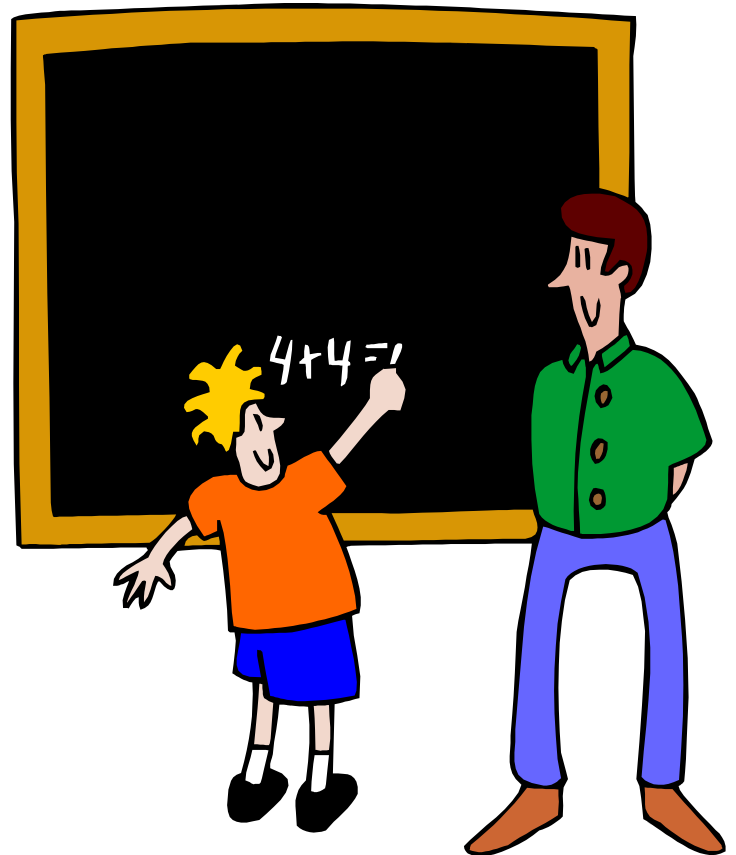
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You will be interviewed.

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 - How the projects has helped you better understanding the world around you.
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Doing A Meaningful Computer Design STEM Fair Project



Follow the Computer Design Process While Doing Your STEM Fair Project

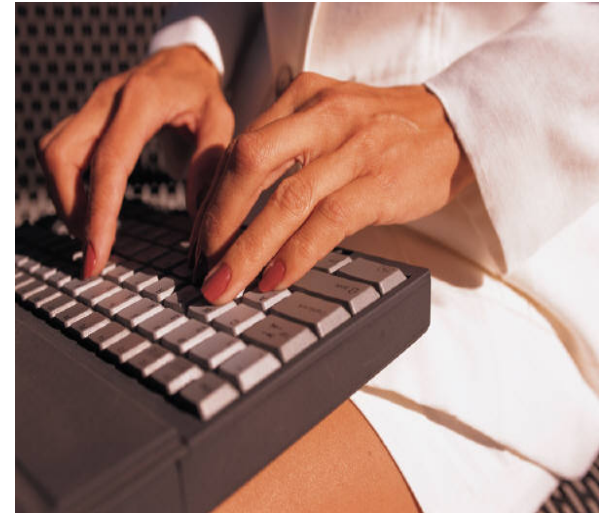
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Computer Design Process

These are the required steps when using the Computer Design Process.

- Define a need for your program
- Research your topic
- Establish requirements of what the program will do
- Design many code ideas
 - Focus on one code for your program
 - Plan the step-by-step process
 - Program your computer with the code.
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The STEM Fair

Computer Design Journal

Before you begin, you need a journal.

- STEM fair projects need to show a record of everything done by you as a “computer programmer” following the Computer Design.
- You need a title page, table of contents, all parts of the Computer Design, and a bibliography in the journal.
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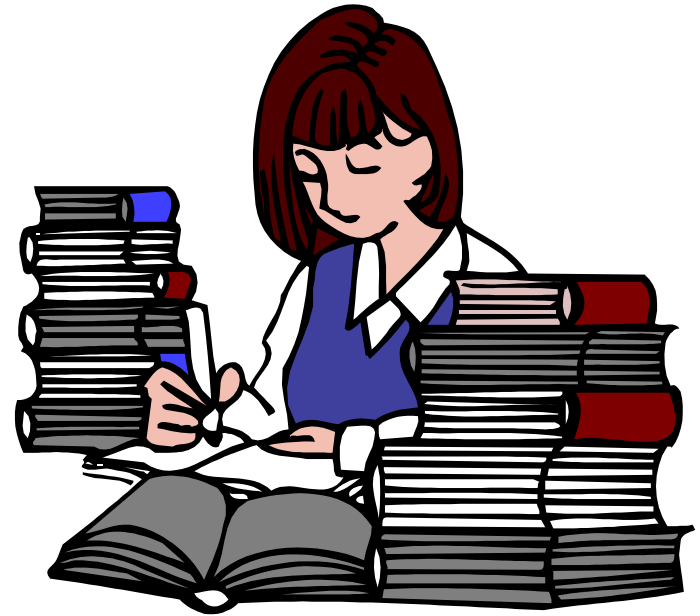
Define a Need

- Begin by writing a need and/or purpose for the program you want to develop.
- It could be something that you:
 - Want people to learn
 - Want people to know
 - Help to learn something in an easier way.
 - To perform a useful function.
- Write it so the need is clearly understood.



Research Your Type of Design

- Before you begin designing, you need some background knowledge about your subject. Use some of these resources:
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Computer Design Requirements

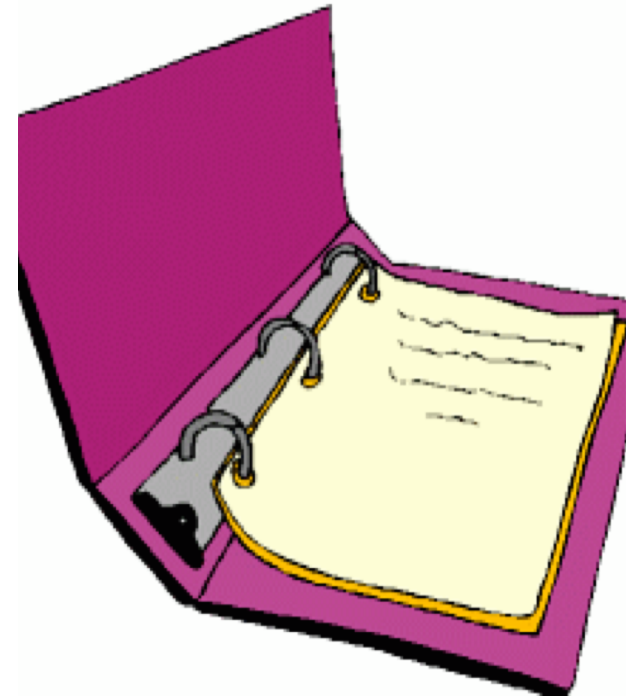
- Based on your research, you now have an idea of what type of program you want to code and its importance.
- Establish the requirements needed for the development of the program code and what you expect it to do.
 - You need to decide how the program code will be designed and how the final program will perform. It will mean:
 - How much memory you will need.
 - What the program will be able to do.
 - What the final outcome the program will help with.
 - The accuracy of the performance.
- The program will need to be tested to see if the desired results came about.



Designing the Program Code

Beginning Designs

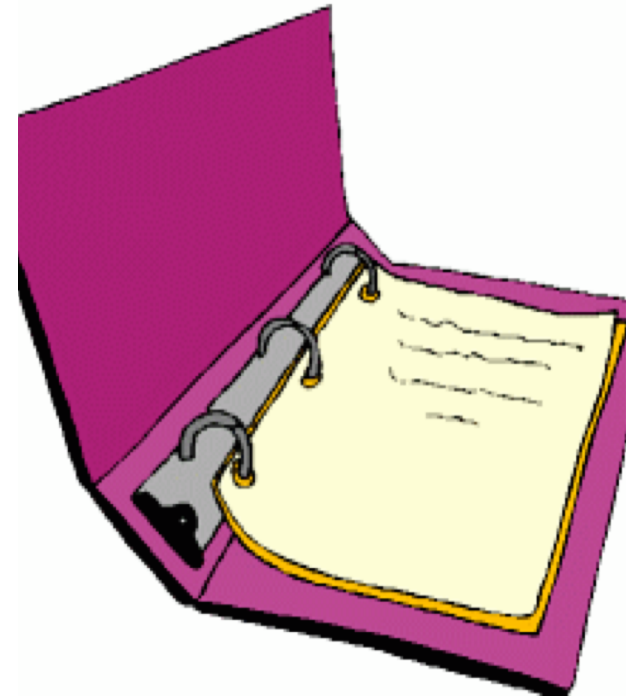
- Begin by brainstorming program codes that might work according to your requirements.
- Write three or four codes that you feel would have the same desired results.
- Focus on one that you think would be the best.



Designing the Program Code

Final Designs

- As you focus on one, continue to write up a series of operations for the program code.
- You are to show the changes in the development of the program code tweaking it as you get closer to the desired results.
- The code development needs to show progress as you work on it.



Putting the Code Into the Computer

- When you have finished designing the code, you need to put this code into your computer.
- If you have decided to change the code while doing this, then go back into the design and show your changes.
- Begin again and put the final code into your computer.
- Write about your programming experience in your journal.



Testing, Recording and Analyzing the Code Results

Testing and Recording

- After coding your computer, the code needs to be tested to see if it works according to the design requirement.
- Run the computer program using the code. Write down what is actually happening during testing.
- Be as descriptive as possible.
- Test it two or three times to get accurate data.



Testing, Recording and Analyzing the Code Results

Analyzing the Data

- Look at your data carefully to see if the results match the design requirements.
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Redesign, Retest, Record And Analyze

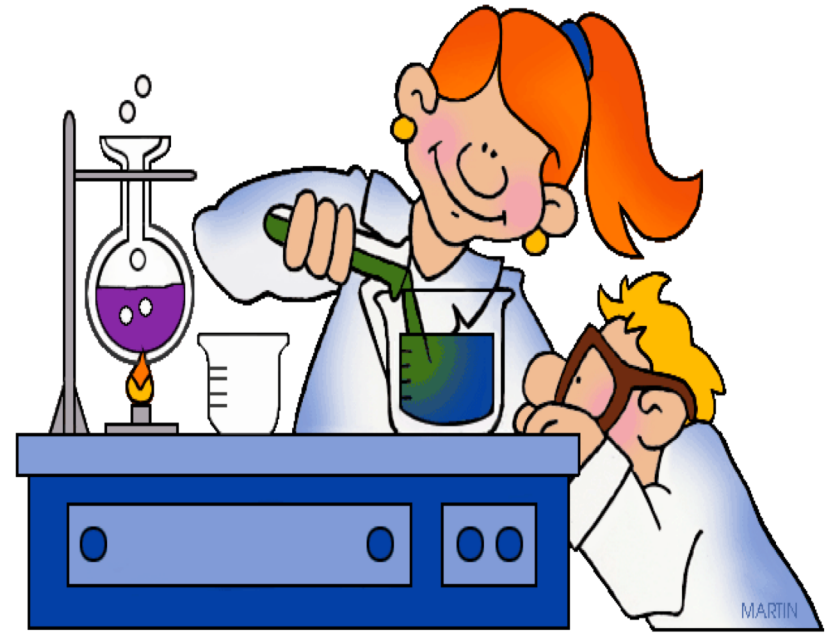
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- Redesign by changing the code as to the notes you took in your journal.
- Keep accurate notes of the changes you needed to make just in case you need to go back and look.
- Make the changes on your computer by changing the code.
- Retest the program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



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- If the results match the design requirements, then you are done.
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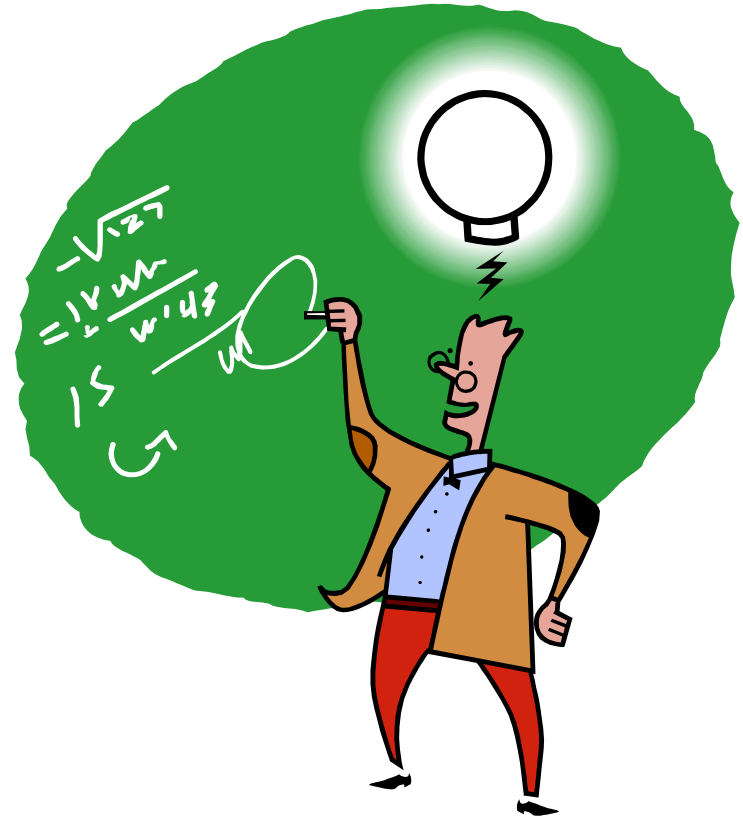


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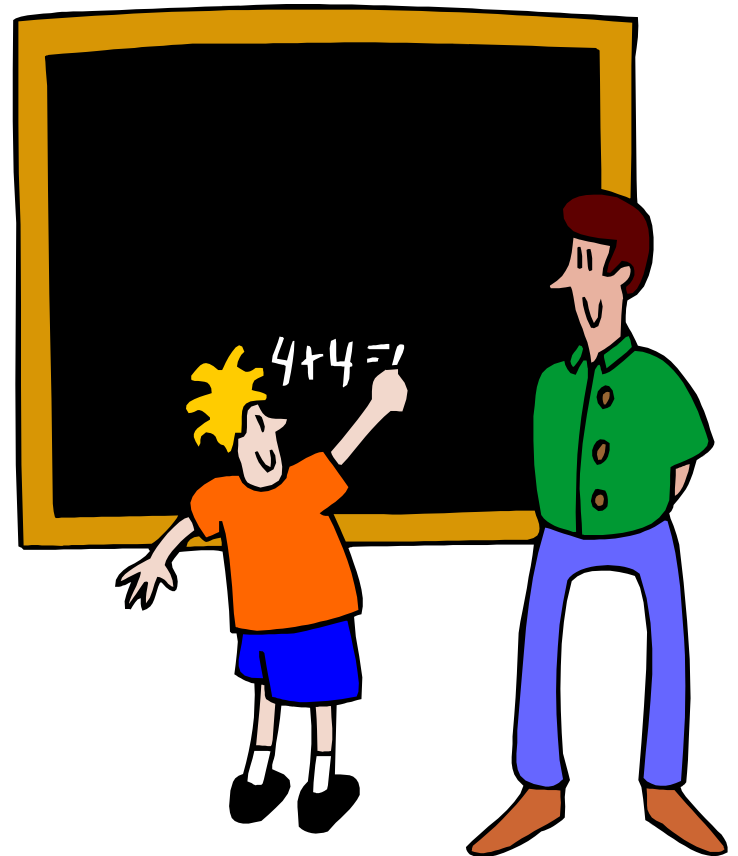
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 - All the things you did while following the computer design.
 - What you learned from your project.
 - How the projects has helped you better understanding the world around you.
 - Other questions you now have.
 - What you would change next time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



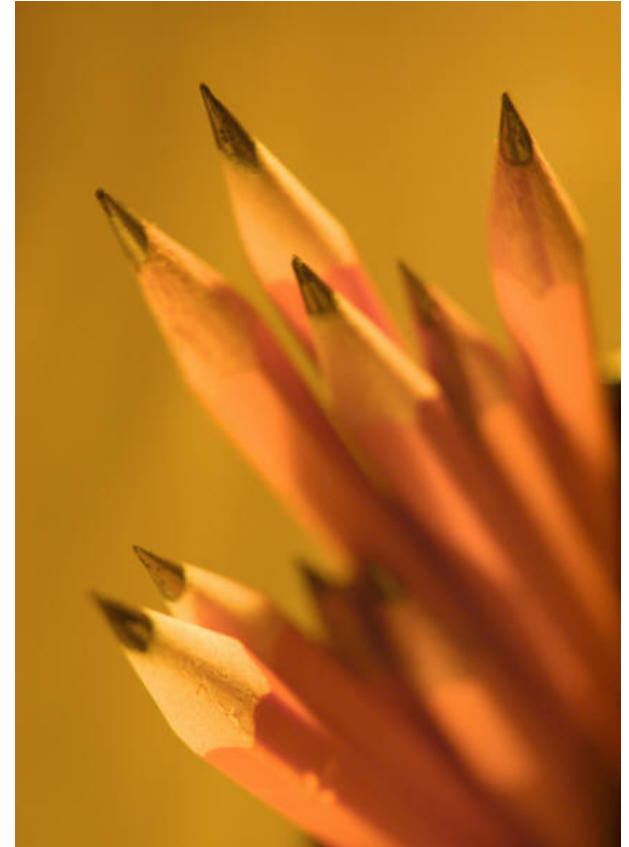
Thoroughness

- 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 Science 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 Science 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 Science 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 Science 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 Science 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 it 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>

