Mark Twain Science Fair Handbook and Planning Guide 2013-14

Follow these simple steps for a super science project by a super scientist—YOU!! (name) _____

Mark Twain Science Fair Information

All 3rd, 4th and 5th grade students are required to participate in the Mark Twain science fair. . Students may work individually or in groups of no more than 3 students. Students within a group must be from the same classroom.

This handbook has been provided to assist students through the process of completing a science fair project. A timeline is also included to help with time management and provide due dates for certain steps of the process.

The projects will be judged at the classroom level. Three projects from each class will enter the school science fair and be judged by volunteers from the community.

Display board materials will be sold in the student store in the mornings before class. It is usually less expensive to buy them here than at a retail store

Adults are welcome to help and consult, an adult is needed to provide supervision during experiments. Adult involvement should be limited to a "supporting" role; the project is for and about **student** learning.

If you have questions, please see one of the science fair coordinators:
Ms. Reese, Mrs. Daniel, Mrs. Zirczy, or Mrs. Gee.

This handbook has been adapted from the "2008 4th Grade Science Fair Preparation Packet" of Cornelius Science and Engineering Academy written by 4th grade teacher, Linda Halliman, and an online packet by Linda Holt. We'd like to thank her for sharing her work.

Table of Contents

-Or-

What is inside this packet and where to find it:

Science Fair Rules and Regulations

1. The project must be the work of the student registered for the fair.

2. **Each student** should develop a project plan before the experiment is started. A plan must be written on the "Project Plan Proposal and Safety Form" found on the final page. The completed form must be turned in and approved by the classroom teacher. (If students are part of a group each individual should turn one in)

3. All projects must be conducted under adult supervision.

4. All projects must follow the steps of the experimental design process found in this handbook.

5. Exhibits should be confined to a space not to exceed 25cm (10 inches) deep, front to back; 114cm45 inches wide, side to side; and 81cm (32 inches) high, floor to top. The maximum height for the display itself is 46 cm (32 inches). Boards will be available in the school store.

6. The scientific and technical community throughout the world uses the metric system (International System of Units-SI). Students are STRONGLY encouraged to use this system of measurement for the science fair.

7. Projects involving cell cultures, bacteria or mold and those using dangerous chemicals are not appropriate for this age group and are not permitted. Human surveys do not readily fit into the experimental design and therefore are not accepted. Approval will not be given for projects where the intent is to harm a living animal. When working with animals, it is not acceptable to study deficiencies such as starvation, withholding of water, etc.

8. The rubric that will be used by the judges to score each project can be found at the end of this handbook.

9. **A project logbook is required for each student. This should include raw data, procedures, observations and reflections recorded each time the student works on the project. This can be in the form of a notebook, a folder with notebook paper, or pages stapled together. If you have questions Mrs. Gee can help you with this portion.**

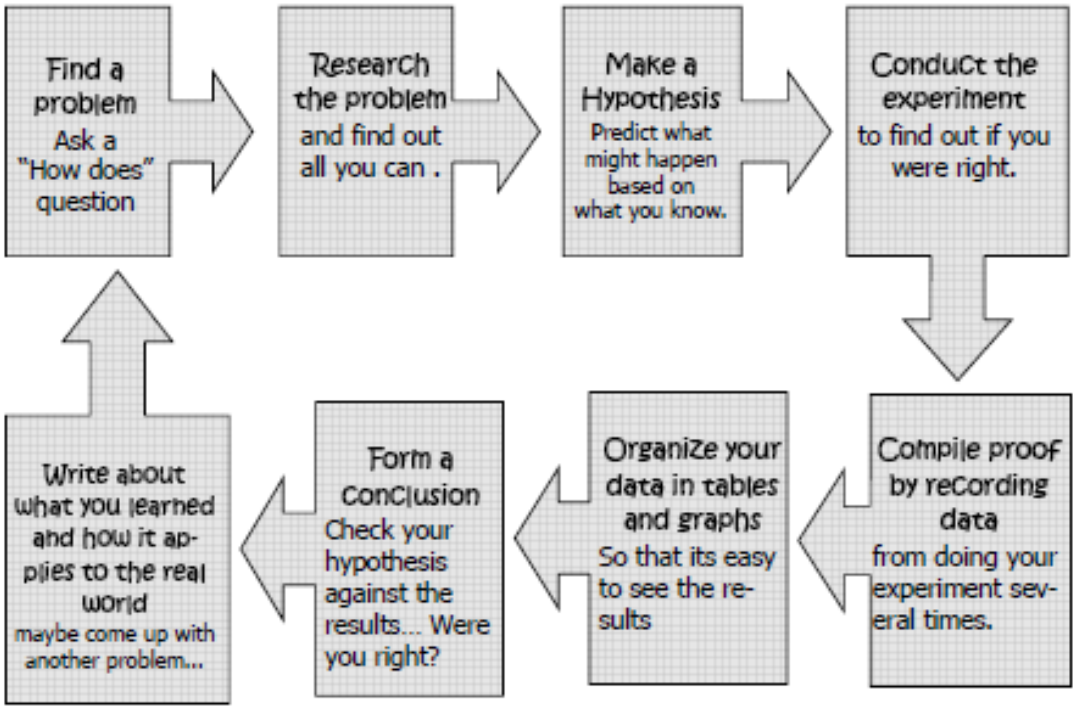
Mark Twain Science Fair Timeline
2013-2014

The following steps to completing a science fair project can be found in this handbook. We hope that this timeline will assist you in managing your time.

Steps of Experimental Design	Recommended Checkpoints
Complete Step 1: Coming up with a Good Question Begin Logbook	
Complete Step 2: Doing the Research and Writing the Bibliography Complete Step 3: Writing the Hypothesis **Project Proposal Form Due Date**	**January7, 2014**
Complete Steps 4-6: Gather your Materials, Write a Procedure, Identify your Variables	
Complete Steps 7-8: Do Multiple Trials, Record Data (Graph), and Results	
Complete Step 9: Conclusion	
Complete Logbook	
Complete Backboard **Project Due Date**	**February 21, 2014**
Class Presentations Selection of top 3 projects from each class	
School Science Fair Judging Science Fair Open House	

"The Scientific Method"

(aka Experimental Design; aka Scientific Inquiry Cycle; aka Steps Scientists follow to test a question)



Scientific Inquiry integrated with PYP Key Concepts

Scientific Method	**IB Primary Years Program's Key Concepts**
Problem	form, function
Hypothesis	change, causation, perspective
Material	form
Procedure & Lab Safety	form, function, responsibility
Data	form, function
Conclusion	All 8 - form, function, change, causation, connection, perspective, responsibility, reflection

Step 1: Coming up with a Good Question…

Choose a topic within your interests. Next, write a question or identify a problem within that topic. You can practice by filling in the following question blanks with the list of words below:

The "Effect" Question:

What is the effect of _____ on _____?

sunlight	**the growth of plants**
eye color	**pupil dilation**
brands of soda	**a piece of meat**
temperature	**the size of a balloon**
oil	**the surface of a ramp**

The "How" Question:

How does the _____ affect _____?

color of light	**the growth of plants**
humidity	**the growth of fungi**
color of a material	**its absorption of heat**

The "Which/What and Verb" Question

Which/What _____ (verb) _____?

paper towel	**is**	**most absorbent**
foods	**do**	**meal worms prefer**
detergent	**makes**	**the most bubbles**
paper towel	**is**	**strongest**
peanut butter	**tastes**	**the best**

Now it's your turn:

Create your Science Fair problem/question using either the "Effect Question", the "How Question" or the "Which/What and Verb Question." If you are having trouble there are some very good ideas and resources I the list of websites on pg 14.

→ **Record your problem/question in your project logbook**

At this time you will need to make sure you have a journal to record **EVERYTHING** you do with your project. You can use a spiral notebook, a journal, a folder or make your own with construction paper and notebook paper. The important thing is that you have a place to report your steps as you go through the scientific process. This can be **handwritten** as neatly as possible or typed. It must reflect your own thoughts and ideas.

The Science Fair Logbook

The Science Fair LOGBOOK is the most important component of your science fair project. The LOGBOOK is a daily diary of ALL project activities from start to finish. The rule to a complete and valid LOGBOOK is "*ALWAYS WRITE EVERYTHING YOU DO IN YOUR LOGBOOK "*. Please note you CANNOT use whiteout nor should you have pen/pencil erasing and scribble outs in the logbook. Mistakes and mark outs show your thinking and learning. If you are writing in your LOGBOOK and you make a mistake or you need to make a correction, line through the mistake, and rewrite what you intended to write. If you have questions Mrs. Gee is available to help.

EXAMPLE: black (write correction over the corrected word)
The horse is ~~blek~~ and white.

The logbook must be neatly done. NO EXCEPTIONS

What Should be in the Science Fair Logbook? (Format your logbook in a way that makes sense to you, the lead scientist on this project. Here are some things that a complete logbook should include, in no particular order.)	**Completed**
1. The LOGBOOK should document your day-by-day activity with dates such as: **01/10 – I picked a topic for the science fair** **01/15 – I came up with a question. My question is…** **01/20– I filled out and turned in my form**	
2. Project name on the front cover (write your name)	
3. Project name on the 1st sheet of the LOGBOOK	
4. Handwritten Introduction (Introduce your Project)	
5. Hand write your Problem Statement in the form of a Question	
6. Hand write your Research Information (one to two full pages)	
7. Hand write your Hypothesis	
8. Hand write a list of all Materials	
9. Hand write a list of the Procedures of this investigation	
10. Hand write Variables – List all CONTROLLED Variables, your MANIPULATED variable, and your RESPONDING Variable	
11. DRAW your Data Charts and Graphs – On this page you must show where you tested your data three or more times. **Trial 1 , Trial 2, Trial 3, Trial 4, Trial 5**	
12. Hand write Results	
13. Hand write the Conclusion - Was your hypothesis supported or not supported. How can you change this experiment if you had to redo the investigation and how does it connect to the real world?	
14. Hand write a list of your three research references- Bibliography	
15. A sketch of your Science Fair Backboard	

Step 2: Doing the Research on your Topic And Writing the Bibliography

It is time to research your problem. Becoming an expert in a topic is what real scientists do in real labs. **So, how do you become an expert?**

YOU READ!

READ about your topic. READ encyclopedias. READ magazine articles and books from the library. READ articles from the Internet. Take notes of any new science words you learn and use them. Keep track of all the books and articles you read. You'll need to make a list of every book, article and website that was used for research.

YOU DISCUSS!

Talk about it with your parents, teachers and experts. Sometimes websites will give you e-mail addresses to experts who can answer questions. Do not write to anyone on the Internet without adult supervision. For safety reasons, you should never give information about yourself online.

Research: My problem/question is about this topic: _____

Examples of topics: magnetism, electricity, buoyancy, absorbency, taste, plant growth, forces and motion. If you are having problems choosing a topic try sciencebuddies.org or ask an adult to help.

- → **Use at least 3 references.**
- → **In your logbook write down at least 3 note facts from each reference.**
- → **Summarize with 5-10 important points that you learned about your topic.**
- → **Document your references by writing a Bibliography**

A **bibliography** is a record of the references that you use to research your project. Use the following information to credit your source in the correct format. Remember to list the bibliography information in alphabetical order.

Example of a BOOK in Bibliography Format:

Black, Susan. The Life of George Gaylord Simpson, New York: Broadway Press, 1999.

Example of a WEBSITE in Bibliography Format:

Andrew, Jim. Paleontologist. (Online) Available http://www.altavista.com , January 8, 2000.

Example of a PERSONAL INTERVIEW in Bibliography Format:

Thomas, Lewis. Personal interview. March 10, 2008.

Step 3: Writing the Hypothesis

It is time to PREDICT what will happen when you **TEST** your problem. This type of "THINKING GUESS" or PREDICTION is what scientists call **a HYPOTHESIS.** The hypothesis is based upon your research. A hypothesis contains two variables. One is "manipulated" or "independent" and the other is "responding" or "dependent."

Manipulated/Independent variable- is what you change

Responding/Dependent variable- is the change that you observe as a result of the manipulated variable. These are the <u>results</u> that are measured.

<u>The hypothesis is often written in the "IF, THEN, BECAUSE" format.</u>

Suppose your PROBLEM/QUESTION was:

How does a change in temperature affect the color of leaves?

This is how you write the hypothesis using the "IF, THEN, BECAUSE" format:
SAMPLE HYPOTHESIS:

IF leaf color change is related to temperature, **THEN** exposing plants to low temperatures will result in changes in leaf color **BECAUSE** the leaf is where plants make their food. Plants need the energy of the Sun to make food. When a plant makes food, the chlorophyll in the leaf of the plant keeps the leaf green. When a plant is exposed to LOW temperature this could mean the plant is not getting enough energy to make food. When the plant can not make food the leaf will change a color other than green.

(This hypothesis not only predicts what will happen in the experiment, but also shows that research was used to back up the prediction.)

Now it's your turn:

→ **<u>In your logbook rewrite your problem/question and formulate a hypothesis based on what you have researched.</u>**

Problem:

Hypothesis: IF… **THEN** (will happen)… **BECAUSE** (based on your research…)

Now the fun Part--Testing your Hypothesis

When designing your experiment, use your imagination to design a **fair test** for your problem. This experiment is meant to help support or disprove your hypothesis. As you conduct your experiment, take **plenty of pictures.**

**** Photographs should not show faces of individuals.****

Step 4: Write a Procedure

A procedure is a list of steps taken to conduct an experiment. When writing each step, be very specific. The procedure is like writing a recipe for your favorite dish. If someone wants to repeat your experiment, they can follow the steps exactly.

→ **In your logbook, list the steps of the experiment that you have planned.**

Step 5: Gather your Materials

What will you need to perform your experiment?

→ **List all the materials you will use in your experiment in your logbook.**

Step 6: Identify your Variables

The variables are any factors that can change in an experiment. In order to get accurate results, you should only **test one variable**. For example, if you want to test the effect that the amount of water has on plant growth, then all the plants you test should be treated exactly the same except for the amount of water given. The plants should all have the same type of dirt, be the same type of plant, live in the same location, be exposed to the same amount of sunlight, etc. These unchanged conditions are called **Controlled/Constant Variables**.

The only variable **you would change** from plant to plant would be the amount of water each plant received (**Manipulated or Independent Variable)**. The **result** of the test is the **Responding or Dependent Variable.** In this case, the amount each plant grew in centimeters is the dependent variable.

→ **In your logbook, make a list of the things you will be sure to keep the same (Controlled) the one thing you will change (Manipulated) and what you will measure (Responding).**

Step 7: Do Multiple Trials and Record Data

TEST. TEST. TEST. Experiments need to be repeated **at least** three times in order to test for **accuracy**. Results should be consistent. When you make your favorite recipe it should taste pretty much the same each time. **Don't forget to take pictures**.

Collect your DATA. This means write down or record the results of the experiment every time you test it. You also need to organize your data in a way that it is easy to read the results. Scientists use tables, graphs and other organizers to

show their results. Graphic organizers such as these make it easier to read your results and to recognize patterns.

Time out: How Do You Collect Data?!!?

• **Use your project logbook/notebook:** In your journal you can record observations, collect research, draw and diagram pictures and jot down any additional questions you might have for later.

• **Have the right tools to do the job: Make sure you have the tools you need to take accurate measurements like rulers, meter tapes, thermometers, graduated cylinders or measuring cups that measure volume. The recommended standard of measurement in science is metric so keep your measurements in meters, liters, Celsius, grams, etc.• Tables, charts and diagrams** are generally the way a good scientist like you would keep track of your experiment trials. Remember you are testing at least 3 times or more. A table is organized in columns and rows and ALWAYS has labels or headings telling what the columns or rows mean. You will probably need a row for every time you did the experiment and a column telling what the manipulated variable was (what you tested) and the responding variable (the result that happened because of the manipulated variable). In this example they were testing the effect of water on plant growth.

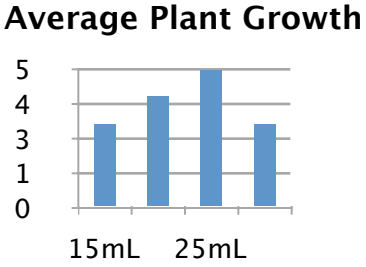
	Plant Growth in cm			
	15 mL water	20 mL water	25 mL water	30mL water
Trial 1	2cm	4cm	5cm	2cm
Trial 2	4cm	4.5cm	4cm	5cm
Trial 3	3cm	3.5cm	6cm	2cm

• **Be accurate and neat!** When you are writing your tables and charts please make sure that you record your data in the correct column or row, that you write neatly, and most of all that you record your data as soon as you collect it **SO YOU DON'T FORGET WHAT HAPPENED!!!!** Sometimes an experiment might be hard to explain with just a table, so if you have to draw and label a diagram (or picture) to explain what happened, it is recommended that you do.

→ **<u>Be sure to make a chart in your logbook and use it during your experiment to record what you observe.</u>**

• **Use the right graph for your experiment**.. There are all types of graph designs, but these seem to be easy to use for science fair experiments. Choosing the right type of graph is important in expressing your data.

• **Pie graphs** are good to use if you are showing percentages of groups. Remember that you can't have more than 100% and all the pieces need to add up to 100%.



• **Bar graphs** are good to use if you are comparing amounts because the bars show those amounts in an easy to read way. This way the judges will be able to tell

your results at a glance. Usually, the bars go up and down. The x axis (or horizontal axis) is where you label what is being measured, and the y axis (or vertical axis) is labeled to show the unit being measured (in this case it would be centimeters that the plant grew).

• **Line graphs** are good to use if you are showing how changes occurred in your experiments over time.

….And now, back to the Experiment Steps

Step 8: Results - What happened in the experiment?

The result is a summary of your experiment. Analyze your data and simply state what happened.

→ **Be sure to summarize your results in your logbook**

Step 9: Conclusion and Application – What did you learn (and who cares)?

Write a Conclusion to tell us what happened. Was your hypothesis supported or not, how? Were you successful/How did it turn out? What would you change about the experiment? What else are you curious about now that you've completed this experiment? What changes would you make if you had to do this experiment over again? And…WHAT DID YOU LEARN FROM DOING THIS EXPERIMENT? Then, apply it: Write about how what your learned can be used in a real life situation. Why was your experiment important?

→**Be sure to write your conclusion and reflections in your logbook.**

Step 10: The Display-Showing off all that hard work!

Your display board is kind of like an advertisement for all your hard work. So take our advice: **BE NEAT!!** The judges like to see a nice, easy to read display, that is typed or written neatly with easy to read graphs and tables and you guessed it…. lots and lots of pictures!! (Did you remember to take pictures?)

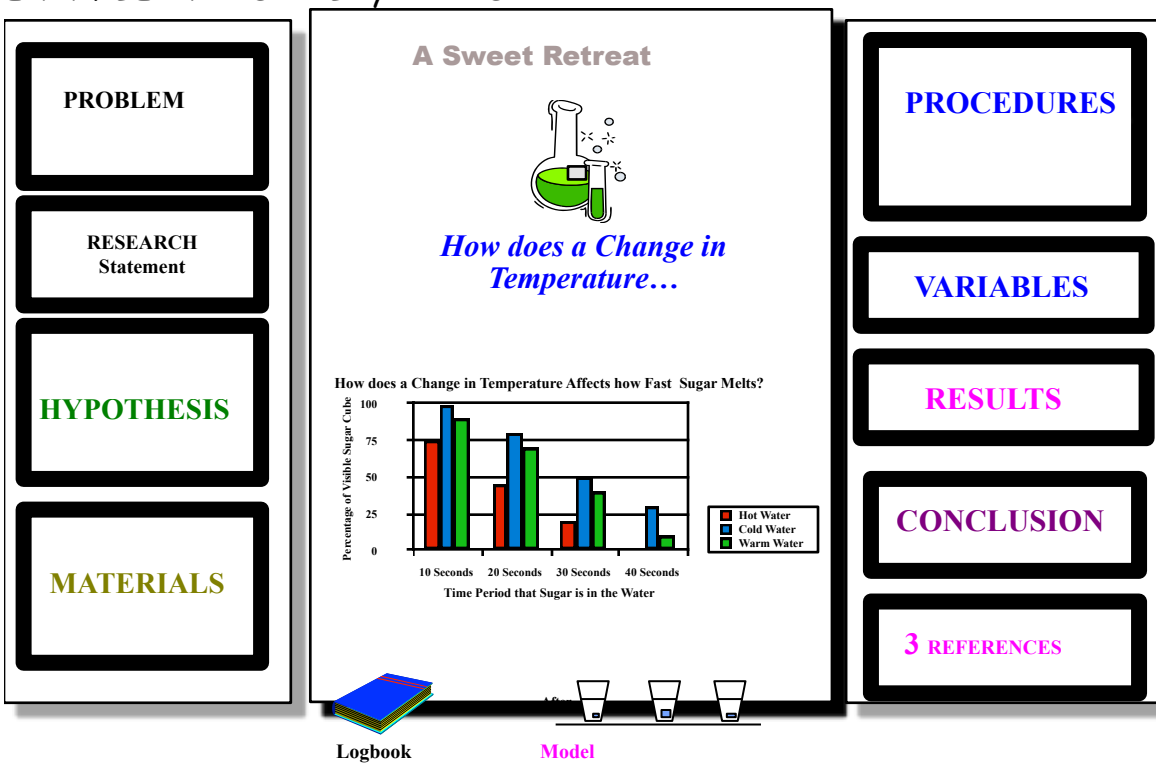
Putting the Back Board Together

Although the main focus of science fair is completion of a scientific experiment, there are other components that are essential, as well. One of the components is a proper display of your science fair investigation. You can find legal size file folders at office stores or the school store.

1. Type all information, so that it is very easy to read
2. Make your display eye-catching!
3. Display photos - Try to focus pictures on the items in your experiments such as organisms used or equipment, rather than people.
4. Use large letters for titles and headings.
5. Before gluing everything on your backboard, first lay the board down and arrange ALL the parts on the board.
6. Check for misspelled words and typos.
7. Your display board should be organized in a way that tells the "story" of your investigation.

   This is an example of a neat looking Science Fair Display Board. It is just an example. Depending on your information and the amount pictures, tables and graphs, you may have a different layout. Just make sure it is **neat**.

EXAMPLE OF A DISPLAy BOARD



Judging Rubric	**Circle One**			
	IMPRESSIVE	ADEQUATE	MINIMAL	NOT PRESENT
Clearly stated problem/question	3	2	1	0
Clear & specific Hypothesis stated	3	2	1	0
Thoroughly stated step by step procedures and materials list	3	2	1	0
In depth report/research on science topic	3	2	1	0
Measureable data that includes 3 or more trials	3	2	1	0
Clearly Identified variables (manipulated, responding) and controls	3	2	1	0
Effective analysis of data, clearly stated results (graphs, charts, tables)	3	2	1	0
Conclusion stated and supported by results; relevant to Hypothesis	3	2	1	0
Complete Logbook (all steps clearly documented during the project)	3	2	1	0
Stated real life connections	3	2	1	0
3 or more resources cited in bibliography	Present 2		Not present 0	
Demonstrated in depth understanding of the project through presentation/interview with use of related (grade level appropriate) vocabulary	3	2	1	0
TOTAL SCORE	Maximum = 35 Exemplary Level=30-35			

If you completed everything in this packet you probably have a terrific science fair project, and you are now a real scientist! Good Job!
If you still need more ideas, here is a list websites that you can check out about science fair projects to give you even more ideas.

Websites

Internet Public Library
http://www.ipl.org/div/kidspace/projectguide/
Are you looking for some help with a science fair project? If so, then you have come to the right place. The IPL will guide you to a variety of web site resources, leading you through the necessary steps to successfully complete a science experiment.

Discovery.com: Science Fair Central
http://school.discovery.com/sciencefaircentral/
"Creative investigations into the real world." This site provides a complete guide to science fair projects. Check out the 'Handbook' which features information from Janice VanCleave, a popular author who provides everything you need to know for success. You can even send her a question about your project.

Science Fair Idea Exchange
http://www.halcyon.com/sciclub/cgi-pvt/scifair/guestbook.html This site has lists of science fair project ideas and a chance to share your ideas with others on the web!

What Makes A Good Science Fair Project
http://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.

Try Science
http://tryscience.com
Science resource for home that gives you labs to try and 400 helpful links all related to science

The Yuckiest Site in the Internet

http://yucky.kids.discovery.com/
Brought to you by Discovery Kids, this site gives you lots of ideas on how to do the messiest yuckiest experiments

The Ultimate Science Fair Resource
http://www.scifair.org/
A variety of resources and advice

Science Fair Primer
http://users.rcn.com/tedrowan/primer.html
A site to help students get started and run a science fair project.

Experimental Science Projects: An Introductory Level Guide
http://www.isd77.k12.mn.us/resources/cf/SciProjIntro.html
An excellent resource for students doing an experiment based science fair project. There are links on this page to a more advanced guide and an example of an actual experiment- based project.

Science Buddies
www.sciencebuddies.org
A Resource for project ideas guidelines and a great Project idea "wizard" for those having trouble deciding what to do.

Gateway to Educational Materials: Science Fair Projects
http://members.ozemail.com.au/~macinnis/scifun/projects.htm The Gateway to Educational Materials extensive and detailed step-by-step guide to doing a science fair project.

Science Fair Project Guidebook
http://www.energy.sc.gov/files/BestOfScienceFairProjectGuidebook.pdf The State of South Carolina publishes a K-12 science fair guidebook. It can be viewed using Adobe Acrobat Reader.

Cyber-Fair
http://www.isd77.k12.mn.us/resources/cf/welcme.html
This site has one-sentence explanations of each part of a science fair. One of the steps described is presenting your project to judges. This may or may not be a part of your science fair. The site also has an explanation of what makes a good project and an explanation of how to come up with your own science fair project

Mr. McLaren's Science Fair Survival Page
http://www.ri.net/schools/East_Greenwich/Cole/sciencefair.html Tips from Archie R. Cole Junior High school on what makes a good project.

Neuroscience for Kids: Successful Science Fair Projects
http://faculty.washington.edu/chudler/fair.html
Site made by Lynne Bleeker a former science teacher, science fair organizer, and judge. Gives a thorough and detailed description of the steps to a successful science fair project

PROJECT PLAN PROPOSAL AND SAFETY FORM
(fill out, tear off, and give to your teacher)

Grade Level: _____ Teacher's Name: _____

If an **individual (1)**, **group (2 or 3)** project, provide the student(s) name(s).

Student's Name: _____

Student's Name: _____

Student's Name: _____

Title of Project:

_____
(**5 words, 50 characters, maximum**)

QUESTION/PROBLEM:

_____
_

_____
_

HYPOTHESIS (If…Then):

_____
_

_____
_

PROCEDURES; (Include, if applicable, safety measures, animal care measures, etc.)

_____
_

_____
_

_____
_

_____
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_____
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_____
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If experimentation is conducted off campus provide the name of adult supervisor:

Name of Adult Supervisor: _____

I certify that I have reviewed the project plan prior to the beginning of the experiment and it does comply with the rules and regulations of HISD Science Fairs.

Classroom Teacher _____

Please Print

Classroom Teacher Signature: _____

Date: _____