SCIENCE FAIR MANUAL
K-5
School Year: 2014-2015

Website Address: http://dhstem.weebly.com/
Click on Science Fair button (in white lettering) towards to top right corner of the web-page. It will take you to a science fair resource page. Smart-phone users can use the QR code above to navigate to the site.

Science Fair Project Timeline

Science Project Title: _____

Due Date	WHAT TO WORK ON AT HOME	Items Due	Grade

9/8/2014	Begin a Planning Sheet	Title Problem Statement Hypothesis	✓
	Final topic		✓
	Develop Purpose		✓
	Develop and write a Problem Statement		✓
	Write a complete Hypothesis		✓
9/15/2014	Gather materials	Materials Procedures Variables	✓
	Put together a step by step plan to complete the actual experiment		✓
	State your controls and variable(s)		✓
	Continue logging information on the planning sheet		✓
	Locate appropriate research materials on the topic		✓
10/20/2014	Begin/Complete the actual experiment	Observations Data Results Conclusion	✓
	Begin/Complete recording observations and gathering data		✓
	Photograph work in progress		✓
	Record the results of the three experimental trials.		✓
	Using background information gathered on the topic, from books, reference materials and the internet, write a complete Conclusion of your experiment.		✓
11/03/14	Complete the Abstract (use reference books on the topic to write an informed abstract, list the books in the bibliography)	Abstract Application Bibliography	
	Write a complete bibliography of all resources used: books, reference materials, web page(s) the experiment and its Applications to the real world.		
11/07/14	Use all of the information gathered and complete a report.	Project PPT Grade 4 & 5 Project Report (4th & 5th	✓

		Grade Only)	
	Finalize all parts of the experiment in PowerPoint presentation.		✓
11/17/14	Complete the exhibit. Make a neat, colorful and organized display. Remember to give it a title	Class Finalist ONLY Complete Science Fair Project Display	
	Proof read each part of the display, checking for spelling and grammatical errors. The display can be written neatly in ink or it may be printed out from the computer.		
	Finalize all parts of the project		
	Science Fair will take place 11/19/14 A Dorothy Hains Science Fair Winners will be announced 11/20/14 during morning show Science Fair Projects will be displayed in the Media Center 11/20/14 -11/21/14		

Science Fair Project Steps

1. **Choose a Project Topic**
2. **Research the Topic**
3. **Write Purpose/Problem Statement**
4. **Form Hypothesis**
5. **Design Experiment**
6. **Conduct Experiment and Collect Data**
7. **Analyze Data & Draw Conclusion**
8. **Write Abstract**
9. **Write Research Paper**
10. **Put together Display Board/Power Point Presentation**

GET A LOG BOOK!

Follow your teacher's guidelines for the appropriate format. Basically, anything to do with your project should be recorded in your log book! See Log Book attached.

Whether you are a research scientist or a first time science fair student, a logbook is a crucial part of any research project. It is a detailed account of every phase of your project, from the initial brainstorming to the final research report. The logbook is proof that certain activities occurred at **specific times**.

Log the date of every step. Include the date your topic was approved and the date the experimentation started!
Write about your ideas.
Write about the problems you had and tell how you solved them, or if not, what you did.
Plan Experiment design
Identify and list the variables, and control experiment
Record all of your observations.
Your name is written on the inside (only)

Choose a Project Topic

A key step in the Science Fair process is to choose a science fair project idea. Consider what interests you. Perhaps it is something you read about or saw on television. Think of some kind of experiment that you would like to try. Establish a purpose and identify the problem.
Purpose/Problem Statement*: A single sentence that describes the reason for doing your experiment.*

Research the topic

Once you have an interest/topic, you must identify a problem and form a testable question. To do this step you need to do some research on the topic to: make a testable question, gain enough background information to form a hypothesis, and develop an experimental design. You should research information about what scientists think about your topic; what do they already know about the topic? What are the processes involved and how do they work? How can your question be tested? What materials and steps are necessary to test your question/hypothesis?
Background research can be gathered first hand from primary sources such as interviews with a teacher, scientist at a local university, or other person with specialized knowledge. You can use secondary sources such as books, magazines, journals, newspapers, online documents, or literature from non-profit organizations.

Gathering Background Research:
Helps gain in depth knowledge about the topic and processes you will be observing during the investigation.
Sparks ideas about different variables to test when setting up your investigation.
Provides the basis for predicting what will happen in the investigation when making a hypothesis.
Provides the understanding needed to interpret and explain the results to others –especially a science fair judge!

You must have a minimum of five references. Books, encyclopedias, websites, magazines or interviews from experts in the field can give you background information to help you understand your topic. The information you comprehend from your readings will not answer your question. It will only give you enough knowledge about your topic to develop a testable question, experimental design, and to be able to analyze results.

Write 2 pages of research information. Explain every concept, scientific principle, etc., that you used or referred to in your project. These explanations must be complete and detailed. The background information is **not** a summary of your experiment. It is a **summary of everything you learned while researching your topic**. When you found your **five** resources, you should have highlighted the information you found useful or make note cards (these notes may be included in your log book). The information from those resources is what you will use to write your background information. You are basically summarizing in your **own words** what you learned from your resources in a short essay. Do not forget to make a record of any resource used so that credit can be given in a bibliography. The proper format for a bibliography entry is included in Appendix A. Remember google.com is not a source. Wikipedia is not accepted! Follow the format explained under the bibliography section of this manual.

Write Question

Question: A single sentence stated as a testable question that describes what you want to solve.

The question sets up the investigation and it should be a testable question. Testable questions are those that can be answered through hands-on investigation. Testable questions are always about ***changing one thing to see what its effect is on another thing***. A good testable question includes: the (a) independent/test variable and (b) the dependent/responding variable.

There is standard form for expressing the question:

What is the effect of (a) _____ on (b) _____?
How does (a) _____ affect (b) _____?
A Study of the Effect of (a) _____ on (b) _____.
Make sure that your Problem Statement is testing only one thing/variable.

Compose Hypothesis

After gathering background research, you will be better prepared to formulate a hypothesis. More than a random guess, a hypothesis is a testable statement based on background knowledge, research, or scientific reason.

A hypothesis states the anticipated **cause and effect** that may be observed during the investigation. The hypothesis shows the relationship among variables in the investigation and often (but not always) uses the words if and then. A hypothesis needs to be detailed and specific. The word "I" or "we" must not be included in your hypothesis and your hypothesis can only be one sentence long. Use passive voice when writing your hypothesis (e.g., "if the solution is mixed", **not** "if I mix the solution.") The scientific point of view is impersonal. Avoid the use of first person pronouns (I, me, and mine). Consider this one: If ice is placed in a Styrofoam container, it will take longer to melt than if placed in a plastic or glass container. The time it takes for ice to melt (dependent variable) depends on the type of container used (independent variable).

A good hypothesis will have a cause and effect relationship.
If (a) _____ then (b) _____.
Be sure to include the **independent and dependent variable** identified in your problem statement

Here are a few examples:
If mint plants are given water, tea, apple juice and soda over a five week period, then the mint plant being fed water will grow the fastest.
If mint plants are grown in a garage, a closet, a greenhouse, and outdoors, then the mint plant grown in a greenhouse will grow the tallest.
Remember, it's not important whether or not your hypothesis turns out to be right or wrong; either way new knowledge is gained.

Design Experiment (Identifying Variables, Developing Control Group, Procedures, & Materials)

Once you have composed a hypothesis for your investigation, you must design a procedure to test it. A well-designed investigation contains procedures that take into account all of the factors that could impact the results of the investigation. These factors are called variables and they are things or conditions that may affect the outcome of the experiment. Whenever possible, the experimental design should include a control test/control group to validate the results.

Identifying Variables – There are three types of variables to consider when designing an experiment plan:
The **independent (manipulated/test) variable**; this is the variable that you are changing in your experiment. This is the cause. This is part (a) of the problem statement (see Problem Statement section).
The **dependent (responding/result) variable**, this is the variable that reacts or changes in response to the independent variable. This variable should be measurable. This is what you will be observing and recording throughout the experiment and will go in the data section. This is part (b) of the problem statement (see Problem Statement section.
The **controlled variables or constants** are the factors in your experiment that you have control of and keep constant (keep the same) in order to observe the effects of the one variable that you **do** change (the independent variable).

Control Group (Control Test) – To validate the results of an investigation, a control test or control group should be included. A control experiment is the group that does not receive the test variable (the factor that you are testing). The control group serves as a standard to which compare your results. The control experiment has what is usually considered "normal" conditions, i.e., room temperature, normal amount of water, normal amount of sunlight. A control experiment or group helps you to be sure that what you are testing for is a result of what YOU DID in the experiment. For example if you are testing two different types of soap on a shirt, the control experiment would be comparing the shirts that were washed with the different soaps to a shirt that was washed with water only. This control test was missing soap which is what you were testing.

Materials & Procedures

When conducting a science experiment, it is important to document all of the materials used and provide a detailed summary of the steps taken throughout the experiment. Make your report for materials and procedures detailed to the point that when someone goes over your science fair work, they could repeat the project exactly the way you did.
The materials and procedures should be listed in bulleted format. Use past tense, passive voice (e.g., "the solution was mixed", not "I mixed the solution.") The scientific point of view is impersonal. Avoid the use of first person pronouns (I, me, and mine).

Conduct Experiment and Collect Data

Experiment:
Conduct your experiment following your procedure. Carrying out the investigation involves data collection. Record observations in your log book a data table. When making an observation, write down the date and time. Recor
d measurements in metric units, i.e., centimeters (cm); grams (g); degrees Celsius (°C).

Trials **–**How many times do you need to repeat an experiment? You need to perform the same experiment enough times to be confident you would get the same results if you were to perform the experiment again. Record your results as carefully as you did for the first time.

Data: Keep a record of all the information you have gathered while performing your experiment in your log book. Present your observations and data by using charts, graphs and/ or photographs (include photograph consent form).
Record and present data in charts, graphs and written summaries
Use photographs whenever possible to show changes.
Display all your results and measurements, even if it doesn't match what you thought was going to happen.

There are two types of data that may be collected—quantitative data and qualitative data.

Quantitative Data
Uses numbers to describe the amount of something.
Involves tools such as rulers, timers, graduated cylinders, etc.
Uses standard metric units (For instance, meters and centimeters for length, grams for mass, and degrees Celsius for volume.
For quantitative data, be exact with your numbers or counts and include averages (means), range, mode and median.

Qualitative Data
Uses words to describe the data
Describes physical properties such as how something looks, feels, smells, tastes, or sounds.
Include a rating scale for independent variables that are not easily quantifiable (counted or measured).

If you use qualitative, describe what you observe in detail. Whenever possible, quantify qualitative data by using a rating scale.
Example of rating scale: Stain Removal

4	no change
3	faded
2	slightly faded
1	gone

Analyze Data/ Results & Draw Conclusion
After collecting data the next step is to analyze it. The goal of data analysis is to determine if there is a relationship between the independent and dependent variables. In student terms, this is called "looking for patterns in the data." Did the change made have an effect that can be measured? Data analysis goes under the results section.
Analyze Data/ Results: Look at all the data collected and state the findings of the experiment based upon the data you recorded and observed.
What can be learned from looking at the data?
Identify patterns or trends in the data.
In your summary be sure to include the averages, range, mode or median as appropriate.
Make sure to include comparison statements i.e., increased by ___, decreased by ____.
Include any errors or uncertainties that may affect the validity of your result.
How does the data relate to the student's original hypothesis?
Did what you changed (independent variable) cause changes in the results (dependent variable)?

The next step is to write a conclusion.
Conclusion: Your conclusion should begin with a statement on whether or not your results support or reject your hypothesis. State the major findings from your experiment and include the reason why this happened in your experiment. State any problems that occurred in your experiment that may have affected your results. All other findings should be summarized in this section. Make sure your conclusion answers the following questions:
What was investigated? (Refer to the Problem Statement)
Was the hypothesis supported by the data?
What were the major findings? (Results)
How did your findings compare with other researchers? (Same/Different, refer to research)
What possible explanations can you offer for your findings? (Why did this happen? Use background research for possible explanations.)
How could you improve this experiment? (Focus on controlling variables and/or limitations of measurements recorded.)
What recommendations do you have for further study? (How would you extend this experiment if you were to do this experiment again next year?)
Application: State how your project and its results will be beneficial and who might benefit from this research. What field of study or persons could benefit from the information gained from your experiment?

Final Repot

A final report should be prepared and available along with the project data log book and **any necessary forms.** A final report (research paper) helps organize data as well as thoughts. The research paper should be typed with double spacing. A good paper includes the sections below.
Each section must begin on a separate page:

Title page - should include your topic, your name, school's name, grade, science teacher's name, city, state, and zip code.
Table of contents - A table listing the page numbers of the entire project report.
Abstract – see abstract section.
Introduction and Purpose - This section introduces the topic of the project, explains why you are interested in the project, and states the purpose of the project.
Background Research – This section notes any information already available on the topic. This is a summary of everything you learned while researching your project. Here you describe the work and findings of others related to your topic. If you are going to state references in your report, this is where most of the citations are likely to be, with the actual references listed at the end of the entire report in the form of a bibliography. See background research section and bibliography section.
Question and Hypothesis – State your question and hypothesis.
Materials and Procedure - Describe the materials you used and then provide a step-by-step explanation of how you conducted the experiment. Include drawings or photographs to help clarify your procedures. Include variables under this section.
Results - The outcome of your experiment and the data collected is shared in graphs, charts or as a daily log of observations. See Results section.
Conclusion - In this section you will interpret your findings and results. Refer back to your purpose and indicate whether or not your findings support your hypothesis. Follow the steps in the conclusion section and include application. See Conclusion section
Acknowledgements - In this section you can identify people who have helped you.
Bibliography - List the books, magazines, pamphlets, or other communications you used to research your topic.

Write Abstract

The abstract is a 250 word summary of your entire project and is written after experimentation. It is the last thing you will write and the first thing everyone will read. The abstract is done on a separate page and should be the first page of your research paper.

The abstract should start with the purpose of the investigation. From there make sure to include a brief explanation of your experimental procedure, your results, and your conclusion. **Do not include any of your background information**.

This brief 250 word summary needs to wrap up your entire project. When writing your abstract make sure it is written in past tense, passive voice. Never use the word "I" or "we". Write "The mint plants were watered for two weeks," not "I watered the mint plants for two weeks." Since this is the last thing you will write, make sure everything is completed before writing it. Do not start writing your abstract if you have not finished your conclusion yet.

A 250 word summary can fill-up very quickly. Be careful how you word your sentences because you want to get as much detail in this section as possible, using limited space. You want your abstract to

interest the reader and persuade them that your research is valuable. Your abstract is like the cover to a book. When it looks and sounds interesting, the reader will be enticed to read more.
Use the guidelines below to write your abstract:

Title
Student Name
School Name
Purpose of the Experiment
An introductory statement of the reason for investigating the topic of the project.
A statement of the problem or hypothesis being studied.
Procedures Used
A summarization of the key points and an overview of how the investigation was conducted.
An abstract does not give details about the materials used unless it greatly influenced the procedure or had to be developed to do the investigation.
An abstract should only include procedures done by the student. Work done by a mentor (such as surgical procedures) or work done prior to student involvement must not be included.
Observation/Data/Results
This section should provide key results that lead directly to the conclusions you have drawn.
It should not give too many details about the results nor include tables or graphs.
Conclusions
Conclusions from the investigation should be described briefly. The summary paragraph should reflect on the process and possibly state some applications and extensions of the investigation.

Sample Abstract

Effects of Marine Engine Exhaust Water on Algae

Mary E. Jones

Hometown High School, Hometown, PA, United States

This project is the result of bioassay experimentation on the effects of two-cycle marine engine exhaust water on certain green algae. The initial idea was to determine the toxicity of outboard engine lubricant. Some success with lubricants eventually led to the formulation of "synthetic" exhaust water which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance. Toxicity was determined by means of the standard bottle or "batch" bioassay technique. *Scenedesmus quadricauda* and *Ankistrodesmus* sp. were used as the test organisms. Toxicity was measured in terms of a decrease in the maximum standing crop. The effective concentration - 50% (EC50) for *Scenedesmus quadricauda* was found to be 3.75% exhaust water; for *Ankistrodesmus* sp. 3.1% exhaust water using the bottle technique.

Anomalies in growth curves raised the suspicion that evaporation was affecting the results; therefore, a flow-through system was improvised utilizing the characteristics of a device called a Biomonitor. Use of a Biomonitor lessened the influence of evaporation, and the EC 50 was found to be 1.4% exhaust water using Ankistrodesmus sp. As the test organism. Mixed populations of various algae gave an EC 50 of 1.28% exhaust water.

The contributions of this project are twofold. First, the toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature (1.4% vs. 4.2%). Secondly, the benefits of a flow-through bioassay technique utilizing the Biomonitor was demonstrated.

Science Project Presentation:

In effort of going Green students will present science fair projects on powerpoint presentations. Teachers will provide all students with a powerpoint template. The three students selected as finalist in each class will be responsible for preparing a display board for the District Science Fair. Please use Student Time Line for deadlines.

Bibliography:

It is important to follow the same form throughout a bibliography. Bibliographic entries are placed in alphabetical order. For on-line help, go to **www.citationmachine.com** and select MLA format.

Part of a book

Author, Title (underlined or in italics), Place of Publication, Publisher, Date, Pages
Example: Shippen, Katherine B. *A Bridle for Pegasus.* New York: Viking, 1951. pp 28-42.

Encyclopedia:

Author (if given), Title of Article (in quotation marks), Name of Encyclopedia (underlined or in italics), Edition (year), Volume, Pages, Date
Example: "Balloon – the First Aircraft of Man." *Compton's Pictured Encyclopedia.* 1964, vol. 2. pp.101-102.

Magazines
Author, Title of Article (in quotation marks), Name of Magazine (underlined or in italics), Volume: Number
Pages, Date
Example: Lewis, C. "Navy Unveils Low-Cost Sounding Rocket," *Aviation World.* 69:6. pp. 49-51, November, 1958.

People
Last Name, First Name, Occupation, Address: Date Contacted
Example: Smith, Bob. Gardener. 2801 N 5th, St. Louis, MO 63001: November 28, 1987

Websites
Name of Website Page (in quotation marks), Date, Organization, Date Accessed, URL Address
Example: "Writing an Abstract." 2008. Society for Science and the Public. 20 Jun 2008.
HYPERLINK "http://www.societyforscience.org/isef/students/abstract.asp"

Parent Letter

Dear Families,

The Science Fair is right around the corner. We have compiled a packet of information and support worksheets for your child. Your child will need a log book style journal, a 3-Prong folder with 2 Pockets to turn in their work and a display board for their final project. It is imperative that your child meets the deadlines so that we can return corrected work back to them. Students are more than welcome to work ahead and turn things in earlier. This is a major project and will represent a significant portion of your child's grade for the 2nd 9 weeks in science. The primary objective of this project is to have students approach a problem scientifically.

This includes:

1. Asking questions and forming a hypothesis
2. Creating experiments to test that hypothesis
3. Organizing/Analyzing data and drawing conclusions
4. Writing about scientific research

The project must be **experimental** in nature as opposed to research oriented. In other words, students must do a test, survey, or experiment to determine the answer to their question instead of simply looking up information in a book. We encourage students to pick topics that they are genuinely interested in, since they will be working on these projects for the next several months. Topics must also be **"original"**, something students do not already know.

We are going to have a Science Fair workshop on **September 11, 2014** at 6:00pm in the media center. During this meeting we will be there to answer any questions that happen to come up. Please complete the bottom portion of this form to ensure that you have received and reviewed the information. Thank you,

I have read the information in the packet and I'm aware of the project timeline.

Student Name (Print) _____ ID# _____
Science Teacher _____

Parent Name (Print) _____
Parent Signature _____
We encourage all students to keep this packet in your science fair folder.