

# How to Create a Science Fair Project

## 2012 - 2013 Edition

# A “How-To Guide for Students

*Written by Students!*



# So what exactly IS a science fair project?



**The Definition: Independent research of a scientific topic using the scientific method.**

- **You** ask the question. **You** figure out the answer.
- Think of it as designing your own class where you give yourself the homework.

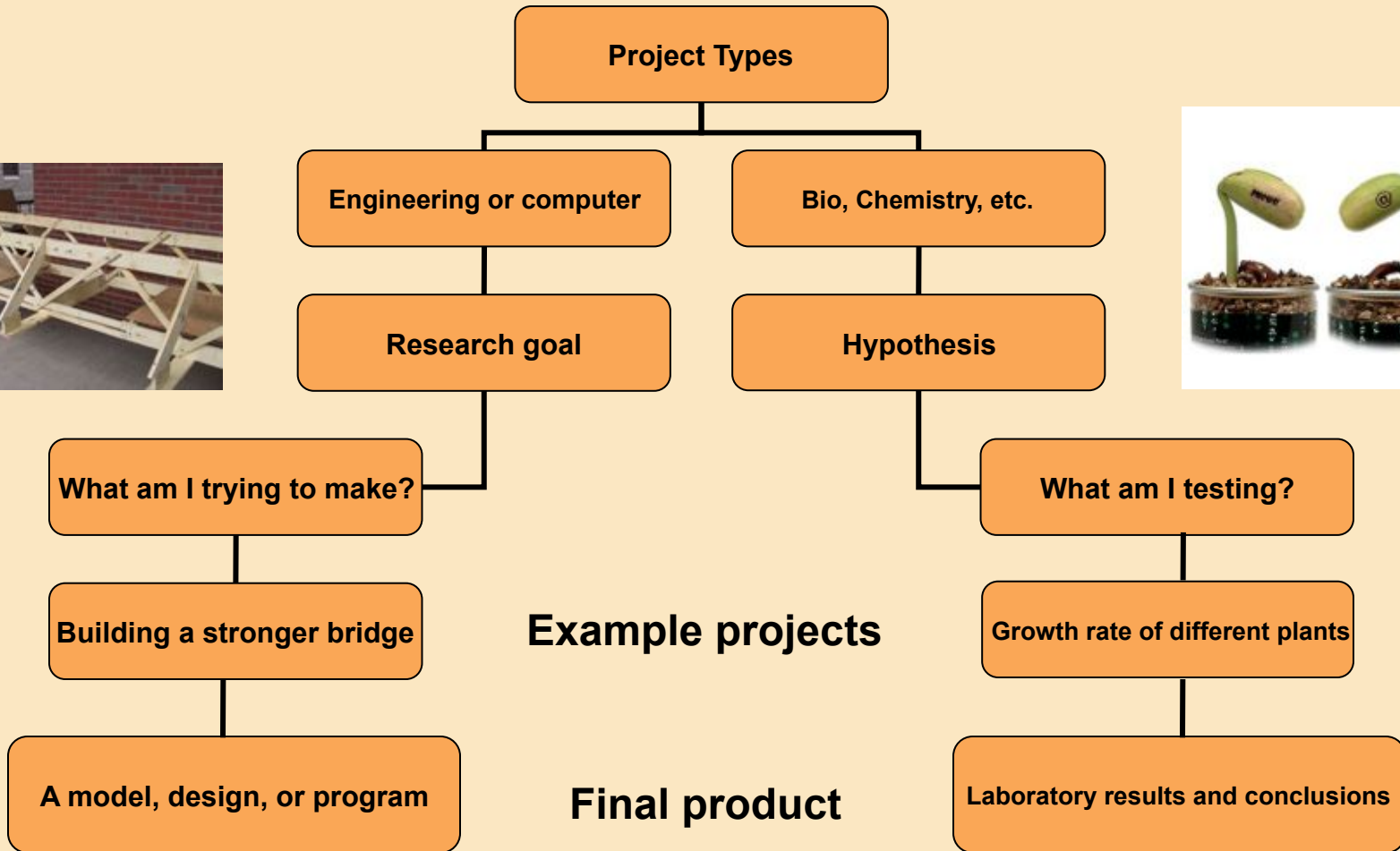
# Why should I do a science fair project?

- A science fair project allows you to **pose your own question** and answer it learning things you may never cover in your high school classes.
- Learning how to **think independently** to develop your ideas.
- Laboratory **research**, statistical **analysis**, and public **speaking** skills are required.

Projects build self-confidence and often enable you to present ideas to others in various situations, such as college and job interviews.



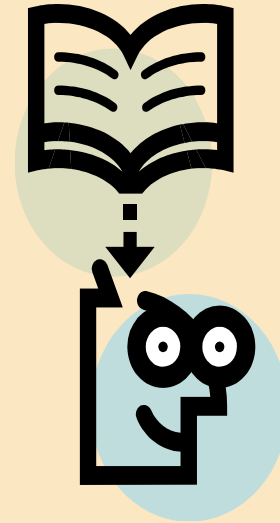
# What kinds of projects can I do?



# So what do I need to do?

## Well, here are the basics:

1. **Get a notebook** to record your observations, experiments, diagrams, pictures, and questions.
2. **Select a topic** and a research question: the more specific the better. Hint: It is always better to ask a simple question about something specific and get more complex than starting complicated and not knowing where to go!
3. **Read the literature** on the topic and problem: books, magazines, etc – you can do better than Wikipedia!
4. **Form a hypothesis** or state the purpose of the research.



### **Special Notes:**

For engineering & computer science projects...

### **Hypothesis = project goal**

What is a project goal?

To build a device, write a program, or design a system to solve a problem.

## The basics (continued)

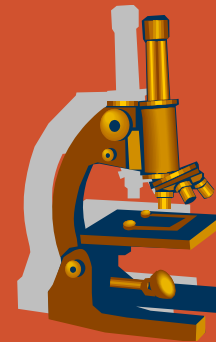
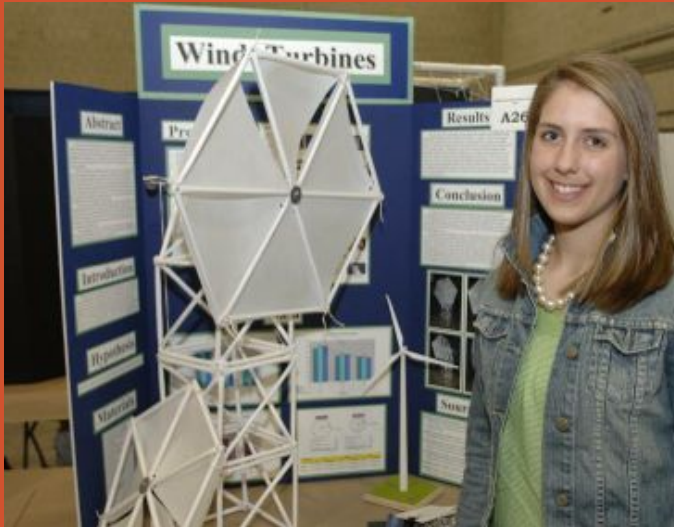
5. **Develop a research plan/** experimental design.
6. **Conduct the experiment.** Record the quantitative and qualitative data.
7. **Analyze data,** applying appropriate statistics.
8. **Repeat** your experiment.
9. **Form your conclusions** based on your results.
10. **Write** the laboratory report.
11. **Create** the visual display.



*These steps should be in every project, even though the order might be different, and the time spent on each will not be the same. Each participant must decide which steps to give more weight and when to do which step.*

# How do I choose a topic?

1. Consider what interests you. A hobby such as music, a sport, an article in a magazine, newspaper or a website is a good place to start.



2. Determine whether the project is feasible:

- Do you have enough time to do the necessary trials?
- Do you have the right equipment?
- What will the cost be?
- Is it within MSSEF safety regulations? When in doubt, check.

**Remember that restricts exist against:**

Potentially hazardous biological agents (microorganisms, DNA, human and vertebrate animal tissue, blood, body fluids, etc.), vertebrate animals, human subjects, hazardous chemicals, activities or devices, controlled substances.

Check the MSSEF website for rules and further description.



# Where do I get information for my project?

**Libraries.** Be nice to librarians! They can help you find unbelievable amounts of information... even more than the Internet can, and without all the pop-ups!

**Verifiable Internet Sources.** When a URL ends in .edu or .org, it's often something you can use.

**Previous Projects** that you or others have done if this is a continuous project.



## Some example of good magazines for research:

*Air and Space Magazine*  
*American Journal of Physics*  
*Chemical and Engineering News*  
*Environmental Science Technology*  
*Natural History*  
*Science News*

*American Biology Teacher*  
*Astronomy*  
*Discover*  
*Journal of Chemical Education*  
*Science*  
*Scientific American*

**Remember to cite every source you use!**

# What's the notebook for?

## How to keep a scientific notebook

Every experiment should be reproducible and the entries in your notes should be sufficient for someone else to reproduce your experiment. So describe everything that you have done in detail.

A neat log book will not only show the judges how much time you put into it, but it will help you in writing your report, setting up your display, and in your oral presentation as a reference.

If you take pictures or draw diagrams, record both your successes and failures.

Make sure each page is dated and describe your progress from day to day. Write each day after work, not a week or two later!



# The Scientific Method

All science fairs (and all of science... hence, the name!) follow these simple steps. Don't get overwhelmed, it's a way to organize your thinking. It's logic, not an exam!

1. **Observations** – This is what you learn from your research and experience about what you are interested in.
2. **Hypothesis** – A question that you form based on your observations that you want to test to prove or disprove.
3. **Design an experiment** – Think of how you want to test the hypothesis, gather the materials you need, and think of the steps you need to take.
4. **Test the experiment** – Use your design and see what happens. Make sure to take good notes recording what you do and the result.



5. **Accept or reject results** – These are your conclusions based on your experiment combined with your research.

Then...

6. **Go back** and make a new hypothesis based on these conclusions.

# Forming a hypothesis or stating the purpose

**Hypothesis:** A trial solution to a research problem. The data you acquire through experimentation can be used to support or refute the hypothesis. It does not matter if you prove it is right or wrong, so long as you stick to the topic.

## Sample Hypotheses

- The ingestion of caffeine increases the heart rate of *Daphnia* sp.
- Hard materials are more effective at reducing sound levels than soft materials.



## Tip: Brevity is Key!

Be specific in stating your hypothesis or purpose, but don't be overly wordy.

Think **two sentences maximum**. If you need more space to describe the problem, you're making it too complicated. **Simplify!**

# Before you start your experiment:

**Organize** all material and equipment to be ready for use as you need them. *In science you should look for trends in your data. Think about what those trends mean and plot them, if possible.*

**Outline the procedure** and make a timeline for yourself (when do you start each part, keep in mind when it is due).

**Keep your scientific notebook/log and graph paper handy.** Make entries in your scientific notebook as you go. Record data, both quantitative and qualitative, in your logbook.

**Determine** the precision of your data points using statistical analysis, if applicable.

**Complete all certification and compliance forms.**

**Observe safety rules.**



# Analyzing errors

Ask yourself these questions:

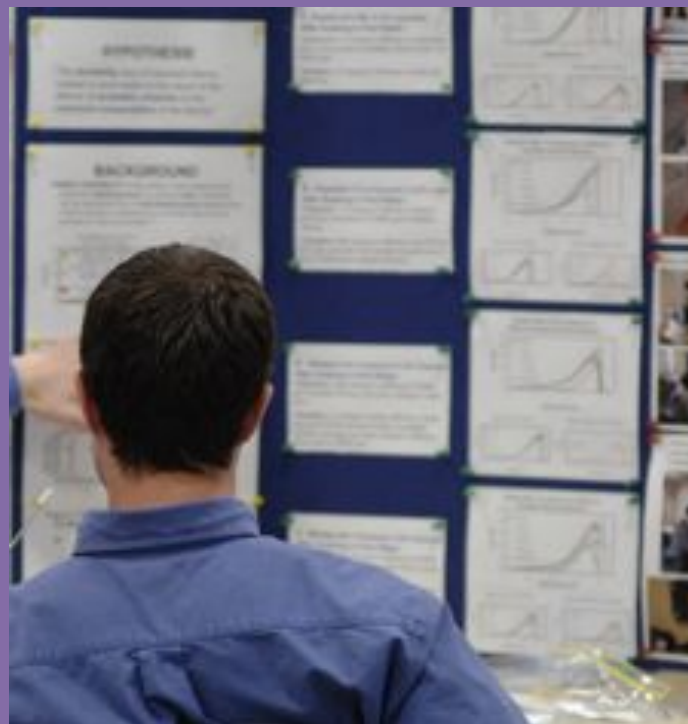
- What were the limitations of your experiment?
- How were the extraneous variables minimized?
- What went wrong? What went right?
- How might you improve your experimental design in future studies?



Write up answers to these questions in your report along with the rest of your data.

# Looking for trends & forming a conclusion

- Did you collect enough data?
- Which variables are important?
- How do your results compare with other studies?
- Do your results seem reasonable?
- Are there any trends in your quantitative or qualitative data?
- Do your results support your hypothesis? If not, why not?
- Has your experiment tested your hypothesis?



Remember to keep an open mind about your findings. **Never change or alter your results to coincide with what you think is accurate or with a suggested theory.** Sometimes the greatest knowledge is discovered through so-called “mistakes.”

# Writing the research paper

Your report will provide interested readers with a comprehensive look at your topic and research. Your paper should include information collected during the research as well as a complete description of your experiment, data, and conclusion.

## A good research paper...

**Should be written in the past tense and should have the following components:**

- Title and/or Title Page
- Abstract, Summary Page/Index
- Introduction, including Literature Review
- Hypothesis or Statement of Purpose
- Materials and Experimental Methods
- Data and/or Results
- Discussion and Analysis of Data or Results
- Conclusions
- Acknowledgements
- Bibliography



*Also, it is helpful to make a summary of your report with bullet points so your judges can quickly and easily see your main points.*



# Citing sources & avoiding plagiarism

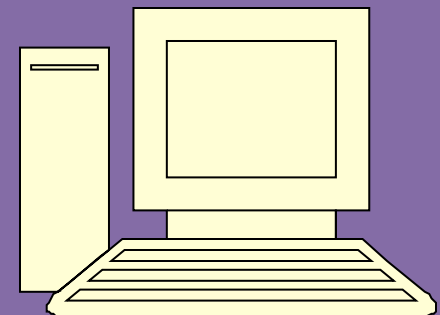
When using the work of other scientists, you must document their contributions by citing your sources of information. Scientists use the American Psychological Association (APA) Style.

For more details, you may want to consult “A Writer’s Reference,” by Diana Hacker, or Purdue University’s APA Style Guide

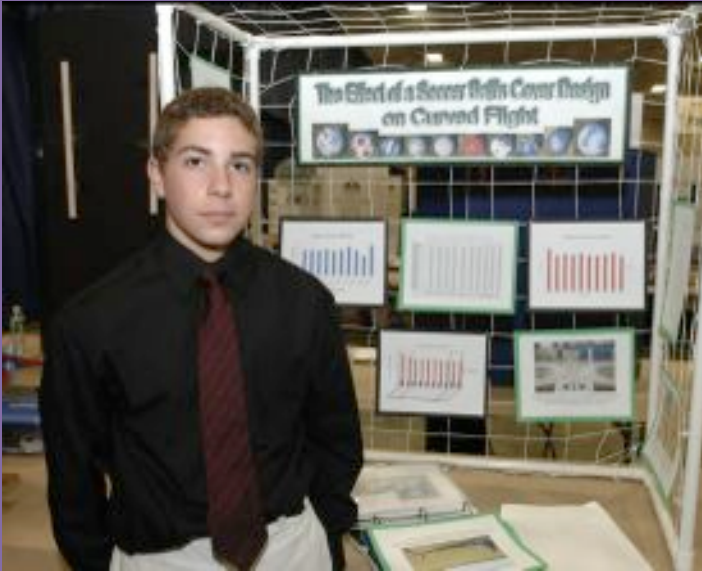
([owl.english.purdue.edu](http://owl.english.purdue.edu))

In text example:

**Internet source:** Author, date, and state “Internet”  
(Martin and Stephen, 2000, Internet) OR (Compost and Worms, 1952, Internet)



# Writing the abstract



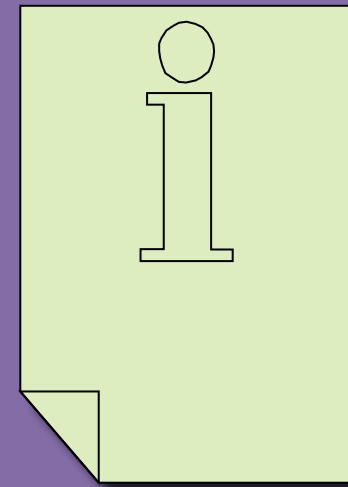
Once you're done with the experimentation, it's time to summarize!

The abstract is the last part of the project report to be prepared, and it is written after the project is completed. An abstract is a short summary of your project that informs the reader what the project covered, and what has been accomplished.

## **An abstract should include:**

- A statement of purpose or a hypothesis
- The experimental design, descriptive outline of the procedures and methods
- A summary of the results
- Your conclusion
- Application of the research project, if you have space, and your ideas for future studies

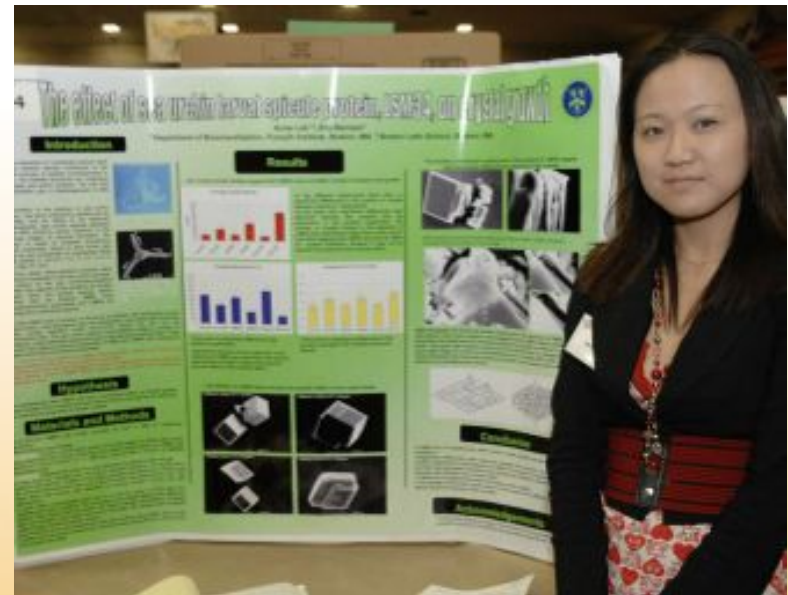
In total, the abstract should be a paragraph, not a page.



## Preparing your project board & visual display

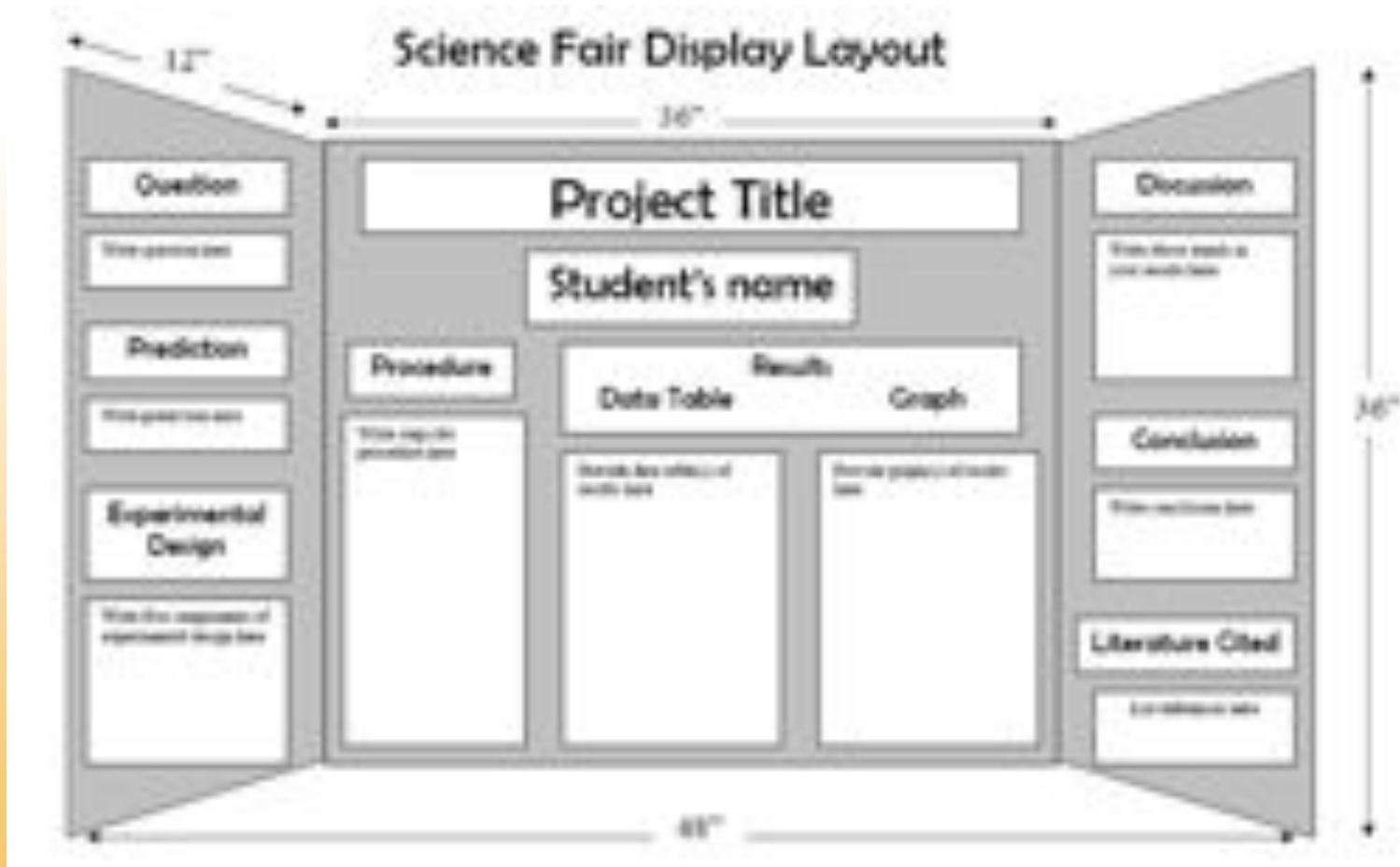
The following items are part of the project board:

- Title
- Introduction or Background
- Problem or Purpose
- Hypothesis
- Procedure or Experimental Design
- Materials Used
- Results (data, charts, diagrams, etc.)
- Analysis
- Conclusions
- Applications
- Future Applications or Future Research



**Rules of thumb:** Your project title and section headings on your board should be large enough to be easily read from six feet away. The regular text displayed on your board should be readable from a distance of three feet. Make it easy for the judges and others to assess what you have done: if they don't understand it, they cannot tell if your work was great or not.

# Sample board layout



# Oral presentation

## Some key features of a good presentation

- Be positive and confident about your work. You worked hard and know your project better than anyone else.
- Practice ahead of time in front of a mirror, family members, or friends.
- Try not to read from a script.
- Dress appropriately and neatly.



- Keep eye contact with your listeners during your presentation.
- Use your board/poster as a prop and tool to help you present your work.
- Present your work enthusiastically.

**Judges' Pet Peeve:** Judges will ask you questions. If they ask you something you don't know, tell them you don't know! Don't try to make something up "on the spot."

# For more science fair information...

## Websites:

**Massachusetts State Science & Engineering Fair**

[www.scifair.com](http://www.scifair.com)

The MSSEF Student Guide: “How to do a Science Fair Project” is very helpful. Additional Resources for science fair information are listed in the Resources section of the MSSEF website.

**Science Buddies**

[www.sciencebuddies.org](http://www.sciencebuddies.org)

**Dr. Shawn’s Science Fair Project**

[www.scifair.org](http://www.scifair.org)

## Reference Books:

Bochinski, Julia. 1996. *The Complete Handbook of Science Fair Projects*. John Wiley and Sons. New York.

Brisk, Marion. 1994. *1001 Ideas for Science Projects*. Simon and Schuster. New York.



**Hope to see you at MSSEF!**

**Massachusetts State Science & Engineering Fair, Inc.  
wishes to express its appreciation for  
the creation of this guide for students**

**to**

**Lanay Tierney**

**MSSEF Alumna & Award Winner  
2000 Graduate, Springfield Voc-Tech High School**

**2008 Graduate, Boston College**

**MSSEF Intern Extraordinaire**