Science Project Handbook

Resource:
http://www.societyforscience.org/isef/participate

Prepared by
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Choosing a Topic

A good project asks a question that can be answered by conducting an experiment **with results that you can measure**. Projects do not have to be elaborate, but must be well-thought out and thoroughly researched.

Projects must follow the scientific method of problem solving. These steps are presented and practiced in science class. Keep in mind that the project must be one in which a problem is solved by measuring something. The project must also comply with the Regional Science Fair standards.

It is strongly suggested that you do not use vertebrate animals, mold, fungi or bacteria, pathogens, or controlled substances in your project unless you are willing to do the extra requirements for these types of projects.

If you are having trouble finding a project, there are some excellent websites that offer project ideas.

Step 1:

Go online to the websites listed below and look at the science project ideas. Write down any projects that interest you.

- http://youth.net/nsrc/sci/sci.index.html
- http://scienceclub.org/scifair.html
- http://www.ipl.org/youth/projectguide/
- http://www.scifair.org
- http://www.floridassef.net
- http://www.societyforscience.org/page.aspx?pid=291
- http://www.floridassef.net/

Step 2:

Discuss with parents and/or teachers possible topics and consider all topics that might be of interest to you and that benefit the community. If you choose to work in a group, talk to your group members about possible topics.

Step 3:

Once you have narrowed your search down to several topics, go to the school website and look at the **research links** in **Destiny** to see if you can find enough information on these topics.

Step 4:

Think about the time and resources that you have available. Some experimentation will take more time than others. For example, you need several weeks to do a project involving seeds or plants. Other projects require using a commercial lab to conduct your experimentation and/or a supervisor that is an expert in a field of study.

Once you decide on your topic, fill in the information on the "Topic Selection Sheet" and turn it in by the due date to your science teacher for approval. **You may not start your research until your project is approved and your forms are turned in.**

Remember, you may not copy an experiment from the internet or a book. However, it can be changed or enhanced to make it your own.

You must have a project idea <u>before</u> starting research. ALL projects must be approved by your science teacher BEFORE research begins.

Step 5**:**

After your project is approved, log in to the *Society for Science* website below and read the rules for your topic, answer all of the questions about your topic, and at the end it will tell you which forms you need. **You will need a flash drive.**

- Go to **http://www.societyforscience.org/isef/rulesandguidelines**
- Click on **"Intel ISEF Rules Wizard"**
- **Read and answer all of the questions**
- At the end, **save** the forms on a flash drive
- Open the forms on your flash drive
- Type in the information (the Adult Sponsor is your science teacher)
- **Save**
- Print the forms at home (all students must complete forms 1A, 1B and 3)
- **Get a parent signature on any of the forms that require one**
- Turn the forms in to your science teacher

Research

1. Once you have determined a purpose, background research is necessary in order to develop a hypothesis.

2. Begin, by listing topics that you will need to research in order to answer your scientific question (purpose).

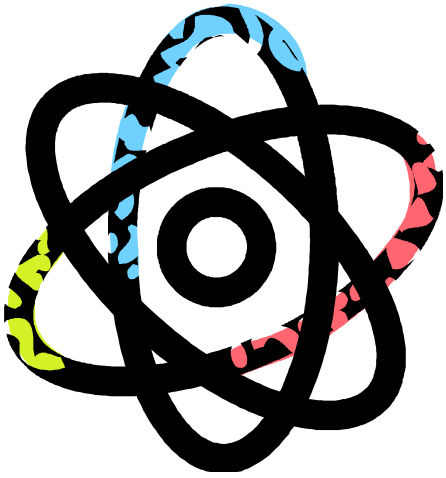
   Purpose: "What is the effect of microwave radiation on seed germination?"

   Topics to research: types of seeds, microwave radiation (amount, effect), seed germination

3. Record information about every resource that you use on the **source documentation packet**. This will be needed for your works cited page later in the project.

4. Continue doing research throughout your project if necessary.

You are now ready to read and take notes. You must have at least 6-10 different sources and they cannot be all Internet sources. Put the information you gather into your own words. Do not copy information word-for-word from your sources. Do not write complete sentences…only phrases, notes, bullets.



Choosing an MYP Area of Interaction

Once you have chosen your topic, you will need to choose one of the **Areas of Interaction** below to relate to your project. The area of interaction you choose should be evident in your project and provide a focus for your project. It will also be included in your conclusion.

Here are some questions to consider before choosing an area of interaction for your project:

- What do I want to achieve through my project?
- What do I want others to understand through my work?
- What impact do I want my project to have?
- How can a specific area of interaction enrich my project?

The 5 Areas of Interaction

Approaches to learning

How do I learn best?
How do I know?
How do I communicate my understanding?

Community and service

How do we live in relation to each other?
How can I contribute to the community?
How can I help others?

Environments

What are our environments?
What resources do we have or need?
What are my responsibilities?

Health and social education

How do I think and act?
How am I changing?
How can I look after myself and others?

Human ingenuity

Why and how do we create?
What are the consequences?

Purpose

1. Your purpose should be stated as a scientific question.

2. It should only include 2 variables (1 independent variable and 1 dependent variable).

3. It should be one sentence long.

   Example: "What is the effect of sunlight on newspaper?"

   Example: "What is the effect of salt on the freezing rate of tap water?"

   Example: "What is the effect of water temperature on a fish's breathing rate?"

   Example: "What is the effect of the surface of a road on a car's speed?"

Hypothesis

1. A hypothesis is an educated guess. Based on the background research you have done, what do you think will be the outcome of your experiment?

2. This is your answer to your question and a short explanation why.

3. It should include the independent variable and the dependent variable.

4. Remember your answer may be right or it may be wrong—that's okay! This is why you are doing your experiment.

5. It should only be one sentence.

6. Start the sentence with, "It is hypothesized that…," and include your "if…then statement." and then state why you feel this will happen based on knowledge you already have.

   Example: "It is hypothesized that <u>if</u> a newspaper is exposed to sunlight, <u>then</u> it turns yellow because of the ultraviolet rays from the sun."

   Example: "It is hypothesized that <u>if</u> a fish is put in cold water, <u>then</u> it will breath more times per minute than in warmer water because colder water holds more dissolved oxygen."

Example: **"**It is hypothesized that <u>if</u> salt is added to tap water, <u>then</u> the water will take longer to freeze because it lowers the freezing point."

Variables, Factors Held Constant and Experimental/Control Group

When testing your hypothesis, your test must be valid. There are many variables in an experiment. <u>You must change only one variable</u> when testing your hypothesis.

The *independent* (manipulated) *variable* is the one factor that you are going to change in your experiment.

The *dependent* (responding) *variable* is the one factor that may or may not change because you changed the manipulated variable.

The *factors held constant* are all the factors that you will keep the same in each of your trials.

The *control group* in an experiment is the trial done without changing any of the original factors.

Example

Purpose: What is the effect of salt on the freezing rate of tap water?

Hypothesis: It is hypothesized that if salt is added to tap water, then the water will take longer to freeze because it lowers the freezing point.

Manipulated Variable: The amount of salt added to the water

Responding Variable: How long the water takes to freeze

Factors Held Constant:

- Amount of water in each container
- Starting temperature of the water
- Size and shape of the container
- Material the containers are made from
- Freezer used
- Thermometer

Control: The container in which no salt is added

Materials List

List **ALL** materials needed for your project. Your list should be exact, including how much and what size. **Use metric measurement only.** You may arrange ahead of time to borrow metric beakers, thermometers, sensors, etc from the science lab. These must be signed out and returned after your experiment is finished.

Example:

Poor List	Good List
Measuring cup	250 mL graduated beaker
Water	750 mL water
Thermometer	Celsius thermometer
Container	20 cm X 20 cm aluminum cake Pan

REMEMBER TO LIST EVERYTHING YOU USE! TAKE PICTURES OF WHAT YOU ARE DOING

Procedures

I should be able to read your procedures and repeat your experiment exactly, without having to ask you to explain any steps.

1. Number your procedures in order of their occurrence.
2. Be sure to list ALL of the steps of your experiment and include details.
3. Be specific and include amounts and times if they were used.
4. Include all safety procedures that were followed.
5. Use metric measurement only.

What Makes a Good Experimental Procedure?	For a Good Experimental Procedure, You Should Answer "Yes" to Every Question
Have you included a description and size for all experimental and control groups?	Yes / No
Have you included a step-by-step list of all procedures?	Yes / No
Have you described how to the change independent variable and how to measure that change?	Yes / No
Have you explained how to measure the resulting change in the dependent variable or variables?	Yes / No
Have you explained how the controlled variables will be maintained at a constant value?	Yes / No
Have you specified how many times you intend to repeat the experiment (should be at least five times), and is that number of repetitions sufficient to give you reliable data?	Yes / No
The ultimate test: Can another individual duplicate the experiment based on the experimental procedure you have written?	Yes / No
If you are doing an engineering or programming project, have you completed several preliminary designs?	Yes / No

Taken from http://www.sciencebuddies.org/science-fair-projects/project_experimental_procedure.shtml

Measurement Help

The data collected during the course of your experiment must be measureable. Metric measurement is required. If you measure using the standard system of measurement you may use a calculator or a website to convert your data to metric measurement.

Length is measured in meters. **1 inch = 2.54cm**

Weight (mass) is measured in grams. **1 pound = 453.59g**

1 pound = 0.45kg

Liquid (volume) is measured in liters. **1 teaspoon = 5mL**

1 tablespoon = 15mL

Temperature is measured in °Celsius

To convert inches to centimeters go to http://manuelsweb.com/in_cm.htm

To convert Fahrenheit to Celsius go to http://www.wbuf.noaa.gov/tempfc.htm

For all conversions go to www.convert-me.com

	Name	Abbreviation	Number of Base Units	Approximate Comparison
LENGTH	Kilometer	km	1000	10 city blocks
	Meter	m	1	Half the height of a door
	Centimeter	cm	$\frac{1}{100}$	Length of a raisin
	Millimeter	mm	$\frac{1}{1000}$	Width of a period at the end of a sentence
MASS (weight)	Kilogram	kg	1000	Mass of a cantaloupe
	Gram	g	1	Mass of a raisin
VOLUME (liquid)	Liter	L	1	Half a large bottle of soda
	Milliliter	mL	$\frac{1}{1000}$	Half an eyedropper of water

You may round to the nearest tenth, hundredth or thousandth, depending on your data.

The Research Plan

The Research Plan is complete BEFORE experimentation. Your procedures will be more detailed in your log book and on your display board. This is just a plan (like a rough draft) but it must be typed in outline form.

FONT STYLE AND SIZE: TIMES NEW ROMAN OR ARIAL, 12 ONLY

SAMPLE PAGE:

Type your first and last name
Lawton Chiles Middle Academy
Grade

Title of Your Project

A. Purpose (type your question here, What is the effect of _____ on _____?)

B. Hypothesis or Engineering Goal (type your if…then, because statement here)

C. Procedures (number these and provide a detailed description of what you will do step-by-step. See the *Procedures* page in your Science Fair folder for help.

1.
2.
3.
4.
5.

Data Analysis: (explain in a paragraph how you will collect and analyze the data to see if it supports your hypothesis, see the example on the next page)

D. Bibliography

- use the MLA format to type your bibliography
- you must have at least **6** sources
- they cannot all be internet sources
- remember to put your sources in alphabetical order
- type your bibliography on a separate page
- use the *Citation Machine* website to help you format your bibliography
- **everyone** must include the *Society for Science* website

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SAMPLE RESEARCH PLAN

Name
School
Grade

What's the Potential?

A. What is the effect of potential/kinetic energy on the distance a Newton car will travel?

B. It is hypothesized that if the number of rubber bands used to throw the object off the Newton car is increased, then the car will roll farther than when a lesser number of rubber bands are used because you are increasing the potential energy.

C. Procedures:

1. Put on safety goggles to cut a wooden block 10cm x 20cm x 2.5cm and screw in the first wood screw 1cm from the top and 3cm from the closest side. Repeat with a second wood screw on the other side parallel from it. Next, screw the last wood screw 1cm from the bottom and 5cm from the sides. Screw down the wood screw until 1.5cm of the screw is into the wood.
2. Put 18 metal washers into the plastic film canister and close the lid. Cut 9 strings 12cm long and tie them in a loop of 8cm.
3. Cut 12 – 12cm dowel rods.
4. Put the first rubber band on by slipping the string on the rubber band. Stretch the rubber band onto the first two screws. Now, stretch the string loop to the last screw at the end. Scoot the film canister all the way to the end of the rubber band. Set all 12 of the dowel rods 10cm apart to form a track. Set the car at the beginning of the track so the film canister will shoot out of the way of the car's path. Strike a match and light the string.
5. Measure how far the car went from the starting point to the front of the car and record the results. Repeat the procedure for the next 19 trials the same way and record the results.
6. Repeat steps 4 and 5 using two rubber bands on the car.
7. Repeat steps 4 and 5 using three rubber bands.

Data Analysis:

The data will be recorded in data charts for each of the trials. There will be three separate charts, the first one will be data collected using 1 rubber band. The second chart will have the data using 2 rubber bands and the third chart will be data from 3 rubber bands. On each chart, the data will be averaged and the averages will be graphed and compared.

D. Bibliography:

(Citations of your 6-10 sources are typed here in alphabetical order. Do not number them. You may use *Citation Machine*)

Everyone must use the one listed below as their first source on the page.

"International Rules and Guidelines." 3 October 2011. http://www.societyforscience.org/isef/rulesandguidelines.

Log Entries

1. First Page: (centered in middle of the page)	State your problem in the form of a question Write your first and last name Write the address of your experimentation site (home) Your Science Teacher's Name, Adult Sponsor
2. Second Page:	Table of Contents for your log book
3. Third Page:	State your hypothesis Remember to say, "It is hypothesized that…"
4. Fourth Page:	List all of your variables, constants, control (label them independent…)
5. Fifth Page:	List your materials
6. Sixth Page:	List ALL of your procedures
7. Seventh Page +: (Continue numbering pages until you finish experimenting)	Begin dated entries Write the date and time started/ended at the top Describe **in detail** what you did that day **Your log should start on the first day that you actually start your experiment**
8. Last Page:	For your final entry write this sentence filling in the dates: This is the end of data collected during the period of (beginning date) to (ending date). Sign your name and put the date under it: *Your name* *Date of final entry*
REMEMBER:	Do not write on the back of the pages Write neatly in blue or black ink Date every entry; record time started & ended Keep a detailed record of everything you observe Make **qualitative** and **quantitative** observations Record any sources consulted (people, book, website) Detail any problems and/or solutions **Record all safety procedures followed (detailed)** Use only metric measurements Make a chart or table in your log book to record data (label units used – ex: grams, mL, etc.)

Sample Log Pages

PURPOSE:
Write your Question here

Name
Home Address
Lakeland, FL

Adult Supervisor

(do not number this page)

Page 1

Table of Contents

(do not number this page)

Page 2

Hypothesis

It is hypothesized that…

(**start** numbering your pages)

3

Page 3

Variables

The manipulated variable is….

The responding variable is…

The factors held constant are….(make a bulleted list)

The control is…

4

Page 4

Materials

1. _____
2. _____
3. _____
4. _____
5 _____

5

Page 5

Procedures

List everything you have done in order step-by-step (be very specific)

Number your procedures

6

Page 6

Sample Log Pages cont.

Date
Time started/ended

Today I ….

(describe what you did in detail, the data you collected and include plans for the next day's work)

7

Page 7

Date
Time started/ended

Today I …

(continue to document what you do each day, including data and plans for the next day's work)

8

Page 8+

Put any
Pictures or graphs, etc
on the next page(s)

Other Pages

This is the end of data collected during the period of (beginning date) to (ending date).

Your signature
Date

(Do not number this page)

Last Page

- ***Remember the more log entries you have, the better!***
- ***Include everything! Be specific!***
- ***Include data tables in your logbook***
- ***Include photographs of on-going experiment***
- ***Print if you do not have clear handwriting***
- ***If you make a mistake, mark through it with a ~~single line~~***

Data Tables and Graphs

Data/Results

Observations of everything that happens during the experiment. Use metric measurements only. Repeat trials to assure accurate results. Final results are displayed in the form of graphs, tables, and photographs.

Line graphs are used to show changes over short and long periods of time

Bar graphs are used to compare things between different groups.

Pie charts are used when you are trying to compare parts of a whole. They do not show changes over time.

Data Table or Chart Checklist

What Makes for a Good Data Analysis Chart?	For a Good Chart, You Should Answer "Yes" to Every Question
Is there sufficient data to know whether your hypothesis is correct?	Yes / No
Is your data accurate?	Yes / No
Have you summarized your data with an average, if appropriate?	Yes / No
Does your chart specify units of measurement for all data?	Yes / No
Have you verified that all calculations (if any) are correct?	Yes / No

Taken from http://www.sciencebuddies.org/science-fair-projects/project_data_analysis.shtml

Graph Checklist

What Makes for a Good Graph?	For a Good Graph, You Should Answer "Yes" to Every Question
Have you selected the appropriate graph type for the data you are displaying?	Yes / No
Does your graph have a title?	Yes / No
Have you placed the independent variable on the x-axis and the dependent variable on the y-axis?	Yes / No
Have you labeled the axes correctly and specified the units of measurement?	Yes / No
Does your graph have the proper scale (the appropriate high and low values on the axes)?	Yes / No
Is your data plotted correctly and clearly?	Yes / No

Taken from http://www.sciencebuddies.org/science-fair-projects/project_data_analysis.shtml

Conclusion/Abstract

Before writing your conclusion, ask yourself these questions:

- What was the purpose of this project? Did the data support your hypothesis or not?
- What did you do?
- What were your results? Did you gather enough data?
- Did you do at least 5 trials?
- Would you do your experiment differently the next time? Were there any unexpected problems that might have affected the results of your experiment?
- Did you make any mistakes and have to start over? How would they have affected the outcome?
- Is there some way you could improve on your experiment or expand it in the future?
- Who can use this information? Why is it important?
- How does it relate to the area of interaction I chose?

The conclusion is written in third person and in past tense. See the sample on the next page.

1. Your first sentence should state the purpose of your project. Then briefly explain what you did. The area of interaction should also be identified in the first paragraph.

2. In the second paragraph, tell whether or not your test results supported your data.

   Example: **It is concluded that the data collected <u>supported</u> the hypothesis.**

   or

   It is concluded that the data collected <u>did not support</u> the hypothesis.

3. Then state the results and write 2 or 3 sentences explaining the results and why the results supported or did not support the hypothesis.

4. In the third paragraph explain any problems or errors that may have affected the results of the experiment. Tell of additional experiments that can continue from your present one. Write at least 3 sentences in this paragraph.

5. Write a fourth paragraph explaining the real-world applications of this research/data and who could use this information and how. Explain how it is related to the area of interaction you chose.

6. When you type the conclusion for your board, justify the margins.

Sample Conclusion

The purpose of this project was to determine if color has an effect on the temperature of water in a container that is exposed to sunlight. Six aluminum cans were used. Three cans were painted using the three primary colors: red, green and blue, one can was painted white and one can was painted black. The control was an aluminum can that was left unpainted. The cans were placed in direct sunlight and the temperature was measured and recorded over a two-hour period. This was repeated on several different days in differing weather conditions. The area of interaction that was chosen for this project is environments because the focus was to identify ways to improve the heating or cooling of water in a simple, cost effective way.

It is concluded that the test results supported the hypothesis. The data collected showed that the water in the black can got hotter faster than the water in the other cans, including the unpainted can. The results also showed that the temperature of the black can remained an average of 2.5 degrees Celsius higher than the unpainted can. The data indicated that in this experiment the black can absorbed more of the sun's rays than the other cans.

This experiment was done during the latter part of December when the sun's rays are slanted the most since the sun is over the Tropic of Capricorn. It would be interesting to do this experiment during the summer solstice when the sun's rays are shining more directly on this part of the earth. Some days during the experiment were cloudier than others and this affected the results. The thickness of the paint could have affected the results, also. Therefore, next time the unpainted can should be painted with paint as close in color as possible to the original can color. This would eliminate a variable that was overlooked and test only the effects of the color of the cans.

This project relates to the area of interaction "environments" because the results can be used to find ways to reduce energy costs in the community. The information learned from this experiment could be helpful to home or commercial canners who want their products to remain as cool as possible after the canning process is completed. This information could also be used by roofing manufacturers, allowing consumers to choose roof colors that would help save energy and reduce the cost of heating and cooling their homes.

Designing the Display Board

A display board is your way of presenting your project to others. Plan your display carefully.

MAXIMUM SIZE: Depth **(front to back): 30 inches or 76 centimeters**
Width **(side to side): 48 inches or 122 centimeters**
Height **(floor to top): 108 inches or 274 centimeters**

All boards must be free-standing.

Follow these steps:

1. Purchase your display board at *Teacher's Exchange, WalMart, Staples, Office Depot,* etc.

2. Display the title of the project in large pre-cut letters, cut out your own letters, or use the computer to type your title. Your title should be an attention-grabber !

3. Choose complementary colors and back all of your information with construction paper. Using 2 layered colors really makes your work stand out.

4. Label each part as shown below. Write or type large enough for the viewer to read easily. You may use purchased labels or make your own.

5. Use rubber cement to mount your paper to the backboard. Make your design appealing. Include photos, charts, drawings, graphs, etc. **All pictures, graphs or photographs should be clearly labeled. If you use a graphic from the internet, be sure to give credit to the source.**

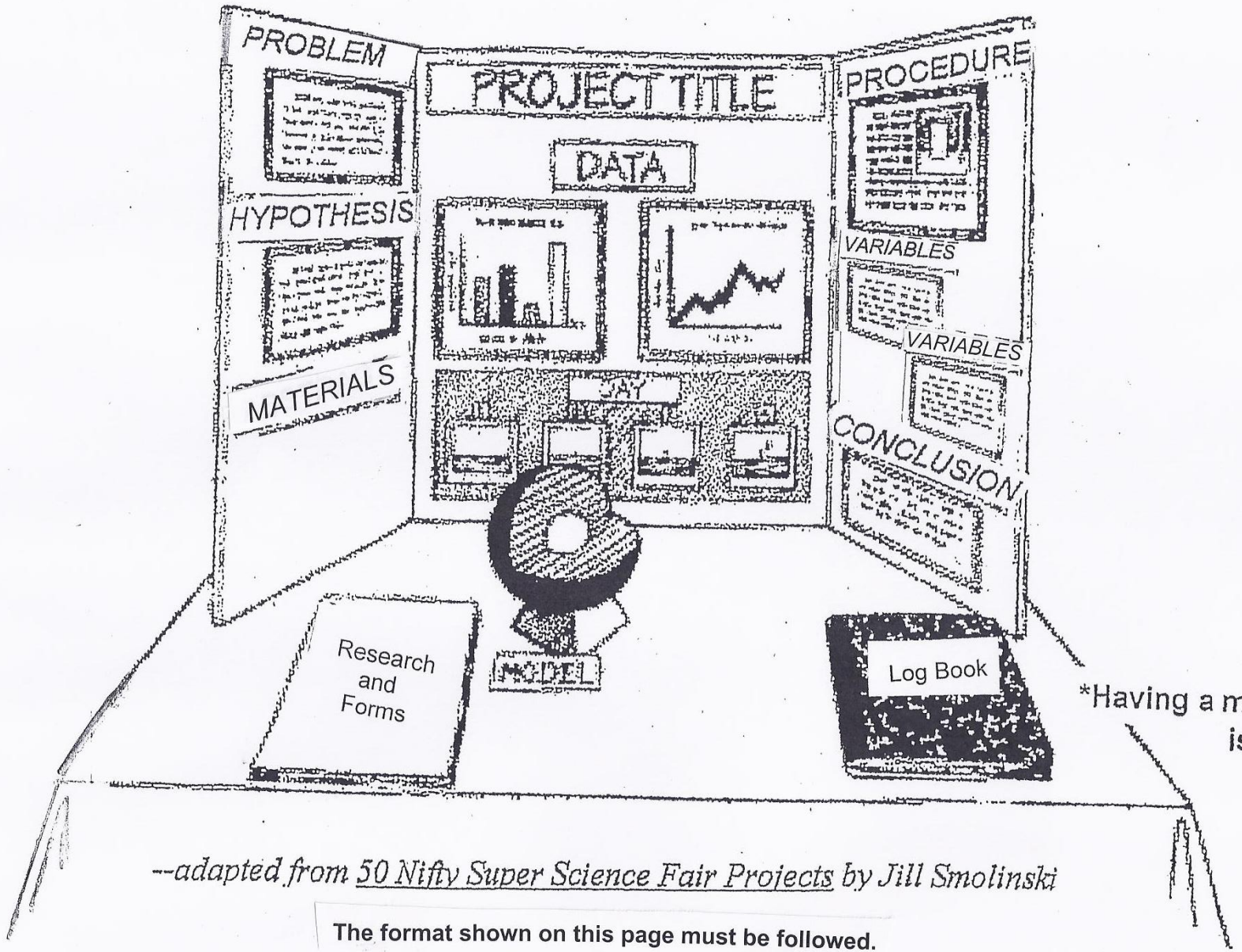
6. **If you use photographs on your board, they should have a caption explaining what is happening in the picture and credit has to be given to the photographer.**

7. Place your Log Book and Research Paper on the table in front of your board. Design a report cover or folder that will interest the reader in your project.

IMPORTANT

You cannot have photographs of anyone's face other than your own on your board.
You cannot have any brand or product names showing in your photographs.

BEFORE gluing anything onto your board, lay the whole thing out on the floor and evaluate the arrangement.



--adapted from 50 Nifty Super Science Fair Projects by Jill Smolinski

The format shown on this page must be followed.

Glossary of Terms

Abstract
Short (250 words) summary of the entire project. It should summarize the purpose, procedure, and results. There is a specified format you must follow.

Background Research
Learning about the topic by reading books, newspapers, and magazines, watching television, films, and videos, or interviewing knowledgeable people. Information gathered should result in a paper 1 to 3 pages in length using the formal writing procedure—3rd person only. You must have at least 3 sources.

Conclusion
Written summary of findings. Evaluate the accuracy of your hypothesis. Determine any problem areas. Note future changes. List ways this experiment would apply and benefit real-life situations.

Controls
Conditions which do not change during experimentation. Used for comparison. You should use as many controls as possible

Data/Results
Observations of everything that happens during the experiment. Use metric measurements only. Repeat trials to assure accurate results. Final results are displayed in the form of graphs, tables, and photographs.

Display
Backboard, logbook, and research paper. Must follow the specified format.

Hypothesis
An educated guess presuming the outcome of the experiment. Follows the background research and is one possible outcome of the problem. Should state, "It is hypothesized that …" followed by an if…then statement.

Log
A notebook in which a record is kept of ALL notes, information, measurements, events, observations, sketches, data, etc. Be sure to date your entries. Do not recopy your logbook to make it neater. The log should be in your own handwriting in blue or black

ink and contain the original data. This will become an important part of the project display.

Materials
A complete list of everything used during the experiment including equipment, chemicals, organisms, etc.

Operational Definition
A statement that describes how to measure a particular variable or define a particular term for an experiment. (ex: room temperature = 20-24°C)

Problem/Purpose
The specific problem that is going to be investigated. State this in the form of a question. "What is the effect of _____ on _____?"

Procedure
Step-by-step instructions describing the entire experiment. Steps should be explained so that another person could duplicate the experiment. Time and amounts are very important.

Variables
The independent/manipulated variable is that which causes change. There should be only one. It is the focus of testing.

The dependent/responding variable may or may not change as a result of the independent/manipulated variable.

The control is what you are comparing your variables to, it remains constant.