
# Student Sheets

Science Fair Topic

1. What general field of science are you interested in?

   Botany - the study of plants
   Behavioral science - the study of human behavior
   Zoology - the study of animals
   Physics - the study of energy and its effect on matter
   Chemistry - the study of the composition of matter
   Geology - the study of rocks and minerals
   _____

2. Within this field, what topics would you like to do a project on?

   a. _____ (first choice)

   b. _____

   c. _____

3. What do you already know about your first choice topic? List as many facts as you know, using extra paper if necessary.

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

   f. _____

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Writing (Language)** | Communication of ideas is unclear, with spelling / grammar mistakes | Communication is reasonably clear, but with minor spelling / grammar mistakes | Clear communication with complete sentences and proper spelling and grammar | Clear, concise communication with no grammatical or spelling mistakes |
| **Use of Information (Learning Skills)** | Needed major assistance to investigate and obtain information. | Needed some assistance to investigate and obtain information. | Investigated and obtained information independently | Investigated and obtained information independently and with initiative |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

Science Fair Question

Keep in mind the following four points when picking your question!

1. Your question must include both an independent (manipulated) and a dependent (responding variable). An independent variable is something that you intentionally change in your experiment. A dependent variable is something that changes as a result of what you intentionally changed.

2. Your question must be one that is safe to investigate. You may not investigate a question that would involve putting yourself, someone else, or an animal in any danger. Be sure to think your question through by asking yourself what materials or actions would be involved in completing the experiment. If your experiment would require dangerous chemicals, tools, apparatus, or procedures, you should think of another question.

3. Pick a question that does not have a commonly found answer. In other words, the question should not be something that you could look up in an encyclopedia or on the Internet to find the answer. It needs to be something that you must investigate through experimentation to find the answer. Your question should not be answered with a simple "yes" or "no."

4. Choose a realistic problem that you are able to investigate with your current resources. Investigating the effect of lemon juice on the growth of bread mold is a lot more realistic than trying to conduct an experiment on the effectiveness of a certain type of tile on the space shuttle's outer hull. It would be easy for you to find the materials needed to see how lemon juice affects bread mold. You could probably get the materials needed to conduct such an experiment from home - you would just need some lemon juice and bread. You probably wouldn't be able to conduct hands-on tests with the space shuttle because you don't have one easily accessible.

**Format** (Choose a, b, or c)

a. What is the effect of _____ on _____?
independent variable dependent variable

b. Does (the) _____ affect _____?
independent variable dependent variable

c. To what extent does (the) _____ affect _____?
independent variable dependent variable

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Plans investigations (Science)** | Lack of independent or dependent variable | Independent and dependent variable are present but unclear | Clear independent and dependent variable | Clear, concise independent and dependent variable |
| **Plans investigations (Science)** | Impractical to investigate due to safety, materials, or other factors | Practical problem with minor concerns | Practical problem. | Original, practical problem |
| **Plans investigations (Science)** | Unoriginal problem with a totally predictable answer | Some creativity in problem, outcome not certain | Imaginative problem with outcome of interest | Highly original problem with outcome of interest |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

Science Fair Research

Look for sources of information on your science fair topic. Do not look for the answer to your possible science fair problem; look for:

- General background information
- Definitions of words related to your topic
- Statistics - results from other experiments
- Examples
- Scientists / people related to your topic

You may use books, magazines, encyclopedias, the internet, CD-ROM, etc.
Your sources must be listed in proper bibliography format.

1. List 10 pieces of information in point form you found in at least 3 different sources.

2. Use the list of information to write a background information page of at least 75 words.

3. List at least three sources of information in proper bibliography form.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Writing (Language)** | Communication of ideas is unclear, with spelling / grammar mistakes | Communication is reasonably clear, but with minor spelling / grammar mistakes | Clear communication with complete sentences and proper spelling and grammar | Clear, concise communication with no grammatical or spelling mistakes |
| **Writing (Language)** | Information is not arranged logically in a paragraph. Many mistakes in format. | Information is arranged logically in a paragraph. Some mistakes in format. | Information is arranged logically in a paragraph. Proper format is followed. | Information is arranged creatively as well as logically in a paragraph. No errors in bibliography format. |
| **Use of Information (Learning Skills)** | Needed major assistance to investigate and obtain information. | Needed some assistance to investigate and obtain information. | Investigated and obtained information independently. | Investigated and obtained information independently and with initiative. |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

General Guide to Formatting a Bibliography

1. For a book:
   Author (last name first). Title of the book. City: Publisher, Date of publication.
   Example:
   Dahl, Roald. The BFG. New York: Farrar, Straus and Giroux, 1982
2. For an encyclopedia:
   Encyclopedia Title, Edition Date. Volume Number, "Article Title," page numbers.
   Example:
   The Encyclopedia Britannica, 1997. Volume 7, "Gorillas," pp. 50-51.
3. For a magazine:
   Author (last name first), "Article Title." Name of magazine. Volume number, (Date): page numbers.
   Example:
   Jordan, Jennifer, "Filming at the Top of the World." Museum of Science Magazine. Volume 47, No. 1, (Winter 1998): p. 11.
4. For a newspaper:
   Author (last name first), "Article Title." Name of newspaper, city, state of publication. (date): edition if available, section, page number(s).
   Example:
   Powers, Ann, "New Tune for the Material Girl." The New York Times, New York, NY. (3/1/98): Atlantic Region, Section 2, p. 34.
5. For a person:
   Full name (last name first). Occupation. Date of interview.
   Example:
   Smeckleburg, Sweets. Bus driver. April 1, 1996.
6. For a film:
   Title, Director, Distributor, Year.
   Example:
   Braveheart, Dir. Mel Gibson, Icon Productions, 1995
7. CD-ROM:
   Disc title: Version, Date. "Article title," pages if given. Publisher.
   Example:
   Compton's Multimedia Encyclopedia: Macintosh version, 1995. "Civil rights movement," p.3. Compton's Newsmedia.
8. Magazine article:
   Author (last name first). "Article title." Name of magazine (type of medium). Volume number, (Date): page numbers. If available: publisher of medium, version, date of issue.
   Example:
   Rollins, Fred. "Snowboard Madness." Sports Stuff (CD-ROM). Number 15, (February 1997): pp. 15-19. SIRS, Mac version, Winter 1997.
9. Newspaper article:
   Author (last name first). "Article title." Name of newspaper (Type of medium), city and state of publication. (Date): If available: Edition, section and page number(s). If available: publisher of medium, version, date of issue.
   Example:
   Stevenson, Rhoda. "Nerve Sells." Community News (CD-ROM), Nassau, NY. (Feb 1996): pp. A4-5. SIRS, Mac. version, Spring 1996.
10. Internet:
    Author of message, (Date). Subject of message. Electronic conference or bulletin board (Online). Available e-mail: LISTSERV@ e-mail address
    Example:
    Ellen Block, (September 15, 1995). New Winners. Teen Booklist (Online). Helen Smith@wellington.com
11. World Wide Web:
    URL (Uniform Resource Locator or WWW address). author (or item's name, if mentioned), date.
    Example: (Boston Globe's www address)
    http://www.boston.com. Today's News, August 1, 1996.

Science Fair Hypothesis

A hypothesis is an educated guess about the question. After doing research on your topic and coming up with a problem to investigate, you now have the tools to make “an educated guess.” To construct a hypothesis, all you really have to do is ask yourself what you think the outcome of the experiment will be. Use knowledge you already had, common sense, and your research to help you predict what the answer will be.

Right or wrong does not matter. At the end of the experiment you will find out whether your hypothesis was right or not. As a scientist, you should understand that it is not important that you "got it right." It is more important that you learned something about your topic. Don't get hung up on having the right answer.

1. Use an "If...then..." format. An "If...then..." statement is one that shows a cause and an effect relationship. For example, "If a plant is given acidic liquids, then the plant's growth will decrease." In this hypothesis, there is a cause (acidic liquid) that produces an effect (decrease in plant growth).

2. Use a second sentence to help explain why you think that will happen. Use information you know from research and personal experience / knowledge to help you guess the outcome.

3. The hypothesis must address the independent and dependent variables. The cause and effect in your hypothesis are related to the independent and dependent variables in your question. For example, look at this question: "Does the type of music affect a plant's growth?" The type of music can be changed intentionally, so it is the independent variable. The plant's growth may change as a result of the type of music, so it is the dependent variable. Your hypothesis must include an IV and DV: "If a plant is exposed to classical music (IV), then it will grow very fast (DV)."

Your hypothesis:_____

_____

_____

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Plans investigations (Science)** | Lack of independent or dependent variable, format is not followed | Vague independent and dependent variable, format not followed correctly | Clear independent and dependent variable in correct format | Clear independent and dependent variable with cause and effect in correct format |
| **Plans investigations (Science )** | Hypothesis shows poor use of background material and general knowledge | Hypothesis shows some use of background material and general knowledge | Hypothesis shows use of background material and general knowledge | Hypothesis shows excellent use of background material and general knowledge |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

Science Fair Experimental Design

1. Controlled Variables

   Before you do any designing, you must decide what variables will need to be controlled or kept the same in your experiment to ensure a fair test. Remember that you can change only one thing intentionally - the independent variable. Everything else must remain the same in your experiment or your results will not be valid.

2. Operational Definitions

   How will you measure your variables so that they can be put into a number or quantitative terms? If you are measuring growth of a plant, then how will you define "growth?" Is it the height of the plant (measured in millimeters or centimeters)? Is it the weight of the plant (grams)? In your experiment, does growth refer to the size of the leaves? Whatever you want growth to be in your experiment must be clearly defined ahead of time. Write down all measurements you will use to define each variable operationally.
   If you are measuring length, use millimeters, centimeters, or meters. If you are measuring weight, use milligrams, grams, or kilograms. To measure volume, you must use milliliters or liters. Temperature must be measured in degrees Celsius. All measurements must be Metric.

3. Materials

   What equipment will you need to conduct the experiment? Think about what you will be testing in your experiment and decide what materials you will need. Be sure that the materials are ones to which you have easy access.

4. Method

   List all the procedures you need to complete in order to conduct the experiment. Starting from the very beginning, list all of your steps in order. Include many details. Mention how you will control variables. Write down how you will measure your results. It is important to have more than one trial, that is to try some steps more than once. Your finished method should be detailed enough so that anyone who wants to duplicate your experiment can do so simply by following your list.

   **Important**: Normally you must do many trials. This means you have to repeat the experiment enough times to be sure of the results. If you're growing plants, you probably have to grow a few of each type or variation in case one seed or plant was healthier to start.

In Summary:

1. List your important controlled variables.
2. Operationally define your variables. As part of this, make sure you describe how will you measure your dependent variable so that you have a quantitative result.
3. List your materials.
4. Write out your method.

| Experimental Design | | | | |
|---|---|---|---|---|
| | **1** | **2** | **3** | **4** |
| **Controlled Variables (Plans Investigations)** | Controlled variables are not central, more than two central not listed | More than one central controlled variables not listed | Most central controlled variables listed | All central controlled variables listed |
| **Plans Investigations - Variable Definitions (Science)** | Variables are defined qualitatively or measurement does not reflect definition | Variables are defined but measurement may not accurately reflect definition | Variables are defined with a quantitative value and a way to measure it. | Variables are defined with a meaningful quantitative value and a valid way to measure it. |
| **Plans Investigations - Materials (Science)** | Central equipment not included. Materials in sentence and/or paragraph form. Size / amount of equipment not included where needed | Minor equipment missing. Size / amount of equipment not included where needed | All equipment and supplies needed to carry out the experiment in list form | All equipment and supplies needed to carry out the experiment in list form. Size and amount of items included where appropriate |
| **Plans Investigations - Method (Science)** | Method assumes knowledge of the experiment. Does not flow logically. Written in paragraph form. Contains extra information, steps, or instructions not required. | Step-by-step numbered description that misses not more than two key details. | Step-by-step numbered description that misses not more than one key detail. | Method consists of clear and concise numbered steps that flow in a logical, chronological order. Method is performable by a student unfamiliar with the experiment. |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

Science Fair Results

You must include four parts in your results.

1. Keep raw data in your logbook. Raw data is the first information you get as you make observations during your experiment. For example, if you were charting plant growth, you might find that on the sixth day of the experiment, the plant has grown to a height of 1 cm. On the next day, it is 1.5 cm. Then the following day the plant is 1.7 cm. All of this information is raw data. It needs to be kept in your logbook with the date and other relevant experiment data.

2. Construct a data table to record data on blank paper. A data table is the easiest way you can record your information.
   - the independent variable is always placed on the left side of the table
   - the dependent variable is always located on the right side, or across the top
   - list the independent variable numbers from smallest to largest
   - the numbers for the independent variable should fall into a pattern
   - leave a column for the average of trials

   Example:

   The Effect of Water Temperature on Plant Height

| Water Temperature ($^{O}$C) | Plant Height (cm) | | | |
|---|---|---|---|---|
| | Trial 1 | Trial 2 | Trial 3 | Average |
| 5 | | | | |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |

3. Draw a graph on graph paper using the values for the independent variable and the dependent variable.
   - values for the independent variable are placed on the horizontal axis
   - values for the dependent variable are placed on the vertical axis
   - label horizontal axis and vertical axis with what the variables stand for
   - include the units you used to measure each variable after the label in brackets
   - title the top of your graph

   **Bar graph** – used for comparison
   **Line graph** – used to show change over time, or independent variable is changed in a consistent incremental fashion
   **Pie or circle graph** – used to show parts of a whole (percentage)

4. A paragraph or two of observations taken during the experiment. *Summarize* what you saw, heard, felt, or smelled during the experiment. Keep notes as you perform the experiment and write up the paragraph(s) after it is complete. Don't include any opinions or judgments, only what happened during the experiment.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Communicates Results - Logbook (Science)** | Most data present but hard to follow. Titles and dates missing. | Data present but not always easy to follow. Dates or titles missing. | Communicates data in chronological order with units. Logbook is complete with most titles and dates. | Clearly communicates data in logical, chronological order with units. Logbook is complete with all dates and titles. |
| **Communicates Results - Data Table (Science)** | Table makes data hard to interpret. Variables are in wrong locations with units missing. No title. | Some parts of the table are unclear due to a missing title, missing units or an incorrect setup. | Titled with units. Variables are in correct locations. | Table set up allows easy interpretation of data. Titled with units. Variables are in correct locations. |
| **Communicates Results - Graph (Science)** | Few rules for scientific graphing are followed. | Many rules for scientific graphing are followed. | Most rules for scientific graphing are followed. | All rules for scientific graphing are followed. |
| **Writing (Language)** | Communication of ideas is unclear, with spelling / grammar mistakes | Communication is reasonably clear, but with minor spelling / grammar mistakes | Clear communication with complete sentences and proper spelling and grammar | Clear, concise communication with no grammatical or spelling mistakes |
| **Homework Completion / Work Habits (Learning Skills)** | Did not pay attention to instructions or missed time guidelines | Followed most directions | Followed directions and completed task on time | Followed directions and completed task on time and with attention to details |

Science Fair Conclusion

- Restatement of your problem
- Restatement of your hypothesis
- General statement of the final average result of your trials. Don't restate the results of each and every trial; this information is already in your data table. Averages are a good summary.
- General patterns or trends seen in your analysis of results
- A sentence which states if your hypothesis was correct or incorrect
- Answer to the problem
- A list of factors which may have affected your project, including sources of error
- A general statement of what your experiment taught you, or implications

Example :

For this science fair project the effect of water temperature on plant growth was tested. It was hypothesized that warmer temperature water would improve the plant height (up to a point) as it would speed diffusion and osmosis. The results indicated that radishes with water below $10^{O}C$ had the most growth, with a gradual decline in average height until plant death at about $45^{O}C$. Therefore, the hypothesis was rejected. In conclusion, warm water has a detrimental effect on plant growth. This may be due to the effect of warmer water on plant cell membranes. The experiment could also have been affected by different germination times of the seeds, as radish plants with warm water tended to sprout later but grew well afterwards. If further experiments support these results, cooler water could speed the growth of cash crops and be a cost effective strategy for farmers.

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Writing (Language)** | Communication of ideas is unclear, with spelling / grammar mistakes | Communication is reasonably clear, but with minor spelling / grammar mistakes | Clear communication with complete sentences and proper spelling and grammar | Clear, concise communication with no grammatical or spelling mistakes |
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Science Fair Display

Now to present your information. You'll need a free-standing backboard to attach your project to. Use of logic and careful planning of the board will result in an attractive display.

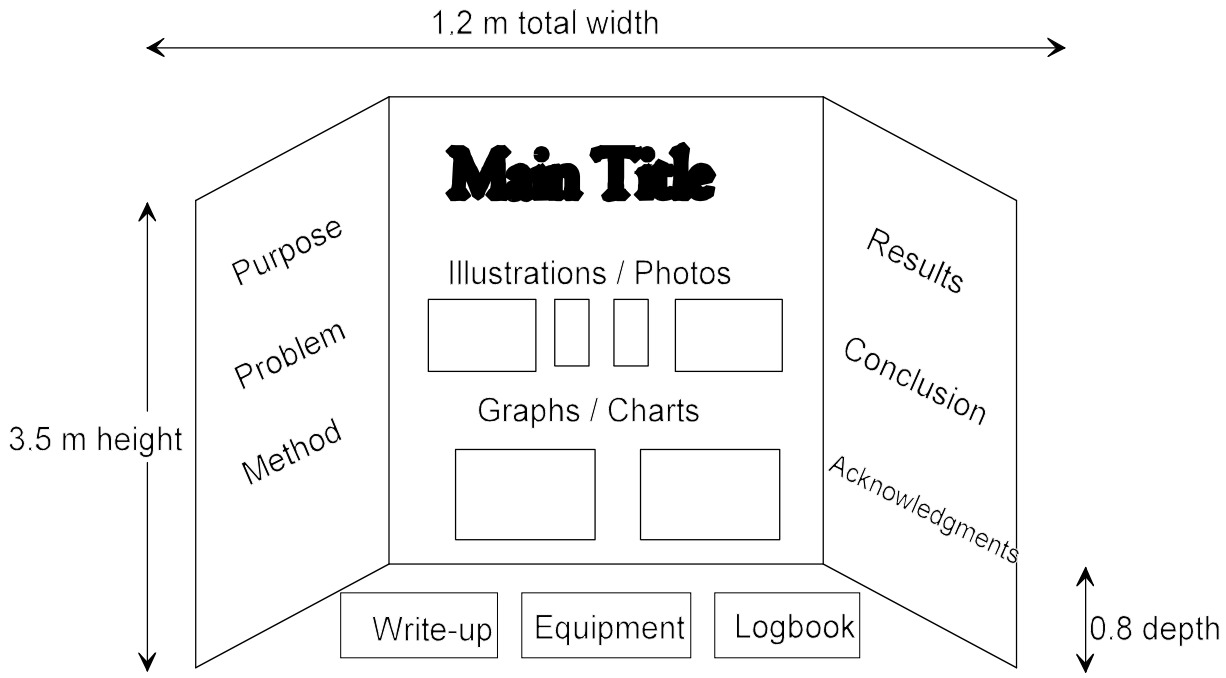
- Avoid clutter
- Use at most two or three colors
- Label all data tables, charts, graphs, or photographs you use
- Artwork, diagrams, and other elements of the display should be your own work.

Lettering/Headlines/Type

The attention-getting headlines should be readable from way down the aisle. The subheads should be readable from across the aisle, and the body text by someone standing next to your display. Be cautious when using "fancy" type styles: text in script or ornate styles can be difficult to read.

Display Board

You are limited in the *maximum* size of your display. Most display boards are of a 3 panel configuration, but could be 2 or 4. Below is a possible way to set up the board with the maximum sizes.



Project Summary

1. Your project will be summarized in a booklet. This will include the background research, purpose, hypothesis, materials, procedure, results *summary only*, and conclusion. Basically it is your complete write-up with the raw data removed. Maximum length is five pages, typed on one side and double spaced. The font must be Times New Roman or Arial 12 point.

2. Attach the following cover sheet to your summary. Do not place the summary in a report cover or duotang and do not include an extra title page. Fill in all the required information. In the Outline and Results section write an approximately 30 word summary of the method and results / conclusion in paragraph form.

# SCIENCE AND INVENTORS' FAIR PROJECT HIGHLIGHT SHEET

| PROJECT NUMBER _____ | | |
|---|---|---|
| Last Name | | |
| First Name | | |
| Address | | |
| | | |
| | | |
| School | | |
| Grade | | |
| Region | | |

PROJECT:

| | | | |
|---|---|---|---|
| Division: | Life Science | Physical Science ( ) | Computer ( ) |
| Category: | Junior Grade 7/8 ( ) | Intermediate Grade ( ) | Senior Grade 11-12 ( ) |
| Type: | Study ( ) | Experiment ( ) | Innovation ( ) |

Title :

Purpose/Hypothesis:

Outline/Procedure:

Results:

Signature(s) (1) _____ (2)_____


# Teacher Information Sheets

Project Types

There are three types of projects students can complete - Experiment, Innovation, and Study. Use the judging rubric (page 2.13) to decide where the student's ideas will fall.

Most students will do an experiment, which most of the student sheets address.

The student sheets can also be used for a study with some minor modifications; they will still completing the same steps. A study is kind of like an experiment, but the students don't carry out a procedure they just collect and correlate data already available. A good example might be 'Does the phase of the moon affect crime rates? The student collects crime stats and correlates them to the cycle of the moon. Note that to achieve a level 3 or higher some statistical analysis must be done.

Students wishing to do an innovation should have their idea carefully checked by the teacher first for practicality, many students do not have an accurate assessment of their own abilities. Students should complete the sheets for the SPICE model from the Science and Inventors Fair handbook if they wish to do an innovation.

Science Fair Topic

1. Discuss the areas of science with the students. For the regional science fair students choose whether their project is life science or physical sciences. Botany, Behaviourial, and Zoology are life sciences while Physics, Chemistry and Geology are physical sciences.

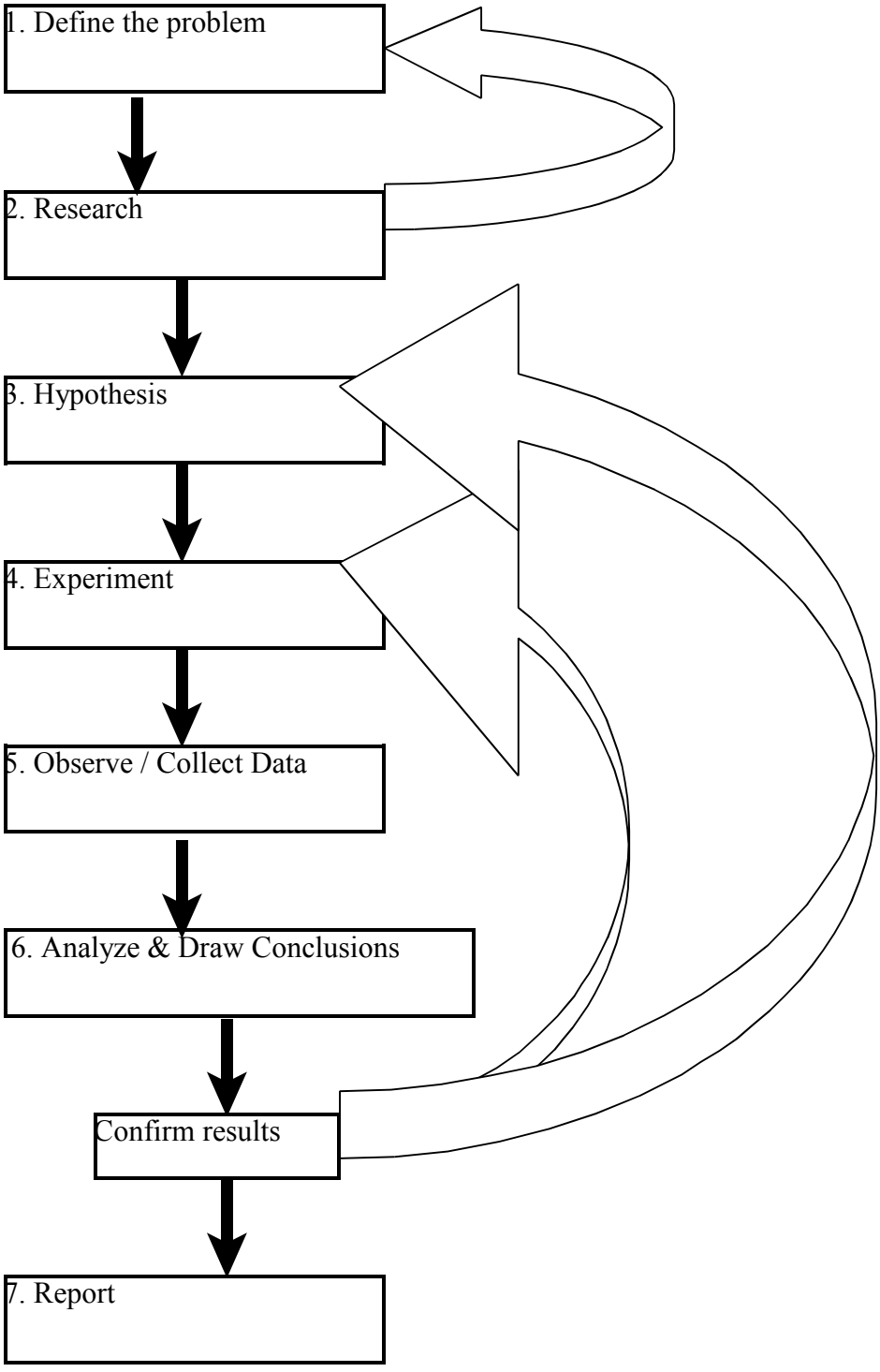
   It really is better to pick an area they're interested in first, and then work around to the question and hypothesis. However, this is harder to work with some students / classes and a search of possible topics may help lead the students. These websites have lists of possible questions and other resources.

   http://members.aol.com/_ht_a/ScienzFair/ideas.htm?
   http://www.accessexcellence.org/21st/TL/scifair/
   http://www.west.net/~science/expindx.htm
   http://www.stemnet.nf.ca/~jbarron/elem.html
   http://www.stemnet.nf.ca/~jbarron/intermed.html
   http://www.stemnet.nf.ca/~jbarron/biology.html
   http://www.twingroves.district96.k12.il.us/ScienceInternet/TopicChoices.html
   http://youth.net/nsrc/sci/sci.index.html
   http://www.brighterkids.com/exper8.htm
   http://www.flexi.net.au/~willdown/
   http://www.exploratorium.edu/science_explorer/
   http://edweb.tusd.k12.az.us/jtindell/

Students need help? they can ask questions at this website.

   http://www.askanexpert.com/

# The Scientific Method



Science Fair Problem

1. The class must already be familiar with independent and dependent variables. Run through some good examples that show the two variables and the cause and effect pattern needed. If their problem or question can be written in one of the given formats, they will automatically have their independent and dependent variables.

   Example:

   "Does the type of music affect a plant's growth?"
   The type of music can be changed intentionally, so it is the independent variable.
   The plant's growth may change as a result of the type of music, so it is the dependent variable.

2. Dangerous experiments are fairly obvious. Run through the safety sheet included in the manual with special attention to:
   - no pressurized containers
   - proposed use of chemicals
   - procedures which cause harm or distress to animals

3. Have the class evaluate these following problems as a whole class discussion or in pairs. Try to follow up with sample problems from the class and invite feedback on them.

   A. Does colour influence people's food choices?

   B. How are rainbows formed?

   C. To what extent does age affect a person's reaction time?

   D. Does eating food affect the growth of a person?

   E. How does the amount of sunlight affect the growth of bread mold?

   F. In a crash, how does the speed of a train affect the amount of damage done to a non-moving car?

   G. Do different diet supplements affect a cat's coat?

   H. Does the type of liquid a plant receives affect its growth?

   I. Does studying affect test scores?

A – good
B – no independent variable
C – good
D – too long time span, dangerous to test, impractical to test
E – good, with some concerns about growing mold
F – dangerous & impractical to test
G – may have animal issues, could be good
H – good
I – This one has generated some good discussion. The answer is obvious, but is it a good question anyway? It could be better stated as “To what extent does studying affect test scores?”. The exact extent of the influence may be useful to answer, even if the answer is obvious. It could also be re-phrased “What effect does the amount of studying have on test scores?”.

Here's a list of actual science fair topics from a middle school that can give ideas or be examined for suitability.

| | |
|---|---|
| What type of metal, steel, copper, or bronze, will rust faster?<br>What makes yeast react the best?<br>What are the effects of aspirin, vitamin C, calcium, and benadryl on plant growth?<br>Can you reproduce the effects of the commercially produced (Pomona's Universal Pectin) with homemade citrus pectin?<br>What type of materials are strongest when they interact with acid rain?<br>Which material filters water the best?<br>How sound affects plant growth.<br>What liquid works best in making invisible ink?<br>Strength of paper towels.<br>Which age of people use their left brain more often?<br>Do beans grow better in clay, sand or potting soil?<br>Where should you study?<br>What household material will put out fire the fastest?<br>Which part of Allen County is the most polluted? What type of water do plants grow best in?<br>Oil spills: Which bird can survive?<br>How does ultraviolet light react with different materials?<br>Does the wattage of the bulb affect the beam it produces?<br>Does the distance between the transmitters affect the volume of sound?<br>What carries the most static electricity?<br>Will different types of salt grow different kinds of crystals?<br>What computer font is easiest to read?<br>Which type of battery is able to pick up more staples and hold them the longest, and how much does the battery cost?<br>What brand of paint protects metal best against rust?<br>What percent of food is water<br>Which kind of bread grows mold the fastest? Which type of liquid will make the best invisible ink?<br>Does the length of a propeller affect the speed at which a plane travels?<br>What kind of mouthwash kills the most bacteria?<br>What brand of matchbox car rolls more freely?<br>Does the material of a parachute affect how fast it drops?<br>How much sleep does the average sixth grade girl need? | What factors affect the growth of mold on bread?<br>What type of water additive helps plants grow best?<br>Does cold or heat affect how high a ball bounces?<br>Which soap kills the most bacteria?<br>What type of soil resists erosion most effectively?<br>Which weather station predicts the weather more accurately?<br>What battery is the best deal in terms of price and the length of use?<br>Do the non-smoking sections in a restaurant protect you from second-hand smoke?<br>Do males and females of different age groups minds' react to color and words at different speeds?<br>What type of salt melts ice faster?<br>Which product waterproofs shoes the best?<br>Which brand of paper towels are the strongest?<br>Which material does a magnet go through better?<br>Does the amount of water a plant receives affect how much water it gives off?<br>Does the amount of air in a balloon, the color of the balloon or the material the balloon is made of change the affect of heating or cooling the balloon?<br>Do steroids affect plant growth?<br>Does the location of a planted seed affect its growth?<br>Does the color or amount of food coloring affect the speed of the ice melting or the taste of the cone?<br>What kind of light do plants grow under best?<br>Sunlight, grow light or regular light bulb?<br>Which type of water do plants grow best in?<br>What is the difference in ozone in Detroit, Ft. Wayne, and Los Angeles?<br>What kind of butter can make better cookies? Will the amount of light affect how fast a Venus Fly-Trap closes its jaws around an insect?<br>Do boys see different optical illusions than girls?<br>Does artificial colored light make plants grow better than natural sunlight?<br>How does music affect the growth of plants?<br>What soil do plants grow best in?<br>Which vegetables serve as the best conductors of electricity?<br>How does changing the exposure time affect the quality of images taken with a pinhole camera?<br>What shape causes the most drag? |

Research

A library / computer lab period is likely needed for this step. Bibliography formats are attached at the end of the package.

Hypothesis

Here are some examples of hypotheses. Have the students evaluate them for problems.

a. Question: To what extent does studying affect test scores?
Hypothesis: If a person reviews his or her class notes for 30 minutes each day, then his or her test scores will improve.

b. Question: Does eating breakfast improve marks?
Hypothesis: If a person eats a healthy breakfast each day, then his or her writing skills will improve.

c. Question: Does light colour affect plant growth?
Hypotheses: If a plant receives light filtered through a green piece of plastic, then it will produce more leaves.

d. Question: How does Colour influence people's food choices?
Hypothesis: If people see a red sweater, then they will choose it over a different Colour.

e. Question: How are paper towel brand names and absorbency related?
Hypothesis: If the brand name is expensive, then the absorbency will be higher.

f. Question: How does age affect a person's reaction time?
Hypothesis: If a person is older, then he or she can react.

g. Question: How does the size of a wheel affect the speed of a HotWheels car?
Hypothesis: If the car has large wheels, then its speed will be slower.

h. Question: How do different diet supplements affect a cat's coat?
Hypothesis: I think that using a brand-name diet supplement will make the cat's coat very shiny.

i. Question : What is the effect of music on mood?
Hypothesis : If music is played then people will be happier.

a - Good
b - Good, but how do you measure writing skills?
c - Good
d - Question is not answered - food not in hypothesis.
e - Question does not mention price, but hypothesis does.
f - No dependent variable
g - Good
h - Good, but how do you measure shininess? Also, no *If...Then* statement or format.
i - Vague hypothesis. While the independent and dependent variables are in their correct spots, they are unclear and hard to measure. What type of music? How do you measure happy? The discussion of how to measure 'happy' leads into the next idea of operationally defining variables.

Experiment Design

Make sure you explain the importance of doing enough trials. The students should repeat their experiment to ensure their results are accurate.

Following are two examples of experiment design. In their pairs the students can evaluate each design.

A. The plant growth experiment is fairly well written up, with one major point. There is only one trial. Use the sample data chart to show why more than one trial is frequently needed.
- What would happen if a plant died? If an insect you didn't see afffected one plant?
- If you grew one of each plant, does that prove your results for sure? Might one seed just have been better to start? Could one plant have picked up a virus?

A good example is testing toothpaste. If a person brushing with Crest gets a cavity and a person using Colgate doesn't, does this prove that one is better? This also spirals into a discussion of the many controlled variables. In a toothpaste trial 1000's of people are usually used, not just one trial.

B. The cookie experiment is missing the materials list and numbered steps for the method.
'Record Data' is an instruction not required.
Size and shape of the cookie cutter is not mentioned, which is needed for a level 4.
There is no step that tells to make different colour cookies!
The brand and type of cookie should be mentioned.

The student analysis of this experiment can lead to some good discussion of controlled variables. Would it matter which colour was closest to the guest? Does it matter if each person sees what colour is chosen by the person before them?

A good way to approach this is to ask "Could you repeat this experiment exactly from th einstructions? Why or why not?"

Question: Does the amount of water affect the growth of a plant?

Hypothesis: I think that if a plant receives too much water, then the plant will become unhealthy or die.

Controlled variables Type of plant, age of plant, size of pot, amount of soil, type of soil, amount of sunlight, type of water provided, time of day that growth is measured

Materials

| | |
|---|---|
| 5 small, identical plastic pots, | bag of soil |
| bean seeds | water |
| measuring cup | sunny window |

Operational definitions: Water will be measured in milliliters, and cold tap water will be used. Plant growth will be measured using centimeters. I will measure from the soil to tallest part of the plant.

Method

1. Measure 300 ml of soil and pour into plastic pot. Repeat for each pot.
2. Place a bean seed on the top of the soil in each pot.
3. Measure 100 ml more of soil and sprinkle over beans. Repeat for each pot.
4. Place all 5 pots in a sunny window. All pots should be positioned to receive the same amount of light.
5. Label each pot with a number using a magic marker. Pots will be numbered 1 - 5.
6. Measure 10 ml of water and pour into pot #1. Measure 20 ml of water and pour into pot #2. Put 30 ml in pot #3, 40 ml in pot #4, and 50 ml in pot #5.
7. Record date in log book along with water measurements for each pot.
8. Check plants at the same time every day. Measure and record height for each plant.

Question: How does colour influence people's food choices?

Hypothesis: I think that if people see a red cookie, then they will choose it over any other colour of cookie offered to them.

Operational definitions: Colour will be measured by what colour the cookie is.
Food choices will be measured by how many people eat a cookie.

Method

Mix the flour, sugar, milk, and butter according to the recipe.
Cut out the cookies using a round cookie cutter. Be sure the cookies are exactly the same size and shape.
Bake cookies according to the recipe and cool for 1 hour.
Place 5 of each colour of cookie on a serving tray.
Offer guests cookies. Serve the cookies to one guest at a time, and replace the colours as they are taken.
Count how many cookies of each colour are taken.
Record data.

Results

1. Logbook - Encourage students to keep neat accurate records *as they go.*

2. Data tables are usually difficult for grade 7 students.

3. Students need to be familiar with line graphs. A key point is keeping a constant scale, regardless of recorded values.

   Use the two experiment write-ups and ask what type of graph would be used, and why.
   Plant growth - Line graph of averages, or bar/line combination graph.
   Cookie choice - Bar graph, comparing choices.

4. The results summary is needed for the regional science fair project summary, and is in fact the only results allowed in the summary at the regionals.

Conclusion

A shorter conclusion could be used if the students have experience. Otherwise, following this format will yield a consistent suitable conclusion.

Display

Most stationary type stores will sell backboards (MicroAge, Walmart, etc.). A good source of cardboard for students to make their own is a store like the local Sears catalogue store; they will have a lot of large cardboard boxes.

The display must be free-standing and should fold for transport.

While the Canada Wide (and technically the Regional) Science Fair require wooden backboards, this is usually unreasonable at the school level.

Project Summary and Highlight

These sections are required for the regional science fair. You could have only the students going on to the regional complete these sheets.

Sample Timeline

There must be adequate time between your school fair and the regional registration to mark projects and inform parents as to the winners.

This is a pretty lax timeline - while students need a good block of time to complete the actual experiment, several of the other sections can be done in a few minutes in class. You can also ask for a couple of sections to be completed together, like the research with the hypothesis.

| Item Due | Time needed | Possible 2003 Date |
|---|---|---|
| Introduction to science fair, assign topic sheet, letter home | 12 weeks before School Fair | Right Away! |
| Topic | 10 weeks before School Fair | Mon. Jan. 27 |
| Question / Problem | 9 weeks before School Fair | Mon. Feb. 3 |
| Research | 8 weeks before School fair | Mon. Feb. 10 |
| Hypothesis | 7 weeks before School Fair | Mon. Feb. 17 |
| Design | 6 weeks before School Fair | Mon. Feb. 24 |
| Results | 2 weeks before School Fair | Mon. Apr. 24 |
| Conclusion | 1 week before School Fair | Mon. Mar. 3 |
| In School Science Fair | 3 weeks before Regional | Mon. March 17 |
| Regional Science Fair registration due | — | Fri. Mar. 21 |
| Regional Science Fair | — | Wed. April 2, 2003 |

Dear Parents / Guardians:

Your child is involved in developing a science fair project. Science fair projects present an exciting challenge that many students haven't previously experienced. The work introduces students to the use of the methods of scientific investigation, and can do more to teach true science than many class experiments.

The students will be working through several handouts to help them with the development of their projects. Also be aware of safety considerations so that your child is not exposed to any dangerous chemicals, electrical hazards, or other potential dangers in the development of their project.

A lot of work is required to complete a high quality project. Your support is welcomed, but should not extend to the point where you are doing a lot of the work. Support is most valuable when you can encourage, suggest, and help in accessing research information and the materials needed to complete the project. Assistance in checking spelling and good grammar are welcomed. Your child must solve most of the problems associated with the development of his / her project, otherwise little science will be learned.

Our school science fair will be held on Monday, March 17. The top 4 projects from the school will be chosen to go on to the regional science fair in Seaforth, where they will have a chance to win a trip to the Canada wide fair in Calgary and other prizes.

Thank you for your assistance and support,

I. Newton

Science Fair Marking

The following pages have rubrics that can be used for marking science fair projects. The first two pages (2.14, 2.15) are copies of the forms used at the regional science fair. They tend to penalize fairly heavily if the project idea is not original. If your focus was more on the scientific method you may wish to adjust this slightly.

The third page (2.16) shows a rubric that takes the second page point system from the regional marking and condenses it into a levelled system that may be easier to use.

| PART A: SCIENTIFIC THOUGHT - 45% | | |
|---|---|---|
| **EXPERIMENT** | **INNOVATION** | **STUDY** |
| **Definition:**<br>An investigation undertaken to test a scientific hypothesis using experiments. Experimental variables, if identified, are controlled to some extent. | **Definition:**<br>The development and evaluation of innovative devices, models or techniques or approaches in technology, engineering, or computers (hard/software). | **Definition:**<br>A collection and analysis of data to reveal evidence of a fact or a situation of scientific interest. It could include a study of cause and effect relationships or theoretical investigations of scientific data. |
| **Level 1**<br>Duplicating of a known experiment to confirm the hypothesis. The hypothesis is totally predictable. | **Level 1**<br>Building models (devices) to duplicate existing technology. | **Level 1**<br>Study of existing printed material related to the basic issue. |
| **RANGE: (50 - 59%)** | CIRCLE ONE MARK: 23, 24, 25, 26, 27 | |
| **Level 2**<br>Extend a known experiment through modification of procedures, data gathering, and application. | **Level 2**<br>Make improvements to, or demonstrate new applications for existing technological systems or equipment and justify them. | **Level 2**<br>Study of material collected through compilation of existing data and through personal observations. The display attempts to address a specific issue. |
| **RANGE: (60 - 69%)** | CIRCLE ONE MARK: 27, 28, 29, 30, 31 | |
| **Level 3**<br>Devise/carry out an original experiment with controls. Variables identified. Some significant variables are controlled. Analysis such as graphs/simple statistics. | **Level 3**<br>Design and build innovative technology or provide adaptations to existing technology that will have human benefit and/or economic applications. | **Level 3**<br>Study based on observations and literary research illustrating various options for dealing with a relevant issue. Appropriate analysis (arithmetic, statistical, or graphical) of some significant variable(s). |
| **RANGE: (70 - 79%)** | CIRCLE ONE MARK: 31, 32, 33, 34, 35, 36 | |
| **Level 4**<br>Devise and carry out original experimental research which attempts to control or investigate most significant variables. Data analysis includes statistical analysis. | **Level 4**<br>Integrate several technologies, inventions or designs and construct an innovative technological system that will have human and/or commercial benefit. | **Level 4**<br>Study correlating information from a variety of significant sources which may illustrate cause and effect or original solutions to current problems through synthesis. Significant variable(s) are identified with in-depth statistical analysis of data. |
| **RANGE: (80 - 100%)** | CIRCLE ONE MARK: 37, 38, 39, 40, 41, 42, 43, 44, 45 | |

| PART B: ORIGINAL CREATIVITY - 25% | | | |
|---|---|---|---|
| **Level 1**<br>Little imagination shown. Project design is simple with minimal student input. A textbook or magazine type project. | **Level 2**<br>Some creativity shown in a project of fair to good design. Standard approach using common resources/equipment. Topic is current or common one. | **Level 3**<br>Imaginative project. Good use of available resources. Well thought-out above ordinary approach. Creativity in design &/or use of materials. | **Level 4**<br>A highly original project or a novel approach. Shows resourcefulness, creativity in design, use of equipment and/or construction of project. |
| **MARK:** 12, 13, 14, 15 | **MARK:** 15, 16, 17 | **MARK:** 17, 18, 19, 20 | **MARK:** 21, 22, 23, 24, 25 |

| | | |
|---|---|---|
| **TOTAL MARKS:** | **SCIENTIFIC THOUGHT** | _____ |
| | **CREATIVITY** | _____ |
| | **TOTAL** | /70 |

# SCIENCE FAIR JUDGES TALLY SHEET

***PART A: SCIENTIFIC THOUGHT - 45 Marks***

***PART B: ORIGINAL CREATIVITY - 25 Marks***

**YOUR SCHOOL NAME HERE!**


***PART C: DISPLAY***
(Maximum 20 marks)

| 1. **SKILL** (Maximum 10 marks) | **Marks** |
|---|---|
| • Necessary scientific skill shown | 3 |
| • Exhibit well constructed | 3 |
| • Material prepared independently | 2 |
| • Judge's discretion | 2 |

1 2 3 4 5 6 7 8 9 10
(Circle one)

| 2. **DRAMATIC VALUE** (Maximum 10 marks) | **Marks** |
|---|---|
| · Layout logical & self-explanatory | 3 |
| • Exhibit attractive | 3 |
| • Presentation by student clear, logical and enthusiastic | 2 |
| • Judge's discretion | 2 |

1 2 3 4 5 6 7 8 9 10
(Circle one)

***PART D: PROJECT SUMMARY***
(Maximum 10 marks)

| 1. **INFORMATION** (Maximum 8 marks) | **Marks** |
|---|---|
| • Has all the required information been provided? | 3 |
| • Is the information in the required format? | 1 |
| • Is the information presented clearly with continuity? | 2 |
| • Does the summary accurately reflect the actual project? | 2 |

| 2. **PRESENTATION** (Maximum 2 marks) | **Marks** |
|---|---|
| • Neatness, grammar and spelling in report | 2 |

1 2 3 4 5 6 7 8 9 10
(Circle one)

***JUDGE'S SUMMARY***

**PART A: Scientific Thought _____ / 45**

**PART B: Original Creativity _____/ 25**

**PART C: Display**

**1. Skill _____/10**

**2. Dramatic Value _____/10**

**PART D: Project Summary _____/10**

**TOTAL SCORE (A+B+C+D)=**

**JUDGE'S COMMENTS**

## PART A: SCIENTIFIC THOUGHT - 45%

| EXPERIMENT | INNOVATION | STUDY |
|---|---|---|
| **Definition:** An investigation undertaken to test a scientific hypothesis using experiments. Experimental variables, if identified, are controlled to some extent. | **Definition:** The development and evaluation of innovative devices, models or techniques or approaches in technology, engineering, or computers (hard/software). | **Definition:** A collection and analysis of data to reveal evidence of a fact or a situation of scientific interest. It could include a study of cause and effect relationships or theoretical investigations of scientific data. |
| **Level 1** Duplicating a known experiment to confirm the hypothesis. The hypothesis is totally predictable. | **Level 1** Building models (devices) to duplicate existing technology. | **Level 1** Study of existing printed material related to the basic issue. |
| **RANGE: (50 - 59%)** | CIRCLE ONE MARK: | 23, 24, 25, 26, 27 |
| **Level 2** Extend a known experiment through modification of procedures, data gathering, and application. | **Level 2** Make improvements to, or demonstrate new applications for existing technological systems or equipment and justify them. | **Level 2** Study of material collected through compilation of existing data and through personal observations. The display attempts to address a specific issue. |
| **RANGE: (60 - 69%)** | CIRCLE ONE MARK: | 27, 28, 29, 30, 31 |
| **Level 3** Devise/carry out an original experiment with controls. Variables identified. Some significant variables are controlled. Analysis such as graphs/simple statistics. | **Level 3** Design and build innovative technology or provide adaptations to existing technology that will have human benefit and/or economic applications. | **Level 3** Study based on observations and literary research illustrating various options for dealing with a relevant issue. Appropriate analysis (arithmetic, statistical, or graphical) of some significant variable(s). |
| **RANGE: (70 - 79%)** | CIRCLE ONE MARK: | 31, 32, 33, 34, 35, 36 |
| **Level 4** Devise and carry out original experimental research which attempts to control or investigate most significant variables. Data analysis includes statistical analysis. | **Level 4** Integrate several technologies, inventions or designs and construct an innovative technological system that will have human and/or commercial benefit. | **Level 4** Study correlating information from a variety of significant sources which may illustrate cause and effect or original solutions to current problems through synthesis. Significant variable(s) are identified with in-depth statistical analysis of data. |
| **RANGE: (80 - 100%)** | CIRCLE ONE MARK: | 37, 38, 39, 40, 41, 42, 43, 44, 45 |

## PART B: ORIGINAL CREATIVITY - 25%

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| Little imagination shown. Project design is simple with minimal student input. A textbook or magazine type project. | Some creativity shown in a project of fair to good design. Standard approach using common resources/equipment. Topic is current or common one. | Imaginative project. Good use of available resources. Well thought-out above ordinary approach. Creativity in design &/or use of materials. | A highly original project or a novel approach. Shows resourcefulness, creativity in design, use of equipment and/or construction of project. |
| **MARK:** 12, 13, 14, 15 | **MARK:** 15, 16, 17 | **MARK:** 17, 18, 19, 20 | **MARK:** 21, 22, 23, 24, 25 |

## PART C: DISPLAY - 20%

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| Little scientific skill is shown. Exhibit is sloppy and somewhat attractive. Illogical layout with unclear presentation. | Some scientific skill is shown. Exhibit is fairly well constructed and attractive. Layout is somewhat logical but presentation has unclear areas. | Very good scientific skill is shown. Exhibit is well constructed and attractive. Layout is logical. Presentation is clear. | Sophisticated scientific skill is shown. Exhibit is well constructed and very attractive. Layout is clear and logical. Presentation is clear and enthusiastic. |
| **MARK:** 10, 11, 12 | **MARK:** 12, 13 | **MARK:** 14, 15 | **MARK:** 16,17, 18, 19, 20 |

## PART D: SUMMARY- 10%

| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| Summary has missing information, disorganized, several errors in spelling or grammar. | Summary has most information, fairly neat, some spelling and/or grammar errors. | Summary has all information, neat, few errors in spelling & grammar. | Summary has all information, is neat, and virtually error-free. |
| **MARK:** 5, 6 | **MARK:** 6, 7 | **MARK:** 7, 8 | **MARK:** 9, 10 |

| MARKS | PART A | PART B | PART C | PART D | TOTAL | LEVEL |
|---|---|---|---|---|---|---|

March 18, 2003

Dear Parent / Guardian:

Your child has been selected to participate in this year's Regional Science Fair. The fair will take place on WEEK DAY, MONTH DATE,YEAR at the Seaforth Arena. They will have the opportunity to win cash prizes, magazine subscriptions, or possibly a trip to the Canada Wide Fair in CITY!

Please note that myself or the school cannot provide transportation for this event. As there are four winners from our school, parents / guardians are encouraged to car-pool students to help everyone out.

Contact Mr. Newton at the school with any questions or concerns.

I. Newton

| | | | |
|---|---|---|---|
| Student Name | | Health Card # | |
| Home Address | | | |

---

| | | |
|---|---|---|
| April 1 | **1:00 - 5:00 p.m.** | **Project Set Up** |
| | **7:00 - 9:00 p.m.** | |
| April 2 | **10:30 a.m.** | **Students arrive** |
| | 10:30 a.m. - 12:30 p.m. | Judging or Activity |
| | 12:30 a.m. - 1:00 p.m. | **Lunch. Students are asked to bring their own and a drink.** |
| | 1:00 - 3:00 p.m. | Judging or Activity |
| | 3:00 - 4:00 p.m. | Judges results finalized |
| | 4:30 - 5:30 p.m. | Participation Certificates presented |
| | **4:30 - 6:30 p.m.** | **Open house for family, friends and community** |
| | 5:30 - 6:30 p.m. | **Dinner provided for students** |
| | **6:30 p.m.** | **Awards presented and projects removed** |