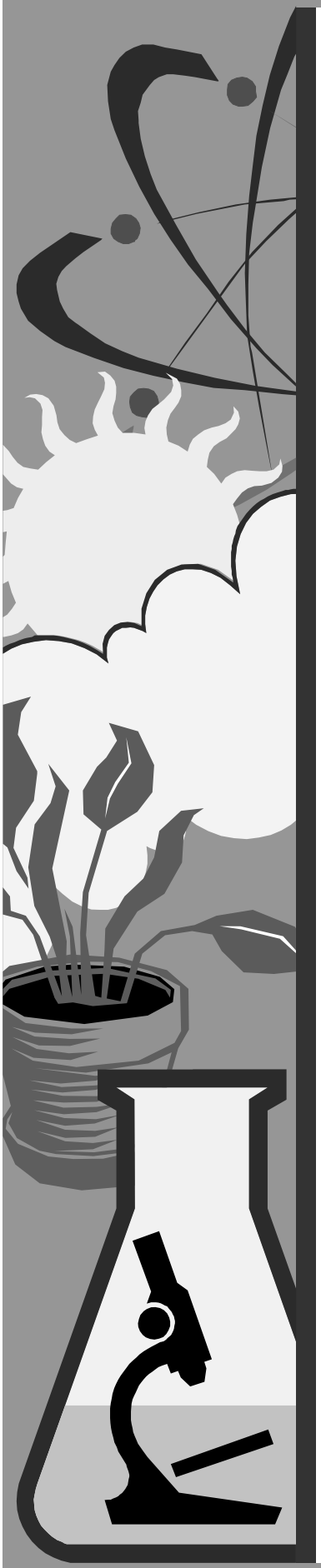

STEM Fair Student Journal

Topic_____

Name _____

Teacher _____

Grade ____

_____

(Name of School)

Prince George's County Public Schools

BOARD OF EDUCATION
OF
PRINCE GEORGE'S COUNTY, MARYLAND

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Kara Miley-Libby, Ed.D., *Coordinating Supervisor, Academic Programs*

Treesa Elam Respass, *Science Instructional Specialist, K-8*

Acknowledgements

Prince George's County Public Schools wishes to thank Virginia Casbourne whose work while at William Beanes Elementary School led to the development of this STEM Fair Student Journal. Several pages from the Prince George's County Public Schools Parent Involvement Guide, "Kids for Science" STEM Fair Rules and Regulations packet, and additional support documents have been incorporated into this revised STEM Fair Student Journal. Additional thanks are given to the Elementary Science Team for their valuable input, modifications and resource documents.

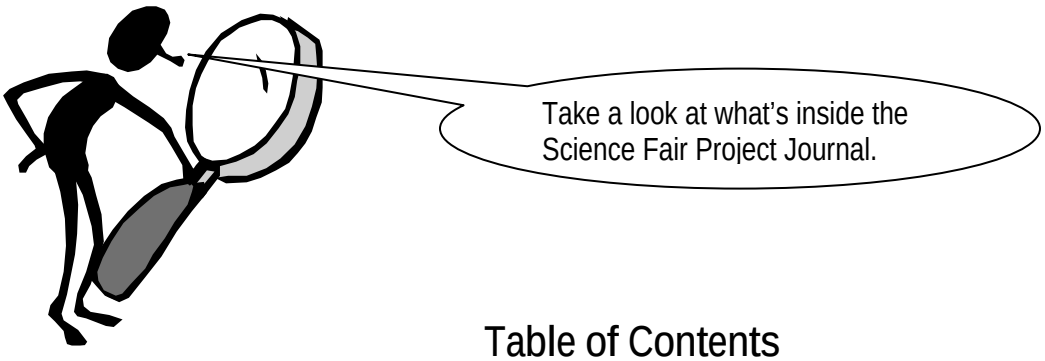


Table of Contents

Steps to the Scientific Method

1. Research*
2. Topic Selection
3. Question/Purpose/Problem
4. Prediction/Hypothesis
5. Experiment
   - Variables
   - Procedures
   - Materials
6. Data Collection/Results
7. Conclusion

*Research is an ongoing process. It occurs at the beginning to get ideas for a topic. Then research continues to develop and support the topic. A research paper with a bibliography is mandatory for fourth, fifth and sixth graders.

Timeline for STEM Fair Project

Date Due _____ Brainstorming

Date Due _____ Question

Date Due _____ Prediction

Date Due _____ Variables

Date Due _____ Materials

Date Due _____ Procedures

Date Due _____ Data Collection Tool

Date Due _____ Results

Date Due _____ Conclusion

Date Due _____ Research paper

Date Due _____ STEM Fair Display Checklist

Date Due _____ Display board is due at school

BE A WINNER

- ✓ Meet your due dates so you can finish on time!
- ✓ If you complete something early, start on the next step!

This year's Science Fair will be held on _____.

TOPIC GUIDELINES

1. No **testing** of vertebrates will be allowed. A vertebrate is an animal that contains a backbone. PEOPLE are VERTEBRATES as well as amphibians, reptiles, birds, and other mammals. Projects that involve observations of vertebrates with no interaction between a vertebrate and the observer are acceptable for a STEM fair. However, these projects **MUST** be approved by your School Safety Review Board (see pages 7-8).
2. Invertebrate projects are acceptable such as worms, insects and mollusks where **no injury to the animal is involved**.
3. **NO MODELS** will be accepted such as solar systems or volcanoes.
4. Projects that involve the growth of bacteria are **not allowed** at any time as a STEM fair project. Mold; the use of fire; or potentially dangerous materials will require adult supervision and safety protocols to be signed prior to approval of the project. Any project that falls into these areas **MUST** have the approval of your School Safety Review Board to ensure county policy and safety protocols are followed (see pages 6-7).

SELECTING A TOPIC

A good topic can be found in two basic ways. First, you can research topics using the library and Internet. There are many good books available at the school and public libraries, as well as websites found on the web. Second, you can brainstorm a topic by asking yourself the following questions:

1. **What do I already know about the topic?**
   Example: Vitamin C
   Vitamin C is good for you
   Some people take Vitamin C when they are sick.
   You can buy Vitamin C in a tablet.
   Orange juice has Vitamin C.
2. **What do I need to know to better understand the topic?**
   What is a vitamin?
   What is Vitamin C?
   How do I test for Vitamin C?
3. **What possible questions could I explore about the topic?**
   Which fruit juice has the most Vitamin C?
   Does fruit juice from concentrate have more/less Vitamin C?
   Do any vegetables have Vitamin C?
   Does freezing change the amount of Vitamin C?
   Do all citrus fruits have the same amount of Vitamin C?

Use the **three next pages** *as you brainstorm your topic. Before deciding on your final topic and question, check the Pre-Approval Project Key to be sure your proposed topic is acceptable as an entry into your school's STEM Fair.*

Topic Brainstorming

Date _____

My Topic: _____

What do I already know about the topic? _____

Topic Brainstorming

Date _____

My Topic: _____

What do I need to know about the topic? _____

Topic Brainstorming

Date _____

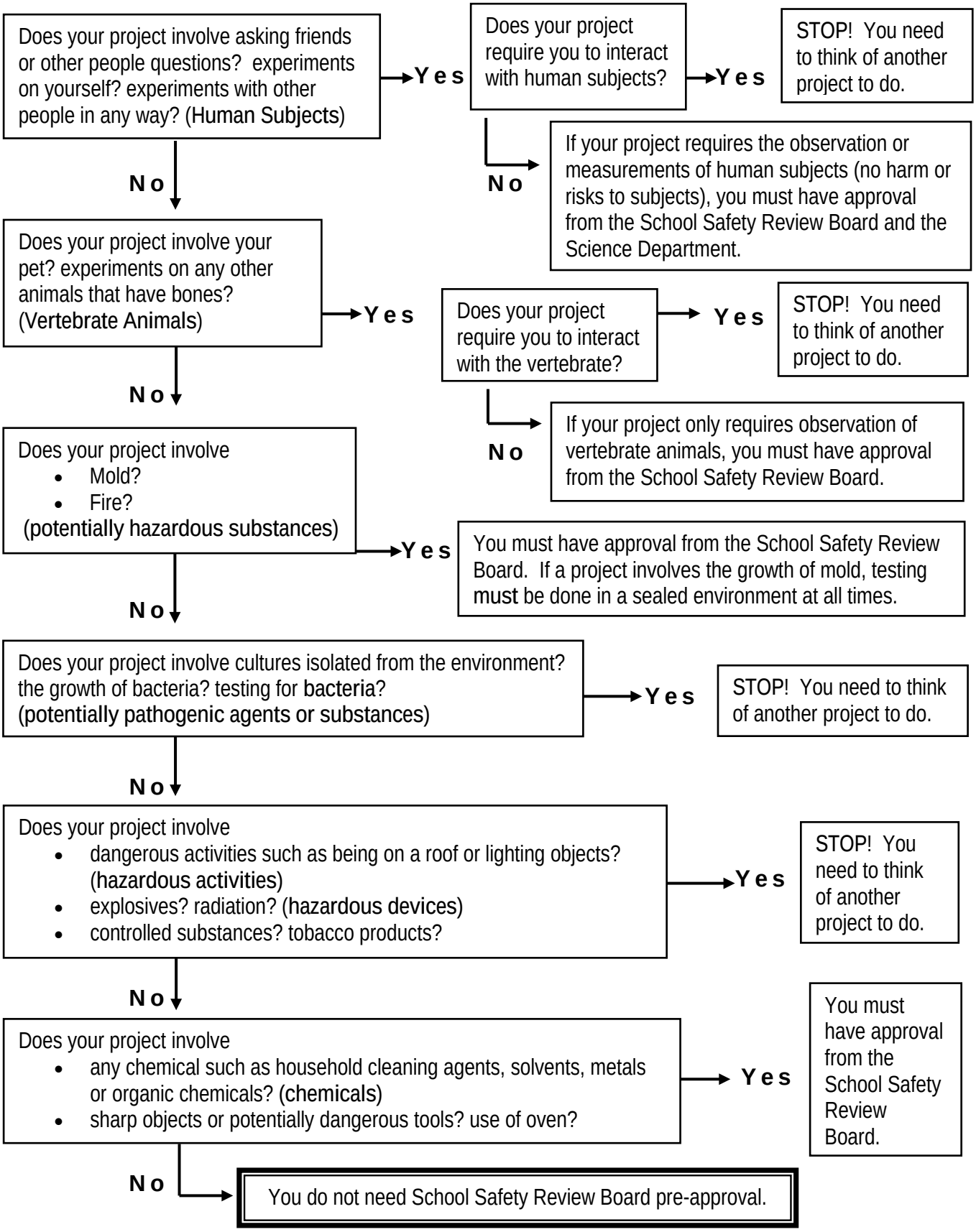
My Topic: _____

What possible questions could I explore about the topic? _____

Reminder: Before deciding on your final topic and question, check the Pre-Approval Project Key to be sure your proposed topic is acceptable. If you are not sure, ask your science teacher.

Elementary PRE-APPROVAL Project Key

Do I need the School Safety Review Board's pre-approval before I can begin my project?



Elementary PRE-APPROVAL Project Form
School Safety Review Board

Fill in the information required for your project and submit to your teacher. Approval by the School Safety Review Board is required before experimentation. If chosen as a "Kids for Science" STEM Fair participant, this pre-approval form must be submitted with your packet. The School Safety Review Board or school system's Safety Review Committee reserves the right to deny any project due to safety concerns. For further questions about "Kids for Science" STEM Fair rules, see Appendix.

Student's Name_____ School _____

Title of Project _____ Grade _____

1) Describe the purpose of your investigation and the reason you responded to a yes on the pre-approval key. If a survey or questionnaire (for vertebrate animals and human subjects) is being used, please attach.

2) Describe any potential risks or areas of concern that need to be addressed and approved before experimentation.

3) Describe: the procedures that will be used to minimize risk; safety measures taken; disposal procedures that will be followed (when applicable); and sources of safety information.

The following section is to be completed by the School Safety Review Board prior to experimentation.

Safety Review Board SIGNATURES (The first three signatures are required)

1) Science Fair Coordinator: _____ (print name) _____ (signature and date)

2) Science Teacher: _____ (print name) _____ (signature and date)

3) School Administrator: _____ (print name) _____ (signature and date)

For projects that involve human subjects or chemicals:

4) School Health Aide/Nurse: _____ (print name) _____ (signature and date)

To be completed by Parent/Guardian: _____ (prior to participation) (print name)

Yes	No	
☐	☐	I have read and understand the conditions and risks above and consent to the participation of my child.
☐	☐	Project testing/trials will be supervised by an adult at all times.
☐	☐	I have reviewed a copy of any survey or questionnaire used in my child's research. (if applicable)
☐	☐	I consent to the use of visual images (photos, videos, etc) involving my child in this research.

_____ (parent/guardian's name (please print)) _____ (parent/guardian's name signature and date)

Date_____

The **Question** is also referred to as the **PROBLEM** or the **PURPOSE.** A good question is the key to a good science fair project. Scientists ask questions and then conduct experiments to find out the answer. Therefore, the question asked should only be answered by performing an experiment, not by looking in a book.

Be specific when writing a question. For example:

Instead of asking – How do bean plants grow?

Ask:
1. Does the amount of water affect how tall bean plants will grow?
2. Does soaking bean seeds before planting affect how fast they will germinate?
3. Do bean plants grow better in an acid soil or an alkaline soil?

Use the space below to write a rough draft of your question.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

- ☐ Question is not approved. Make revisions on a separate sheet of paper and attach it to the book.
- ☐ Question is approved. You are ready to write your hypothesis/prediction.

Teacher Signature _____ Date _____

Parent Signature _____ Date_____

Revising your Question: Try to state your question more clearly. Be sure the question you decide upon can be answered by collecting data in an experiment.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

- ☐ Question is not approved. Make revisions on a separate sheet of paper and attach it to the book.
- ☐ Question is approved. You are ready to write your hypothesis/prediction.

Teacher Signature _____ Date _____

Parent Signature _____ Date_____

Write approved question in pen here:

_____

_____

_____

_____

_____

The **HYPOTHESIS** is another name for a **PREDICTION**. When you are writing the hypothesis you are trying to predict the answer to your question. You should always give a reason for your prediction either from your own experiences or from research you have done.

For example:

Question: Does soaking bean seeds before planting affect how fast they will grow?

Possible Predictions:

I think that bean plants that have their seeds soaked before planting will grow faster **because** it will make the hard seed covering soft.

I do not think that soaking the beans will make the bean plant grow faster **because** soaking the seed will just make the seed mushy.

Rewrite the approved question in pen:

Hypothesis/Prediction:

Approved on _____

Teacher _____

Parent Signature _____

VARIABLES

Take time to identify your variables before you start your experiment. It will help you to write your procedures. A variable is something that can change or be changed. There are three kinds of variables: independent, dependent and controlled variables.
In a well-designed investigation, there should be only **one** thing **changed on purpose**, called the **independent** or **manipulated variable**.

Remember the example question: Does soaking bean seeds before planting affect how fast they will grow?

In this example, the thing I am **changing on purpose** is the soaking the some of the bean seeds before planting them. Therefore, the **soaking of the seeds before planting** is the **independent variable** (manipulated variable).

What I think or hope will change during the experiment is called the **dependent variable** or **responding variable**.

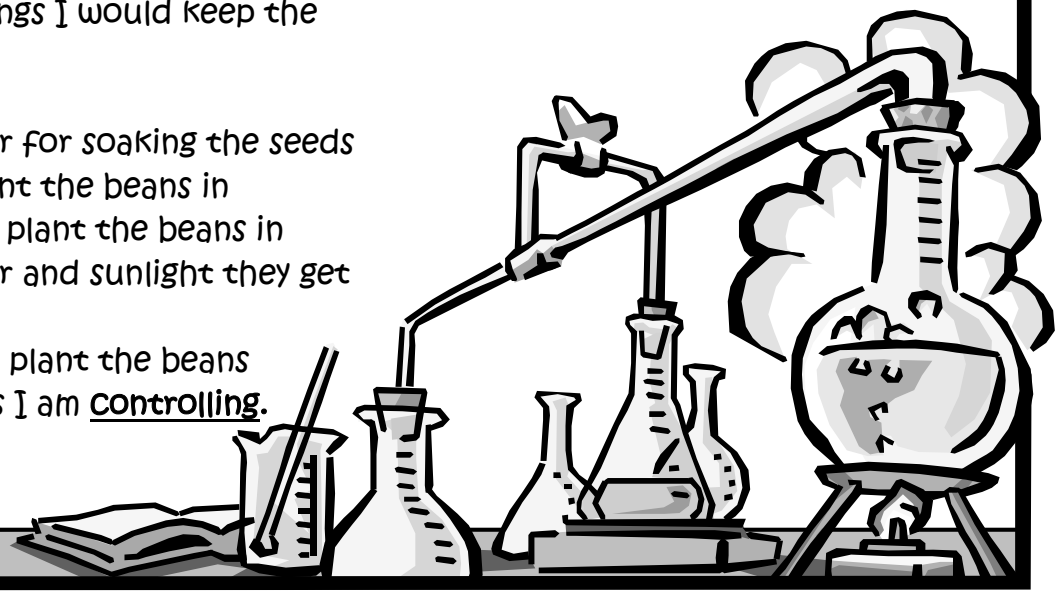
In this example the thing I am hoping or thinking will change during the experiment is how fast the plant grows. Therefore, **how fast the plant grows** is the **dependent variable** (responding variable).

I must try to keep any other things that might be changed the same throughout the experiment. These things that I keep the same are called the controlled variables.

In this example the things I would keep the same are:

- Type of bean
- Amount of water for soaking the seeds
- Type of soil I plant the beans in
- Amount of soil I plant the beans in
- Amount of water and sunlight they get everyday
- Size containers I plant the beans

These are the variables I am **controlling**.



Identifying Variables

Date _____

Independent Variable - what I have changed on purpose:

_____

_____

_____

_____

Dependent Variable – What I think/hope will change during my investigation:

_____

_____

_____

_____

_____

_____

_____

Controlled Variables – what I have kept the same:

_____

_____

_____

_____

_____

_____

_____

_____

Approved on _____

Teacher _____

Parent Signature _____

Date _____

Your **MATERIALS** is a list of all of the items you will need in order to conduct your experiment. As you develop your procedure, you may need to add to your materials list.

Remember to:

- Be specific
- Give amounts and sizes
- Use **METRIC** measurements

Materials:

_____

_____

_____

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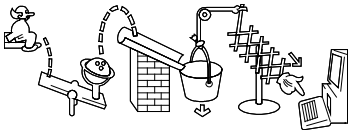
Approved on _____

Teacher _____

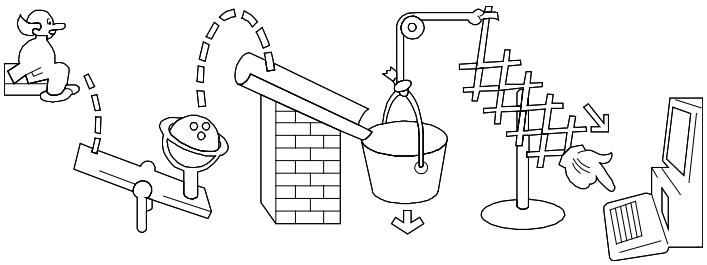
Parent Signature _____



Date_____

PROCEDURES are a detailed step-by-step set of directions of how to conduct the experiment. Details are very important here. Be sure to tell exact amounts of things such as materials, time it will take, etc. It is important that anyone be able to follow your steps and repeat your experiment exactly as you did it. You MUST have **at least 3 repeated trials** and clearly identify what you are keeping the same and what you are changing (**variables**) to ensure a **well-designed investigation**.

Procedures:



Date_____

Procedures - continued

Checked on _____
Teacher_____
Parent Signature _____

Use this space to make any drawings needed to help understand the procedures. Remember to label all parts and provide a title.

Data Collection

Before you start conducting your experiment, it is important that you have thought out your data collection.

- To begin, you should design a chart, table, or journal entry system to record your information. Whenever possible, you must collect NUMERICAL DATA in a chart or table because you are expected to provide both a graph and written results for your project. Your teacher will help you if your experiment requires data that is not in numbers.

- Your chart or table should have room for repeated trials (no less than three - the more trials you complete, the more reliable your data and conclusion) and a place to find the average (mean) of your data.

- The data should be collected using metric units whenever possible because metric is the international system of measurement for scientists. Metric units include centimeters, meters (linear), grams (weight/mass), and liters (liquid volume). Again, consult your teacher if you are not sure which measurement to use.

- Use a ruler to draw straight lines when designing your chart or table. Neatness will help you to keep accurate data.

- Label the different rows and columns of your chart or table. Also include a title.

Remember you will need accurate data to create a graph, report your results, and draw a conclusion.

Checked on _____

Teacher_____

Parent Signature _____

Use this space to design a chart or table to collect your data.

Use this page for journal entries made while conducting the experiment. Notes may be brief but should be very descriptive. Always include the date for each entry.

Checked on _____

Teacher_____

Parent Signature _____

These pages are for students who are not able to collect numerical data due to the nature of their project or for students who wish to include descriptive data along with their charts or tables.

Use this page for journal entries made while conducting the experiment. Notes may be brief but should be very descriptive. Always include the date for each entry.

Checked on _____

Teacher_____

Parent Signature _____

These pages are for students who are not able to collect numerical data due to the nature of their project or for students who wish to include descriptive data along with their charts or tables.

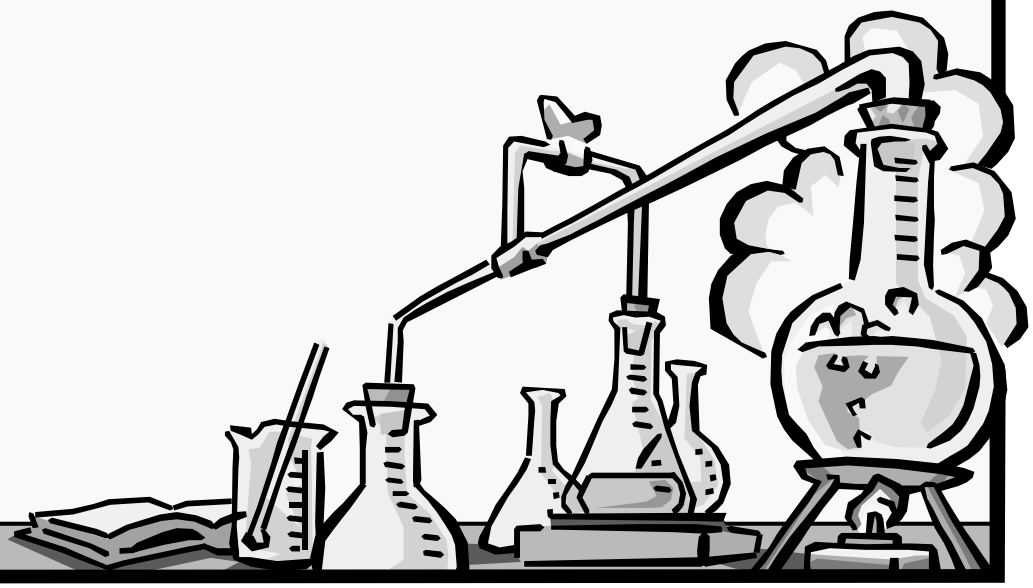
You are now ready to conduct your

Experiment

To conduct the experiment you will need to:

- follow the procedures just as you wrote them;
- keep accurate records by filling in your data chart and making journal entries as you go;
- have all the materials gathered together before you begin.

I will need _____ to conduct my experiment. (Time Frame)

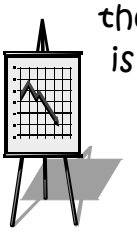


All **RESULTS** should include three parts: a data chart; an appropriate graph (line, pie or bar) of the data collected in the chart; and a written explanation of the chart information and the graph.

Graphs

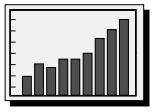
When choosing a graph, be sure to use the most appropriate one.

Line graphs should be used to display continuous data. Experiments that have dependent variables that involve temperature, time, mass, height or distance will *usually* result in data that can be graphed on a line graph. On a line graph, the horizontal (x) axis is always the independent variable and the vertical (y) axis is always the dependent variable. Line graphs should also have:



- numbers (scale) in even intervals (1's, 2's, 5's, 10's, 100's, etc.),
- labels for the horizontal and vertical axes,
- and a title that reflects the information that is being graphed.

Bar Graphs are used to display data that separate or are distinct from other pieces of data. The data in a bar graph can be displayed either vertically or horizontally. A bar graph should include:



- numbers (scale) in even intervals (1's, 2's, 5's, 10's, 100's, etc.),
- labels for the horizontal and vertical axes,
- and a title that reflects the information that is being graphed.

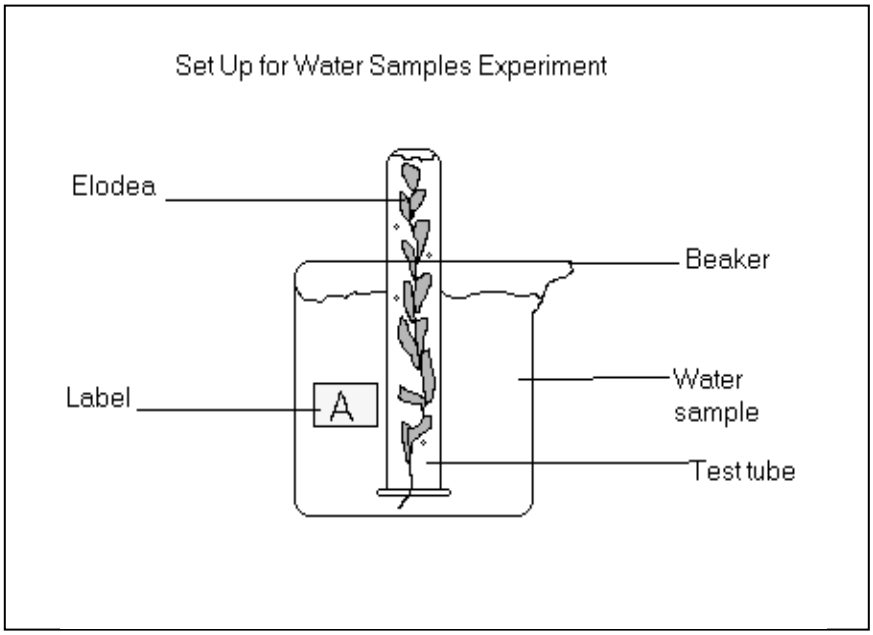
Remember to find the AVERAGE or MEAN of your DATA before graphing.

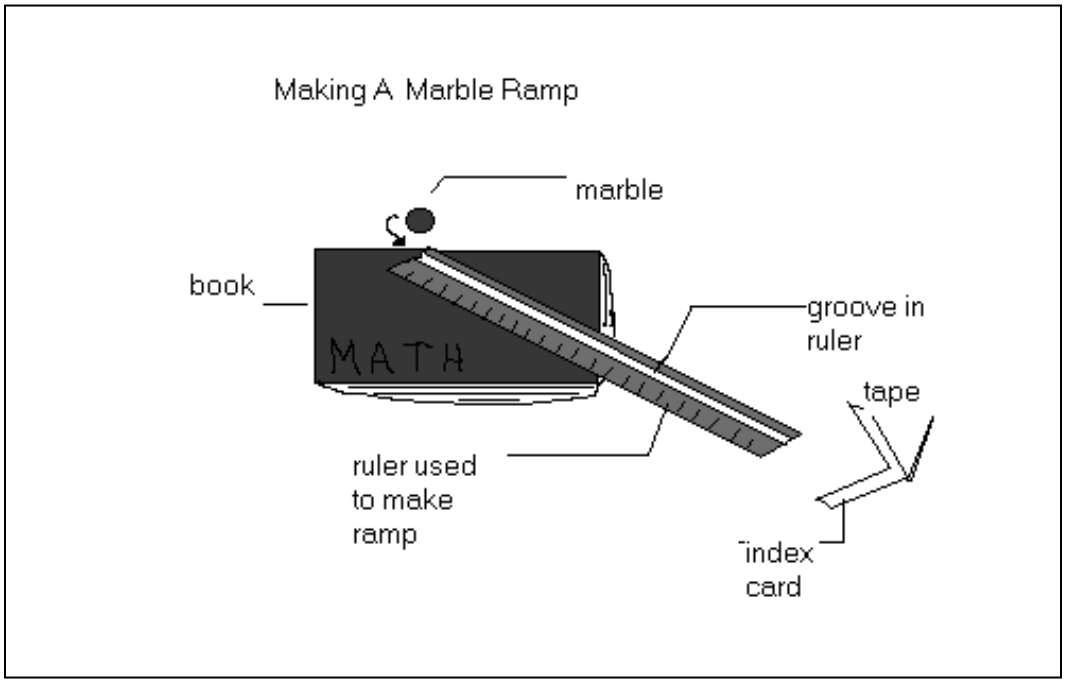
Pie Graphs should be used only when the results are best shown as a percentage of a whole. The data of a pie graph should include:

- a circle that is divided into the necessary number of parts,
- sections (or slices) of the pie should be sized accurately according to the data,
- labeled sections or color coded with a key,
- and a title that reflects the information being graphed.

Be extra careful when using a computer to create your graphs. The computer will create any graph you want, whether it is the correct graph or not. Also, many computer graphs leave off important titles and labels.

A Written Explanation is also required for an experiment. Explanations should be at least a paragraph long and explain the data displayed in the chart and graph.
RESULTS may also include photographs and diagrams that help to display and understand the data.





Date _____

A **WRITTEN EXPLANATION** gives a brief explanation of the data on the chart and graph. It can include any trends that may occur in the data. This is not the conclusion. It is simply a **summary** of what the data shows.

Checked on _____

Teacher_____

Parent Signature _____

Date_____

The **CONCLUSION** tells what you learned about the topic by completing the experiment. It contains many parts. Answer each of the questions below. Then join them together in paragraph form to write your conclusion.

Was my hypothesis/prediction correct or incorrect? _____

What is the answer to my question? Support the answer with data collected.

Were there any problems with the investigation or things I would do differently?

Date_____

What other things would I like to investigate about my topic? _____

How does what I learned apply to the real world? _____

Checked on _____

Teacher_____

Parent Signature _____

Now, rewrite your answers to the previous questions together to form a complete conclusion.

Date_____

Checked on _____

Teacher_____

Parent Signature _____

RESEARCH

RESEARCH

Research is important to a good STEM fair project. It helps you to choose a topic and then learn more about the topic.

A research report is mandatory for anyone in grades four, five and six. The research report is not complicated and need only include the following five things:

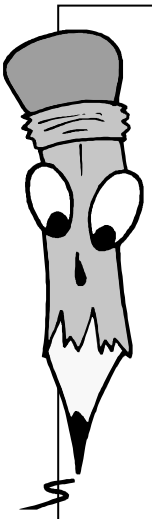
1. **Title Page**- The title page includes the title of your project, your name, school, grade, teacher and the date the project is being turned in to your teacher.

2. **Acknowledgements**-This is a personal thank you to anyone who helped you with the project (teacher, parent, sibling, scientist, librarian etc.).

3. **Question**- The specific question you asked for your experiment

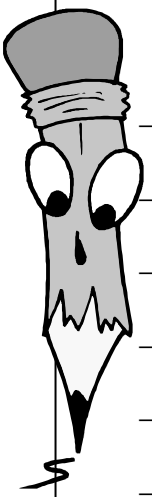
4. **Background Research**
   a. If you made a list of things you wanted to know about your topic on your brainstorming pages (pp. 4-6), this is a good place to start your research. Write down some questions that could be found through research about your topic, if you haven't done this already.
   b. Use books from the library and internet sites to find out interesting and relevant information about your topic.
   c. Rewrite the information you find in your own words. Do not copy from the book or print out pages from the Internet. This is considered PLAGARISM and it is illegal. If you are having difficulty putting what you read in your own words, try saying aloud a small section that you have just read without looking at the text. Chances are, you will put say this section in your own words. If you need help, ask an adult for assistance.
   1. Keep track of what books or websites you used to get your information so you can list your sources in a bibliography.

5. **Sources/Bibliography**- An alphabetical listing of books, articles or other sources including websites that you used when researching your topic. Look in the appendix for specific rules for writing a bibliography.



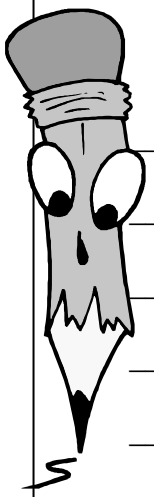
RESEARCH NOTES

Date_____



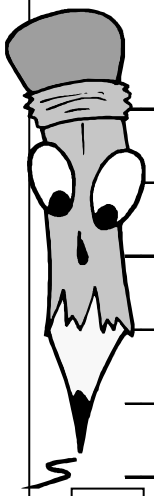
Date_ _ _ _ _ _ _ _ _ _ _ _

RESEARCH NOTES



Date_____

RESEARCH NOTES



Date_____

BIBLIOGRAPHY

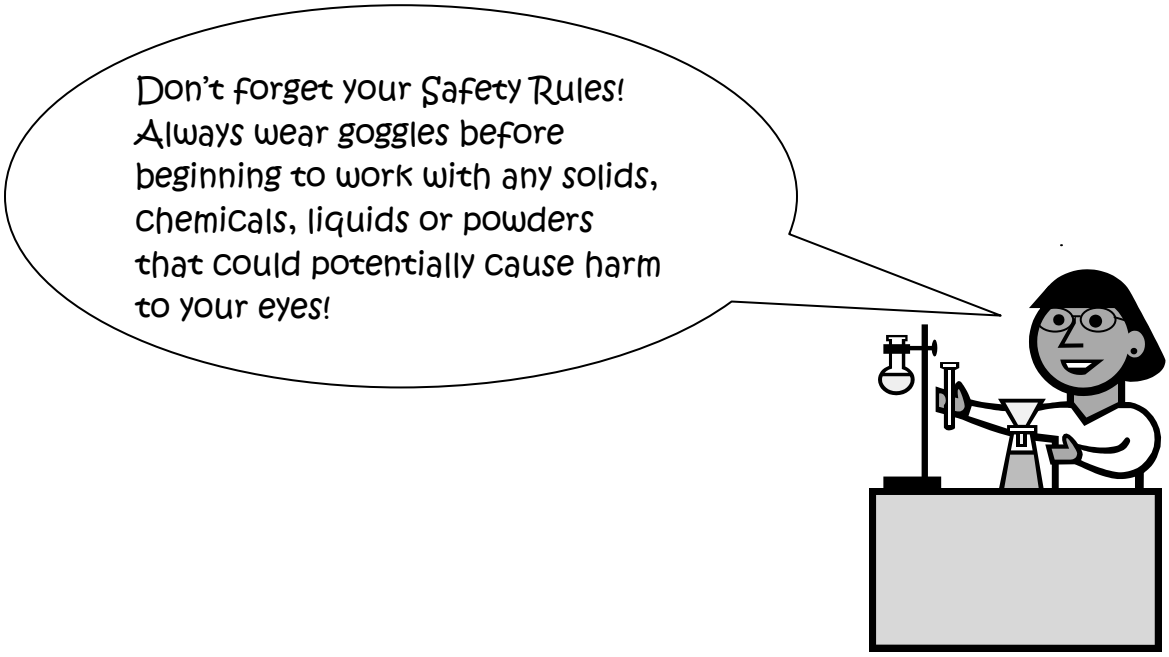
Still need to figure out some things? Need some more help? Check out the great resources in the Appendices.

Appendices

The remaining pages of this journal have been divided into several sections. These appendices are designed to provide additional information to help students with the STEM fair project. Items that may be helpful in finding a topic, project ideas, writing a research paper, creating the display, how the STEM fair project will be judged, sample scoring sheets for teachers and a summary of acceptable and non-acceptable projects may be found in these sections.

Also, included in Appendix B are sample research papers written by William Beanes Elementary School students. These samples are meant to help illustrate the 5 parts to be included in the research paper. Notes inside of balloons, are added to the papers to highlight special parts of the paper. These notes and highlighted areas should not be duplicated into your own papers. The contributions of Schntae Graham (4th grade) and Venetta Bronson (6th grade) are greatly appreciated. They generously donated their research papers to be used in this journal.

Table of Content of Appendices



Appendix A

Writing a Bibliography

Writing a Bibliography

When you write a bibliography, you are listing all of the sources of information you used to write your paper in alphabetical order. For the different types of sources follow the examples listed below.

BOOKS

Author (last name, fist name). Title of the book. City where book is published: Publisher, Copyright date.

Tillerman, Jon. The Way the Earth Moves. Chicago: McMillian, 1998.

MAGAZINES

Author (last name, fist name). "Title of the article." Title of Magazine Date (day month year): page numbers of article.

Smith, Sarah J. "Why Don't We Fall from Rollercoasters?" Science News 8 July 2000: 77-79.

ENCYCLOPEDIA

"Article Title." Title of Reference book. Edition (if available). Year published.

"Microscopes". Encyclopedia Britanica. 1996.

FILMS, SLIDES. or VIDEO TAPES

Title. Medium (state if it is a film, slide, video tape, laser disc etc). Production company, date. Time length

Under the Microscope- Amoebas. Videocassette. Science and Kids Productions, 1994. 15 minutes.

INTERVIEWS

Person you interviewed (last name, first name). Type of interview. Date.

Aberwitz, Shelly. Personal interview. 20 Sept. 2002.

ON LINE SOURCES (Websites)

Author (last name, first name – if there is one) "Title of Article". Title of Website or Publication. Date of Publication (or last update). On-line. Date of access (when you went to website). Available website address.

"Deserts". BrainPop. 2002. Online. 13 May 2002. Available: http://www.brainpop.com/science/ecology/desert/index.weml

Appendix B

Sample Research Papers

This is the title page. It is the first requirement of the research paper.

Title of Project

TRUTH DECAY

(Sample Research Paper 1)

Subtitle gives additional understanding of topic

THE TRUTH ABOUT

TOOTH DECAY

Student Name

Schntae Graham

School

William Beanes Elementary School

Fourth (4th) Grade

Grade level

Teacher Name

Teacher: Ms.Ward

Date due

February 19, 2002

Notice the student was specific with type of help received.

Acknowledgements

This page acknowledges the help that the student received in doing the project. It is the second requirement of the research paper.

I would like to thank my Mom for helping me with this project and typing the information, because it was taking me forever. Special thanks to Ms. Ward and Ms. Casbourne for encouraging me to do the project. I wanted to change projects because things weren't working the way I thought.

Both the question and research are on the same page of this research paper.

QUESTION

The Science Fair question is the third requirement of the research paper.

To find out, if you let an egg sit in lemonade, Coca-Cola, Diet Coke, orange juice or water for seven days, what effect will it have on the egg?

The first two paragraphs are the introduction to the topic.

RESEARCH

Background research about the topic is the fourth requirement of the research paper.

This research paper and STEM project taught me a lot about why my Mom always asks, "Did you brush your teeth?" I hear it every day. I see that it is important to brush your teeth, eat well and visit the dentist. That's why this project is titled, TRUTH DECAY. This paper will give you a better understanding about why our teeth are important, how tooth decay begins, and how to prevent tooth decay.

This sentence tells the specific ideas that will be covered in this research paper.

Tooth decay can start at any age. While we are young, we should take good care of our teeth. I do not like to go to the dentist but my mom makes me go at least two (2) times a year. My mom says it is important to go to the dentist, so when you get older you won't have a lot of problems with your teeth and spend a lot of money.

What Are Teeth Made Of?

The student organized the research information by writing important questions as headings and then answering the questions from research.

The white covering on teeth is called enamel. The function of the enamel is to protect the tooth from damage and pain. Under the outer covering of enamel is a hard, yellow substance called dentin. Most of the tooth is made up of dentin.

What Is Tooth Decay?

Tooth decay is a bacterial disease of the teeth. This decay is the primary source of tooth loss in people no matter what their age is of a person.

Important, interesting fact

Why Do You Get Tooth Decay?

Tooth decay happens when bacteria, sugary foods, and a target tooth surface work together or react against each other. Our mouths contain lots of bacteria. We eat a lot of different foods at different times of the day; therefore, the bacteria convert some of the sugary foods to acid. The bacterium that grows on our teeth is called plaque. Plaque is the sticky coat that forms on the outside of our teeth. When you don't clean or brush your teeth regularly, plaque will build. Bacteria eat through the outside of the teeth or what is called tooth enamel; this makes the tooth surface soft. Once the bacteria get through the enamel of a tooth, tooth decay can make a tiny cavity or little hole in the tooth. You can tell when you have a cavity because something cold (ice cream), hot (soup) or sugary (candy) may cause you to get a toothache or your teeth may feel tender. When this happens tell a parent so you can go to the dentist.

Important Definition

Detailed explanation

Gives real examples

Why Was An Egg Used In The Experiment?

This question and answer make the connection between the research and the science experiment.

A hard-boiled egg was used because this is the closest model of your teeth. The damage to the egg during the experiment is in relation to the damage that can be done to your teeth.

How Do You Prevent Tooth Decay?

This paragraph gives three very important ways to prevent tooth decay with supporting details.

To prevent tooth decay, it is important to brush your teeth regularly. Brushing is not just to make sure that your teeth are clean, but to remove plaque that builds on your teeth and causes tooth decay. You should brush more than just once a day. Books and articles suggest that your brush after every meal. Use fluoride toothpaste. Fluoride helps protect your teeth from tooth decay. Visit the dentist at least twice a year. The dentist checks for problems. The dentist may prevent small problems from getting out of control. Tooth decay may take several months to happen, but modern technology, like an x-ray, will show small problems.

Our teeth must last a lifetime. One or two cavities may not seem like a big deal, but your teeth tell a lot about you. If you have rotten teeth, you may not smile a lot or it may cause you embarrassment. Now that you know what "TRUTH DECAY" is, let's get busy and brush "TOOTH DECAY" away.

This paragraph is the conclusion. It ends the paper with an appeal to readers to make good use of the information provided. This is one good strategy for writing a conclusion.

BIBLIOGRAPHY

This is the bibliography page and it is the fifth and final requirement of the research paper. Notice that the sources are listed in alphabetical order by author's last name.

Listing website resources can be tricky because all the same information is not always available. Always give as much information about the website as you can.

Dr. Green website. 2000-2002. Online. 20 Jan. 2002. Available: http:// www.drgreene.com.

Name of website

Website address

Day you went to the website. This is important because the Internet information is always changing.

Silverstein, Alvin and Silverstein, Virginia. Tooth Decay and Cavities. Danbury: Grolier Publishing, 1999.

Stay, Flora Parsa. DDS. The Complete Book of Dental Remedies. Garden City Park: Avery Publishing Group, 1996.

Ward, Brian R. Dental Care. New York: Franklin Watt, 1986.

Copyright date

Author name is written with the last name first

Title of book is underlined

City in which book was published

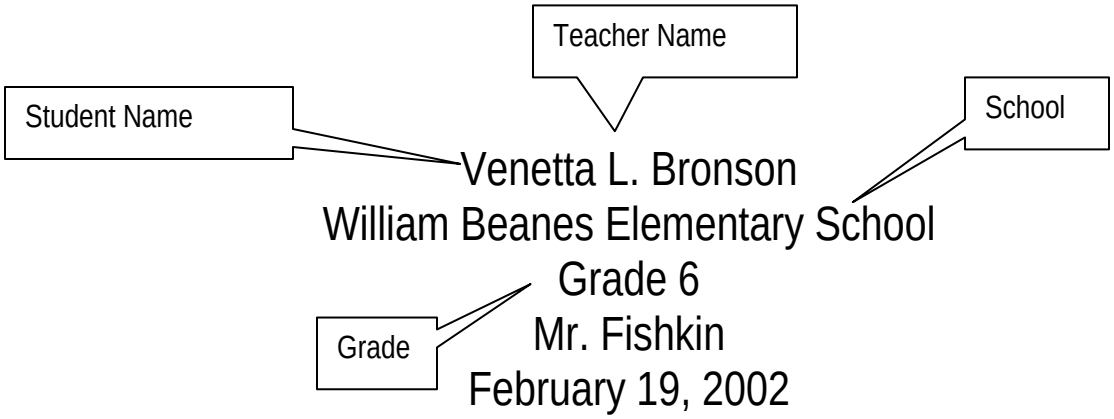
Name of publisher

This student used three books and one website as resources for the research found in this paper.

This is the title page. It is the first requirement of the research paper.

What is the Effect of Thermal Inversion on Air Pollution?

(Sample Research Paper 2)



ACKNOWLEDGEMENTS

This page acknowledges the help that the student received in doing the project. It is the second requirement of the research paper.

Thanks Mom for all of your help.

Thanks Ms. Casbourne for the STEM Fair "make and take."

Thanks Mr. Fishkin for helping me with my corrections.

Notice that the student was specific with the type of help given here.

The Science Fair question is the third requirement of the research paper.

Question: What is the Effect of a Thermal Inversion on Air Pollution?

The student decided to place the Science Fair question on a separate page.

Background Information

Background research about the topic is the fourth requirement of the research paper.

Air and water are essential to life. Air pollution is caused when chemical substances are released into the atmosphere that are not normally found there. Polluted air can cause or lead to lots of health problems in people. It can also harm plants and animals.

This paragraph introduces the topic of pollution and tells why it is important.

Smog, the dark haze in the air (smoke and fog) is the most common form of air pollution. It is a major problem for many cities in the world. Polluted air is dirty air. It can make the air smell bad and can make things dirty. It can rise up into the atmosphere and be carried away for many miles by the winds. The atmosphere can be damaged by polluted air.

This paragraph gets more specific and focuses on one type of pollution.

Many activities of human beings pollute the air. People pollute the air by allowing chemicals, poisonous gases, and tiny particles of dirt to get into the air.

This paragraph tells what causes this type of pollution.

My STEM Project

Student decided to add a separate heading for more background research as it is related to the project.

My STEM project is about the effect of a thermal inversion on air pollution. A thermal inversion occurs when hot air is above colder air. Hot air rises and cold air falls. If the cold air is nearer to the ground, there will be no mixing of air. This still air has no wind to carry away the pollution particles.

Important definition

This paragraph makes a connection between the research and the experiment.

A thermal inversion traps air near the ground. Pollution molecules build up in the air if there is no wind to carry them away from the city or rain to wash them out of the air. An example of how pollution and smog can be deadly is in Donora, a small town in Pennsylvania. In October 1948, 6,000 people in a town of 14,000 got sick, and 20 died from pollution and smog that was so thick people couldn't see across the street.

Important definition

Uses important, real fact to provide an example.

Smog is a combination of smoke and fog. A lot of the pollution molecules you cannot see. However, sometimes you may see smoke combine with fog to produce smog. Estimates of deaths from pollution caused by still air, a build-up of smog, and pollution include 650 people in London in 1873, 400 people in New York City in 1963 and 4,000 people in London 1952 during five days of smog!

More examples using real facts and data that are important to understanding the topic.

We cannot control the weather or prevent thermal inversions from occurring, but we can reduce the pollution that causes smog. We can drive more fuel-efficient cars. We can use devices to help stop pollution molecules from being released from cars, factories and power plants.

Final paragraph is a conclusion that offers ways to deal with problem presented in topic.

This paragraph gives a quick summary of the background research.

Conclusion

Student decided to include the conclusion of the actual experiment with the research paper. This is an excellent idea but it is <u>not</u> a requirement of the research paper.

This process of warm air rising and cold air falling keeps the air moving and helps carry pollution away from it source. A thermal inversion occurs when hot air is above colder air. Hot air rises and cold air falls. If the cold air is nearer to the ground, there will be no mixing of air. This "still" air has no wind to carry away the pollution particles. A thermal inversion traps air near the ground.

My hypothesis proved incorrect. I predicted that the hot air smoke would not rise out of the bottle. Instead, it would be trapped near the ground (stay in the bottom of the bottle) and the cold air would rise. also predicted that a thermal inversion would have no effect on the air pollution at all.

Restates hypothesis and tells whether it is correct or not.

Includes the actual data from the experiment to tell what was learned.

In doing my experiment, I observed that the cold air smoke stayed in the bottom of the bottle for a long time before it disappeared. At no time did it rise to the top. I was so sure that the hot air smoke would not rise; instead it would stay in the bottom of the bottle. However, it seemed like once I dropped the match into the bottle with the hot air smoke, I saw the smoke rise up to the top of the bottle and then it quickly disappeared. I did this experiment six times. Each time I got the same results. The only problem I remember was that sometimes the match would go out before I could get it to the bottle. I think this happened because I was scared of the fire. I was afraid I might get burned, but my mom said she wouldn't let that happen.

Repeated trials

Mentions problems that occurred during the experiment.

I'd like to try this experiment with a watch instead of a timer. I could check the amount of smoke in the bottles every minute to see if there was smoke in them or not.

Discusses changes that could be made if the experiment was done again.

All of the resources used for this paper were books.

Bibliography

This is the bibliography page and it is the fifth and final requirement of the research paper. Notice that the sources are listed in alphabetical order by author's last name.

Bender, David and Leone, Bruno. The Environment Opposing View Points. San Diego: Greenhaven Press Inc., 1996.

Brower, Michael and Leon, Warren. The Consumer's Guide to Effective Environmental Choices. New York: Three Rivers Press, 1999.

Chandler, Gary and Graham, Kevin. Protecting Our Air, Land and Water. New York: Henry Holt and Company Inc., 1996.

This source is listed alphabetically by the title.

Current Controversies: Pollution. San Diego: Greenhaven Press Inc., 1994.

Ehrlich, Anne H. Betrayal of Science and Reason. Washington, D.C.: Island Press, 1996.

McCormick, John. Acid Rain. New York: Gloucester Press: 1991.

Morgan, Sally. The Ozone Hole. Danbury: Franklin Watts, 1996.

Redalia, Debra Dadd. Sustaining the Earth. New York: Hearst Books, 1994.

This is the source where the project idea came from.

Rybolt, Thomas R. and Mebane, Robert C. Environmental Experiments About Air. New Jersey: Enslow Publishers Inc., 1993.

Copyright date

Stille, Darlene R. Air Pollution. Chicago: Children's Press, 1990.

Author's name listed with last name first.

Book title is underlined.

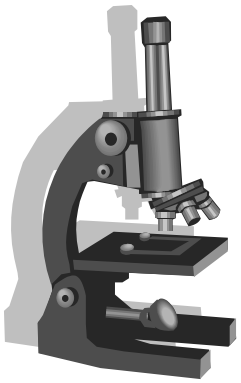
City where book was published.

Name of publishing company

Appendix C

Science, Technology, Engineering and Mathematics Fair

Supporting Documents



Topic Guidelines Summary

Acceptable Topics or Projects	Non-Acceptable Topics or Projects
Projects with a testable question and data gathering	Models
Observational projects of vertebrates. Information or data obtained by observing vertebrates, including humans in their natural environment with no interaction between the observer and subject. *(Note: Any questionable project, such as taking measurements of human subjects, will require the completion of a School Safety Review Board Form and approval from and the Science Department and your school.* Acceptable examples of observational projects include: • tabulating the number and kinds of birds observed at a bird feeder over a period of time; • the observation and recording of data related to left-handedness in males /females by observing a public access door over a period of time; • comparison of the frequency of tree chirps with the ambient temperature over a period of time; and • studies using mathematical or computer models rather than live subjects. Acceptable examples of survey projects include: • research involving the observation of legal public behavior; • research involving collection or study of existing publicly available data or records; • research involving normal educational practices; and • research on individual or group behavior or characteristics of individuals where the researcher does not manipulate a subject's behavior; the study does not involve perception, cognition or game theory; and does not gather personal information; has the potential for emotional distress or invades a person's privacy.	Testing of Vertebrates–Animals with a backbone including humans. Collection of data specifically identifying subjects by name. Unacceptable examples of observational projects include: • watching the running of mice through a maze • monitoring (observing) heart rates or respiration after exercise; • "observing" reactions after the administration of a substance; • treating vertebrates, such as: tapping fish tank before feeding fish; and • testing vision wearing various color glasses. Additional examples of activities that are more than "minimal risk" and are also unacceptable: • Exercise other than ordinarily encountered in DAILY LIFE by that subject; • Ingestion (eating, drinking, etc) of anything (this includes gum) and • Exposure to potentially hazardous materials. Unacceptable examples of survey type projects include: • projects in which a treatment such as exercise, ingestions, touching, inhaling, injection, some type of learning, etc., is done such as comparing the learning rates of girls/boys after a learning treatment has been administered. • monitoring (observing) heart rates or respiration after exercise; and • any observational or survey projects where the student (researcher) is the subject or another vertebrate is the subject of the investigation.
Invertebrates where no harm/injury to the animal is involved	Invertebrate projects that can cause potential injury/harm to the organism
Natural growth of mold in food products in a sealed environment at all times (closed plastic bags or clear containers)	Pathogenic and Potentially Pathogenic Agents (things that could cause disease): Unacceptable examples are cultures of washed and unwashed hands, cutting boards, kitchen sponges and/or saliva. Projects that involve the growth of bacteria
Projects that include the use of fire, high temperatures, or any household chemicals must have authorization from the School Safety Review Board. Kids for Science" Safety Review Board will have the final say on any questionable projects entered into the "Kids for Science" STEM Fair.	Hazardous and/or Controlled Substances ethyl alcohol, tobacco products, explosives or gunpowder, sharp objects or objects that could potentially cause harm, and over-the-counter or prescription drugs

Not sure if the topic you are considering will require approval from your school's School Review Committee? Use pages 7-8 to help you evaluate your topic.

STEM Fair Display Checklist

After you have completed your backboard, take time to complete this checklist yourself to be sure you have everything included on your display board. Then add or revise any areas that you did not check off as being complete. After you have made any changes to your board, have your parent complete the checklist as a final review of your work before turning it in at school.

	Assessment	
	Self	Parent
1. Overall appearance is neat and attractive.	_____	_____
2. All necessary parts are included and labeled (Question, Prediction, Materials, Procedure, Results, and Conclusion.)	_____	_____
3. I used no more than three colors when doing my backboard.	_____	_____
4. My backboard has a short and catchy title.	_____	_____
5. All of the words on my backboard are spelled correctly.	_____	_____
6. I have used proper grammar and punctuation.	_____	_____
7. My procedures are written in clear sequential order.	_____	_____
8. My procedure shows that I conducted repeated trials (at least 3) and used an adequate sample size, if necessary.	_____	_____
9. I have identified my independent, dependent and control variables.	_____	_____
10. All necessary parts are included on my chart (title, labels, and units) and it is neatly drawn and filled in with appropriate data.	_____	_____
11. I have the correct type of graph that displays my data from my chart and the graph includes all the necessary parts (title, axes, increments, labels, and scale). A key is present if necessary.	_____	_____
12. I included a written explanation of my chart, graph and any other observations I made.	_____	_____
13. My conclusion includes the answer to the original question, accuracy of my prediction, what I learned supported with data, any problems and real world applications.	_____	_____
14. My research paper follows the guidelines listed in the journal.	_____	_____

TIPS FOR CREATING OUTSTANDING DISPLAYS

- ❑ BE NEAT- Avoid frayed or ripped edges of paper, glue globs, lots of cross outs or white outs etc.

- ❑ USE COLORS TO ATTRACT ATTENTION BUT DON'T OVER DO IT- No more than (3) three colors should be used on a project except for special situations. Too much color can be distracting. Instead develop a color pattern that is pleasing to the eye.

- ❑ FRAME OR MATTE YOUR WORK-Use construction paper or other colored materials to provide a background for your written work and labels (construction paper, newspaper, wrapping paper, old wall paper, contact paper etc…)

- ❑ TITLES SHOULD BE SHORT, CATCHY AND RELATED TO THE PROJECT IDEA
  For example:
  Color of Cool Cubes is better than The Melting Rate of the Different Colors of Ice Cubes
  Sizing Up Seeds is better than The Relationship between the Size of the Seed and the Size of the Plant

- ❑ WRITING SHOULD BE NEAT AND LEGIBLE- If you choose to use a computer or typewriter, stick to one or two fonts to type your work. Too many fonts can be distracting and difficult to read. If you hand write your work, print or use cursive, don't mix the two. Also, if you are hand writing the information, be extra careful to write so it can easily be read by others. Pen is easier to read than pencil. Messy or illegible writing can really lower your score.

- ❑ SPELLING DOES COUNT-Take time to check over your work before you put it on your display board. Don't overuse white out. Scratching out mistakes is not acceptable. If you do recognize an error after finishing, place a single line through it and write the correct word above. However, too many of these types of marks will affect the overall appeal of your project.

- ❑ PRACTICE YOUR LAYOUT- Do not glue down the parts of your project on your board until you have, practiced moving them around on your display board. They should be evenly spaced and centered. Crowding together or large gaps can take away from your project's appearance. Trying to rip off or move things once they are glued down can be messy and often ruins the paper or display board.

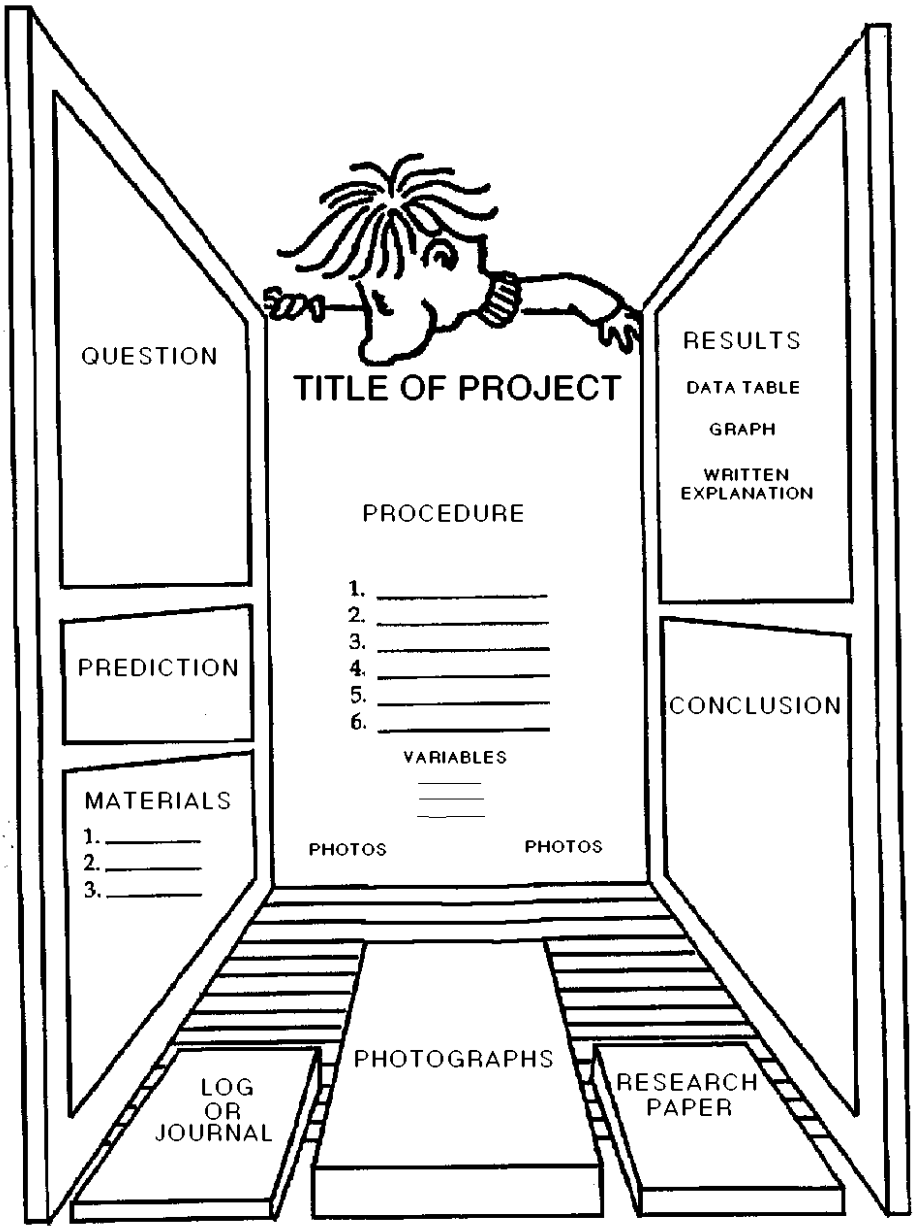
- ❑ DON'T GLUE ON MATERIALS FROM YOUR PROJECT- Do not glue on any food or decomposing items such as M & M's, popcorn or moldy bread to the board. Food products attract bugs; can lead to mold bacteria growth; or other problems. This also includes wrappers from foods. Don't place samples of chemicals or their containers on the board. This includes household items such as vinegar, dish soap, oil etc.

- ❑ TAKE PHOTOS OR DRAW PICTURES/DIAGRAMS OF THE ITEMS FOR DISPLAY- This will help you to avoid attaching materials from your experiment to your display. Inappropriate materials will be removed from the board before allowing it to be displayed in the fair.

- ❑ RESEARCH REPORTS ARE PLACED IN FRONT OF THE DISPLAY- Do not attach the report to the display board. It is placed in front of the display.

STEM FAIR PROJECT DISPLAY INFORMATION

Title:	short, catchy, related to the topic and results of the experiment
Question	the question to be tested
Prediction:	the predicted answer to the question/problem asked with a reason
Materials:	a list of the supplies, equipment to be used
Procedure:	a list of the steps followed to perform the experiment
Results:	data displayed in table and graph form to include data analysis (mean, medium, mode, range) and accompanied by a written explanation
Conclusion:	briefly answers the question asked in the beginning; states the prediction to be supported or not supported, and makes suggestions for further research



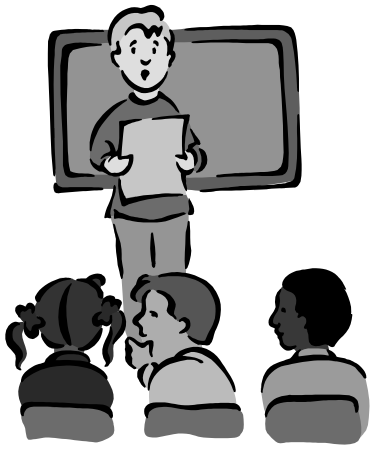
STEM Fair Project- Oral Report
Scoring Guide

Name_____ Total Points ____ /25

Teacher Signature _____ Grade _____

Communication

- Eye Contact: 2 -1- 0
- Loudness of Voice: 2 -1- 0
- Preparation: 2 -1- 0
- Organization: 2 -1- 0
- Enthusiasm: 2 -1- 0



Content

- Title: 1- 0
- Purpose: 1- 0
- Hypothesis: 1- 0
- Materials: 1- 0
- Procedures: 1- 0
- Results: 1- 0
- Conclusion: 1- 0

Questions

- Why did you choose your topic? 2 – 1- 0
- How many times did you repeat your experiment? 2 – 1- 0
- If you were to do this experiment again, what would you do differently? 2 – 1- 0
- (4th-6th only) Tell one interesting fact or idea you learned when completing your research paper. 2 – 1- 0

OR

- (3rd grade only) Tell one thing you learned by doing this experiment. 2 – 1- 0

Overall Score

Excellent – 3	Satisfactory – 2	Fair – 1	Unsatisfactory - 0
Score Range 25-20	Score Range 19-15	Score Range 14-10	Score Range 9-0

Judging Criteria

A. Overall Appearance and Organization of the Backboard — 5 points

- All parts of project are included, clearly labeled, and in sequential order (question, prediction, materials, procedure, results, conclusion)
- Backboard is neat and attractive.

B. Question — 5 points

- Question led to an investigation, not a report, demonstration, or model.
- A creative approach to problem solving was used to formulate the question.

C. Prediction — 5 points

- Prediction must state a possible outcome of the experiment with an accompanying explanation.
- Background information is present showing research was done prior to predicting.

D. Materials and Procedure - (10 points total)

Written Procedure — 5 points

- Materials and equipment are listed with specific amounts using metric units.
- All steps to conduct the experiment are described and in order.

Experimental Design — 5 points

- Independent, dependent, and controlled variables are correctly identified and listed.
- Adequate data were collected through repeated trials to justify the conclusion.
- Sufficient sample size was used to support a conclusion (as necessitated by project.)

E. Results - (10 points total)

Graphic Representation — 5 points

- Data are present in the form of a table with appropriate labels and title.
- An appropriate type of graph is accurately constructed (scale, labels, and title) from the data on the data table.

Written Explanation — 5 points

- Explanation analyzes and summarizes the data to note patterns and trends.
- Explanation interprets the graph.

F. Conclusion — 5 points

- Conclusion answers original question being investigated
- A statement reflecting whether the prediction was supported or not is included.
- Supporting data are referenced.
- Additional questions to investigate are presented.

G. Interview - (10 points total)

Understanding — 5 points

- Student is able to explain the investigation in a way that demonstrates clear understanding.

Application — 5 points

- Student is able to relate findings of project to a real world situation.
- Student is able to identify career connections.
- Student is able to generate ideas for future research

TOTAL 50 points

Teacher Signature _____ Total Score _____

STEM Fair Project Ideas

Physical Science:

What variables affect the swing of a pendulum (length of string or mass of pendulum)?
Is there a relationship between the size and strength of a magnet?
What types of surfaces produce the greatest or least amount of friction?
What variables determine the strength of an electromagnet (number of wire wraps, wire gauge, diameter of a nail)?
What variables affect the flight of an airplane (materials, weight, shape, angle of launch)?
How is the bounce height of a ball related to the drop height?
What variables affect the efficiency of parachutes (size, shape, materials)?
Which shape of windmill blade is most efficient?
Does the length of a ramp (inclined plane) affect the amount of force needed to pull a load up a ramp?
What effect does air pressure have on the bounce of a ball?
Does mass affect how fast objects of equal volume will fall through a liquid?
How does the size of a wheel affect the rate at which it lifts a load?
What is the effect of mass on rocket trajectory?
How does temperature affect the bounce height of a ball?
Does the angle of launching affect how far a paper airplane flies?
What variables affect the distance a balloon rocket will travel (amount of air, nozzle shape, angle of ascent, different pathways)?
Which type of material conducts sound the best?
Do different types of string or string lengths affect the efficiency of a paper cup or tin can telephone?
Do different watt light bulbs produce different amounts of heat?
What effect does temperature have on buoyancy?
Does color affect the rate in which an ice cube melts?
What effect does color have on temperature?
What material makes the best heat insulator?
Which type of container keeps liquids hotter longer?
What effect does temperature have on the elasticity of a rubber band?
Do suction cups stick equally well to different surfaces?
Does the amount of stretch of a rubber band affect the distance a rubber band will travel?
What design shape supports a bridge the best?
Which container shape allows for greater rates of evaporation?
Does salt water or lemon juice have any effect on the rate of dehydration of different types of apples?
How is the strength of a magnet affected by glass, cardboard and plastic?
What is the relationship between temperature and amount of carbonation in soft drinks?
Does the density of a liquid affect its droplet shape?
Do basketballs that are fully inflated bounce better than flatter ones?
Does viscosity (thickness) of a liquid have an effect on the rate of evaporation or the boiling/freezing point?
What coating inhibits rust formation the best?
Which will food coloring mix into faster - hot, medium, or cold water?
Which chemicals slow the browning of apples or other fruits?
What food dry cells (tomato, potato, or apple) will produce the highest amount of energy measured in voltage?
What effect does temperature/packaging have on the ripening of bananas?
Does temperature have an effect on solubility? Does the color of water have an effect on evaporation rate?
Does temperature affect the growth of sugar or salt crystals?
What materials melt an ice cube most efficiently?
How does temperature affect the reaction rate of Alka Seltzer?
Do heavier objects fall faster than lighter ones?
Does the density of wood affect how much weight different pieces of wood will hold in water?
How well do different types of wood absorb water?
What type of metal, steel, copper, or bronze, will rust faster?
What liquid works best in making invisible ink?
Do watches keep the same time?

Mathematics:

What are the most common sums of two dice when rolled?
What is the probability of reaching into a bin and selecting a particular color of M&M candy? Can statistics be used to predict the contents of edible consumer products such as fruit snacks, a bag of jelly beans or M&Ms?
Which juice box manufacturer has the largest volume of juice and uses the least amount of packaging material?
How do the dimensions of a rectangular prism change with respect to each other?
Does the probability of drawing a particular card from a deck depend upon the number of that type of card in the deck?

Computer Science:

Does the font style of the letters (or characters) in a file change the size of the file?
How does the file size change as more letters (or characters) are added to a file?
What search terms give the best results?
Which search engine gives the best results?

STEM Fair Project Ideas

Life Science/Environmental:

What effect do different colors of light have on the growth of plants?
What type of seeds will germinate fastest?
Does the direction a seed is planted affect the growth of the seed?
Do vitamins or fertilizers affect the growth of plants?
Do mirrors have an effect on plant growth?
Does acid rain have an effect on the germination of seeds?
Which direction will a vine grow around its support object?
What medium works best for growing seeds or plants?
Does temperature affect the growth of seeds or plants?
Is there a relationship between seed size and fruit size?
Which fruits or orange drinks have the most vitamin C?
Do potato cubes gain or lose mass in salt water solutions?
What kind of soil is best for water retention?
How does a garden mist spray affect plant growth?
Which plants and vegetables make the best dye?
Which type of wildflower grows best under artificial light?
How does temperature affect the water uptake in celery plants?
Does the type of water affect the growth of plants?
Is soil necessary for plant growth? (hydroponics study)
How does rotation affect plant growth?
Does music affect plant growth?
Does a plant grow best in sunlight or artificial light?
Can plants deprived of sunlight recover?
What is the relationship between root and stem growth?
Which color of light causes green beans to grow best?
Can potatoes be grown without soil?
How do worms affect plant growth?
What affect do Epsom salts have on plant growth?
How does mint extract affect bean growth?
Can recycled newspaper be used to fertilize plants?
How does the concentration of salt in water affect seed germination?
Do beans grow better in clay, sand or potting soil?
What kind of light do plants grow under best? Sunlight, grow light or regular light bulb?
Do detergents affect plant growth?
How does the clarity of a body of water change over time?
What difference is there in the tree species found in high and low areas of a forest?
Does recycled paper break down faster than new paper?
How well does charcoal filter water?
What percentage of an orange is water?
Do magnets affect plant growth?
Are there differences in the amount of air pollution inside vs. outside a building?

Earth Science:

Are there differences in temperature in shaded versus non-shaded areas during the day and at night?
How accurate are local forecasters?
Do weather conditions affect the broadcasting of AM radio stations?
Are there differences or patterns in wind speed or direction over a period of time?
What materials or methods work best for cleaning up oil spills?
How are different depths and shapes of craters made?
Are different sizes and shapes of sand dunes formed at different wind speeds?
How quickly does a creek change water temperature in comparison with air temperature?
What effect does freezing or boiling have on rocks?
Which material absorbs heat most efficiently, sand, soil, or rocks?
Do different types of soils have different percolation rates?
How wet should sand be to build a sandcastle?
How accurate are Web-based weather forecasting services?
What effects do the changes in the length of day and night have on household plants?
Is air in your house the same temperature at floor level and near the ceiling?
Will the size of a crater be greater when the impact object is bigger? faster?
How accurate are long-range weather forecasts?
Is rainwater absorbed at the same rate in different kinds of soil?
From which direction does the wind blow most frequently?
How warm is it under the snow?
How accurate are homemade weather instruments?

Engineering:

What factors affect the top speed of a radio-controlled car?
What brand of matchbox car rolls more freely?
Does the material of a parachute affect how fast it drops?
What levee construction will hold the most water?
Which folded paper structure will support the most stress?
Which truss design will withstand the most weight?
Will the amount of material eroded change as the slope angle increases?
Does the area of a parachute affect how fast it falls?
Which file card bridge hold the most pennies?
Which paper hoop plane will fly the longest distance?
Which building design best withstands an earthquake?