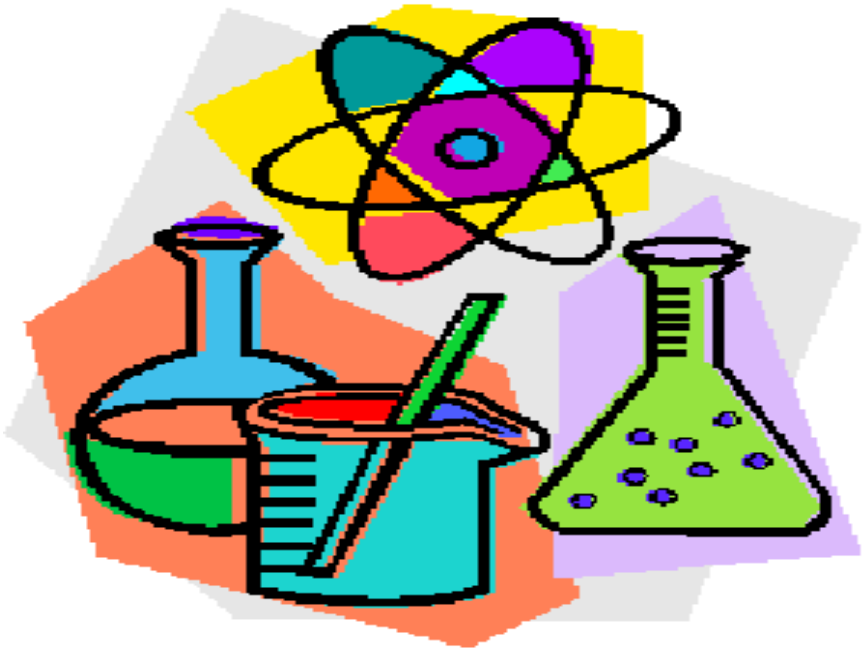
Trenton Public School District

Science Fair Handbook

WHAT IS SCIENCE?



SPRING 2013

TRENTON PUBLIC SCHOOL DISTRICT

Dear Students, Teachers and Parents,

It's time for the District Science Fair! Please refer to this handbook for the guidelines and suggestions that serve as a guide for participation in the District Science Fair.

Participation in the Science Fair is strongly encouraged for students in grades K-12. Students in Kindergarten through grade 2 will do a class project with their teachers. Students in grades 3 -12 can choose to do an individual, class or team project.

Please be mindful of the following Science Fair timeline:

4/24/13 - 5/8/13	**Submit Student Registration Form to Science Supervisor.**
4/29/13 – 5/24/13	**Research and work period.** **K-2: Class Project** **3-5: Individual, Class or Team Project** **6-8: Individual, Class or Team Project** **9-12: Individual, Class or Team Project**
5/28/13	**Final Revisions to Display Boards.**
5/29/13	**Drop off Displays to Kilmer Elementary Gymnasium**
5/30/13 – 5/31/13	**Science Fair Judging**
5/31/13	**Awards Ceremony**

Chris Ritter
Ellen Mushinski
Diane Grillo
Ana Lozada
Ambalika Mukherjee
Mary Courtney

District Science Fair Coordinators

Lucy Feria

Assistant Superintendent of Curriculum, Instruction, Assessment & Professional Development

SCIENCE FAIR HANDBOOK

What Is A Science Fair Project?

A science project is an investigation you do to find the answer to a question or the solution to a problem. It consists of these parts:

***QUESTION OR PROBLEM**

Questions/Problems can be about anything: machines, plants, animals (invertebrates only), consumer products, etc.

The question/problem should be stated to allow for scientific experimentation or solution development through the engineering design process.

For example, Which brand of popcorn pops the most kernels? Does sunlight help plants grow? How can you change a cell phone and make it better and more efficient?

Knowing what you want to ask and how you want to ask the question is often the most difficult part of the project. When your science project question is clearly written, the project is much easier to do. The question itself tells you what you will need to measure.

***RESEARCH (BACKGROUND) & BIBLIOGRAPHY**

You want to do research and learn as much about the topic of your question/problem as you possibly can. The books, scientific journals, articles, and website links you use to learn about your topic will be listed under the Research heading of your science fair display board, along with relevant information (a.k.a. Background) that you learned about the topic, as it pertains to your question/problem.

K- 2nd: Have at least **TWO** references.

3rd – 5th: Have at least **THREE** references

6th – 8th: Have at least **FOUR** references

9th – 12th: Have at least **FIVE** references

***HYPOTHESIS**

A hypothesis is based on prior knowledge and observation, as to the cause of a particular phenomenon. In order to be a scientific hypothesis, it has to be **"testable"** - able to be supported or refuted through careful experimentation/testing and observation. A hypothesis will either be supported or not supported by the results of an investigation. A hypothesis that is not supported should not be seen as "wrong" but lead to modifications of the original hypothesis, creation of an entirely new one and more experimentation – the basis and nature of science!!

"If…. then…"

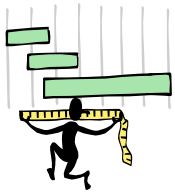
Suggestion to write a "testable" hypothesis:

- Write in an "If…then" format.
- Provide the reason for your hypothesis – literature and/or observations. (*See example below.*)

*Ex.) Research indicates that mice have a preference for granulated white sugar. Therefore, my hypothesis is: **If** mice are given a choice between salt, brown sugar, white granulated sugar and artificial sweetener, **then** more mice will select white granulated sugar.*

***MATERIALS**

Be very **specific** in listing the items used in your experiment. For example, a *pot* is too vague. A more specific listing is one 10 cm diameter clay pot, 8 cm in height. Measure dimensions, quantities, temperatures, etc. accurately. Do **all** measurements in ***metrics***.



***PROCEDURE**

The procedure is the steps you use to test your question/solve your problem. List and number the logical sequence of steps in your experiment. Be specific in describing the steps, as though you are giving directions to someone who is trying to repeat your experiment. An experiment should be repeated multiple times, approximately 3-5 times, to insure accuracy. Take heed to do each test the same way.

Consider and identify these variables when planning your procedure:

1. **Controlled Variables** – These are all the things that you keep the same (control) from one test to the next. Because they are controlled, they are not tested.
2. **Manipulated (Independent) Variables** – These are the things that you purposely change to test the effect of the change.
3. **Responding (Dependent) Variables** – These are the things that you measure from testing the manipulated variables, in order to get your results (data).

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*** JOURNAL /WRITTEN REPORT**

A journal is a day-by-day dated account of your investigation, written in a notebook, from the day you begin the project until the day you finish. It is a written record of your project, not just a copy of what's on your board.

Your journal and/or written report should contain: your question or problem, relevant background information and research of your topic, materials you determined were needed, a description of the variables (controlled, manipulated/independent, and responding/dependent), an outline of your testing procedure, your data (in your journal when making observations, record the dates and what was observed), the results, and conclusion of your investigation.

When on display, your journal or written report is placed in front of your board, with your project title on the front and your name and room number on the back.

***DATA**

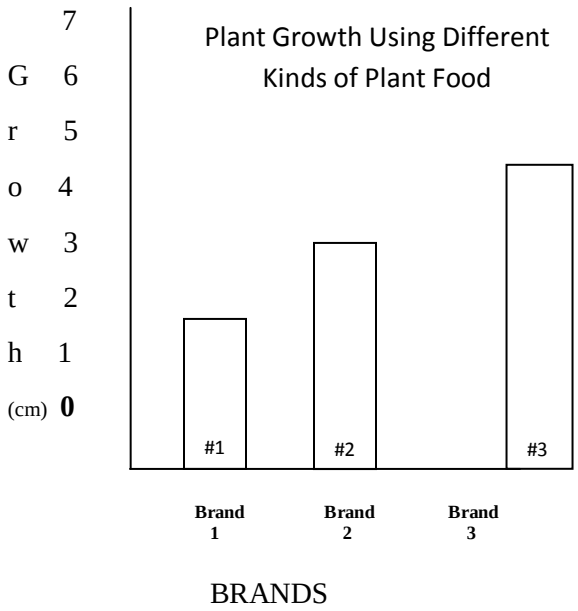
The data section of your display contains all of the observations (Quantitative and Qualitative) you collected during your investigation. The data should be organized in a way that makes it easy to read, such as charts and data tables. (*See example.)*

DATA

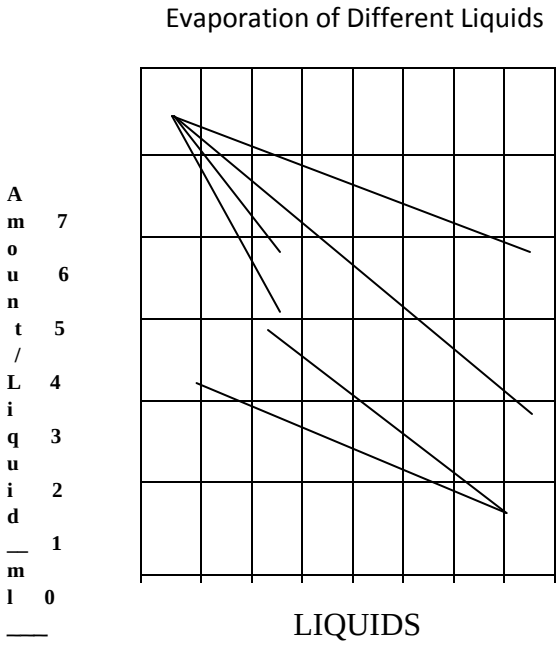
	0 minutes	*5 minutes*	*10 minutes*	*15 minutes*	*20 minutes*	*25 minutes*
Test Tube 1						
Test Tube 2						
Test Tube 3						
Test Tube 4						

***RESULTS** (ANALYSIS OF DATA)

The results section of your science fair board shows the analysis of all the data you collected during your investigation. This information should be expressed in two ways --- in written form and on a graph or chart. Graphs are often used so that the information can be understood at a glance. These are most often line or bar graphs. On the graph, include what units of measurement you used to measure the results such as centimeters, grams, etc.



Bar Graphs – The bar graph is usually used when you want to compare two or more variables such as weight, distance, time, temperature, etc.



Line Graphs - The line graph is usually used to show changes over time. Remember to give all graphs a title and label both axes of the graph to clarify what the graph is showing.

***CONCLUSION & DISCUSSION**

First indicate in your conclusion whether or not the data (the information you collected) supported or did not support your hypothesis.

- **Do not** change your original hypothesis to fit the results of your experiment.
- **Do not** write that your hypothesis was right or wrong.

You are still learning, no matter what happens! If your data does not support your hypothesis, write a revised hypothesis and indicate that it is a revision to your original hypothesis. Also write what you learned from your experiment. State what further experiments related to your project you might want to do or how you might change your investigation if you were to do it again. Don't forget to discuss ways the results can apply to everyday life.

***ABSTRACT** (Grades 9 -12 only)

The abstract is a ***brief*** summary of your investigation. Include what you investigated (question), how you did it (procedure), and what you found (results). When someone reads your abstract, they should get the basic idea of your investigation.

SCIENCE FAIR HANDBOOK

JOURNAL/WRITTEN REPORT

Each student must also submit a journal or written report with the science project. Below is a guideline on what to include in the journal/written report.

Heading: On the Front - Title of your project
On the Back - Student name, Teacher's name, School.

Question/Problem: This is the question/problem your investigating or designing a solution through the engineering design process.

Abstract (Gr. 9th – 12th): A brief summary of your project.

Research: Background information from various sources, i.e. scientific articles, books, websites, etc.

Variables: **(Gr. 3rd – 12th)**
**Controlled Variables*: These are the things that are kept the same throughout your experiments.
**Independent/Manipulated Variable*: This is the one variable that you purposely change and test.
**Dependent/Responding Variable*: The measure of the change observed because of the independent variable.

Hypothesis: Based on the research you have done, you will be writing a testable statement that will be investigated through experimentation. Make sure you write down your hypothesis before you begin your experiment.

Materials: A detailed list of the items you needed to complete your experiments. Be specific.

Procedure: List all of the steps used in completing your experiment. Remember to number your steps. Add photos of your experiment if you like.

Data/Observation: It is easier to understand the data if it is put into a table or chart. Make sure all data is clearly labeled. Remember Metric Measurements! Add photos of your experiment if you like.

Results: All data must be interpreted and analyzed in written and graph form. Make sure all graphs are clearly labeled and metric units designated.

Conclusion & Discussion: A summary of what you discovered based on the results of your experiments. Be sure to indicate whether or not the data supports the hypothesis and explain why or why not. If possible applicable, write a revised hypothesis if your data did not support your hypothesis. Include how you could change a part of your project to improve it for further investigation.

Bibliography: Be sure to include print and electronic sources used to complete your project.

Demonstrations vs. Experiments*

While demonstrations and models can help you learn many important concepts, *this science fair requires students to do an experiment following a scientific method*. Here are some examples of questions that do not require an experiment but can be answered by reading a book or making a model.

DEMONSTRATIONS
Do not pick these kinds of questions!

1. Can I grow bread mold? This event can be shown by a simple **demonstration.**
2. Do plants need light to grow? This question can be answered by a simple "yes" or "no" and a **demonstration**.
3. How does a battery work? This question can be answered by a model or **demonstration**.

Instead, turn these demonstrations into experiments; the following examples are questions that can be answered by doing an experiment.

EXPERIMENTS

1. **What is the effect of different temperatures on growing bread mold?**
   Manipulated Variable: Temperature
   Controls: Light, moisture, kind of bread, location of sample
   Measurement of Responding Variable: Amount of mold

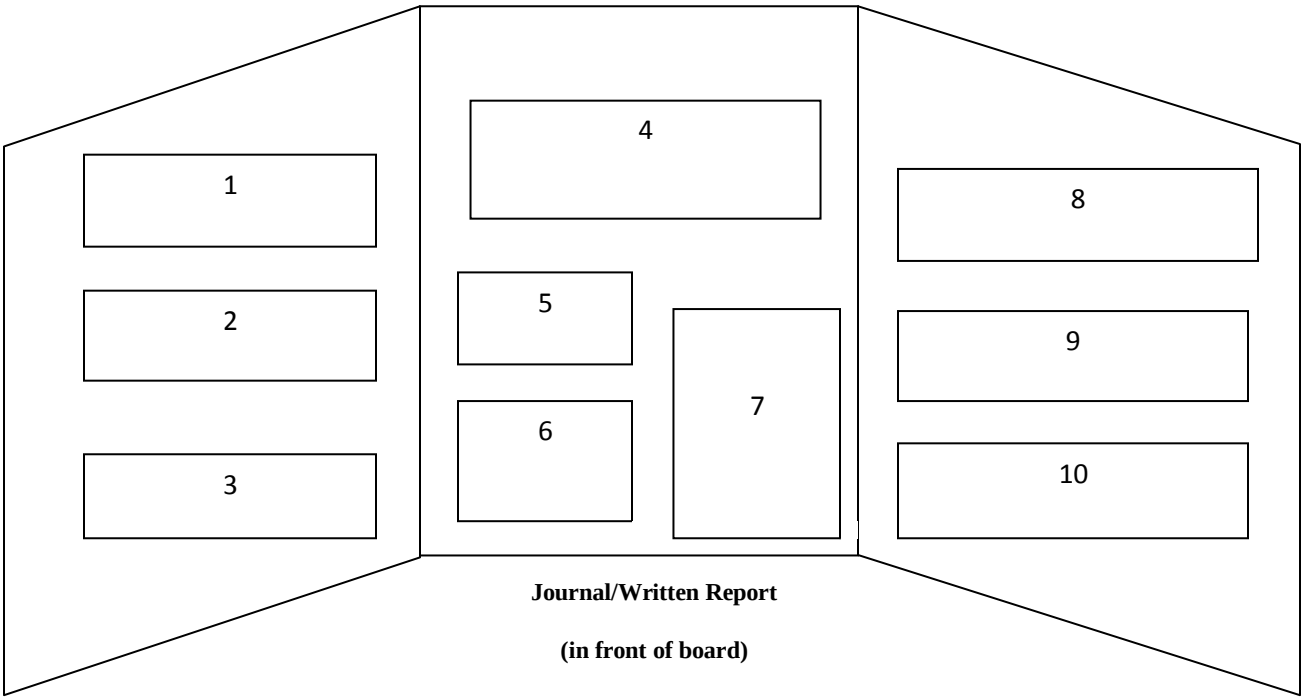
2. **Under what kind of light do plants grow best (grow lights, fluorescent light, sunlight)?**
   Manipulated Variable: Kind of light
   Controls: Kind of plant, location, moisture, kind of soil, size of pot
   Measurement of Responding Variable: Height of plant

3. **How does temperature affect the life of a battery?**
   Manipulated Variable: Temperature
   Controls: Kind and size of battery, type of flashlight, length of time battery will be kept at each temperature
   Measurement of Responding Variable: Length of time the battery will operate the same flashlight bulb

*From *Not Just Another Science Fair* by Laura Vazquez, *et al.*

Example of Display

(Can Differ, Only an Example)



NUMBER KEY

1. Question/Problem
2. Research & Bibliography
3. Abstract (Gr. 9th -12th only)
4. Hypothesis
5. Materials
6. Procedure
7. Data (Tables/Charts)
8. Additional Data (i.e. Photos/Illustrations)
9. Results
10. Conclusion/Discussion

DISPLAY BOARD: <u>On the Back</u> (in the middle section) **DO NOT PUT ON THE FRONT**

-Student's first and last name
-School
-Teacher's name
-Room number

JOURNAL/WRITTEN REPORT

<u>Front</u>:

-Project title

<u>Back</u>*:*

-Student's name
-Teacher's Name

QUALITIES OF A GOOD SCIENCE FAIR PROJECT

1. **OVERALL APPEARANCE**
    a) **Neatness**
    b) **Organization**
    c) **Clarity**
    d) **Visual appeal**
    e) **Correct spelling and grammar**
    f) **Good workmanship**

2. **SCIENTIFIC QUALITY**
    a) **Study well thought out**
    b) **Question/problem clearly stated**
    c) **Scientific method used (making a prediction to a question, then testing the question to produce results)**
    d) **Contains drawing, graph, chart, data, photographs (not all of these)**
    e) **Measurements done in metrics**

3. **DOCUMENTATION**
    a) **List all sources, materials, and findings**
    b) **Process complete**
    c) **Description clear, correct**
    d) **A complete journal/written report included with display**

4. **CONCLUSION & DISCUSSION**
    a) **Conveys understanding of the project, the steps take, the data, and the results.**
    b) **Can explain the project with clarity, in his/her own words.**
    c) **Makes predictions and inferences based on the information gained from his/her project.**

SCIENCE FAIR HANDBOOK

Science Project
CHECKLIST

_____ **Select (with classroom teacher's help) one QUESTION/PROBLEM that you would like to investigation. This handbook offers some suggested topics.**

_____ **Do RESEARCH on the topic of your question. List your references for the BIBLIOGRPAHY. Begin your JOURNAL.**

_____ **Write a HYPOTHESIS that can be tested through experimentation.**

_____ **Plan a PROCEDURE to TEST your hypothesis. Decide what MATERIALS you will need and write STEP-BY-STEP DIRECTIONS for what you will do and how you will do it. Make sure you follow the rules for Science safety.**

_____ **Continue recording in your JOURNAL, writing everything you do, observe, and think during your investigation. As you do your experiment, prepare yourself to give an ORAL PRESENTATION at its completion. You should understand your project thoroughly and be able to answer questions about it.**

_____ **Follow the step-by-step directions of your PROCEDURE and RECORD your data in your JOURNAL. Remember to ORGANIZE your DATA (the information you collected) in a TABLE or CHART.**

_____ **When you are finished your INVESTIGATION, summarize (analyze) the RESULTS of your investigation in a written form and construct a GRAPH or CHART.**

_____ **Write a CONCLUSION which states whether your data supported or did not support your hypothesis. Write a REVISED HYPOTHESIS if your data did not support your hypothesis. Write anything that you learned as a result of doing the experiment. Include how you could change a part of your project to improve it for further investigation.**

_____ **Write a SCIENCE PROJECT ABSTRACT. (Gr. 9^{th} – 12^{th} only)**

_____ **Make headings and a good copy for all sections of your project. Use a font size of at least 24 points.**

SCIENCE FAIR SUBMISSION CATEGORIES

K-2: Class Project

3-5: Individual, Class or Team Project

6-8: Individual, Class or Team Project

9-12: Individual, Class or Team Project

SCIENCE FAIR HANDBOOK

Your project question may originate from something that interest you, the suggested questions listed or other sources. Be careful to select a question that <u>you don't already know the answer to</u> and is <u>not too easy</u> for you.

PHYSICAL SCIENCE TOPICS (**Test at least 3 brands, types, amounts, sizes, kinds, etc.**)

- **Does salt, sugar, or flour cause an egg to float?**
- **What size kite flies the highest?**
- **What kind of things do magnets attract?**
- **Which metal conducts heat best?**
- **What type of material has the most friction?**
- **What materials provide the best insulation?**
- **Which liquid evaporates the fastest?**
- **What shape kite flies the highest?**
- **Which liquid has the highest viscosity?**
- **Which color water evaporates the fastest?**
- **Which type of oil has the greatest density?**
- **Which electromagnet design is the strongest?**
- **Which material reflects sound the best?**
- **Which type of magnet is the strongest?**
- **What height causes a ball to bounce the highest?**
- **Which material conducts electricity the best?**
- **What happens when you cut a magnet into pieces-it becomes weaker, stronger, or stays the same?**
- **Which liquid boils the fastest—thick, thin, or medium?**
- **Through what material does sound travel the best?**
- **What material is the best to keep heat in?**
- **Will raisins rise and sink the fastest in carbonated water, diet soda, or regular soda?**
- **Which dissolves the fastest in water—salt, sugar or baking soda?**
- **Does steel rust faster in water than in other liquids?**
- **What holds two boards together better-a nail, a bolt, or a screw?**
- **Do all colors fade at the same rate?**

TIP:

IF ***YOU SELECT A QUESTION THAT HAS THE WORD "BEST" IN IT, YOU NEED TO EXPLAIN WHAT YOU MEAN BY 'BEST'. TELL WHAT YOU ARE MEASURING IN ORDER TO FIND THE ANSWER TO YOUR TOPIC QUESTION. BE SPECIFIC***

SCIENCE FAIR HANDBOOK

LIFE SCIENCE TOPICS (_Test at least 3 brands, types, amounts, sizes, kinds, etc._**)**

- **On which surface can a snail move the fastest-dirt, cement, or grass?**
- **Do ants like cheese, sugar, bread the best?**
- **What food do mealworms prefer?**
- **Do bigger seeds produce bigger plants?**
- **Does temperature affect the growth of plants?**
- **Will bananas brown the fastest on the counter, in a paper bag, or in a refrigerator?**
- **What is the effect of light on rate of seed germination?**
- **Do different types of apples have the same number of seeds?**
- **Do mint leaves repel ants, worms, or isopods?**
- **Can plants grow without soil?**
- **Does the way a bulb is put into the ground affect the direction in which the roots grow?**
- **What is the effect of temperature on rate of seed germination?**
- **Which travels the fastest-a snail, a millipede, or a worm?**
- **What is the effect of increased or decreased oxygen on plant growth?**
- **Do different types of oranges have different amounts of water?**
- **Does the direction seeds are planted affect plant growth?**
- **Which cheese grows mold fastest?**
- **Does a plant grow the biggest if watered by tap, spring or distilled water?**
- **Does an earthworm react to light, partial shade, or darkness?**
- **What type of soil filters water the best?**
- **Does surrounding color affect an insect's eating habits?**
- **Does heart rate increase with increasing sound volume?**
- **Which grows mold the fastest-dry bread, moist bread, or very wet bread?**
- **Do taller people run faster than shorter people or people of average height?**
- **Does a plant need some darkness to grow?**
- **What is the effect of the size of the pot on plant growth?**
- **Does being in the shade affect a person's temperature?**
- **What is the effect of sensory deprivation, talking, or touching on plant growth?**
- **Does pot type affect plant growth?**
- **What effect do different kinds of water have on seed germination?**
- **What type of pot insulation material affects plant growth-rubber, plastic, or aluminum?**
- **In which type of wood chips would a seed germinate the fastest-oak, pine, or cedar?**
- **Which grows the fastest- plants from leaves, seeds, or stems?**
- **Will adding different amounts of bleach to the water of a plant reduce fungus growth?**
- **Does the color of light affect plant growth?**
- **Do plants grow the biggest in soil, sand, or water?**
- **With which type of corn seed will the largest percent of seeds germinate?**

SCIENCE FAIR HANDBOOK

CONSUMER SCIENCE TOPICS (_Test at least 3 brands, types, amounts, sizes, kinds, etc._**)**

- **Which dishwashing soap makes the most bubbles?**
- **Are more expensive watches more accurate?**
- **Which fabric resists staining the best?**
- **Which type of battery lasts the longest?**
- **Which laundry detergent makes the least bubbles?**
- **Does a bath take less water than a shower?**
- **Which fabric can be cleaned the most easily?**
- **Which type of oil has the greatest density?**
- **Does a baseball go farther when hit by a wood, plastic, or metal bat?**
- **Does the size of a light bulb affect its energy use?**
- **Which is more effective—liquid, gel, or powdered dishwashing detergent?**
- **How accurately do people judge temperature?**
- **Which cleans clothes better—hot, warm, or cold water?**
- **What affects the rate at which a person breathes?**
- **Which is the strongest material—foil, paper cellophane, or waxed paper?**
- **Which kind of glue holds two boards together better?**
- **Which is more effective—liquid powdered, or tablet laundry detergent?**
- **Which cooking method produces the best popcorn—air; stove, or microwave?**
- **What kind of cleaner removes ink stains best?**
- **Do synthetic or natural fabrics resist stains better?**
- **Which is the strongest material when wet—foil, paper, cellophane, or waxed paper?**

EARTH SCIENCE (_Test at least 3 brands, types, amounts, sizes, kinds, etc._**)**

- **Which body of water has the best water quality—a creek, a lake, or a river?**
- **Which land material holds water the best—sand, clay, or soil?**
- **What is the effect of different soil mixtures on plan growth?**
- **Which decomposes the fastest—an apple, an orange, or a tomato?**
- **What is the effect of different types of soil on growth?**
- **Which creek has purer water?**
- **Which river has purer water?**

SCIENCE FAIR SCORING RUBRIC Judge Initials:

SCIENCE FAIR DIVISION (CIRCLE ONE) K-2 3-5 6-8 9-12

FIELD OF SCIENCE (CHECK THE APPROPRIATE BOX)

☐ **Physical Science** ☐ **Life Science** ☐**Earth Science** ☐**Consumer Science**

☐**Engineering/Robotics** ☐ **Environmental** ☐**Chemistry** ☐**Physics**

☐**Behavioral/Social Science** ☐**Other**

PROJECT NUMBER: _____ TITLE: _____

Projects will be awarded either ALL of the available points or NONE

	Available	Earned
A. QUESTION/PROBLEM		
1. Question/problem is stated to be answered through experimentation or the engineering design process, not just a demonstration.	**4**	
(Total Points Available = 4)	***Total:***	
B. RESEARCH		
1. Research pertains to the question.	**4**	
2. Minimum number of references is listed. (Bibliography) **K-2: Two References 3-5: Three References 6-8: Four References 9-12: Five References**	**3**	
(Total Points Available = 7)	***Total*:**	
C. HYPOTHESIS		
1. Stated hypothesis is 'testable' – able to be supported or refuted through experimentation or the engineering design process.	**5**	
2. Supporting literature and/or observations for the hypothesis is evident.	**4**	
(Total Points Available = 9)	***Total:***	

D. MATERIALS	Available	Earned
1. Materials are listed.	2	
2. Specific dimensions, quantities, etc. are given for materials, where applicable.	1	
(Total Points Available = 3)	*Total:*	
E. PROCEDURE		
1. Steps of the procedure are listed in a chronological and logical order that would allow replication of the experiment by another individual.	5	
2. Identification of the control, independent/manipulated, and dependent/responding variables. (Gr. 3-12 only)	5	
3. Description of how the independent variable is manipulated. (Grades 6-12 only)	3	
4. Description of how the dependent variable is measured. (Grades 6-12 only)	3	
(Total Points Available = 16)	*Total:*	
F. DATA		
1. Data (quantitative and/or qualitative) is displayed. (i.e. words, numbers, photos, illustrations, etc.)	5	
2. Data is organized. (i.e. tables, charts, organizer, etc.)	4	
3. Organization of data is appropriately titled and labeled.	4	
4. Units of measurements are identified. *METRIC MEASUREMENTS*	4	
5. Collection of data from multiple trials is clearly recorded.	5	
(Total Points Available = 22)	*Total:*	
G. RESULTS/ANALYSIS		
1. Graph contains appropriate title, labels and units of measurement. *METRIC MEASUREMENTS*	5	
2. Graph accurately displays the collected data.	5	
3. Logical written analysis (interpretation) of data is present.	4	
4. Identify and accurately explain the relationship between the variables (independent/manipulated, dependent/responding). (Gr. 6-12 only)	5	
(Total Points Available = 19)	*Total:*	

H. CONCLUSION & DISCUSSION	Available	Earned
1. States the data supported or did not support the hypothesis - No use of 'right' or 'wrong'.	5	
2. Identifies and explains the results.	5	
3. Describes what was learned from the experiment and further related investigations that could be done.	4	
(Total Points Available = 14)	*Total:*	
I. JOURNAL/WRITTEN REPORT		
1. Includes the question/problem, relevant background information and references, materials, identified variables, procedure, data, results and conclusion.	5	
2. Front: Project Title ; Back: Student and Teacher Names	1	
(Total Points Available = 6)	*Total:*	
J. ABSTRACT (Grades 9 -12 only)		
1. Includes the topic/question of investigation, brief description of procedure, and the results.	4	
(Total Points Available = 4)	*Total:*	
K. OVERALL APPEARANCE		
1. All headings are visible from at least 6 feet away. (*24 Font Size Suggested*)	2	
2. All components are evident: Title, Question/Problem, Research, Hypothesis, Materials, Procedure, Data, Results, Conclusion and Discussion, Abstract (9-12 only) and Journal/Written Report.	5	
3. Text contains correct spelling and proper use of grammar.	5	
4. Display is organized and easy to follow.	2	
5. Presentation is visually appealing. (i.e. graphics, colors and good workmanship)	2	
(Total Points Available = 16)	*Total:*	

Gr. K-2 Total Points	100	
Gr. 3-5 Total Points	105	
Gr. 6-8 Total Points	116	
Gr. 9-12 Total Points	120	