Elementary Science Research Manual
Pinellas County Schools

Table of Contents

Rationale

Twenty-five percent (25%) of the FCAT Science test administered to 5th graders, requires understanding of "***the nature of science***." Practicing the scientific method, through completing a science research project, is a powerful and authentic way for students to internalize this knowledge and to practice the process skills of science.

This manual was developed to provide parents and teachers with the necessary information to assist students in using the scientific method to complete a science research project. The goal of elementary science is to introduce students to science content knowledge and provide practice for them to use inquiry skills to analyze and solve problems. Use of inquiry skills encourages students to think creatively and actively engages them in science on a variety of levels. These skills include ***observing, hypothesizing, measuring, classifying, collecting and interpreting data, predicting, experimenting, inferring and communicating.*** Throughout the process, science investigations reinforce skills in reading, writing, speaking, mathematics and the social sciences.

Ways to Support Your Child: A Guide for Parents:

I. Begin your science project experience with a planning meeting. You and your child will want to review this manual and the scoring rubric prior to starting the project. Some ideas to keep in mind are:

   A. This entire process should be ***fun***. It is a great opportunity to spend time together doing something of educational value.
   B. Budget more time for the project than you think you will need...***then double it***.
   C. Topic selection should be at the child's level. Please keep in mind that the ultimate project choice should remain with the child. The science book and the grade level expectations listed on **http://sage.pinellas.k12.fl.us** are excellent resources for grade level appropriate ideas.

II. Remind your child that the diary begins on Day 1 when ideas are being generated.

III. Help your child focus attention on what is being learned and the accuracy of the information being presented.

IV. Help your child understand the necessary parts of the project.

V. Make sure that your child follows the guidelines as well as all safety regulations.

VI. Encourage your child to refer to the rubric often to assess his/her own progress.

If you have a question as the project progresses, ask the child's teacher or call the district science office at 588-6075.

Some things to think about:

Most of the "how to do a science project" books and websites **are useless**. They typically do not show the scientific process or experimentation. They usually show demonstrations or models that are neither creative nor classical scientific investigation.

The following website may be helpful to an adult who is assisting a child with a project: http;//www.cpet.ufl.edu/sciproj/

District Science Showcase vs. School Fairs

All children are encouraged to participate in a classroom-level or school-level research fair. Students **do not** compete against each other. Projects compete against a standard scoring rubric. Schools will be given information on how many projects can be sent to the district science showcase. Projects will **not** be judged again at the district showcase, but will be on public display. Participation in the District Science Showcase is optional.

District Science Showcase Categories:

There will be three categories of entry into the District Science Showcase:

Class Research Projects – for Primary Grades PreK-2
Individual Research Projects - for Intermediate Grades 3-5
Group Research Projects – for Intermediate Grades 3-5

- Only class research projects may be submitted to the District Showcase at the primary level.

- At the intermediate level, research projects may be submitted as either a group (2 to 4 students working together) or as an individual.

Characteristics of an Effective Science Experiment:

An experiment is a project which asks and investigates a research question of a scientific nature. It requires ***changing only one variable***, observing and recording the effect of changing that variable, and interpreting the importance of that effect. Several examples of research questions are:

Does the *amount of fertilizer* affect the height that bean plants grow?
Does the *diameter of a rubber ball* affect how long it takes to roll down a slide?
Does the *temperature of a tennis ball* affect how high it bounces?

A classic science experiment will require setting up a ***control group*** (a set of trials where everything that might affect the outcome of the investigation is held constant) and an ***experimental group*** (a set of trials set up exactly like the control group EXCEPT one thing is changed). In the three examples above, the one thing that would be changed in each of the experimental groups would be: the *amount of fertilizer*; the *diameter of the rubber ball*; and the *temperature of the tennis ball*.

Another very important feature of an effective science experiment is that ***it must be repeated*** many times to establish a norm. If you grow plants, you would want 10 or more plants in your control group AND 10 or more plants in your experimental group; if you are rolling rubber balls down a slide, you would roll a (control group) ball 10 or more times, AND would roll (experimental group) balls 10 or more times each; if you are changing the temperature of tennis balls to see how high they bounce, you would bounce 10 or more balls at your (control group) temperature AND would bounce 10 or more balls at each (experimental group) temperature. After you record the measurements taken from each of your repeated trials, ***compute the (mean) average*** of those measurements for the control group and for each experimental group. ***The results or conclusions of your investigation should be based on the average values computed from your data***.

Scientists take measurements using metric instruments having ***metric units***. If possible, you should try to use metric instruments to measure:

- ***Length*** can be measured (with a metric ruler) in units of ***meters, centimeters or millimeters.***
- ***Volume*** can be measured (with a graduated cylinder) in units of ***liters, milliliters,*** or can be calculated in ***cubic centimeters.***
- ***Mass*** can be measured (with a platform balance) in units of ***Kilograms or grams***.
- ***Weight or Force*** can be measured (with a spring scale) in units of ***Newtons***.
- ***Time*** can be measured (with a stopwatch or clock) in ***hours, minutes or seconds***.
- ***Temperature*** can be measured (with a thermometer) in ***degrees Celsius***.

Throughout the investigation, special emphasis is to be placed on student understanding of science content, proper use and control of variables, careful measurement and appropriate interpretation of data. At the end, a student should be able to describe what he/she did with fluency, conclude whether the data supports (or fails to support) his/her hypothesis, and to suggest real-life applications of the research.

Characteristics of Projects to Avoid:

Avoid consumer economics or product testing projects (i.e., which brand of popcorn pops the most kernels; which paper towel absorbs the most water; which brand of cereal has the most raisins; which battery lasts longest). Although these may qualify as experiments, they are seldom original and are not fair to the companies that make the products. Consumer economics or product testing projects shall not be displayed at the district science showcase, and may not be allowed at the classroom or school level.

Avoid models, demonstrations or inventions **unless they are used to measure cause-and-effect relationships.** Models created to gather data (i.e., which type of bridge structure will support the most weight; which shape of boat hull has the least water resistance; which type of propeller blade is most efficient in the wind; etc) **are acceptable** and are usually quite creative.

Avoid any project that is dangerous, expensive, involves humans or vertebrate animals, involves controlled substances (cigarettes, alcohol, drugs), or is beyond the understanding or grade-level ability of the child. An adult supervisor must be present whenever students engage in manipulating supplies, materials, or equipment. A detailed description of things to avoid is listed under Safety Regulations, on pages 5 - 6 of this manual.

Explanation of Scoring:

Projects are scored using an instrument known as a rubric. The rubric shown on page (for grade PreK-2 on page 15; for grade 3-5 on page 16) should be used extensively as a guide when designing and completing the science project. A rubric defines specific required elements of a project and gives descriptions of performance for determining the score for each element. No comparison among/between projects is made when determining scores. The overall proficiency of the student's research is determined by totaling the individual element scores in the rubric.

Based on a 99 point scale, the proficiency levels for intermediate projects are:

Proficiency Level	Points Needed
Accomplished Researcher	90 – 99
Developing Researcher	75 – 89
Emerging Researcher	60 – 74
Research Participant	Below 60

Primary grades (PreK-2) class projects also use a rubric for scoring but it is a holistic scoring process. Each required element is rated independently, across the rubric, by circling the level of performance achieved. The final level is determined by looking at the ratings and picking the level that is most characteristic of the project. The primary rubric (on page 15) is a simplified version of the standard intermediate rubric. The rubric should be used extensively in designing and completing the science project.

Safety Regulations

The following safety regulations must be followed. These rules are for the safety of all children and their adult sponsors. Violation of any rule will result in a project that fails to qualify for scoring. If in doubt, contact your child's teacher or the district science office at 588-6075.

During experimentation:

- All projects must be supervised by an adult…..the **Adult Sponsor**.
- Appropriate protective clothing and equipment (goggles, aprons, gloves, tongs) must be worn or used by anyone exposed to potentially harmful materials.
- No vertebrate animal may be used in any way.
- No humans (students or adults) may be used as subjects of experimentation.
- No living organism is to be harmed in any way (plants excluded).

- No drugs (including over the counter medications such as aspirin, cigarettes, alcohol) or substances that may be a safety/health hazard may be used. Safety/health hazards are to be assessed by the Adult Sponsor.

- No microbes (mildew, mold, fungus, bacteria) may be cultured or used.

- No explosives of any type, including firecrackers and/or firearms, may be used.

- Projects involving electrical circuits must use standard batteries not to exceed 12 volts DC. No car or motorcycle batteries, open top batteries, or use of 110 volt AC is allowed. All wiring must be properly insulated.

- Standard household appliances (lights, fans, hair dryers) may be used in their original form, without modification, and with Adult Supervision.

- Heating sources (stoves, hot plates) may be used with Adult Supervision.

In the Display:

- No sharp object; glass; food; liquid (including water); chemical; microbe; laser operation; unshielded wiring; temperature exceeding 70^{o} C; brand names of products; pictures of students (without signed parent permission); loud or distracting sound; bright or distractive light; pressurized gas; unshielded belt, pulley, chain or moving part may be displayed. Pictures of these (except as prohibited in the regulations above) may be taken to document and explain what was done in the experiment.

How To Do An Experiment….

Understand the Project Requirements:

- Don't begin until you know the specific requirements of your teacher or school. Is the project required? Is there a timeline and final deadline for completion? Are there specific restrictions imposed by the teacher that may not be covered in this manual? How will your grade be determined on this project? Will the teacher want you to get approvals at certain "checkpoints" before proceeding?

Start a Logbook….or Project Diary:

- Scientists use logbooks to keep detailed records of everything they do, and all of the data that they collect. For elementary students, we will treat the formal logbook as a project diary.
- Each entry in your diary should be <u>printed</u> neatly and include the date.
- The diary is a notebook, booklet, journal, folder or sheets of paper stapled together. The diary should include pages or sections for each required element in your project. You will find descriptions of most of these elements listed on page 7 - 13 of this manual.

- The way to order the sections of your diary are:
  - ***Cover Page***: (your name, grade, school, teacher, project title, starting date, and ending date.)
  - ***Topic Statement***: (I am interested in studying ____________.)
  - ***Science Content Statements:*** (Learn more about your topic from the library, internet, textbooks, and write down what you learned.)
  - ***Research Question:*** (Does ________ affect ___________?)
  - ***Predictions:*** (List three ways the experiment might end up.)
  - ***Hypothesis:*** (State the prediction you think will most likely happen.)
  - ***Manipulated Variable:*** (The one thing will you change in the experiment.)
  - ***Responding Variable:*** (What will you measure to see if it is effected.)
  - ***Set-Up Conditions:*** (List all of the things that you will keep constant to ensure a fair trial.)
  - ***Materials:*** (List each of the items that will be used. Include size, quantity, and descriptions such that someone else could duplicate your project.)
  - ***Directions:*** (Step-by-step list of what you did with each item in the materials list, in the exact order it was done. Someone else should be able to follow your steps to duplicate exactly what you did. Be sure you have set up a control group and an experimental group.)
  - ***Data Collection:*** (An organized and complete account of everything that was measured and observed in your experiment. Measurements should be in **metric units**, and there should be **many repeated trials**. Each entry must be dated, and any other factor that might affect your experiment should be recorded. Data is usually presented in chart form with appropriate units of measure listed, and averages of the trials given.)
  - ***Graph:*** (Mathematical picture of the data. Use the (mean) averages to plot your graph.)
  - ***Results:*** (Use your data and graphs to tell what happened in the experiment. Did your manipulated variable affect your responding variable? Describe the effect.)
  - ***Conclusion:*** (Tell whether your data supports, or fails to support your hypothesis.)
  - ***Real World Uses:*** (In paragraph form, describe ways, places, or situations where information from your experiment might be useful.)
  - ***Reflections:*** (Include your thoughts, concerns, discoveries, further questions, what you might do differently next time, etc.)

Suggestions for Selecting a Topic:

- Go to your science textbook and open it to the table of contents. Pick a topic that interests you. It may be earth, physical, or life science. You may also wish to check science related websites on the internet for ideas. You may have a hobby, or your teacher may offer suggestions. Pick a topic that interests you. Do not pick a topic that might involve expensive equipment, materials that you do not have or can not get, or methods that you cannot complete without minimal assistance. Do not pick a topic that would violate any of the Safety Regulations listed on pages 5 - 6 of this manual.

- Write your ***Topic Statement***: (I am interested in studying _________________.)

Write your science content statements:

- The science content statements should describe your topic using scientific language. Be as thorough as possible.
- You may use your textbook, library books, encyclopedias or internet resources to help you find information. Remember to write the statements yourself in your own words. Copying someone else's words or downloading information from the internet is not acceptable and may result in your project not qualifying for scoring.

Write your Research Question:

Example 1: Let's suppose you are interested in studying plants.

- Create a three column chart like the one below. In the chart:
    - list some kinds of things **you could change** that might affect the plants;
    - list some things **you could measure** that might be effected;
    - list some **types of plants** that you might like to experiment with.

Things you could change (manipulated variable: x)	Things you could measure (responding variable: y)	Types of plants you might use in your experiment.
Amount of water used Type of water used Amount of fertilizer used Temperature	Height of the plants Number of leaves Size of the flowers Number of seeds that sprout	Marigold plants Petunias Bean plants Grass

- Write your ***Research Question*** by selecting one thing from the x column, one thing from the y column, and one type of plant. Examples include:
    - Does the ***amount of water*** affect the ***number of leaves*** on a ***bean plant***?
    - Does ***temperature*** affect the ***height*** that ***marigold plants*** will grow?
    - Does the ***amount of fertilizer*** affect the ***size of petunia's flower***?
    - What is the affect of ***type of water*** on the ***number of bean seeds that sprout?***

Example 2: Let's suppose you want to study objects rolling or sliding down a ramp:

Things you could change (manipulated variable: x)	Things you could measure (responding variable: y)	Rolling objects you might use in your experiment.
Height of the ramp Mass of the object Length of the ramp Material the ramp is made of	How long it takes (time) How far it travels (distance) The speed at the bottom The energy at the bottom	Toy cars Marbles Tennis balls Wooden blocks

- Write your ***Research Question*** by selecting one thing from the x column, one thing from the y column, and one kind of object. Examples include:
  - Does the ***length of the ramp*** affect ***how far*** a ***tennis ball*** will roll?
  - Does the ***material the ramp is made of*** affect ***how long it takes*** a ***wooden block*** to slide down?
  - What is the effect of the ***mass*** of a ***toy car*** on the ***speed it has at the bottom*** of the ramp?

Notice that the research questions can take several forms:

- What is the effect of x (what you will change) on y (what you will measure)?
- Does x (what you will change) affect y (what you will measure)?

Make three predictions about what you think will happen:

- **Prediction:** Think about all of the possible outcomes of your experiment. Each thing that could happen can be called a prediction. List your predictions

  From Example 1 (studying plants):
  - ***Increasing*** the amount of water will ***increase*** the number of leaves on a bean plant.
  - ***Increasing*** the amount of water will ***decrease*** the number of leaves on a bean plant.
  - ***Increasing*** the amount of water ***will have no effect*** on the number of leaves on a bean plant.

  From Example 2 (studying objects rolling or sliding down a ramp):
  - ***Increasing*** the mass of a toy car will ***increase*** the speed it has at the bottom of the ramp.
  - ***Increasing*** the mass of a toy car will ***decrease*** the speed it has at the bottom of the ramp.
  - ***Increasing*** the mass of a toy car ***will have no effect*** on the speed it has at the bottom of the ramp.

Write Your Hypothesis:

- **Hypothesis:** Think about which prediction you think is most likely to happen. Your **hypothesis** is the **prediction** you think will happen.

  From Example 1 (studying plants):
  - ***Hypothesis: Increasing*** the amount of water will ***increase*** the number of leaves on a bean plant.

  From Example 2 (studying objects rolling or sliding down a ramp):
  - ***Hypothesis: Increasing*** the mass of a toy car will ***decrease*** the speed it has at the bottom of the ramp.

Identify your one manipulated variable:

- This is the **one thing you will change** in the experiment.   It is the "x" from the previous chart.

  From Example 1 (studying plants): the ***manipulated variable*** is ***amount of water.***
  From Example 2 (studying objects rolling or sliding down a ramp): the
  manipulated variable is ***mass of the car***.

Identify your responding variable:

- This is **what you will measure**. It is the "y" from the previous chart.

  From Example 1 (studying plants): the ***responding variable*** is ***the number of leaves on the plant.***
  From Example 2 (studying objects rolling or sliding down a ramp): the
  responding variable is the ***speed of the car at the bottom.***

Define Your Set Up Conditions:

- Your set-up conditions are all of the many things that you will keep constant that might affect the outcome of your experiment. These things are also called constants or controls because they are all of the things that you will keep the same (both in the control and experimental groups) in order to do a fair test. The set up conditions should be in list form.

  In Example 1: (studying plants):
  - If you decide to change only the amount of water given to the bean plants (manipulated variable), then you must keep everything else constant. These things would include:
    - Same temperature (how will temperature be the same),
    - Same soil type (specify soil type),
    - Same soil amount (specify how much soil per pot or plant),
    - Same fertilizer type and amount (specify),
    - Same amount of sunlight (how will sunlight be the same),
    - Same growing location (describe location),
    - Same size of bean plants at the start of the experiment (what size),
    - Same size of the pots (specify size of pots).

  In Example 2: (studying objects rolling or sliding down a ramp):
  - If you decide to change only the mass of the car (manipulated variable), then you must keep everything else constant. These things would include:
    - Same length and height of the ramp (how long and high),
    - Same material the ramp is made of (specify material ramp made of),
    - Same surface the car rolls on at the bottom of the ramp (specify),
    - Same car each time (only add mass to it) (specify car used and mass),
    - Same way the car is released at the start each time (how released),
    - Same way the speed of the car is measured (specify how measured).

- You will experiment with each change 10 or more times. These are called trials. If you are experimenting with giving plants two different amounts of water, you will need 20 plants. Ten of the plants will get one amount of water (control group) and ten plants will get the other amount of water (experimental group).
- Remember to only change **one** variable. For example, do not change both soil type and water type in one experiment. That would be an invalid scientific investigation.

Do the experiment:

- If possible, take pictures of each important step (materials used, set-up conditions, etc) as you do your experiment. The pictures can be placed in your diary or attached to your display board. They will help you explain what you did to the judges. Take pictures that do not include people; at least not faces of people.
- Gather all of the materials you will need (see your materials list).
- Follow the step-by-step directions you have listed (see your directions).
- Be sure your set-up conditions are maintained in both your control and experimental group (see your set-up conditions).
- Be sure you change only one thing (manipulated variable)…and this change is to be done only to your experimental group.
- Measure (in metric units whenever possible) the thing you expect to be effected (responding variable).
- Record your data in the data chart you made. Include (metric if possible) units of measure, and label both the horizontal rows and vertical columns.
- Include a row or column in your chart for the (mean) average. Label this “average.” When you graph your data, you will graph the mean averages rather than all of the individual trial data points.

Make your graph:

- Decide what kind of graph you need. Most experimental data can be represented in a bar graph. Primary projects may wish to use a pictograph. Sometimes a line graph is needed if you measured growth/change over time (such as the average height of plants over a month or the change in temperature over a day). Sometimes a pie chart may be a good way to display your data.
- When setting up your graph, the ***manipulated variable (x) goes along the bottom*** (horizontal axis), and the ***responding variable (y) goes up the left side*** (vertical axis). Label each axis and include unit of measure (example: amount of water in milliliters (x), and height of plants in centimeters (y)).
- Draw your graph carefully and accurately using all labels and explanations. Use your math book to help you. Computer generated graphs are acceptable.
- Acceptable graphs must include a descriptive title; labels on both the horizontal and vertical axes; appropriate units given on each axis; and the scale should be appropriate to the data being displayed. Check with your math book for help.

Write your result statements:

- These statements describe what happened in your experiment. You should try to explain as much as possible about what happened. What does your graph show? Did what you change (manipulated variable) affect what you measured (responding variable)? Describe the effect. If possible, try to use mathematical terms (like twice as much, or one-third as much, or no significant difference) in your results statements.
- **Avoid words that cannot be measured**. Words like healthier, better and greener are examples of words that should not be used.
- **Avoid saying "I proved."** No single experiment ever proves anything.

Write your conclusion statement:

- This statement explains ***whether your data supports, or fails to support your hypothesis.*** It is perfectly fine if your data does not support your hypothesis because now you know how to change your hypothesis to make it an accurate statement of what really happened.

Write your real world uses:

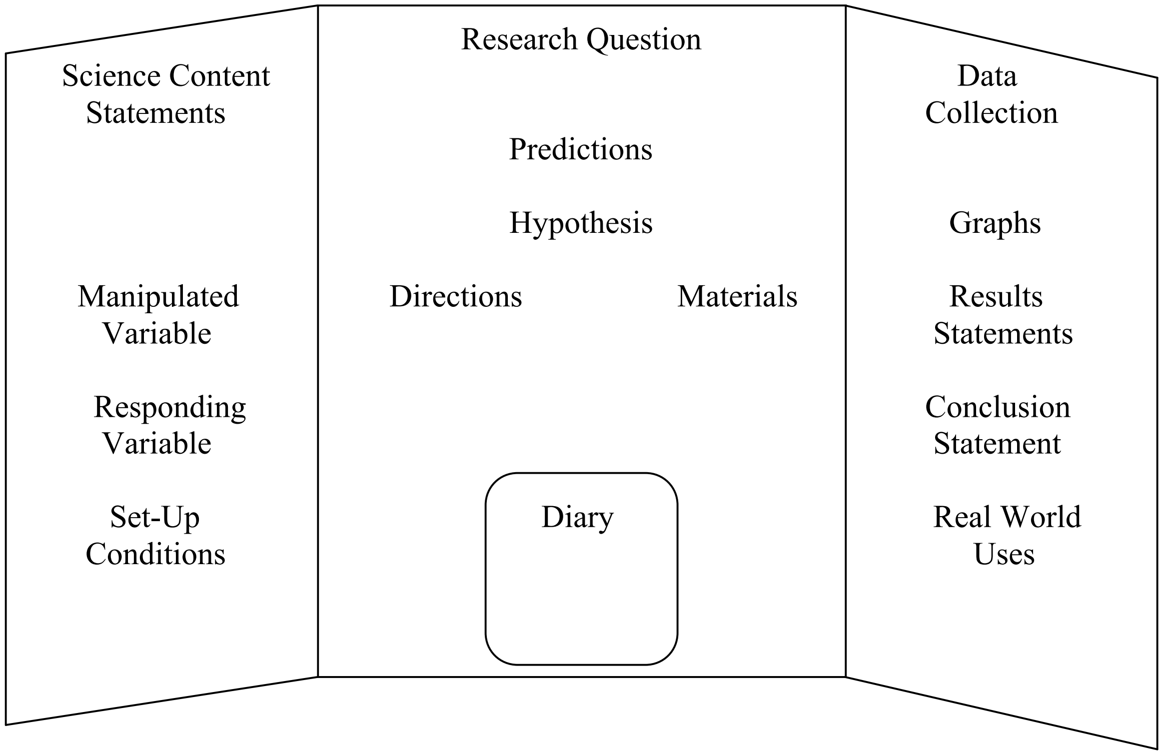
- These statements explain who in the real world might use this information, ways they might use this information, when, where, why or how they might use this information. Try to list and explain at least 3 ways if possible.

Build your presentation board:

- If your school is selling showboards, buy your board there because it is usually less expensive.
- Make sure that all of the elements are present and properly labeled.
- Neatness and proper use of the conventions are important. The labels and elements on your display board do not have to be typed. If you choose to print, be as neat as possible. Computers make great labels and graphs.
- Look on page 13 for a diagram on how to arrange your project board. Be sure to put your name, school, teacher, grade level and project category on the back of your board.
- Be sure to attach the diary to the board so that it is not lost.

- Remember ***not to include the following in your display***:
  - o No sharp object; glass; food; liquid (including water); chemical; microbe; laser operation; unshielded wiring; temperature exceeding 70^{o} C; brand names of products; pictures of students (without signed parent permission); loud or distracting sound; bright or distractive light; pressurized gas; unshielded belt, pulley, chain or moving part may be displayed. Pictures of these (except as prohibited in the safety regulations) may be taken to document and explain what was done in the experiment.

Presentation Board for Experiment



Guidelines for Oral Presentations:

- Oral presentations will be scored when the projects are judged.
- Students should be able to explain (not read from the presentation board) the elements on their board. For example: with experiments the student should be able to answer questions from the judges that relate to the question, variables, how they did the experiment, what they learned and real world uses.
- Students may be asked questions by the judges to help them begin their explanation.
- Students should remember to:
  - ✓ relax and think about what you would say if you were explaining your projects to your parents or grandparents
  - ✓ introduce yourself
  - ✓ smile and be polite
  - ✓ listen to the judges' questions and look at the judge when speaking to them
  - ✓ speak loudly enough to be heard
  - ✓ point to charts or other important parts of your display as you talk about them
  - ✓ stand to the side of your project as you speak so that the judges can see the display

Science Project Completion Schedule
For____________________________

Assignment	Due Date	Date Completed	Teacher initials
Begin Your Project Diary	Week 3		
Select Topic – Write Topic Statement	Week 3		
Complete Science Content Statements	Week 3		
Write Research Question	Week 3		
Write Predictions and Hypothesis	Week 3		
Define Manipulated Variable	Week 3		
Define Responding Variable	Week 3		
Define Set-Up Conditions	Week 4		
Create Detailed Materials List	Week 4		
Create Detailed List of Directions	Week 4		
Create Data Charts in Diary	Week 4		
Begin Experiment – Collect Data	Week 4-13		
Complete Experiment	Week 13		
Create Graph	Week 13		
Write Result Statements	Week 14		
Write Conclusion Statement	Week 14		
Write Real World Uses	Week 14		
Complete Presentation Board	Week 15		

Class Project Experiment Rubric
(Grades K – 2)

Using the Rubric: Begin in the left hand column (Required Elements). Mark each category by circling the description that best matches that element in the project. The final proficiency level is the general trend location (Emerging, Developing or Accomplished) of all the circles on the chart.

Required Elements	Emerging	Developing	Accomplished
Topic Statement (Tells what the class is interested in studying.)	States a topic; but vague, incomplete, or lacks detail.	Accurately states a topic; but incomplete detail.	Accurately states a topic; enough detail to know how the topic may be pursued.
Research Question (A question that explains what is to be studied.)	States a research question; but inaccurate, incomplete, or lacks enough detail.	Accurately states research question; but lacks both cause and effect (x and y).	Accurately states research question: includes detail and cause and effect (x, y).
Predictions (Lists the three possible outcomes of the experiment; hypothesis is the most likely to occur.)	States one or more predictions; but inaccurate, or incomplete, or lacks enough detail to follow.	Accurately states three predictions, but lacks clear cause and effect (x and y); or no hypothesis given.	Accurately states three predictions that include cause and effect (x and y); and hypothesis stated.
Manipulated Variable (Describes the one thing that the students will change.)	States what will be changed but with inaccurate or incomplete details.	Accurately states what will be changed but lacks details (tools, quantities, units, method).	Accurately states what will be changed with enough detail to assure accuracy.
Responding Variable (Describes what the class will measure.)	States what will be measured but inaccurate or incomplete details.	Accurately states what will be measured but lacks details (tools, units, how).	Accurately states what will be measured with enough detail to assure accuracy.
Set-Up Conditions (The things that will be kept constant.)	Lists some constants; some inaccurate or incomplete.	Lists all constants; lacks detail or description of how the conditions are set-up.	Lists all necessary constants with good detail and description of set-up.
Materials List (List all of the items that will be used in the experiment.)	Lists partial, confusing, or inaccurate materials; lacks quantities or measurements.	Lists most materials used; lacks some detail about type, quantity or size.	Lists complete and detailed set of materials; includes type, quantity and size.
Directions (List of steps in order of exactly what was done.)	Gives partial, confusing or non-sequential directions; or lacks enough detail to follow.	Gives most steps in the procedure; lacks proper sequence or enough detail to be followed.	Gives complete list of directions with detail such that the experiment could be duplicated by another.
Data Collection (Chart with the data that was measured in the experiment.)	Most data shown; some data missing, or not organized in chart form, or missing units or average.	Proper chart shown with complete data and average; some units or labels missing; or less than 10 trials done.	Proper chart shown with complete data and average; all units, labels, and detail present; 10 or more trials were done.
Graph (Mathematical picture of the data.)	Graph shown; some elements incomplete or inaccurate.	Proper graph shown; most elements complete and accurate.	Proper graph shown; all elements complete and accurate.
Results (Tells what happened in the experiment.)	Lists some results; some statements inaccurate or incomplete.	Lists most results; most statements accurate and complete.	Lists all results accurately and with detail.
Conclusion (Did the data support, or fail to support the hypothesis.)	Conclusion statement present but inaccurate or incomplete.	Conclusion statement present and accurate; but incomplete.	Accurately states whether the data supports or fails to support the hypothesis.
Real World Uses (Ways that the information might be used.)	States one or more uses; but incomplete, inaccurate, or lacks details.	States two possible uses with some detail; or more uses with incomplete detail.	States three or more possible uses with good detail.
Project Diary and Display (Presentation of the class process and project board.)	Some elements are missing, incomplete or inaccurate.	All elements present; most complete or accurate.	All elements present with good detail and few errors.