Science

Technology

Engineering

Mathematics

Inquiry Investigations Grades K - 5

Broward County Public Schools
Elementary Science Department

STEM Inquiry Investigations © 2012, Broward County Public Schools

The School Board of Broward County, Florida

Ann Murray, *Chair*

Laurie Rich Levinson, *Vice Chair*

Robin Bartleman

Maureen S. Dinnen

Patricia Good

Donna P. Korn

Katherine M. Leach

Nora Rupert

Benjamin J. Williams

Robert W. Runcie

Superintendent of Schools

The School Board of Broward County, Florida, prohibits any policy or procedure which results in discrimination on the basis of age, color, disability, gender identity, gender expression, national origin, marital status, race, religion, sex or sexual orientation. Individuals who wish to file a discrimination and/or harassment complaint may call the Executive Director, Benefits & EEO Compliance at 754-321-2150 or Teletype Machine (TTY) 754-321-2158.

Individuals with disabilities requesting accommodations under the Americans with Disabilities Act Amendments Act of 2008, (ADAAA) may call Equal Educational Opportunities (EEO) at 754-321-2150 or Teletype Machine (TTY)

© 2012, Broward County Public Schools

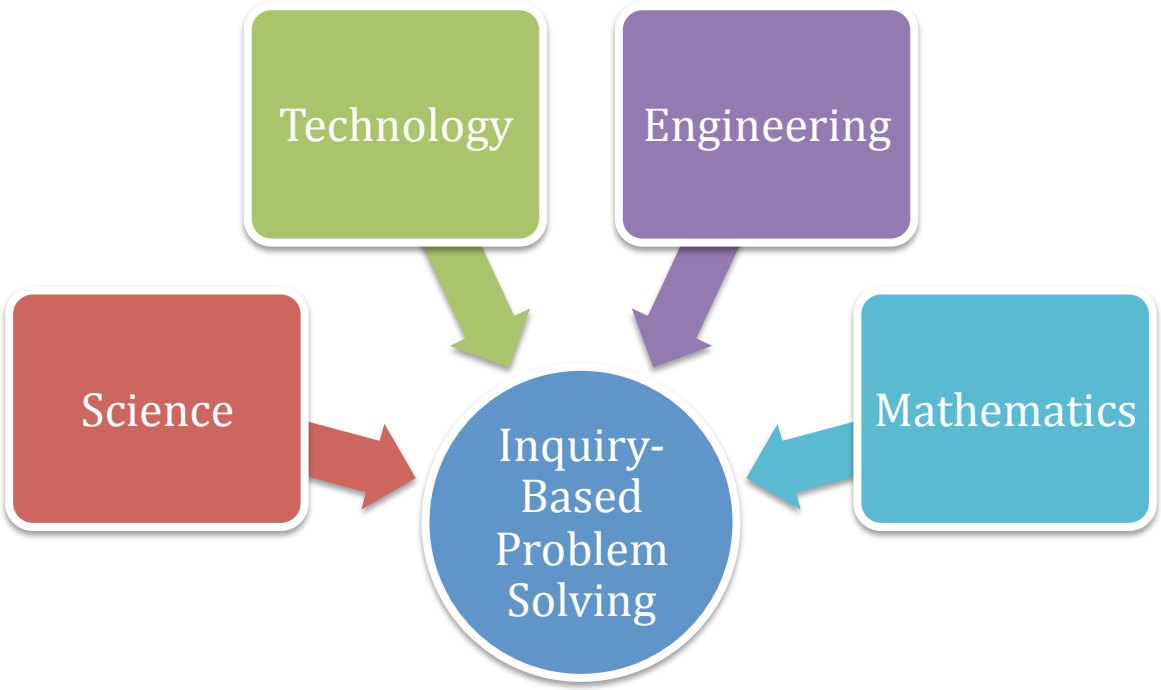
ACKNOWLEDGEMENTS

The STEM Inquiry Investigations Grades K-5 guide was prepared for use by teachers to support the development of inquiry-based problem-solving investigations at the elementary level.

This guide was created by the Elementary Science Department under the direction of Dr. Laura Saef, Science Curriculum Specialist, Broward County Public Schools. Sincere appreciation is extended to Dr. Lisa Milenkovic, Science Staff Developer, for her dedication to the development of this guide. If you have any questions, please contact the Science Department at 754-321-1866.

Table of Contents

District Elementary Academic Showcase
STEM INQUIRY INVESTIGATIONS



PHILOSOPHY

The District Elementary Academic Showcase gives schools the opportunity to display students' outstanding projects in all areas of the curricula, including Science, Technology, Engineering and Mathematics (STEM). Schools are highly encouraged to have a school-based science and engineering fair or STEM showcase.

Students at the elementary level must become literate and proficient in STEM areas in order to compete and survive in a rapidly changing, highly technical world. Teaching students how to solve problems using science and engineering techniques will help assure their future. Learning how to design an inquiry-based STEM investigation in the elementary level, and applying these techniques to solve science and engineering problems, gives students lifelong skills and will enable them to compete in state and national competitions in middle and high school. This preparation will also help students gain

knowledge and skills to prepare them for success in college and future careers.

Inquiry-based problem-solving investigations align to the Next Generation Sunshine State Science Standards (NGSSSS) in the Nature of Science Body of Knowledge Big Ideas as well as content area standards for the topic of the investigation. Concurrently, several Common Core State Standards for both Mathematics and English Language Arts & Literacy in History/Social Studies, Science and Technical Subjects are addressed in the completion and presentation of an inquiry investigation.

In order to prepare students for the future and to maintain high academic standards, it is strongly recommended that the procedures set forth in this booklet be followed. The examples included in this booklet and the supporting technology integration resources are appropriate across all elementary grade levels, primary and intermediate, with varying degrees of guidance and support depending on student ability.

All schools submitting *Inquiry Investigations* in school-based science and engineering fairs and in the District Elementary Academic Showcase are requested to comply with the rules and regulations set forth. These rules and regulations correlate with state recommendations.

INQUIRY INVESTIGATIONS

What is inquiry?

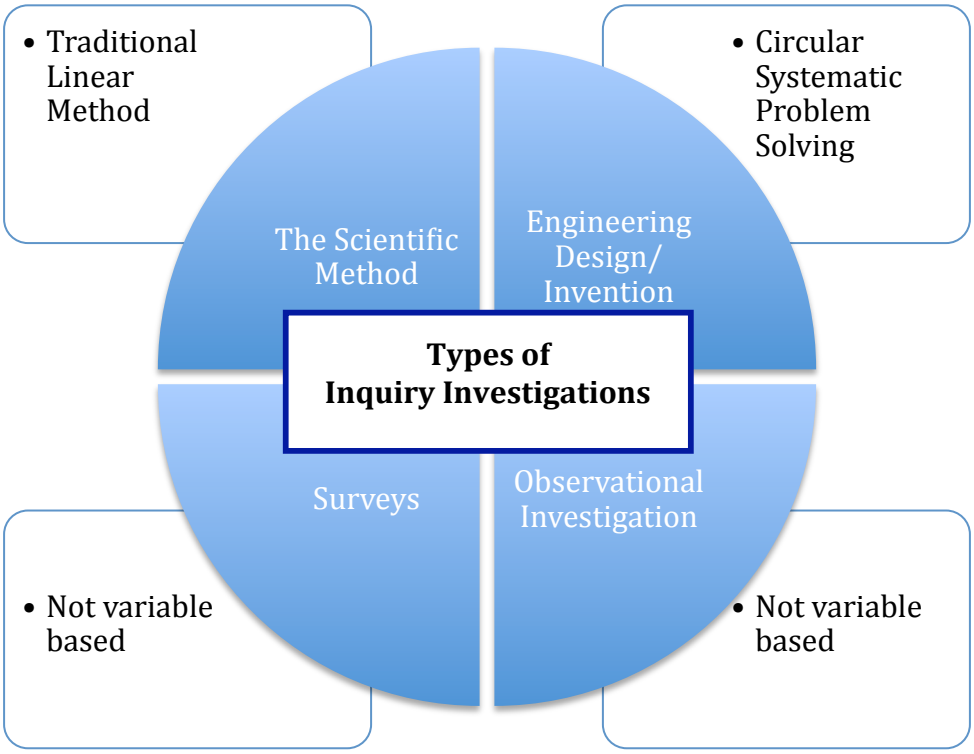
Inquiry is the process of asking questions and obtaining information to better understand a question or problem and potential solutions. Inquiry is the basis of all scientific investigations, embracing the wonder and curiosity to understand the world. This guide will provide students and their mentors (teachers, parents), consistent guidelines for conducting inquiry-based investigations.

What is different about an "Inquiry Investigation" and a "Science Fair Project"?

With the introduction of the Next Generation Sunshine State Standards for Science in 2008, it was recognized that there is more than one method of doing science and solving problems by conducting investigations. The District Elementary Academic Showcase is open to exploring the different methods of "doing science" through student-produced inquiry-based projects.

What are some types of inquiry investigation methods?

In the past, the District Elementary Academic Showcase projects were limited to investigations that followed the linear Scientific Method. Engineers and inventors also use inquiry-based methods to optimize a design to solve a problem. This engineering method is more circular, requiring steps to design, test, revise design and test again. Whether an investigation should use The Scientific Method or The Engineering Design Process depends on the question or problem that is being investigated. The flow chart in Appendix B provides further detail on the different approaches to inquiry.



How does a student select a project?

The ideal project investigates a real problem or question developed by the student. In order to find a topic for a project, students should first think of their hobbies and interests. Students should then think of questions or problems they have been curious about related to these interests. Searching the Internet for projects will yield multitudes of suggestions, but none will provide as great a learning experience as one that is truly student-driven. Appendix D of this document provides some of the many websites that provide guidance in project selection.

What parts should all projects have?

Scientists and engineers record the information they obtain when doing research and experiments as a record of everything that happened during the investigation for use in future investigations by themselves or others. Appendix B contains planning draft notebook templates for both The Scientific Method and Engineering Design projects. All inquiry-based investigations need to be recorded in the scientist's notebook. The notebook will contain all of the following information related to the inquiry investigation project:

TITLE

There is no specific way in which the title page of the project is to be written. Sometimes it is a declarative statement and sometimes it is in the form of a question. The student may be creative and come up with a catchy title. Sometime the title is conceived prior to conducting the investigation, but often times the title is not developed until after the completion of the investigation. Illustrating or decorating the title page is permissible and encouraged.

TABLE OF CONTENTS

The Table of Contents will need to be completed after the investigation. The Table of Contents should be placed in the notebook directly following the title page. All parts of the project should be included in the Table of Contents. Each section of the project should be assigned a separate page in the notebook.

VARIABLES

While engineering and invention projects inherently control variables, the use of variables must be identified and controlled in conducting investigations that follow The Scientific Method. At the elementary level, the experiment should have only one independent, or manipulated, variable. The experiment can have a few dependent variables (the responding variables that are observed or measured). There will be many controlled variables to establish a valid, fair test experiment. For example, in answering the problem statement, "Does fertilizer affect plant growth?" the variables are identified as follows:

Independent Variable – Fertilizer or no fertilizer
Dependent Variables – Quality of plant growth AND height of plant
Controlled Variables – Same amount of soil, sunlight, water, location where plants are kept, and size of pot would be some controlled variables.

A **control group** will need to be set up to validate the experimental procedure. In the example, the control group is a set of plants that are being treated normally and being watered, but not given the fertilizer that is being tested.

STATEMENT OF PROBLEM

The Statement of Problem tells what the project is going to solve or investigate. This should be stated in the form of a question in an inquiry-based project. For example, if a student wanted to test if all brands of bandages had the same amount of "stickiness" the title of the project might be "A Sticky Situation", and the Statement of the Problem could be "Do all bandage brands have the same amount of stickiness?" In an engineering type investigation, the Statement of Problem could be, "Does the design of a model bridge affect the mass of the load that the bridge can support?"

BACKGROUND INFORMATION

Students will need to research their chosen topic, and write a report addressing background information. Print and digital resources (for example, books, encyclopedias, computer programs, Internet sites, newspapers, magazines, interviews and information from organizations, institutions, or experts in the field) are resources that students can use to obtain needed information. Preparing an outline prior to writing the report gives the student an organized way of gathering and recording facts. Note taking strategies prevent copying word for word. The background provides detailed information about the topic. The more information obtained, the easier it will be to form hypotheses and to interpret results during and after the investigation.

Students may NOT include information directly printed from the Internet. All research must be written in the student's own words and cited properly. **Plagiarism will NOT be tolerated.**

The Scientific Method Problems

When using The Scientific Method, this section will be a hypothesis, which is a prediction based on prior knowledge about the problem. For an Engineering Design or Invention type of inquiry investigation, this section will specify the requirements of the design that will be tested.

Hypotheses can be stated using the frame “If …, then …., because ….” Such as “If I use a magnet to pick up objects, then only those objects that contain iron will be attracted to magnets, because based on my research, magnets contain iron.” An alternative frame is “I predict … because …”, such as, “I predict that magnets will attract only those objects that have iron in them because my research indicates that magnets are attracted to iron.”

Engineering Design/Invention Problems

When completing an Engineering Design/Invention Problem project, this section will instead reflect the requirements for the design. The "Requirements of Design" section should include detailed specifications of the design that will be tested in the engineering or invention project. This would be a perfect place to use a labeled diagram with measurements indicating the initial design that will be tested. This is also where the specific requirements should be stated. For example, “The model bridge will be designed to support a load of at least 500 g.” An engineering design will most likely have several design requirements to include in this section. At this stage in the project you should also include several alternative solutions to the engineering problem that you considered before developing the design you will test initially. These alternatives might prove useful for modifications and redesign should your initial design testing results not meet the requirements.

MATERIALS

Make a list of all the materials needed to conduct the investigation (or build and test a prototype in an engineering project). Try to use inexpensive, readily available materials. Have teachers or parents approve of these materials before using them in the investigation. Include the quantity needed (in metric units as applicable). Be sure to include enough materials for all trials and write the materials as a list (similar to the format for ingredients in a typical recipe). For example:

12 small (4-ounce/120-mL) paper cups
45 mL (3 tablespoons) of water

PROCEDURE

In this section you will include the steps necessary for carrying out the investigation or testing the engineering design. The procedure is a step-by-step set of directions on how to do the experiment. This is like the directions in a recipe. It must be written in such a way that the person doing the experiment will know exactly what to do to be able to get the same results. Write down what is done first, second, etc. Be sure that the directions are listed in a clear and sequential manner.

The student should design an investigation that will fulfill the purpose of the project – to either test the hypothesis or test the engineering design. During the investigation, comparisons are necessary. Take care to have adequate controls – vital in both types of projects. That is, keep conditions the same, whenever possible, and make note of any conditions that cannot be controlled.

For example, if experimenting with fertilizers to determine their effect on plant growth, the following is an example of a procedure you could follow:

1. Place six of the same kind of plants in an area in your house or class so that all the plants receive the same amount of light.
2. Water each plant with the 150 mL of water.
3. Add 5 g of fertilizer to each of the three test plants.

4. Leave the other three plants unfertilized. This is the **CONTROL GROUP.**

Type of plant, water and light are some of the controls in this experiment example. The fertilizer is the independent variable, the one part of the experiment that is changed between the two plant groups. The **control group** is used to assure that the experimental conditions are favorable for plant growth.

In all inquiry investigations, a good experimental design only tests one variable at a time. A journal should be used to record the data from the investigation. Data tables are an excellent way to record data in a clear, concise manner.

When setting up an investigation, make sure to do the following:

- Have all materials ready.
- Follow the procedures as written with each trial.
- Record the data in a table, chart, log or observation sheet.

REMEMBER: In order for the investigation to be meaningful, the investigation should be repeated at least three times. This is true for both The Scientific Method and Engineering/Invention Design inquiry investigations.

DATA

Data is the name given to the qualitative and quantitative information obtained during the investigation. The way in which data is recorded is very important. Record the data using charts, tables, logs, photographs, written observations, or anecdotal records. The more data there is, the more accurate the conclusion will be. Doing an investigation just one time does not give sufficient information (evidence) to draw a conclusion. This is why multiple trials are necessary (a minimum of three trials).

After collecting data, present the data in a visual manner using graphs and diagrams. The visual representation will assist you in developing a strong conclusion.

ENGINEERING DESIGN IMPROVEMENT AND RE-TEST

In an engineering investigation, consider the data collected and revise the design, as needed based comparison of the data to the specified "Requirements of Design". The notebook is very important. Do not forget to record any changes made to the design and record the data from the additional tests. Continue this process of revising and testing until the minimum design requirements are met or no further changes and tests are possible.

CONCLUSION

Once the data has been analyzed, a conclusion can be written. In the conclusion, the project is summarized and evidence is given to support or reject the original hypothesis or design requirements. If the data collected does not support the hypothesis or the design requirements are not met, the student should not consider the investigation a failure. Part of the conclusion would be to try to explain why the data did not support the hypothesis or why the design requirements were not met.

RECOMMENDATIONS

This section should include recommendations to be followed if this investigation was to be reproduced or studied further. If this investigation were to be done again, what should be done differently? What new ideas have come from this project? Did the investigation need more trials? Should the study be continued (Example: same study, year two or investigating a revised problem based on the outcome of this investigation)?

APPLICATIONS

Based on the background research and the reason for selecting the project, summarize how the project can be used in everyday life. Include how others may use what was learned in the investigation.

ACKNOWLEDGEMENTS

This part of the project gives the student the opportunity to thank all of the people who helped with the project. The student should state what the person did to help with the project. No proper names should be used here that would identify the researcher. For example, use "My mother" instead of "Mrs. Smith", or "My teacher" instead of "Mrs. Droplet."

BIBLIOGRAPHY

This portion of the project lists all of the resources that were used to gather information about the topic. These resources are written in an organized manner. Below is a sample of the types of bibliography that are needed for a specific type of reference. A website, such as http://www.bibme.org/ can be used to help format the references.

If more than one resource is used, they must be listed in alphabetical order according to author's last name.

MOVIE, FILM, VIDEO

"Title", Series name if known, Publisher, City, Copyright Date.

ENCYCLOPEDIA

"Title of Article", Name of Encyclopedia, Volume Number, Publisher, City Published, Copyright Date, Page Numbers.

ONLINE ENCYCLOPEDIA

Author. "Title of Article". Title of Reference Work. Title of the Database or Online Service. Date of Access.

JOURNAL

Author's Last Name, Author's First Name. Journal Title, Title of Article, Volume, Page Numbers, Publisher, City Published,

Date, (If the journal is only about one topic, do not add page numbers).

BOOK / PAMPHLET

Author's Last Name, Author's First Name. Book/Pamphlet Title, Volume, Page Numbers, Publisher, City Published, Date, (if the book/pamphlet is only about one topic, do not add page numbers). If the book/pamphlet is about many topics, add page numbers after the date.

INTERVIEW

Name of person (last, first), Title of person, Company the person works for or what the person does, Where the interview took place, Date of interview.

INTERNET WEBSITE

Author (if known), "Title of page or document". Title of site or larger work. (if applicable). Date of document. Online http:// URL. Retrieved on date of access.

E-MAIL

Author of e-mail message. "Subject line of message". E-mail to recipient's name. Date of message.

What should be displayed?

While there are many creative ways to communicate the results of inquiry investigations (see Appendix D for resources), in order to participate in the District Elementary Academic Showcase, the project needs to be a freestanding display. The display is an organized and creative way of showing the work that was done on the project. The display contains a summary of the process steps outlined above. Each section should be clearly labeled and included on the board. The display is the advertisement for the project and is the main means to communicate the results of the investigation; therefore it

should be colorful, neat and attractive. Include picture, pamphlets, letters, and anything else in addition to the parts of the project that are included in the notebook. Even though the display may seem to be a copy of what is in the notebook, keep in mind that the notebook can be saved and easily stored. The display board will be viewed by many people and then may be recycled for other projects.

It is highly recommended that showboards be used to display projects. These showboards are available in many supermarkets, office supply store, and art stores. Poster board or any other material that is not strong enough for the project to be freestanding may not be used. Wood, pegboard, cardboard boxes and masonite are all acceptable materials from which a display board maybe constructed.

INDIVIDUAL PROJECT MUST NOT BE BIGGER THAN 24" WIDE, 30" DEEP, AND 48" HIGH. THEY MAY BE SMALLER.

Do class projects have special guidelines?

Class projects must have evidence that the total class participated in the project. It is highly encouraged that cooperative learning strategies be used. Cooperative groups can be assigned to research certain areas of the topic chosen. The total research paper can be included in the notebook and a summary of each group's research can be displayed. Each group can record its team's hypothesis. This hypothesis can be added to the display board. Each group can be given a part of the project to do. One group would write the materials on a large chart for the class to observe. One group would prepare the materials list for the display board. Similar division of work could be for the other parts of the project.

An engineering design project could have one problem and each group developing their own solution to test, regrouping to compare results and revise designs. With a scientific method project each group could do the experiment, record data, and write conclusions. Each group's work would be included in the notebook and on the display board. The students in the class should complete the display board.

CLASS PROJECTS MUST BE NO BIGGER THAN 30" WIDE, 30" DEEP, 48" HIGH. THEY MAY BE SMALLER.

What should be considered with primary vs. intermediate students?

Teaching science process skills is a major emphasis in the elementary grades. Inquiry investigations are excellent opportunities to learn and apply these skills. Primary students might require guidance and scaffolding of support prior to conducting independent inquiry investigations. Writing frames can be used to model the various steps of the process using the Planning Draft Templates provided in Appendix B for guidance.

It is highly recommended that investigations of various types be modeled prior to expecting students to complete investigations independently.

RULES AND REGULATIONS

These rules and regulations, which are adapted from the State and National Science Fair Rules, must be followed to ensure everyone's safety. These rules and regulations apply to all grade levels. Teachers, parents, and students should be given a copy of these rules and regulations **PRIOR** to beginning their project. Only those projects that comply with these standards should be selected for entry into the District Elementary Academic Showcase. It is the responsibility of the entrant's teacher, parent, and school contact person to insure that all projects exhibited follow the rules and regulations set forth in this booklet.

WHO SELECTS PROJECTS TO BE DISPLAYED?

The school will be responsible for selecting projects to be displayed. It is recommended that the judging criteria in this booklet be used to select projects.

WHAT TYPES OF PROJECTS CAN BE DISPLAYED?

Class projects, individual projects, and cooperative group projects may be displayed.

HOW MANY PROJECTS MAY A SCHOOL SUBMIT?

Each school will be given one table on which to display projects. An additional table may be requested. The tables are 2 ½ x 8 feet. Six project boards can be neatly and attractively displayed.

WHAT ITEMS MAY NOT BE DISPLAYED?

Chemicals, rubber bands, noxious gases, glass containers, open flames, liquids, foods, explosives, animals, plants, sharp and/or pointed objects, and drugs may not be displayed.

ANIMAL RELATED PROJECTS

The study of animals by elementary school students under qualified adult supervision is both necessary and important for learning about the life sciences and for encouraging an interest in careers related to the life sciences. Animal projects MUST include a concern for the humane and proper treatment of all animals. Elementary school students may only use animals in **OBSERVATION** types of projects**.** For example, to investigate the question "Which color feeder attracts birds the most?", students may hang different colored bird feeders in the yard and observe which feeder birds are attracted to the most. Observing the sleeping, eating and playing habits of hamsters and other pets are other examples of animal **observation** projects that students may do.

ALL ANIMAL RELATED PROJECTS MUST HAVE A VERTEBRATE ANIMAL VERIFICATION FORM (APPENDIX A). This form will need to be kept on file by the parent and teacher. It will be necessary to attach this form to the project if it is displayed in the District Elementary Academic Showcase.

Any project that has an animal theme to it or anything at all to do with vertebrate animals must be approved **PRIOR** to doing the investigation. A verification form must be signed and included in the project notebook and attached to the project board. It is the responsibility of the school and parent to insure against inhumane treatment of animals. All vertebrate animal projects must have a signed verification form. The following **Florida State Animal Law must be followed:**

ELEMENTARY STUDENTS MAY **NOT** DO A PROJECT WHICH CAUSES PHYSICAL OR PSYCHOLOGICAL STRESS TO VERTEBRATE ANIMALS. NO PROJECT MAY BE DONE WHICH MANIPULATES THE BASIC NEEDS OF ANIMALS, SUCH AS FOOD, SHELTER AND WATER.

For example: Fish cannot be removed from water even for a short period of time. The temperature of the fish tank or container cannot be drastically increased or decreased. In other words, the water

cannot be frozen, boiled, or changed in any way to cause stress to the fish. Animal dissections are not permitted.

ANY PROJECT THAT DOES NOT FOLLOW THE FLORIDA ANIMAL LAW WILL NOT BE DISPLAYED.

The Animal Verification Form is included in Appendix A of this booklet.

HUMAN SUBJECT EXPERIMENTATION AND SURVEYS

Experiments with human subjects will be permitted provided that the human subjects are **not subjected to any physiological or psychological stress. The human subject verification form must be completed prior to initiation of the project and must be attached to the project notebook or project board.**

Surveys are acceptable providing they follow these guidelines:

** No personal questions that involve invasion of privacy are acceptable.

** Permission slips signed by parents are required for those students who participate in surveys related to the tasting of foods and/or drinks.

The Human Subject Verification Form is included in Appendix A of this booklet.

ARCHAEOLOGICAL EXCAVATIONS

Exhibits involving archeological excavation must be supervised by a qualified adult and will not be accepted if such exhibits show evidence of unsupervised excavation. A written statement of approval should accompany such project.

If you have any doubt or questions about any of these guidelines, please contact the science department at 754-321-1866.

APPENDIX A:

ANIMAL/HUMAN VERIFICATION FORM

VERTEBRATE ANIMAL VERIFICATION FORM

THIS FORM MUST BE COMPLETED FOR ALL RESEARCH INVOLVING VERTEBRATE ANIMALS PRIOR TO THE INITITATION OF THE PROJECT. NO PROJECT MAY BE DONE WHICH MANIPULATES THE BASIC NEEDS OF ANIMALS SUCH AS FOOD, SHELTER, AND WATER, SO AS TO CAUSE STRESS.

Any project involving vertebrate animals must have the approval of the school's science fair contact person, parental consent and supervision.

(*Print or type)*

Student: _____

School: _____

Date: _____

Brief Description: _____

_____

I, _____
(Student Signature)

do state that I have complied with the Florida State Statutes – Chapter 85-70, which prohibits projects involving experimentation, which results in physical or psychological stress to vertebrate animals.

APPROVED:

_____
(Science Fair Contact Person)

_____
(Teacher)

_____
(Parent Signature)

THIS FORM WILL NEED TO BE KEPT ON FILE BY THE PARENT AND TEACHER. IT WILL BE NECESSARY TO ATTACH THIS FORM TO THE PROJECT IF IT IS SELECTED BY THE SCHOOL FOR DISPLAY IN THE ELEMENTARY ACADEMIC FAIR.

HUMAN SUBJECT VERIFICATION FORM

THIS FORM MUST BE COMPLETED FOR ALL RESEARCH INVOLVING HUMANS PRIOR TO THE INITITATION OF THE PROJECT. ANY PROJECT INVOLVING TASTING OR DRINKING OF FOODS MUST HAVE A SIGNED PERMISSION SLIP FROM THE PARENT OF THE STUDENTS PARTICIPATING INDICATING THAT THE PARTICIPANT IS NOT ALLERGIC TO THE FOODS BEING SURVEYED. SURVEYS THAT REQUIRE QUESTIONS THAT INVADE PERSONAL PRIVACY ARE NOT ACCEPTABLE.

Any project involving human subjects must have the approval of the school's science fair contact person, parental consent and supervision.

(*Print or type)*

Student: _____

School: _____

Date: _____

Brief Description of the Project: _____

_____

I, _____
(Student Signature)

state that no stress, physical or psychological harm will occur to human subjects participating in my project.

APPROVED:

_____
(Science Fair Contact Person)

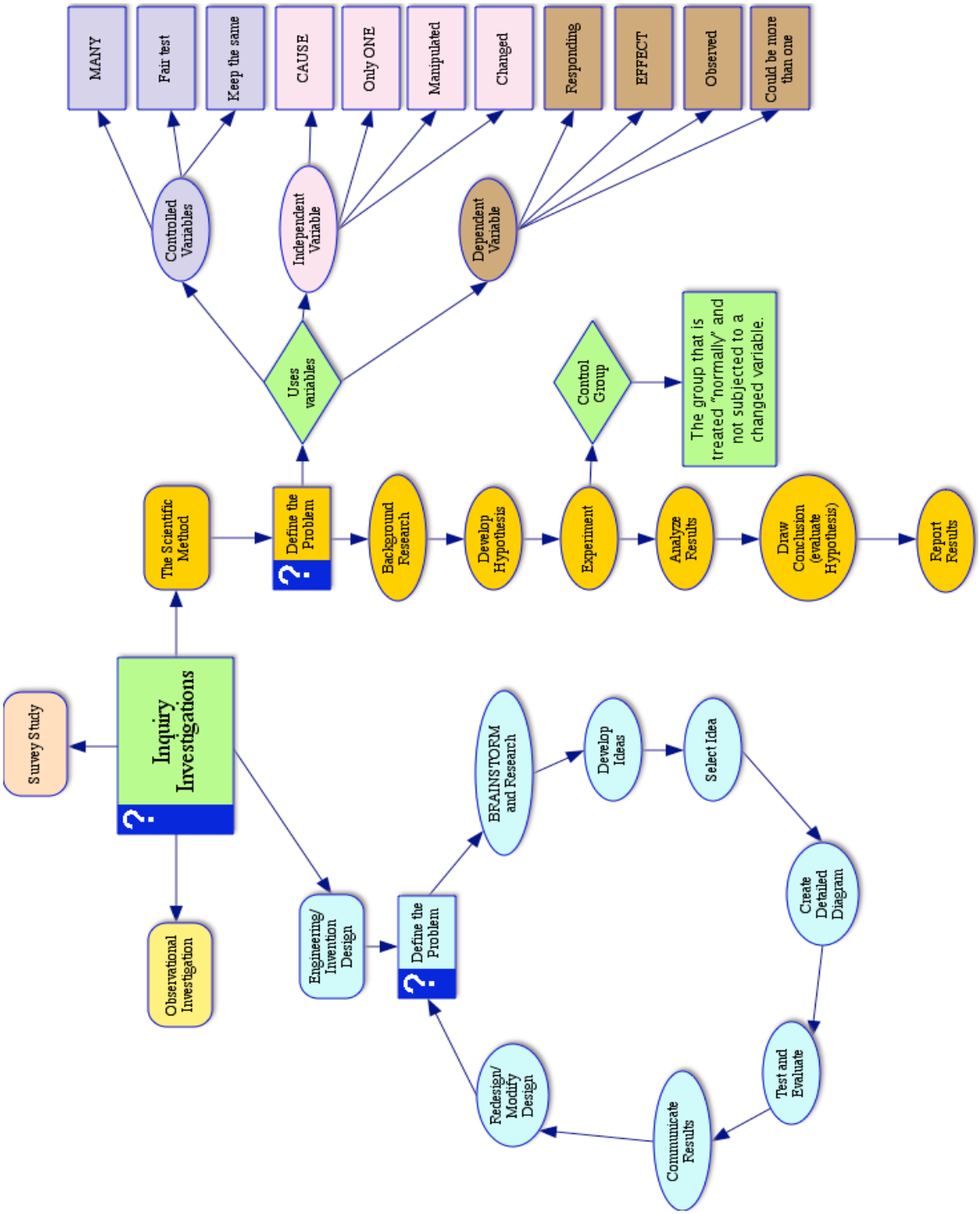
_____
(Teacher)

_____
(Parent Signature)

THIS FORM WILL NEED TO BE KEPT ON FILE BY THE PARENT AND TEACHER. IT WILL BE NECESSARY TO ATTACH THIS FORM TO THE PROJECT IF IT IS SELECTED BY THE SCHOOL FOR DISPLAY IN THE ELEMENTARY ACADEMIC FAIR.

APPENDIX B: PLANNING DRAFT TEMPLATES

(The Scientific Method and Engineering Design Process)



STEM Inquiry Investigations © 2012, Broward County Public Schools

Name: _____ Teacher/Number_____

Engineering Method Inquiry Investigation Planning/Rough Draft

Problem / Engineering Requirements: List detailed requirements of the design:

Background: What I know about this topic and problem already – Note that this is completed before doing the experiment, from prior knowledge or from research (include research sources in bibliography and attach additional pages as necessary):

Brainstorm: List possible solutions to the problem – include labeled sketches and diagrams:

Selected Idea: Describe selected idea and reason for selecting design – include a detailed diagram:

Materials: List of materials I need to build my model/prototype (in a list, include quantities and use the metric system):

Procedure: List the detailed the step-by-step directions to build AND test the model/prototype (Written in the order performed)

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Data – Create a useful table to record all data, also include photographs, including any measurements and observations from design testing and note all design changes (revisions/improvements) – For example:

Title: _____

Design Test	*Observations and measurements*		
Trial	1	2	3

Graph: If possible, Graph – Create a graph based on the data with Design Test on the x-axis and measurements on the y-axis. (Title the graph and label both axes.)

Results – What happened? Summarize results of the design test. Did anything go wrong or did anything unexpected happen when testing the first design? Did you meet the requirements of the original problem?

Revisions: Revise the design – Describe changes you made to improve the design, why you made the changes and how the changes affected your solving the design challenge. Include additional diagrams, if necessary to explain your changes.

Conclusion – Based on the results, what was the best design solution? Compare your results to the project engineering requirements. Did the final design meet expectations? Did your design exceed expectations? Why or why not?

Application: How can this be used in everyday life? Think about why you were interested in the topic to begin with. How others use what I learned:

Acknowledgements: Thank you to those who helped with my project

Bibliography: List books, journals, periodicals – all specific resources used – google.com and the like are search engines NOT resources – give specific websites used – use the bibliography guide in the booklet

Abstract: A summary in one page or less explaining what was done and the results and conclusion:

Name: _____ Teacher/Number_____

Scientific Method Inquiry Investigation Planning/Rough Draft

Topic (main idea/area of science): _____

Brainstorm Variables – A list of things I can change to investigate a problem having to do with this topic:

I will change (**independent variable**): _____

I will measure or observe **(dependent variable(s)):** _____

I will keep these things the same to have a controlled experiment and a fair test **(controlled variables):**

My **problem statement:** The problem statement is a question that I will answer with my experiment and must include a reference to both the independent and dependent variables:

Background: What I know about this topic and problem already – Note that this is completed before doing the experiment, from prior knowledge or from research (include research sources in bibliography and attach additional pages as necessary):

My hypothesis – A prediction based on what I know and what I think will happen. You must include a reason for why you think this way and include the variables as in the problem statement.

Materials: List of materials I need to complete my experiment (in a list, include quantities and use the metric system):

_____

_____

_____

_____

_____

_____

_____

Procedure: A list of the detailed step-by-step directions to perform the experiment, in the order I will perform them:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

Trials (How many times I will repeat the experiment) – <u>minimum</u> of 3: _____

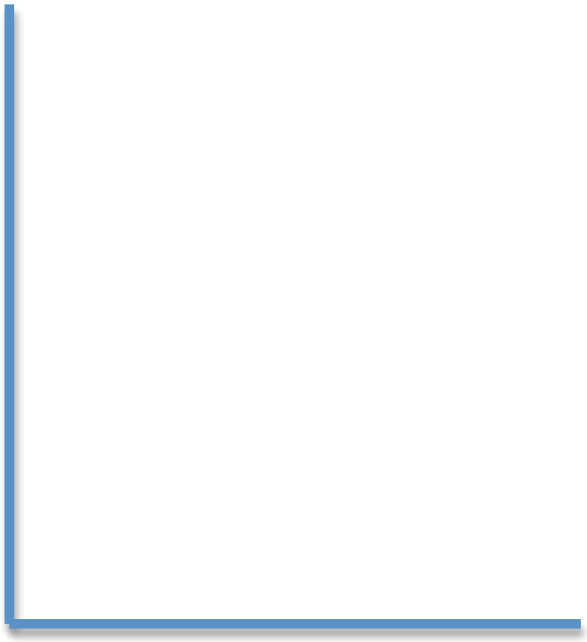
Data – A useful table to record all my data – measurements and observations. Also take photographs and record notes and observations – For example:

TITLE: _____

Independent variable	*Dependent Variable*		
Trial	1	2	3

Graph – A graph based on my data (independent variable on the x-axis and dependent variable on the y-axis). Do not forget to label axes and title the graph.

TITLE:



Results – What happened (summarize results)? Did anything go wrong or did anything unexpected happen when doing the experiment?

Conclusion – Based on results, what I found out as the answer to my question. Compare results to the hypothesis. Did the experiment support the hypothesis? Why or why not?

Applications: How can this be used in everyday life? Think about why you were interested in the topic to begin with. How others use what I learned:

Acknowledgements: Thank you to those who helped with my project

Bibliography: List books, journals, periodicals – all specific resources used – google.com and the like are search engines NOT resources – give specific websites used – use the bibliography guide in the booklet for a suggested format:

Abstract: A summary in one page or less explaining what was done and the results and conclusion:

APPENDIX C:

SAMPLE RUBRIC

STEM Inquiry Investigations © 2012, Broward County Public Schools

Sample Inquiry Investigation Rubric

Project Title: _____

Project Category: _____

Project Number: _____

Criteria: **POINTS**

SCIENTIFIC THOUGHT (30 POINTS) _____

Is the problem concisely stated?
Are the variables clearly and correctly identified?
Are the procedures appropriate and thorough?
Is the information collected complete?

CREATIVITY (30 POINTS) _____

How unique is the investigation?
Is it significant and unusual for the age of the student?
Does the investigation show ideas arrived by the student?

UNDERSTANDING (10 POINTS) _____

What did the student learn about the investigation?
Did the student use appropriate resources for research?
Did the student include authentic applications of the investigation?

CLARITY (10 POINTS) _____

Are the investigation procedures, data and conclusions presented logically?
Can non-scientists understand the objective?
Is the written material clear and articulate?
Is the project appropriately summarized in the abstract?

DRAMATIC VALUE (10 POINTS) _____

How well did the student present the project?
Is the presentation visually appealing?
Is proper emphasis given to important ideas?

TECHNICAL SKILL (10 POINTS) _____

Was the majority of the work done by the student?
Does the written material show attention to grammar and spelling?

APPENDIX D:

RESOURCES FOR PROJECT IDEAS

AND

COMMUNICATING RESULTS

STEM Inquiry Investigations © 2012, Broward County Public Schools

APPENDIX D
Resources for Projects and Presentations

For an up-to-date list of resources, visit the Elementary Science Wiki at
http://elementaryscience.pds-hrd.wikispaces.net/Web+Presentation+Tools

PROJECT IDEAS

Florida Science Fusion – Teacher Resource Bank, available in Online Textbooks on BEEP for every grade level, has resources for participating in a school science fair with editable documents and a letter home.

Science Buddies
http://www.sciencebuddies.org/
The award-winning, non-profit Science Buddies empowers K-12 students, parents, and teachers to quickly and easily find free project ideas and help in all areas of science from physics to food science and music to microbiology. Whether your goal is to find a fun science activity for your kids or win the international science fair, sciencebuddies.org puts comprehensive, scientist-authored tools, tips, and techniques at your fingertips.

Kids' Science Challenge: Fun Educational National Competition!
*http://www.**kidssciencechallenge.com**/*
The Kids' Science Challenge is a nationwide competition for 3rd to 6th graders to submit experiments and problems for REAL scientists and engineers to solve.

ExploraVision
*http://www.**exploravision**.org/*
The Toshiba/NSTA *ExploraVision* Awards program is designed to encourage students to combine their imagination with their knowledge of science and

Search, Collect, and Share | *SMILE*
http://howtosmile.org/
SMILE Pathway – Search, Collect, and Share! Find fun, high-quality STEM informal learning activities from science centers and museums from across the US**.**

What Is BKFK For Kids | *BKFK*
http://*www.**bkfk**.com*
What is BKFK? *BKFK* is entirely dedicated to inspiring the inventive spirit within every young inventor, innovator and entrepreneur.

Invent Now
*http://www.**invent**.org/*
Celebrates inventors, and has indexes of inventors with brief biographies, and an index of inventions so you can find out who is credited with which *invention.* Request Free Invention Kits from Leading Invention Companies Now!

AWIM
*http://www.**awim**.org/*
The development and distribution of the Fuel Cell and the Gravity Cruiser- *AWIM's* newest challenges are the result of GM's funding

BUILDING BIG: *Bridge Basics*
*http://www.pbs.org/wgbh/**building**big/**bridge**/**basics**.html*
Review of how the forces act on different types of *bridges*. Includes photos of real *bridges*.

Cargo Bridge - Play it now at *Coolmath*-Games.com
*http://www.**coolmath**-games.com/0-**cargo-bridge**/index.html*
Cargo Bridge at *Cool Math* Games: A great bridge building game that will really test your construction skills. Build a bridge so that the workers can gather cargo **.**

DESIGN SQUAD NATION . Home | PBS KIDS GO!
http://*pbskids.org/**designsquad**/*
Try engineering and science activities or compete in contests on *DESIGN SQUAD* NATION's educational website for kids. Read a blog from real engineers.

DragonflyTV . Home Page | PBS KIDS GO!
http://*pbskids.org/**dragonflytv**/*
Depicts kids getting interactive, energy-packed opportunities to do real science activities, based on Twin Cities Public *Television's* new science series

PRESENTATING RESULTS

Edmodo.com
http://edmodo.com
Edmodo.com is a private, social network for your classroom. Students can share results and much, much more, using Edmodo.

Create a graph
http://nces.ed.gov/nceskids/createagraph/
An online graph creator from the U.S. Department of Education

Prezi.com.
http://prezi.com/
Make your presentations zoom.

Popplet | Collect, curate and share your ideas, inspirations, and ...

http://popplet.com/
Popplet is an app for the web and iPad, where you can collect, curate and share your ideas, inspirations, and projects

***Make Beliefs Comix*! Online Educational Comic Generator for Kids of All Ages**

http://www.makebeliefscomix.com/
Make your own comic strip.