HILLSBOROUGH ELEMENTARY SCHOOL

STEM FAIR 2017

April 21, 2017

Science, **T**echnology, **E**ngineering, and **M**athematics

Providing an opportunity for students to utilize science knowledge and skills as scientists do in the real world.

Research Plan and Investigation Workbook

Student Name: _____

Teacher: _____

Background Information

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Providing students opportunities to make meaningful connections to the real world is critical as we develop the skills, behaviors, and dispositions necessary for college, career, and life readiness. Developing a S.T.E.M (Science, Technology, Engineering, and Mathematics) Fair investigation will provide students the opportunity to use science knowledge and skills just as scientists, engineers and mathematicians do in the real world. The STEM Fair will provide opportunities to engage in connecting these college, career, and life skills in many ways such as writing clearly, communicating information effectively, collecting and interpreting data, using evidence to justify their thinking, managing time, and providing opportunities to ask "why" leading to the development of an experiment or designing of a solution/innovation.

The information found in this *Elementary STEM Fair Research Workbook* will provide guidance and support in developing the project. Throughout the document there are explanations and clarifications to help better guide student thinking. Students <u>are not required</u> to complete *this workbook.*

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STEM Project Plan

Talk to your parents or teacher if you have questions.

Student Name: _____

Title of Project: _____

Grade/Teacher: _____

Category (see page 3 for clarification):

Physics: _____ Earth/Space: _____ Life Science: _____

Chemistry: _____ Engineering: _____ Math/Technology: _____

What is the question you are trying to answer OR the problem you are trying to solve?

Will you be using the Scientific Method OR the Engineering Process? (Hint – Most projects will follow the Scientific Method, but if the objective of your project is to invent a new product, experience, or environment, then it makes sense to follow the Engineering Design Process.)

What materials will you need for your experiment OR prototype?

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Categories

Choose a specific topic of real interest to you. **What types of things do you enjoy in science? There are 6 different STEM categories your idea may fit into.** If you need help finding ideas for an experiment visit the library. They have books dedicated to Science Fair Experiments. There is also a wealth of information on the Internet. Visit the following website for ideas: http://www.sciencebuddies.org/

- **Physics:** Do you find yourself wondering why or how things work? If so then you might want to choose Physics for your category. Topic examples may include things about matter, electricity, magnetism, sound, light, or energy.

- **Earth and Space**: Do you find yourself curious about our Earth or outer space? If so then this may be the category for you. Topic examples may include things about weather, geology, rocks, fossils or volcanoes, or our sun, stars and planets. (Just a reminder, a model is not an experiment, so be careful when thinking about your investigation. This means no volcano or solar system models.)

- **Life Science:** Do you like plants, animals or are curious about why humans behave certain ways? If so then Life Science may be the category your investigation could fall under. (Please talk to your parents to ensure animals are not harmed).

- **Chemistry:** Are you interested in how chemicals react? There is chemistry in cooking, or you can make various solutions. Topic examples may include: crystal creations, bubbles, rust, baking soda and vinegar, and other chemical reactions. (Make sure to have parental supervision and use eye protection.)

- **Engineering:** Do you have a problem you want to solve? Do you want to design or create an innovative solution? Examples include: How can I prevent children from getting into kitchen cupboards? Which building design best withstands an earthquake? Can you build a Robot arm out of straws or Legos?

- **Math/Technology:** Are you interested in math, probability, or technology? Topic examples may include: dice probability, statistics of M&M's, or how font style picture formats change the file size. What search terms or search engine finds the best results on a computer? How fast is your computer in solving math problems? Can you write a program to solve a problem?

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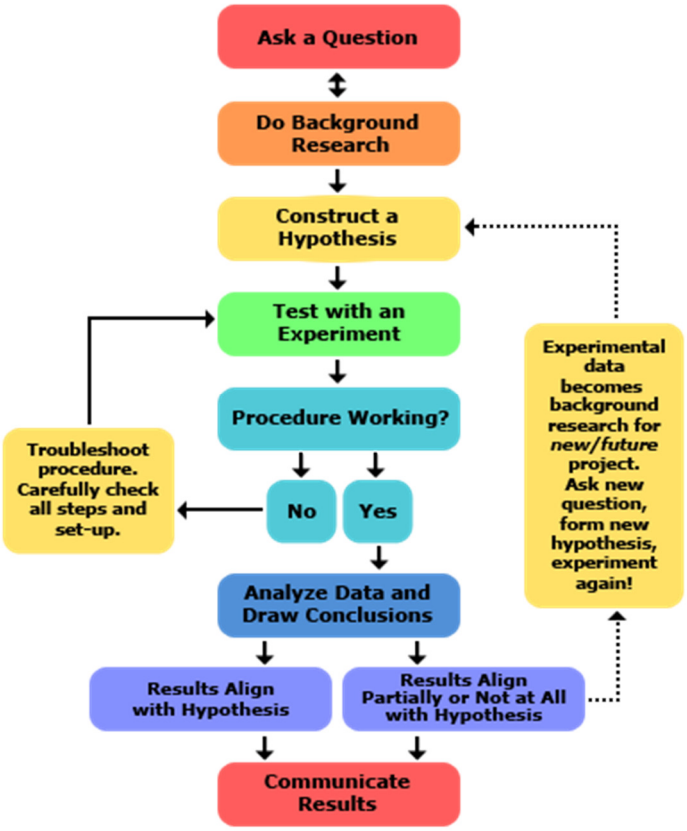
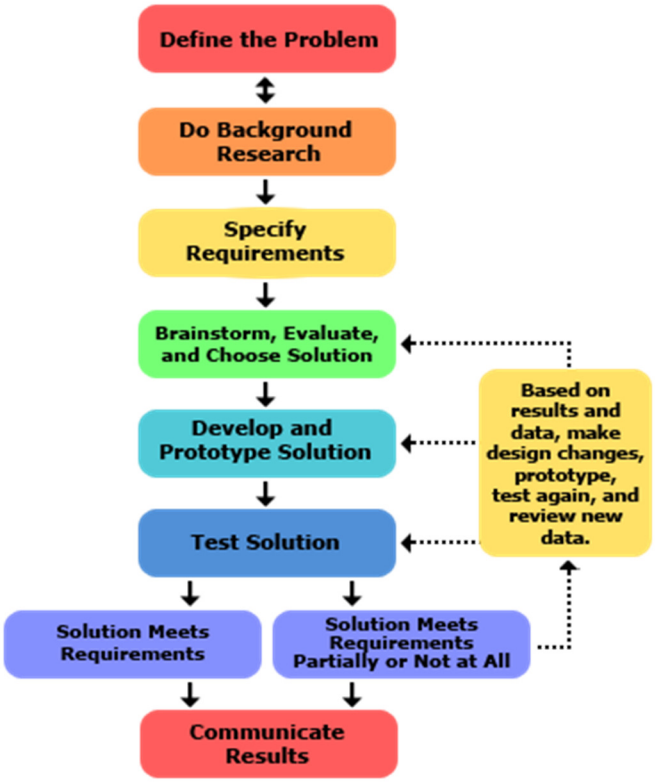
Scientific Method Compared to the Engineering Process

The Scientific Method	The Engineering Design Process
State your question	Define the problem
Do background research	Do background research
Formulate your hypothesis, identify variables	Specify requirements
Design experiment, establish procedure	Create alternative solutions, choose the best one and develop it
Test your hypothesis by doing an experiment	Build a prototype
Analyze your results and draw conclusions	Test and redesign as necessary
Communicate results	Communicate results
Steps of The Scientific Method	Steps of The Engineering Design Process

Scientific Method



Engineering Method



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Question I am Answering OR Problem I am Trying to Solve

STEP 1 – Scientific Question OR Define the Engineering Problem

Once a category has been chosen begin to think about what type of question you are going to answer OR type of problem you are going to solve.

Example(s):

- *Science Question I am going to answer:* "Which brand of diaper is the most absorbent?" This is a good question which would allow students to go through the scientific process manipulating only one variable; the type of diaper.

The Effect Question:

What is the effect of _____ on _____?

sunlight	on the growth of plants
eye color	pupil dialation
brands of soda	a piece of meat
temperature	the size of a balloon
oil	a ramp

The How Does Affect Question:

How does the _____ affect _____?

color of light	the growth of plants
humidity	the growth of fungi
color of a material	its absorption of heat

The Which/What and Verb Question

Which/What _____ (verb) _____?

paper towel	is	most absorbent
foods	do	meal worms prefer
detergent	makes	the most bubbles
paper towel	is	strongest
peanut butter	tastes	the best

- *Engineering Problem I am going to solve:* "How can I prevent children from getting into cabinets where there are chemicals? This problem would allow the student to design a solution and test its effectiveness.

My question I am going to answer OR problem I am going to solve:

_____

Research to Help Support Your Investigation

STEP 2 – Do Background Research

After choosing your investigation category and asking a question or defining the problem, it is important to complete some research to better understand what your investigation is about. How do you complete research? You need to read! The information you gather while completing your research will assist in developing your prediction, designing your experiment or prototype (if applicable), collecting data, drawing conclusions, and communicating like a real scientist or engineer. Make sure to include at least the title, author, and date published or accessed.

Books or Articles about my topic:

Internet Websites about my topic:

People I talked to about my topic:

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Prediction OR Specify Requirements

STEP 3 – Scientific Prediction (Identify Variables & Materials) OR Specify Engineering Requirements

The purpose of creating your prediction is to identify what you think will happen based on research that was collected. The prediction needs to be worded as an "If… then…because" statement explaining the cause and effect relationship that is being investigated. Evidence from your research needs to be used to support and justify your thinking.

- *Science question I am going to answer:* **If** I put 30mL of water in the Huggies diaper, **then** it will absorb the most water **because** Huggies diapers have an extra layer of polyfiber material.
- *Engineering problem I am trying to solve:* ***If*** *I create a cabinet lock,* ***then*** *kids won't get into dangerous chemicals,* ***because*** *cabinets will be secured with my invention.*

If _____

then _____

because _____.

Variables: *A variable is a fancy word for things that you will be changing or keeping the same throughout your investigation. There are 3 types of variables:*

- *Independent: This is the variable that will be changed in your investigation.*
- *Dependent: This is the measured variable that will show an effect in your investigation.*
- *Constants: These are all the things that will be kept the same throughout your investigation to make sure it is valid.*

Example(s):

Question I am going to answer: ***If*** *I put 30mL of water in the Huggies diaper,* ***then*** *it will absorb the most water* ***because*** *Huggies diapers have an extra layer of polyfiber material.*

- *Independent variable: The different brands of diapers that are being tested (Huggies, Pampers, Luvs)*
- *Dependent variable: The amount of water absorbed (measured using mL) by each brand of diaper.*
- *Constant: temperature of the water, location in the diaper in which water is poured*

Problem I am trying to solve: ***If*** *I create a cabinet lock,* ***then*** *kids won't get into dangerous chemicals* ***because*** *the cabinets will be secure with my invention.*

- *Independent variable: Invention prototypes*
- *Dependent variable: Time it takes to open secure cabinet.*
- *Constant: cabinet door*

The **Independent (or manipulated) Variable** that I will change in my investigation will be:

The **Dependent (or measured) Variable** that will show an effect on my investigation will be:

The **Constant (or controlled) Variable** in my investigation are:

Science Materials OR Engineering Materials: What types of materials will be used to conduct your investigation? Make a list of them here using either words or pictures.

Testing My Prediction

STEP 4 – Procedure OR Create Alternative Solutions. Choose the best one and develop it.

Science Procedure/Engineering Design: What steps will I use to carry out my investigation? It is very important that the steps in developing/designing your investigation are recorded precisely so another student can replicate the investigation. Are there safety concerns? In designing a solution, create alternatives and choose the best one to develop.

If I am *answering a question* do I need to draw a picture of how I will set up my experiment? If I am *solving a problem,* a labeled diagram of the proposed solution needs to be sketched here.

Do the Experiment OR Build a Prototype

STEP 5 – Test your Prediction by doing the experiment OR Build a Prototype

Do the experiment! This is like a recipe; step by step instructions for what you will do to test your prediction. It should be so thorough that even a person, who knows nothing about science, could duplicate the experiment.

Scientific Data and Results

STEP 6 – Analyze your results and draw Conclusions OR Test and redesign as necessary

When conducting your investigation it is important to collect some data (information) to help either prove or disprove your prediction. When you are collecting data please make sure to be as precise as possible in using labels, dates, and even pictures. Once you finish collecting your data it is important to record your data/results into a table and then organize it into a chart or graph to easily communicate your findings. Please use additional pages or a journal to record your data and organize it into charts, tables, and graphs.

Data and Results collected over time:

Organizing my Data and Results into Charts, Tables, and Graphs:

OR Engineering Test and Redesign as Necessary

Test your engineering solution. If the solution meets the requirements or solves the problem, you are ready to communicate the results. If not, go back to brainstorming, evaluate and choose a solution. Develop another prototype and test again.

Conclusion

STEP 7 – Communicate Results

During your investigation you have learned many new things including whether or not you were able to prove or disprove your hypothesis. Your conclusion should be a summary of your results and state whether or not your investigation supported your hypothesis. Use the questions below to help guide you in sharing what you learned.

- Did your results support your hypothesis? Identify and explain the types of data you used to prove or disprove your hypothesis.
- What did you learn from the trials you conducted in your investigation?
- What types of problems did you encounter throughout your investigation?
- If you conducted this investigation again, what would you do differently?
- How does your investigation make connections to real life?

Acknowledgements

Who helped you with your project?

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Science/Math Tri-Fold Suggestion

Question Research Prediction	**Title** By: Student Name Grade Teacher Materials/Variables (Pictures)	Experiment Procedure Tables and Graphs Results/Conclusion

Engineering/Technology Tri-Fold Suggestion

Define Problem Research Specify Requirements	**Title** By: Student Name Grade Teacher Create/Diagram (Pictures)	Build Prototype Test/Redesign Results/Conclusion

Rules:

- No Flames, explosives or flammable materials
- Liquids – No open liquid containers, dry ice, dangerous chemicals
- No mold, fungi, or microbial cultures allowed that involve the growth of bacteria
- **No Animals - No live or preserved vertebrate or invertebrate animals or parts.**
- No projects that cause potential injury or harm to vertebrate or invertebrates. (Animals must be observed in their natural habitat with no interaction between the student and animal.)
- No hazardous and or controlled substances (tobacco, ethyl alcohol, drugs or sharp objects)

Present to Judges

A judge will review each project. Each student participant will be asked a few questions about the project. These questions will be presented in an informal and positive manner and will last only a few minutes. STEM Fair projects will be then judged with certificates awarded.

Try to be able to answer some of the following questions if asked.

- How did you get the idea for your project?
- What were you trying to find out or solve when you did your experiment?
- Was there anything that surprised you after you did your experiment?
- Explain how you did your experiment.
- What did you like best about doing your science project?
- If you did the same project again next year what would you change or do differently?
- Were the results of the experiment how you guessed they would be? If not, what surprised you the most?
- Why is your STEM fair project important in today's society (how will it help people today?). You don't have to cure cancer. Perhaps your work will help a small group of people, but it's still important.