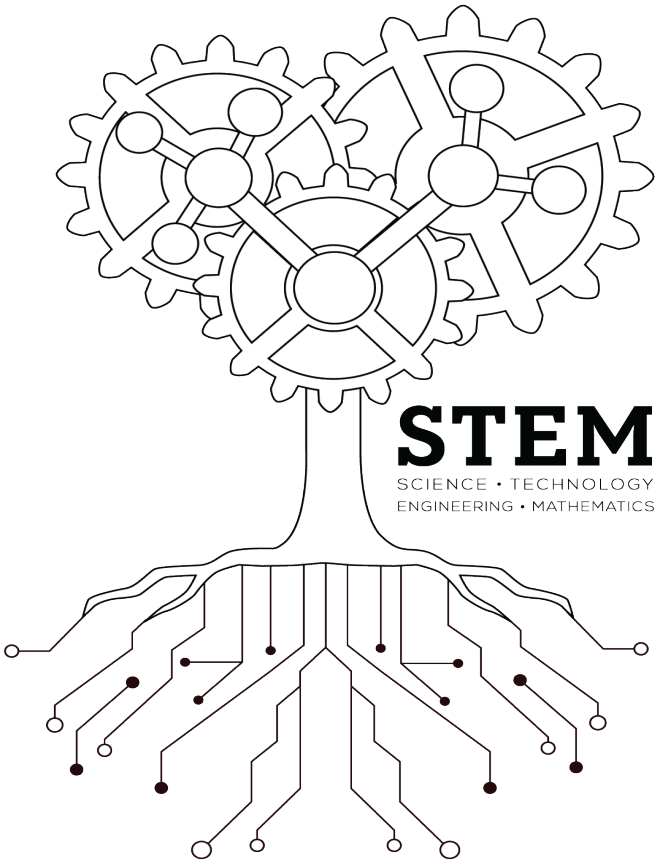
Elementary STEM Fair

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 Report Forms

Student Name: _____

Teacher: _____

School: _____

Background Information

(adapted from sciencebuddies.org)

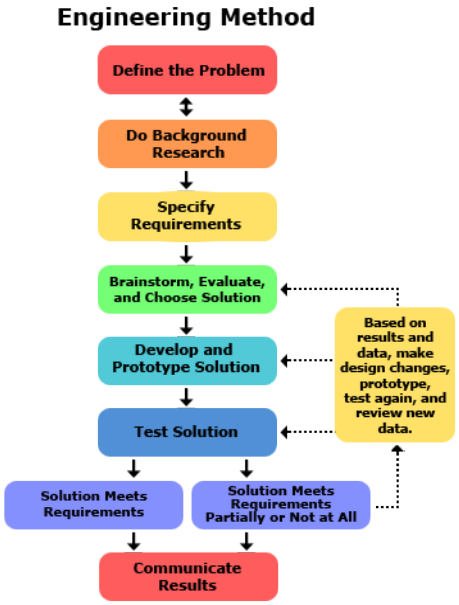
Providing students opportunities to make meaningful connections to the real world is critical as we develop the skills, behaviors, and dispositions necessary for college, career, and life readiness. Developing a **STEM** investigation (**S**cience, **T**echnology, **E**ngineering, and **M**athematics) will provide students the opportunity to use knowledge and skills just as scientists and engineers 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 Plan and Investigation Report Form*** document will provide guidance and support in developing the project. Throughout the document there are explanations and clarifications to help better guide student thinking. Students need to complete:

- ✓ "***Elementary STEM Fair Research Plan and Investigation Report Forms" –*** (this packet)
- ✓ ***Investigation Log*** – timeline outlining experiences and observations throughout the investigation
- ✓ ***Backboard*** – required for District STEM Fair participation; individual schools will identify specific requirements for school fair

Comparing the Engineering and Design Process with the Scientific Method

While scientists study how nature works, engineers create new things, such as products, websites environments, and experiences. Because engineers and scientists have different objectives, they follow different processes in their work. Scientists perform experiments using the **scientific method**; whereas, engineers follow the creativity-based **engineering design process**. Keep in mind that although the steps are listed in sequential order, you will likely return to previous steps multiple times throughout a project.



Why are there two processes?

Both scientists and engineers contribute to the world of human knowledge, but in different ways. Scientists use the scientific method to make testable explanations and predictions about the world. A scientist asks a question and develops an experiment, or set of experiments, to answer that question. Engineers use the engineering design process to create solutions to problems. An engineer identifies a specific need: **Who** need(s) **what** because **why**? And then, he or she creates a solution that meets the need.

Which process should I follow for my project?

In real life, the distinction between science and engineering is not always clear. Scientists often do some engineering work, and engineers frequently apply scientific principles, including the scientific method. Your project may fall in the gray area between science and engineering, and that's OK. Many projects, even if related to engineering, can and should use the scientific method.

However, if the objective of your project is to invent a new product, computer program, experience, or environment, then it makes sense to follow the engineering design process.

Table of Contents

Research Plan

The research plan needs to be completed before beginning the investigation but ***AFTER*** thinking through pages 5 through 10.

Student Name: _____

School: _____

Address: _____

_____

Title of Project: _____

Adult Sponsor: _____

Where will you complete your experiment?

Home: _____ School: _____ Field: _____

Category (see page 4 for clarification):

Physical: _____ Earth/Space: _____ Life: _____

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

Describe the methods, materials, and procedures you intend to use.

List any major sources of information that you are using for research. If you are studying animals, please make sure to reference animal care when appropriate.

Parent/Guardian approval:_____ **Date:** _____

Teacher approval: _____ **Date:** _____

Things to Consider When Choosing Your Investigation

What types of things do you enjoy in science? There are three different SCIENCE categories your idea may fit into:

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

Earth and Space Science: 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 (things that make up the Earth such as 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.

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. (There are special rules anytime you work with animals. Please talk to your teacher to ensure you are following any rules).

ASK A QUESTION or DEFINE THE PROBLEM

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

Example(s):

- *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.
- *Problem I am going to solve:* "I am constantly losing things out of my pant pockets. How can I create a pant pocket that keeps items inside?" 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: (What am I wondering about?)

BACKGROUND RESEARCH

After choosing your investigation category 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 hypothesis, designing your experiment or prototype (if applicable), collecting data, drawing conclusions, and communicating like a real scientist. 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:

Ideas Related to my Beginning Question or Problem and Identifying Variables

PART A

***Scientific Process*:** Things I could change or vary:

IMAGINE *Engineering Design Process:* What are some solutions? How could this problem be solved?

PART B

PART B *Scientific Process and Engineering Design Process:* Things I could measure or observe.

Identifying Variables

I will change:
Independent Variable

Place sticky note from **PART A** here

I will measure or observe:
Dependent Variable

Place sticky note from **PART B** here

I will not change (I will keep these the same so my test is fair):

Place remaining sticky notes from **PART A** here

Place remaining sticky notes from **PART A** here

Place remaining sticky notes from **PART A** here

I will not measure or observe:

Place sticky note from **PART B** here

Place sticky note from **PART B** here

Place sticky note from **PART B** here

Focusing in on my Testable Question (Refining my beginning Wondering)

When I change _____ → What happens to _____?

What I will change?

What I will measure or observe?

NOW, write the question or problem that will guide your experiment or investigation:

Based on prior knowledge and research, what do you already know about this?

Predictions

(Note: List 3 possible outcomes: *Increase, Decrease, and No Affect*.)

Based upon my question, I predict:

Circle the number you want to investigate

1.

2.

3.

CONSTRUCTING A HYPOTHESIS SPECIFYING REQUIREMENTS

The purpose of creating your hypothesis is to identify what you think will happen based on research that was collected. The hypothesis 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.

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.
- **PLAN -** *Problem I am trying to solve:* **If** I create a magnetic pocket casing, **then** I will lose fewer items out of my pockets **because** magnets provide a tight seal due to their characteristics.

If……**THEN**……

…… **BECAUSE**……

……

Setting up the Procedure

TESTING with an EXPERIMENT  DEVELOPING A PROTOTYPE 

(Note: Others should be able to follow the way you set up your fair test)

Now that you used some research to develop your hypothesis it is time to begin your investigation or develop your prototype. To help answer your question or solve your problem. The next few pages will help guide you in setting up and conducting your investigation.

Materials List
(detailed)

Directions

 List exactly what you will do in each step of your experiment OR

 PROTOTYPE - draw a detailed diagram, label the parts and record any notes needed to assist in carrying out the development of the prototype

Set-Up Conditions/Controls
(What conditions should be kept constant?)

Place remaining sticky notes from Part A here

Place remaining sticky notes from Part A here

Setting Up the Experiment or Investigation

What steps will I use to carry out my investigation? It is very important that the steps in designing your investigation are recorded precisely so another student can replicate the investigation.

What I will change or vary (independent variable):

What I will change

What I will do to carry out the change:

Number of trials I will conduct or amount of samples to include: _____

The data I will collect by measuring or observing (dependent variable):

What I will measure or observe

How I will collect the data:

How I will record the data (for example: table, chart, picture):

Complete "RESEARCH PLAN" now – page 4

Carrying Out the TESTING of the Experiment

DEVELOPING a Prototype and Testing it

Data Collection:

When I changed _____, what measurements or observations resulted?

What I will change (independent variable)	What I will measure or observe (dependent variable)

Record your Data: (Note: This is intended simply as an example to help get you started. You may design your own chart to fit your experiment.)

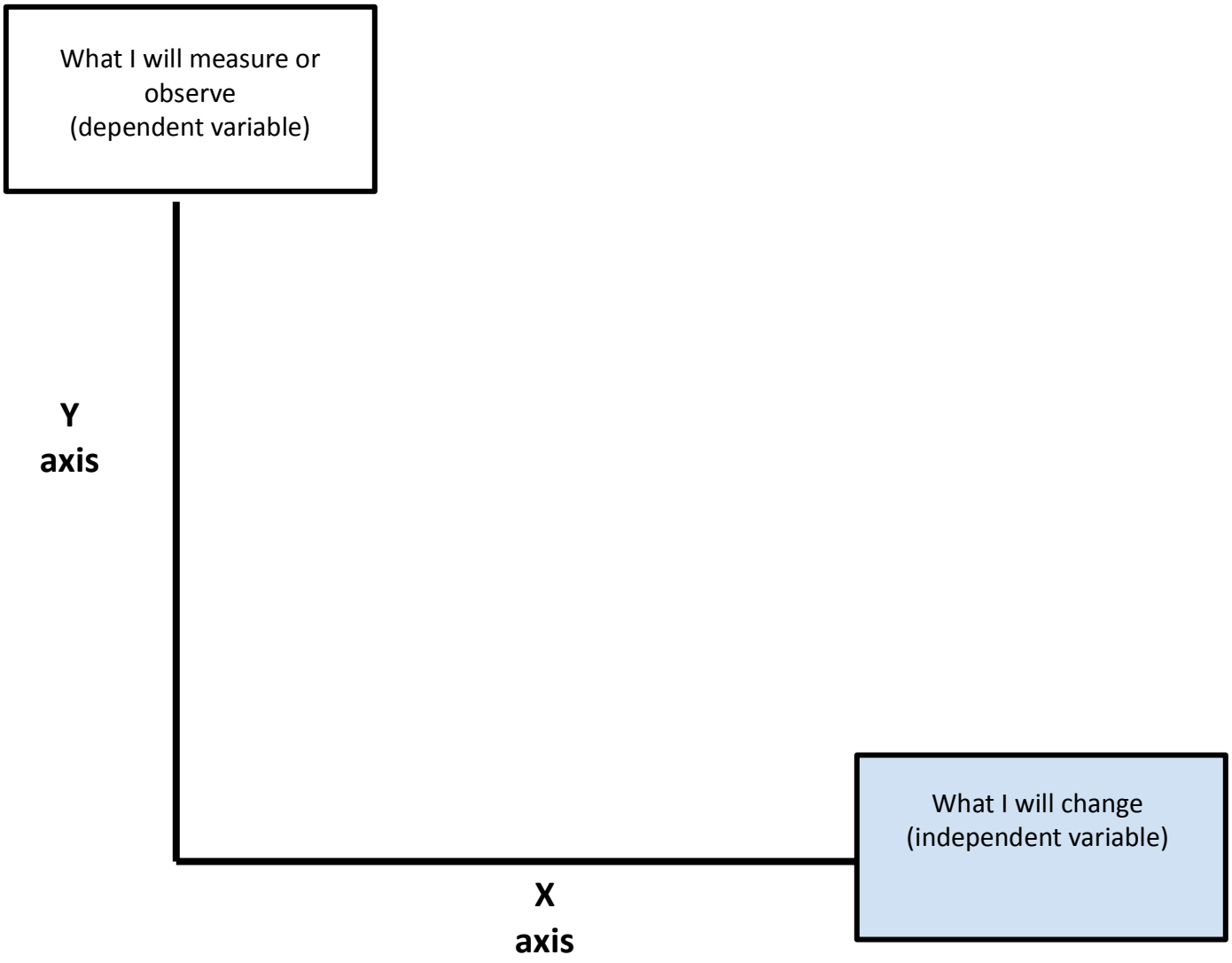
Data Collection *(metric measurement)*

Item(s) Tested	Trials (Increasing the number of trials will provide more valid data. Minimum required amount is 5 trials)										
	1	2	3	4	5	6	7	8	9	10	avg.

Graphing Results

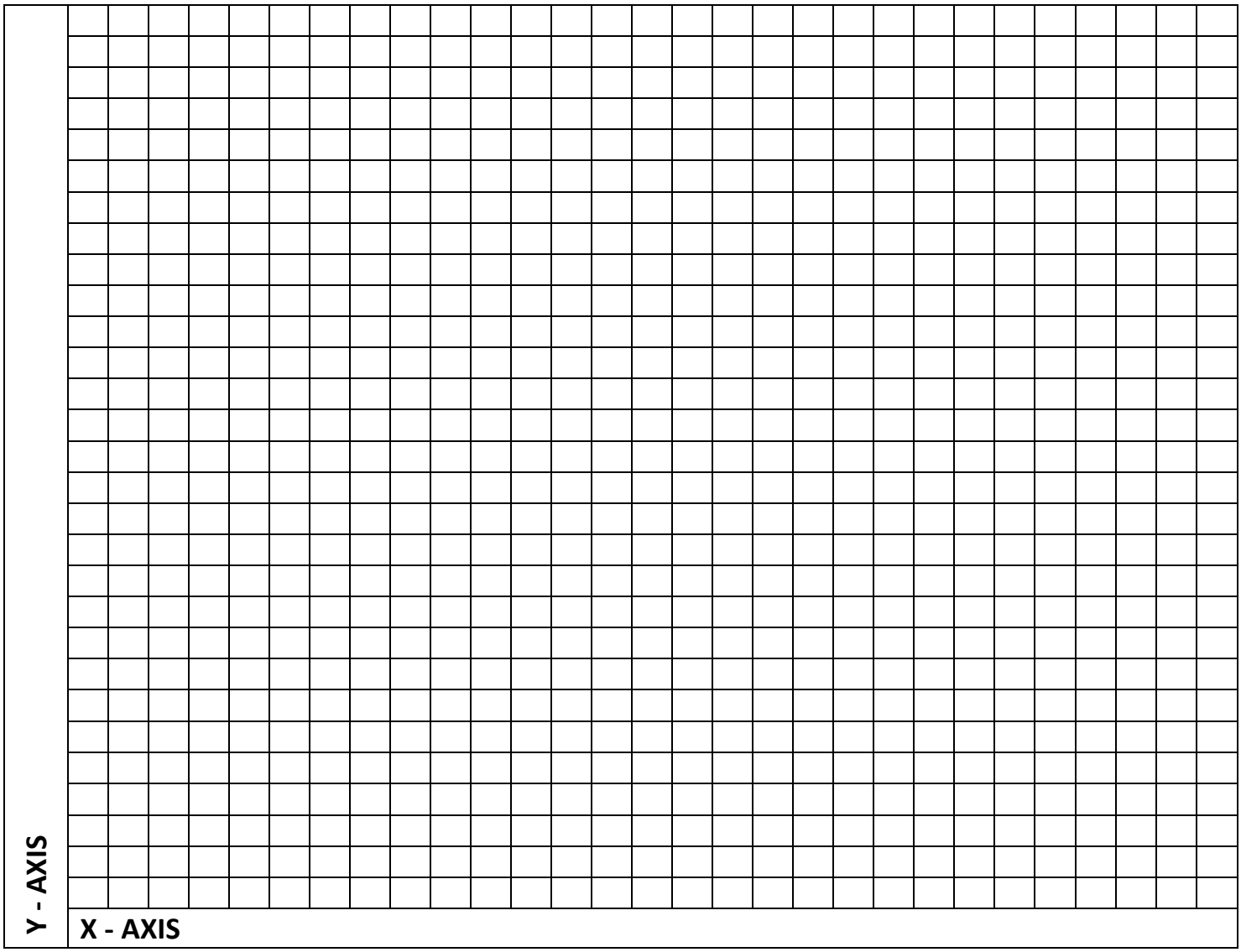
Which type of graph is best? (line graph or bar graph) _____

Graph: should reflect the average of trials



(Note: Both axes will need to be labeled and the appropriate scale marked)

Title of Graph: _____



When I changed _____, what happened to _____?

What I changed (independent variable)	What I measured or observed (dependent variable)

DRAWING CONCLUSIONS and COMMUNICATING RESULTS

IMPROVE – What happened when the prototype was tested?

During your investigation you have learned many new things including whether or not you were able to prove or disprove your hypothesis and what happened when your prototype was tested. Your conclusion should be a summary of your results and state whether or not your investigation supported your hypothesis or if any modifications need to be made to improve your prototype. Use the questions below to help guide you in sharing what you learned.

- ✓ Looking at your graph, describe your results (patterns or relationships shown by your data) using mathematical language.

- ✓ Write an explanation that reflects your predictions and data in your experiment.

- ✓ Did your results support your hypothesis?

- ✓ What did you learn from the trials? Were there any problems that you encountered?

- ✓ Explain real world uses relating to research and the experiment.

- ✓ Any new questions for further investigation- what else do you wonder about?

- ✓ How can you improve the prototype to make it better/what would you do differently?

Abstract

The abstract is the part in your project log in which you summarize the entire investigation. Remember to include things such as the questions you were trying to answer or problem you were trying to solve, hypothesis, procedure, data/results, and conclusions based on evidence collected.

Student Name:
Project Title:
School:

ACKNOWLEDGEMENTS

Who helped you with your project?

Backboard Suggestion

The following is a suggested layout for your backboard. You need to make sure that the abstract is in the lower left hand side of the board.

QUESTION or PROBLEM	TITLE and AUTHORS The title should describe the work to the reader. Include the variables that are manipulated.	DATA and RESULTS Describe the results clearly. Use graphs, tables, charts, and pictures to prove or disprove your hypothesis to help clarify the results. Include a discussion on the statistics you use to describe or test your data. Save any conclusions for the discussion.
HYPOTHESIS	TESTING and PLANNING PROCEDURES, VARIABLES, MATERIALS This section should include three sections in sufficient detail so that others can repeat your research.	
ABSTRACT The abstract is the part in your project log in which you summarize the entire investigation.		CONCLUSION A summary of your results. State whether or not your investigation supported your hypothesis or if any modifications need to be made to improve your prototype.
RESOURCES CITED		