Science Fair

Hosted by the STEM Guild

Thank you for your interest in submitting a project into the Science Fair hosted by the STEM Guild. This is an entree level fair designed for people to become interested in STEM. As such our rules differ from the Minnesota State Science and Engineering Fair as well as the National Science Fair.

What is a Science Fair?

For the STEM Guild, we plan to host multiple types of project fairs, this project fair is specifically a Science Fair. For the STEM Guild, a science fair project is one that demonstrates an understanding of what a variable is, how to test a variable, clear display of data collected, and a conclusion drawn from collected data. The project involves experimenting, testing, and gathering data to interpret into a conclusion. Please read our rules below to know if you are eligible and how our classifications work.

The following pages are to help you be successful at the science fair and offer information on each step plus example science fair questions and ideas. See the end of the document for a list of Project Ideas.

Your project must include:

1. The question the project is answering
2. A hypothesis of what you think will happen
3. The materials used for the experiment
4. What is the variable?
5. Step by step process of how the experiment was conducted or carried out
6. Images, graphs, charts, or other forms of displaying data
7. A conclusion about what happened that answers the question

Think of it as if another parent at the science fair took a picture of your board so they could go home and try out what you did, what would they need on it to do exactly what you did?

2.1 The Question the Project is Answering

Questions must be testable. That means the question has to be one that the participants can find an answer to and it must be through experimentation.

Questions that can be answered through experimentation:

- Which brand of battery lasts the longest?
- How tall is the average tulip?
- What happens if you replace eggs in a cookie recipe with an egg alternative?
- What is the longest a plant can go without water before wilting?

Questions that cannot be tested:

- What is a supernova made of?
    - While scientists are currently testing this, the resources needed to find the answers make it not testable for kids. We could research what scientists have found in supernova, but that would be googling the information, not finding it out for ourselves.
- How are cars made?
    - This is a research project and has nothing hands-on for the participant to experiment or try and so it is not testable.

Questions that cannot be answered:

- Why does my brother not like me?
    - Only your brother knows why he doesn't like you. This is a research question where you could ask why he doesn't like you, but that's just a conversation, not something testable.
- What came first, the chicken or the egg?
    -

2.2 A Hypothesis of What You Think Will Happen

A hypothesis is an educated guess. After the question has been formed, think of an answer to that question, what might happen?
If the question is “What fruit can power a clock the longest?” Think about all the fruit you will be testing and which one do you think will power the clock the longest?

It is important to note that hypotheses do NOT have to be correct. Being correct or incorrect with a hypothesis does not impact whether a science project performs well or not.

Forming a hypothesis helps scientists think about a reason why they think something will happen and when the hypothesis is wrong, helps scientists think about all the reasons that they were wrong. Those reasons can lead to some of the best follow up research later down the line. The Science Fair includes the rule of having a hypothesis so participants can practice this important skill.

2.3 The Materials Used for the Experiment

Once you think you have everything you need to run the experiment, write them all down, everything you used. A simple bullet point list is all that is needed for the board. Make sure you don’t forget anything!

There is nothing worse than reading a cooking recipe and realizing step 4 includes an ingredient not on the ingredient list you didn't know you needed to buy. People want to replicate your experiment, don’t leave them in a lurch.

2.4 What is the Variable?

The variable is what you are testing or changing in your experiment. Think about your question and how you are going to test it out. Another way to think about it is what will be different? Are you testing different foods, materials, locations, times of day, products, ect?

A good science experiment is a simple one: 1 variable. Your project should only have 1 thing that changes. In science we have a *control*, it is often what we are comparing all the result to from the tests we did. The control can be the first test you conduct, from there there should only be one thing about the control that changes- that is your variable.

On you board simple state out "the variable in the project is _ _ _ _"

For example:
If you wanted to test a bread recipe, the control would be the recipe you are following. From there, what do you want to change about the recipe, to test out if it could be better? If you choose the amount of flour to be different, **The variable in this project is the amount of flour.**
After doing one test to double the flour, you can't choose to change the amount of water. That is 2 variables or 2 changes: water and flour. This makes it hard to know if this recipe was better because it had more flour or because it just had less water. There are too many things that are different to pinpoint what made it better without guessing! Your variable is flour, so try halving the flour, doubling the flour, tripling the flour, ect.

**Hot tip, when doing your trials, under "Variable" in your notebook, write in how you are changing the variable to help you keep track of how you changed it!*

While this may seem complicated, it is actually forcing you to be as simple as possible. **Pick one thing and think about what you can change about it to test it out.** Changing too many things makes it difficult to come to any conclusions.

While it is not normally a rule for a science fair to state the variable, we at the STEM Guild find it will help students create a project that is a science fair project and not a different type of project. A project about different types of volcanoes would not have a variable to test and is a research project not a science fair project. By having to state the variable, we are helping participants make sure what they are working on is indeed a science project.

Examples of Questions and the Variables in the project

- What is the most acidic juice
    - Variable: different types of juices are tested
- Which exercise increases my heart rate the most?
    - Variable: different types of exercises are tested
- How tall is the average 9 year old?
    - Variable: different children who are 9 years old are measured
- How does light affect the growth of plants?
    - Variable: different sources of light are used

A common misconception for what is a science project:

- What happens when I add Baking Soda to Vinegar?
    - While 2 chemicals are put together this is what is called a demonstration. The demonstration shows what happens, but there isn't something that is changing, being tested, or experimented on.
    - To turn this classic demonstration into an experiment we can change the question to: How much baking soda should I add to vinegar to get the biggest reaction?
        - This new question has a variable of baking soda. The amount of baking soda will change to find the best recipe to create a big reaction.
- Creating static electricity using a balloon
    - We can use a balloon on our hair to create static electricity, but this is a demonstration about static electricity. It does not have a variable to test or experiment with.
    - To turn this classic demonstration into an experiment we can change the question to: what materials create the strongest static electricity?
        - If you have done the demonstration before, you know hair works. But what about other stuff? What things would you try to see if they create the same effect? Wool? Cotton? Carpet?

2.5 Step by step process of how the experiment was conducted or carried out.

Most experiments will require you to do the same process 2 or 3 times. If you are testing which paper towel holds the most water, you want to make sure you follow the same exact steps for each brand you test. When you do the first test, write down all the steps you took, then follow that step by step process for all the rest.

Example
The paper towel test:

1. Buy 3 brands of paper towels
2. Set 1 sheet of paper towel from brand A on table
3. Add 1 tablespoon of water to the middle of the paper towel
4. Wait for water to be absorbed
5. Repeat steps 3 & 4 until a water puddle is formed around the edge of the towel
6. Write down how many tablespoons of water the paper towel could hold
7. Repeat steps 2-7 for all paper towel brands

2.6 Images, graphs, charts, or other forms of displaying data

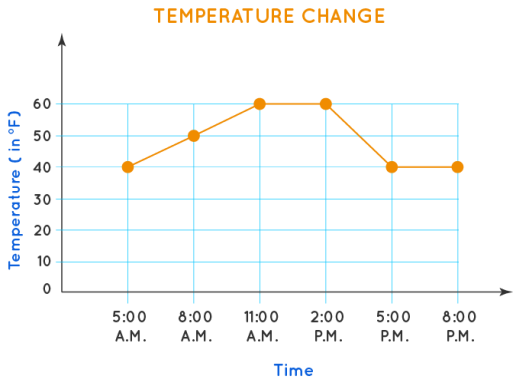
We the audience were not there, show us what happened though pictures, charts, or graphs. Here are some suggested ways to include them.

Pictures

- Use pictures to show before and after photos
    - Flourless cookies before they went into the oven, pictures of cookies with no flour after the oven.
    - Marigold seeds day 1, 2, 5, and 10.
    - Watermelon dropped from 5 feet, 10 feet, 20 feet.
- Use pictures as data
    - What kind of weather will happen in April? In addition to writing down the temperature, you could also take pictures of the clouds every day.
    - How many birds visit the pond on average? Take pictures of the birds you see, you can ID them later in the photos you took if you want or just use the pictures to count birds. The pictures are a tool here.

Graphs or Charts

- Use charts or graphs to show what happens over time.



This is an example of a line graph. The experiment involved testing temperature throughout the day and this graph shows the results. In the interpretation of the graph, a participant may say the temperature increased during the middle of the day and was colder in the morning and evening.

Kind of flower	Number of flowers
Rose	1
Tulip	5
Lily	5
Orchid	4
Forget-me-not	9
Total	24

This is a table chart. This experiment involved seeing how many flowers were affected by the experiment and separating them out by type of flower. It helps the reader clearly see all the data and once. An interpretation a participant may have of this chart is Roses were the least affected or Forget-me-nots were the most affected.

2.7 A Conclusion About What You Think Happened That Answers the Question

The conclusion is an explanation of what happened before, during, and after the experiment. A conclusion should include in no particular order:

- The question
- What you did to test it (a summary of the procedure),
- Interpret your data (tell the reader about your chars, graphs, or pictures)
- Mention whether your hypothesis was right or wrong
- Answer the question.

A simple way to frame the conclusion is to start by repeating your question, summarizing what you did (the procedures) and telling us what you saw and noticed in the data (your pictures, charts, graphs). This is the information part of the conclusion. Now it is time to tell us about the hypothesis and answer the question. Was your hypothesis right or wrong? Did anything surprise you or was not what you expected? Look at your question you asked and answer the question.

Use this color guide to understand the examples below:

Start by repeating your questions, summarizing what you did (the procedures) and telling us what you saw and noticed in the data (pictures, charts, graphs). This is the information part of the conclusion. Now it is time to tell us about the hypothesis and answer the question. Was your hypothesis right or wrong? Did anything surprise you or was not what you expected? Look at your question you asked and answer the question.

Examples A

I wanted to know which brand of paper towels is the best brand. To find this out, I decided to test which paper towels held the most water. I bought 4 brands of paper towels, and one by one added drops of water onto them until they could not hold any more water. My hypothesis was wrong, I thought Sparkle would be the best paper towel. I was surprised to see the walmart brand held a lot of water, I thought that it wouldn't do very well because it was the cheapest. But, the chart shows, the cost of the paper towel brand had nothing to do with how well the paper towel soaked up water. The brand that was the best paper towel was Brawny.

Example B

What kind of weather will be the most common in April? To test this out, every day I recorded what the weather was like including the temperature, clouds, and whether there was precipitation or not. The graph of the weather shows all the weather for 20 days. Out of all the days it was rainy most of the day and cloudy the second most often. My hypothesis was right, I thought it would rain a lot because of the phrase "April showers." I was surprised it was only sunny 2 days of the month, that isn't very much. The weather we have the most often in April is rainy.

Looking for where to start with a science experiment idea?

Here is a list to start you off and get thinking. Want to try one of these but are not sure how to frame it? When you fill out the form intent to participate, you get a Science Fair Mini Guide for Kids to help you get started!

1. Product Testing

- **Focus:** Testing the effectiveness or qualities of various products.
- **Examples:**
    - Comparing different brands of batteries for longevity
    - Testing laundry products for which takes out more stains
    - Testing the Absorbency of Different Paper Towels
    - Measuring the Strength of Adhesives like glues or tapes

2. Cause and Effect

- **Focus:** Exploring how one variable (cause) influences another (effect).
- **Examples:**
    - Studying how different amounts of sunlight affect plant growth
    - Seeing how temperature affects the rate salt or sugar dissolves in water
    - How do Different Surface Types Affect the Speed of a Rolling Object
    - How does the Angle of a Ramp Affects the Speed of a Rolling Object
    - How does Exercise Affects Heart Rate
    - How the Size of an Object Affects Its Rate of Falling

3. Exploration and Observation

- **Focus:** Observing natural phenomena and seeing how change happens over time.
- **Examples:**
    - Watching the Growth of Mold on Different Foods
    - Tracking weather patterns over time
    - Observing how plants respond to different environments
    - Observing which bird seed birds eat more of at bird feeders
    - Which foods are ants more likely to eat?

4. Comparative Studies

- **Focus:** Comparing two or more things to draw conclusions based on similarities or differences.
- **Examples:**

- Comparing the Strength of Different bridge shapes
- Comparing the Strength of Different materials used to build bridges
- Comparing the Growth Rates of Different Plant Species
- Comparing the Water Retention of Different Soil Types
- Comparing the Effectiveness of Different Insulation Materials
- Comparing the Buoyancy of Different Materials
- Comparing the Melting Rate of Different Materials

5. Investigation of Materials

- **Focus:** Studying the properties of materials and how they behave under certain conditions. Material might include popsicle sticks, wood, tin foil, rubberbands, wool, cotton, paper, and more.
- **Examples:**
  - Investigating the Strength of Different Building Materials
  - Investigating the Insulating Properties of Different Materials
  - Investigating the Conductivity of Various Materials
  - Investigating the Water Absorption Rate of Different Fabrics
  - Investigating the Durability of Materials in Outdoor Conditions
  - Investigating the Flexibility of Materials
  - Investigating the Absorption of Different Types of Paper
  - Investigating the Strength of Different Adhesives

Want more Ideas? Check out these resources:

https://www.sefmd.org/Resources/200%20Science%20Fair%20Project%20Ideas.pdf
https://sciencefaircentral.com/sites/default/files/downloads/sfc-scientific%20project%20starters.pdf