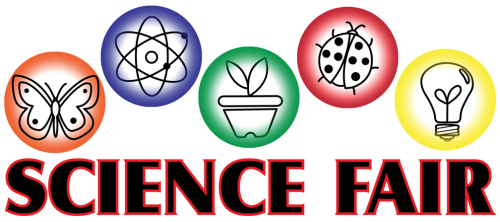

Science Investigation

Kindergarteners to Fifth Graders

Students in all grades can submit a science experiment. Students will conduct an investigation to find the answer to a question/problem. Using a well-designed investigation will take the students through the process of asking questions, doing preliminary research, making a hypothesis (your best guess at how it will turn out), planning and conducting the experiment, and analyzing the results.
The well-designed investigation has five parts:

1. Problem/Question: (What do I want to find out?) Ask a question. How does one variable affect another? What effect does something have on something else? This question should be very specific.

2. Hypothesis: (What do I think will happen and why?) Make a prediction about the relationship between the independent variable (what you change on purpose) and the dependent variable (what you are measuring). The hypothesis should be explained using scientific reasoning.

3. Procedure: Design an experiment to test the validity (correctness) of your hypothesis, and write a plan detailing the steps of the experiment. The plan should include the materials needed to set up and execute the experiment. Before beginning the experiment, evaluate the plan to make sure it is a "fair test." In some experiments, a control group should be included that receives the same conditions as the test groups but will not be influenced by the "independent variable" or condition the other groups are testing. In other experiments, there will not be a control group, but all of the variables except for the independent variable will be controlled (kept the same). The independent variable is the variable that the students wants to test and is changing on purpose. When possible, a large sample size should be used or an experiment should be repeated numerous times to replicate/verify the results.

4. Collection and Display of Data/Results: Collect and record your measurements and observations in a journal. Make sure to include units on your measurements (for example, "cm" for centimeters). Include at least two types of data displays to present your results. Possible types of data displays include tables, graphs, charts, or sequential pictures. The information should be thoroughly labeled with titles on graphs and keys if needed.

5. Conclusion: (What do my data tell me about the problem? What summary statements can I make about this experiment?) Write a conclusion that addresses the question/problem that you tested. Use your data to explain what you found. A strong scientific explanation includes a claim (what you think), multiple pieces of evidence

(relevant data), and scientific reasoning (scientific principles that connect your evidence to your claim). Finally, discuss an application of your findings or a way that the results of your experiment could be used by others. Also, discuss the next experiment you would like to conduct based on your experience with this one.

Parents are encouraged to support and work with their child on this project at home. This usually results in a better student understanding. Students are also permitted to work with a friend or a small group. A general rule of thumb to go by is:

- 4th and 5th graders should be able to do almost the entire project by themselves.
- 2nd and 3rd graders should be able to do many parts themselves.
- Kindergarteners and 1st graders will need help for most of the project.

An Example of a Well-Designed Investigation

Problem: How will the amount of fertilizer affect the growth of plants?

Hypothesis: I think that higher levels of fertilizer (independent variable) will cause greater growth (dependent variable) in tomato plants. I think this because advertisements show that plants grow better using fertilizer. So, if a plant receives more fertilizer, then it should grow taller than a plant with less fertilizer.

Procedure: The independent variable will be the amount of fertilizer being used, so all the other variables and conditions must stay the same. That means the following:

1. The seeds must all come from the same package and should be randomly selected.
2. All seeds must be planted in the same sized pots with similar soil.
3. All plants must receive exactly the same amount of water and light.
4. The temperature should be the same for all plants.
5. At least five plants should be used for each test group.
6. Set up one group of plants as the "control group." This group is not given fertilizer.
7. Set up two other test groups. One receives 20 mL of liquid fertilizer each week. The other group receives 40 mL of liquid fertilizer each week.

Data/Results: Use a separate notebook for recording all measurements and observations. Record information daily and consider the following things:

- Make sure that measurements are made in a consistent way. Include units on all measurements.
- Keep a lot of notes! It is better to have too much data than not enough.
- Write down the date and time when making an observation. Be as specific as possible.
- Keep track of the materials used and their quantities.
- Take photographs as part of your display, if possible.

Conclusion: The amount of fertilizer did not affect the growth of the tomato plants. The control group that did not receive any fertilizer grew to 55 cm in 9 weeks. The first test group, Experimental #1, received 20 mL of liquid fertilizer each week. After 9 weeks, these plants grew to 63 cm. The second test group, Experimental #2,

received 40 mL of liquid fertilizer each week. After 9 weeks, these plants grew to 35 cm. 20 mL of fertilizer each week seemed to improve the height of the tomato plants compared to the group that received no fertilizer. However, the group that received 40 mL of fertilizer did not grow nearly as tall as the control group or Experimental #1 group. It seems that too much fertilizer can affect the plants by keeping them from growing as tall while the right amount of fertilizer can improve the growth. People can use these findings when growing their plants. Instead of using extra fertilizer, gardeners and farmers should use just the right amount of fertilizer. For my next experiment, I would be interested in testing different amounts of fertilizers to find out what the "right amount" should be for a tomato plant.

Selecting a Topic for Investigation

After you have selected an area of science that interests you, think about the questions that you are curious about and would like to solve. The question you try to solve will be the topic of your science fair project. You need to choose a question that can be answered by an experiment that you can do. Do not choose a question that does not interest you or one that is too hard to solve.

The best format to think of a question may be: How does _____ affect _____?

Here are some questions that may help you think of your own research question that you would like to solve. Make sure that you can plan and carry out an experiment to solve the problem.

- How does air pressure in a basketball affect the height it bounces?
- Which paper towel is the most absorbent?
- How does the color of a container affect the cooling time of water?
- Which brand of dishwashing liquid makes the longest lasting suds?
- What metal conducts heat the fastest?
- How does the type of surface affect the speed of a remote control car?
- Does the color of colored water affect the rate at which it freezes?
- Which sandwich bag has the strongest seal?
- How does the size of a playground ball affect how high it bounces?
- Which ball travels fastest when thrown with the same force?
- What icepack in your lunch bag keeps food coldest the longest?
- What floating material will support the most weight?
- How does color affect a material's ability to absorb heat?
- How does the temperature of water affect the rate of evaporation?
- How do different string lengths on parachutes affect their falling times?
- How does the weight of an object affect how far it can be thrown by a catapult?
- Which type of insulation retains the most heat?
- How does the temperature of a ball affect how high it bounces?

*A note on plants: Be cautious with any experiment that involves growing. These projects take long periods of time and constant attention.
*No experiments that harm living organisms will be permitted.

Science Fair Websites

www.ipl.org/div/projectguide
This site is a good source of project topics.

http://school.discovery.com/sciencefaircentral
The Discovery Channel organizes this site which has a great list of science fair topics.

http://www.madsci.org/libs/libs.html
This site gives other sites to choose from such as search engines to locate projects similar to the child's interest.

Displaying a Science Investigation Project

This is a visual way to communicate to others who will not hear your presentation, so take your time and do a good job. Use color to make your display attractive. It is a good idea to use photographs as part of your display to help others understand what you have done. When you have decided what you are going to put on your display board, lay the whole thing on the floor and look at it. Have others look at it and ask their opinion. THEN you can glue everything on your display board.

Projects should be not larger than 24" front to back, 36" wide, and 72" high. Most boards will have three sections and will stand on their own. Many office supply stores sell boards for about $5.00.

Clearly visible on the display must be your name and grade, the title, the purpose and the steps of the
Scientific Method: problem, hypothesis, procedure, data/results, and conclusion,

Open flames, dangerous chemicals and sharp objects are not permitted. If electricity is needed, students must provide their own extension cord.

Congratulations!
You are now ready to display your Science Investigation at the Clemens Crossing Elementary School Science Fair