Science Fair Projects

PCA Science Fairs

Providence Christian Academy holds an in-house science fair. Winners from the PCA science fair will move on to compete in the Fauquier County Science Fair. A student of PCA won the science fair logo contest and her logo will be used to promote the Fauquier County Science Fair.

In previous years PCA competed in the Prince William Science Fair with the following results.

Several students placing and invited on to participate at higher level science fairs to include the CIA.

Science Fair Project Guidelines

The following provides important information students will need as they prepare and present their science fair projects.

Downloadable Resources

Click on the following links to download the following documents:

- Deadline Sheet_2017-2018
- Project Approval Form_2017-2018
- Science Fair Guidelines_2017-2018
- SF Calendar_2017-2018
- Help Your Student

[NOTE: The above documents require Adobe Acrobat Reader, which can be downloaded from https://get.adobe.com/reader/).

Science Fair Project Steps

Step 1 – Selecting a Topic

The most important part of any science fair project is determining what the project will be about. One of the most important considerations in picking a topic is to find a subject that you consider interesting. You will be spending a lot of time on it, so you don’t want your project to be about something that is boring.

Another important part that must be considered is can you design a fair test to answer your question? A “fair test” requires that you change only one factor (variable) and keep all other conditions the same. If you cannot design a fair test then you should change your question.

DO NOT use a topic that is a preference or a choice. An example of this would be “Which tastes better: Coke or Pepsi?” Such experiments do not involve the kind of numerical measurements we want in a science fair project. This is more of a survey than an experiment.

Your science fair project should involve factors that you can easily measure using a number such as a time, length, weight, or speed. If you can’t measure the results of your experiment, than you are not doing science!

There should be at least three sources of written information on the subject. You want to build on the experience of others.

Look around you. What interests you? What do you want to know more about? Try to think of a topic for which you can easily find materials and will fit into both your budget, and the time that you have.

To begin, please select three topics for the following reasons: Each science fair project this year will be a different project from your peers, so if you happen to duplicate an idea that one of your classmates has already chosen, you will need to choose one of your other topics. Secondly, you will need to have your topic cleared through your science teacher to be certain that it is an acceptable, affordable, and safe project.

Step 2 □ Ask a question?

Ask yourself: Is my question testable? Can I get an answer to my question by doing an experiment? Can I measure the results using numbers? Can this investigation be done in a reasonable amount of time?

A few different ways that we can word this question would be as follows.

- How does ________ affect ________?
- In what way could ________ improve the performance of ________?
- What type of relationship exists between ________ and ________?

As we decide on our topic, there are endless possibilities as to what type of "test" we will be performing. Having a question will help to focus our thoughts and energy to one ascertainable goal.

<u>Example</u>: I choose the topic of magnets. Here are a few questions that I may ask…

- How do magnetic fields affect the rate of flow of water?
- What type of effect does temperature have on magnets?
- How does the number of coils affect the strength of a magnet?
- How does a bar magnet's field interact with the earth's magnetic field?
- What type of relationship exists between Neodymium magnets, Ferrite magnets, and electromagnets.

maybe I am trying to see how magnets affect other sources…

- Is plant growth affected be the presence of a magnetic field?
- Is seed germination affected by the presence of a magnetic field?
- What type of a relationship exists between the magnetic fields given off by a computer, wall current, power lines, etc.?
- If you change magnetic field orientation, does it have an effect on organisms? (fruit fly, meal worm, planaria, etc.)

…or possibly you are trying to do an experiment on magnetism, which metals are magnetic and why… the list goes on and on. This is the reason it is so important to have a well thought out, concise question for your science project.

Step 3 Research

No matter what the topic or purpose of your science fair project, the next step should be research. Find out all you can about your topic. Look for information that will help you understand your topic. Look for information that will help you understand your topic better and will help you design your investigation.

Be sure to use more than one source. **Make sure that you write down the name of your sources so that you can show where your information came from.**

You MUST take notes on the information that you find, but make sure not to plagiarize that information. Absolutely **all work must be your own work. You are not to copy any experiment that you may find on an internet site, or through any other venues. This is YOUR project where YOU are to find or the answers to YOUR questions and to see if YOUR hypothesis was correct.**

Step 4 Variables

Scientists use an experiment to search for **cause and effect** relationships in nature. In other words, they design an experiment so that changes to one item cause something else to vary in a predictable way.

These changing quantities are called **variables**. A variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled.

The **independent variable** is the one that is changed by the scientist. To insure a fair test, a good experiment has only one independent variable. As the scientist changes the independent variable, he or she **observes** what happens.

The scientist focuses his or her observations on the **dependent variable** to see how it responds to the change made to the independent variable. The new value of the dependent variable is caused by and depends on the value of the independent variable.

For example, if you open a faucet (the independent variable), the quantity of water flowing (dependent variable) changes in response—you observe that the water flow increases. The number of dependent variables in an experiment varies, but there is often more than one.

Experiments also have **controlled variables**. Controlled variables are quantities that a scientist wants to remain constant, and he must observe them as carefully as the dependent variables. For example, if we want to measure how much water flow increases when we open a faucet, it is important to make sure that the water pressure (the controlled variable) is held constant. That's because both the water pressure and the opening of a faucet have an impact on how much water flows. If we change both of them at the same time, we can't be sure how much of the change in water flow is because of the faucet opening and how much because of the water pressure. In other words, it would not be a fair test. Most experiments have more than one controlled variable. Some people refer to controlled variables as "constant variables."

In a good experiment, the scientist must be able to **measure** the values for each variable. Weight or mass is an example of a variable that is very easy to measure. However, imagine trying to do an experiment where one of the variables is love. There is no such thing as a "love-meter." You might have a **belief** that someone is in love, but you cannot really be sure, and you would probably have friends that don't agree with you.

So, love is not measurable in a scientific sense; therefore, it would be a poor variable to use in an experiment.

Step 5 – Hypothesis

After having thoroughly researched your question, you should have some educated guess about how things work. This educated guess about the answer to your question is called the hypothesis.

The hypothesis must be worded so that it can be tested in your experiment. Do this by expressing the hypothesis using your independent variable (the variable you change during your experiment) and your dependent variable (the variable you observe-changes in the dependent variable depend on changes in the independent variable). In other words, write it as an **"If… then…" statement.** Do not start your hypothesis with the words "I think" or "I hope" because it should be stated as fact.

Step 6 – Materials

Now that you have a hypothesis, you will need to write a list of all the materials you will need and use in your investigation. A good materials list will tell the size, quantity, or amount of **ALL** items that will be used.

Materials List Examples

A Good Materials Lists Is Very Specific	A Bad Materials List Is Vague
500 ml of de-ionized water	Water
Stopwatch with 0.1 sec accuracy	Clock
AA alkaline battery	Battery

Step 7 – Procedures

Now you need to develop an experimental procedure for testing whether your hypothesis is true or false.

The first step of designing your experimental procedure involves planning how you will change your independent variable and how you will measure the impact that this change has on the dependent variable. To guarantee a fair test when you are conducting your experiment, you need to make sure that the only thing you change is the independent variable. And, all the controlled variables must remain constant. Only then can you be sure that the change you make to the independent variable actually caused the changes you observe in the dependent variables.

Scientists run experiments more than once to verify that results are consistent. In other words, you must verify that you obtain essentially the same results every time you repeat the experiment with the same value for your independent variable. This insures that the answer to your question is not just an accident. Each time that you perform your experiment is called a **run** or a **trial**. So, your experimental procedure should also specify how many trials you intend to run. Most teachers want you to **repeat your experiment a minimum of three times**. Repeating your experiment more than three times is even better, and doing so may even be required to measure very small changes in some experiments.

In some experiments, you can run the trials all at once. For example, if you are growing plants, you can put three identical plants (or seeds) in three separate pots and that would count as three trials.

Every good experiment also **compares** different groups of trials with each other. Such a comparison helps insure that the changes you see when you change the independent variable are in fact caused by the independent variable. There are two types of trial groups: experimental groups and control groups.

The **experimental group** consists of the trials where you change the independent variable. For example, if your question asks whether fertilizer makes a plant grow bigger, then the experimental group consists of all trials in which the plants receive fertilizer.

In many experiments it is important to perform a trial with the independent variable at a special setting for comparison with the other trials. This trial is referred to as a **control group**. The control group consists of all those trials where you leave the independent variable in its natural state. In our example, it would be important to run some trials in which the plants get no fertilizer at all. These trials with no fertilizer provide a basis for comparison, and would insure that any changes you see when you add fertilizer are in fact caused by the fertilizer and not something else.

However, not every experiment is like our fertilizer example. In another kind of experiment, many groups of trials are performed at different values of the independent variable. For example, if your question asks whether an electric motor turns faster if you increase the voltage, you might do an experimental group of three trials at 1.5 volts, another group of three trials at 2.0 volts, three trials at 2.5 volts, and so on. In such an experiment you are comparing the experimental groups to each other, rather than comparing them to a single control group. You must evaluate whether your experiment is more like the fertilizer example, which requires a special control group, or more like the motor example that does not.

Whether or not your experiment has a control group, remember that every experiment has a number of controlled variables. Controlled variables are those variables that we don't want to change while we conduct our experiment, and they must be the same in every trial and every group of trials. In our fertilizer example, we would want to make sure that every trial received the same amount of water, light, and warmth. Even though an experiment measuring the effect of voltage on the motor's speed of rotation may not have a control group, it still has controlled variables: the same motor is used for every trial and the load on the motor (the work it does) is kept the same.

A little advance preparation can ensure that your experiment will run smoothly and that you will not encounter any unexpected surprises at the last minute. You will need to prepare a detailed experimental procedure for your experiment so you can ensure consistency from beginning to end. Think about it as writing a recipe for your experiment. This also makes it much easier for someone else to test your experiment if they are interested in seeing how you got your results.

<u>Example</u>: Experimental Procedure

1. Number each battery so you can tell them apart.
2. Measure each battery's voltage by using the voltmeter.
3. Put the same battery into one of the devices and turn it

on.

4. Let the device run for thirty minutes before measuring its voltage again. (Record the voltage in a table every time it is measured.)
5. Repeat #4 until the battery is at 0.9 volts or until the device stops.
6. Do steps 1–5 again, three trials for each brand of battery in each experimental group.
7. For the camera flash push the flash button every 30 seconds and measure the voltage every 5 minutes.
8. For the flashlights rotate each battery brand so each one has a turn in each flashlight.
9. For the CD player repeat the same song at the same volume throughout the tests.

Step 8 – Complete Your Investigation

Now you are ready to do the actual experiment! You CANNOT make observations only at the beginning of the investigation and at the end. You will need to make frequent observations **throughout the entire investigation** and write these observations in a journaling format as you complete your project. Make sure that you observe specific details and changes as you proceed through the experiment. Date each journal entry.

Obtain a notebook to record all of your observations during your experiment. You will copy these observations when you have completed your display on your project board.

Before starting your experiment, prepare a data table, so you can quickly write down your measurements as you observe and make them. A data table contains both the independent and dependent variables.

Follow your experimental procedure exactly. If you need to make changes in the procedure (which often happens), write down the changes exactly as you made them.

Be consistent, careful, and accurate when you take measurements, Number measurements are best.

Take pictures of your experiment for use on your display board if you can.

Step 9 Results

Your investigation is complete and you have collected data. This is the part where you have to show what happened during your investigation.

There are two parts to this section that will be included on your display board: a graph and a summary paragraph. The graph will show your data one way, while the summary paragraph will tell what your graph shows in words.

Make sure to clearly label all graphs. Include a title. Place your *independent variable on the x-axis* of your graph and the *dependent variable on the y-axis*. Include the units of measurement that were used.

A website that will help you complete your graph is:

- http://nces.ed.gov/nceskids/createagraph

Step 10 Conclusion and Reflection

This is the last step before you put it all together on your display board. Your *conclusion*

summarizes how your results support your hypothesis or do not support your hypothesis. Your *reflection* will evaluate your procedure to tell what you did right and what you might do differently if you were to do this experiment over again.

Follow these steps to write this part:

1. You will need to restate your hypothesis exactly as it was written at the beginning of your experiment.
2. Tell whether your hypothesis was *correct* or *incorrect*. If the results of your experiment did not support your hypothesis, do not change your results to for the hypothesis. Simply explain why things did not go as expected. (Professional scientists commonly find that results do not support their hypothesis, and they use those unexpected results as the first step in constructing a new hypothesis for a new investigation!)
3. Summarize your science fair project in a few sentences. You can include facts from your background research to help explain your results. If you can, talk about the relationship between the independent and dependent variables.
4. Reflect on what happened in your investigation. What went well? What did you have trouble with? This is the place where you can suggest changes in the experimental procedure or design if you were to do it again or for possible future study.

Here is an example of a good conclusion:

My hypothesis stated that If an Energizer battery was used in a toy car, then the car will run for a longer period of time. My results do not support my hypothesis. Energizer batteries did not last as long as Duracell batteries in the same toy car.

I think the tests that I did went smoothly, and I had no problems. I found out that the batteries regain some of their strength if they are not running constantly. This means that batteries would probably last longer if the device was turned off once in a while. I had to take measurements at shorter intervals because not all batteries last the same length of time. If I had to do this investigation again, I might try testing batteries at different temperatures to see how temperature affects the life of a battery.

Step 11 □ Displaying your Science Fair Project

Organize your information on a 36□ tall by 48□ wide standard, three-panel display board. It should be composed like a newspaper, so that your audience can follow the order of your experiment by reading from top to bottom, then left to right. The title of the project should be larger than the other labels of your display. Your name should be smaller and below the title in the middle section of your board.

Use color construction paper to add accents to your display board. A common technique is to put color sheets behind the white paper which contains your text. Pictures or photographs can be added to your display board. Make sure these pertain to your experiment.

The parts of the scientific method should be displayed in the positions and in the order shown. Use the diagram in the downloadable document to see where each of the parts goes on the display board. Include each step of your science fair project as a label: Question, Hypothesis, Materials, Procedure, Results, and Conclusion. Remember that the □Procedure□ has three parts that need to be displayed together.

Step 12 – Typing the research Paper

Guidelines for typing the paper:

Heading:

- Name
- Grade
- Providence Christian Academy
- Title:
- Date

Body:

Follow the format from the student’s science fair journals. Introduce each topic that is in bold print in your journals by putting it in bold print also. The order in the journal is as follows:

- Question
- Research Facts
- Hypothesis
- Variables
- Materials
- Procedures
- Safety Procedures
- Results
- Conclusion and Reflection
- Works Cited Page
- Biblical Integration

Students will use their journal information to type a one page paper – using Times New Roman, 12 font. This should NOT be double spaced. The one difference will be that the works cited page will not be included after the research facts as it appears in their journals.

Step 13 – Biblical Integration

This is a great way to help students develop a Biblical worldview. After learning through throughout your experiments, as yourself How can I see God's attributes? How are the characteristics of God seen through the laws of science? Is God orderly? This section should be at least one paragraph.