**Vocabulary**

**Ahhhhh, What is the question?**

Once you have chosen a topic of interest, you will need to create a related scientific question. Without a good question, your whole science fair project will be much harder, if not impossible! It is important to select a question that is going to be interesting to work on for at least a few weeks and that is specific enough to allow you to find the answer with a simple experiment. A scientific question usually starts with: How, What, When, Who, Which, Why, or Where. Here are some characteristics of a good science fair project question:

* The question should be interesting enough to read about, then work on for the next few weeks.
* There should be at least three sources of written information on the subject. You want to be able to build on the experience of others!
* The question should contain one factor (variable) that you can change in your experiment and at least one factor (variable) that you can measure.

Now, for something like a science fair project, it is important to think ahead. This will save you a lot of stress and unhappiness later. Visualize the experiment you might perform to answer your question. How does that possible experiment stack up against the following issues?

* The experiment should measure changes to the important factors (variables) using a number that represents a quantity such as a count, percentage, length, width, weight, voltage, velocity, energy, time, etcetera. Or, just as good might be an experiment that measures a factor (variable) that is simply present or not present. For example, lights *on* in one trial, then lights *off* in another trial, or *use* fertilizer in one trial, then *do not use* fertilizer in another trial. If you cannot observe or measure the results of your experiment, you are not doing science!
* You must be able to control other factors that might influence your experiment, so that you can do a fair test. A "fair test" occurs when you change only one factor (variable) and keep all other conditions the same.
* Is your experiment safe to perform?
* Do you have all the materials and equipment you need for your science fair project, or will you be able to obtain them in a reasonable amount of time at a cost that is okay for your family?
* Do you have enough time to do your experiment before the science fair? For example, most plants take weeks to grow. If you want to do a project on plants, you need to start very early! For most experiments you will want to allow enough time to do a practice run in order to work out any problems in your procedures.
* Does your science fair project meet all the rules and requirements for your science fair?
* Have you avoided the bad science fair projects listed in the [Science Fair Topics to Avoid](https://www.sciencebuddies.org/science-fair-projects/science-fair/science-fair-project-question#topics-avoid) table in this project guide?

If you do not have good answers for these issues, then you probably should look for a better science fair project question to answer.

Keep in mind that science fair projects that involve human subjects, vertebrate animals (animals with a backbone) or animal tissue, pathogenic agents, DNA, or controlled or hazardous substances, often need approval from your science fair's Scientific Review Committee **beforehand**. Check with your teacher or the science fair coordinator for rules specific to your science fair. You can also read more about common science fair rules on our [Scientific Review Committee](https://www.sciencebuddies.org/science-fair-projects/competitions/scientific-review-committee-src) page.

Variables for Beginners

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Doing a Fair Test

It is important for an experiment to be a **fair test**. You conduct a fair test by making sure that you change one factor at a time while keeping all other conditions the same.

For example, let's imagine that we want to measure which is the fastest toy car to coast down a sloping ramp. If we gently release the first car, but give the second car a push start, did we do a fair test of which car was fastest? No! We gave the second car an unfair advantage by pushing it to start. That's not a fair test! The only thing that should change between the two tests is the car; we should start them down the ramp in exactly the same way.

Let's pretend we're doing an experiment to see if fertilizer makes a plant grow to be larger than a plant that doesn't receive fertilizer. We put seeds of the same kind in three pots with fertilizer and rich soil. But, we run out of soil so we put the seeds without fertilizer in three pots filled with sand. We put all six pots in the same location and water each one with the same amount of water every other day. The plants with soil and fertilizer grow to be much larger than the ones grown in sand without fertilizer. Is that a fair test of whether fertilizer makes a plant grow to be larger? No! We changed two things (type of soil and fertilizer) so we have no idea whether the plants with fertilizer grew to be larger because of the fertilizer or whether the other plants were stunted by being grown in sand. It wasn't a fair test! All of the plants should have been in the same kind of soil.

Conducting a fair test is one of the most important ingredients of doing good, scientifically valuable experiments. To insure that your experiment is a fair test, you must **change only one factor at a time while keeping all other conditions the same**.

Scientists call the changing factors in an experiment **variables**.

**Hypothesis:**

A hypothesis is an educated or reasonable guess based on an idea that one would like to figure out.

**alternative hypothesis:**

The alternative hypothesis, H1, is the clear and concise statement of the initial claim.

**null hypothesis:**

The null hypothesis,  Ho, is the opposite of what you are hoping to claim.

**hypothesis testing:**

Hypothesis testing involves testing the difference between a hypothesized value of a population parameter and the estimate of that parameter which is calculated from a sample.