

# Steps of the Scientific Method

## 1. Ask a Question

The scientific method starts when you ask a question about something that you observe: How, What, When, Who, Which, Why, or Where?

For a science fair project some teachers require that the question be something you can measure, preferably with a number.

## 2. Do Background Research

Rather than starting from scratch in putting together a plan for answering your question, you want to be a savvy scientist using library and Internet research to help you find the best way to do things and ensure that you don't repeat mistakes from the past. **As well you need to know a lot of information so that you understand your topic.**

### Questions to answer during background research:

#### Why:

Why does \_\_\_\_\_ happen?

Why does spiciness happen?

Why do spicy foods taste hot?

#### How:

How does \_\_\_\_\_ happen?

How does the tongue detect spiciness?

How does one measure spiciness?

How does \_\_\_\_\_ work?

Who needs spiciness?

How do you measure \_\_\_\_\_?

What causes spiciness to increase or decrease?

How do you use \_\_\_\_\_?

What are the properties and characteristics of spicy substances?

#### Who:

Who needs \_\_\_\_\_?

When does spiciness cause upset stomachs?

Who discovered/invented \_\_\_\_\_?

Where in the body does spiciness occur?

#### What:

What causes \_\_\_\_\_ to increase or decrease?

What is the composition (what is it made of) of \_\_\_\_\_?

What are the properties and the characteristics of \_\_\_\_\_?

What is the relationship between \_\_\_\_\_ and \_\_\_\_\_?

**When:**

When does \_\_\_\_\_ cause \_\_\_\_\_?

When was \_\_\_\_\_ discovered or invented?

**Where:**

Where does \_\_\_\_\_ occur?

Where do we use \_\_\_\_\_?

**Some important points that I learned about my topic are: Write things below that you found are important to your topic.**

**3. Construct a Hypothesis and decide on your variables.**

**A hypothesis is not simply a guess! It's a statement of what you believe will happen based on the information you have gathered.**

It is an attempt to answer your question with an explanation that can be tested. A good hypothesis allows you to then make a prediction:

"If \_\_\_\_\_ [*I do this*] \_\_\_\_\_, then \_\_\_\_\_ [*this*] \_\_\_\_\_ will happen."

State both your hypothesis and the resulting prediction you will be testing. Predictions must be easy to measure.

- **If** 7th graders and 8th graders complete the same math problems, **then** the 8th graders will get more answers correct, **because** they have studied math or one year longer than the 7th graders.
- **If** dry bread and moist bread are left in bags for two weeks, **then** the moist bread will grow mold more quickly than the dry bread, **because** mold is a living organism, and organisms need water to survive.
- **If** some students eat breakfast before school and others do not, **then** the ones who do eat breakfast will have better grades in their morning classes, **because** their brains have more energy to think.

## Variables and Constants Cheat Sheet:

Scientists use an experiment to search for cause and effect. There are many items that could be altered to test the reaction of another. 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.

**Independent variable:** the one that I am manipulating or changing on purpose.

**Dependent variable:** the one that gets changed as a results, what I am measuring and recording in my data table.

**Constants:** everything that stays the same throughout the trials.

**Example Question:** How does the type of water affect the growth of a plant?

I.V. type of water

D.V. growth of the plant

Constants: location of the plants, how much I

water them, the type of plants I use.

## 4. Test Your Hypothesis by Doing an Experiment

Your experiment tests whether your prediction is accurate and thus your hypothesis is supported or not. It is important for your experiment to be a fair test. You conduct a fair test by making sure that you change only one factor at a time while keeping all other conditions the same.

You should also repeat your experiments several times to make sure that the first results weren't just an accident.

## Experimental Procedure Checklist

What Makes a Good Experimental Procedure?	For a Good Experimental Procedure, You Should Answer "Yes" to Every Question
Have you included a description and size for all experimental and control groups?	Yes / No
Have you included a step-by-step list of all procedures?	Yes / No
Have you described how to the change the independent variable and how to measure that change?	Yes / No

What Makes a Good Experimental Procedure?

For a Good Experimental Procedure, You Should Answer "Yes" to Every Question

Have you explained how to measure the resulting change in the dependent variable or variables? Yes / No

Have you explained how the controlled variables will be maintained at a constant value? Yes / No

Have you specified how many times you intend to repeat the experiment (should be at least three times), and is that number of repetitions sufficient to give you reliable data? Yes / No

The ultimate test: Can another individual duplicate the experiment based on the experimental procedure you have written? Yes / No

If you are doing an engineering or programming project, have you completed several preliminary designs? Yes / No

Examples:

## 5. Analyze Your Data and Draw a Conclusion

Once your experiment is complete, you collect your measurements and analyze them to see if they support your hypothesis or not.

Scientists often find that their predictions were not accurate, and their hypothesis was not supported, and in such cases they will communicate the results of their experiment and then go back and construct a new hypothesis and prediction based on the information they learned during their experiment. This starts much of the process of the scientific method over again. Even if they find that their hypothesis was supported, they may want to test it again in a new way.

For detailed help with this step, use these resources: