Materials List & Procedure

Materials List

What type of equipment will you need to complete your experiment?

Make a materials list being as specific as possible, and be sure you can get everything you need before you start. Visit our Supplies & Materials Web page for tips on places to purchase some of the harder to find items that you may have on your list.

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

Procedure

Now that you have come up with a hypothesis, you need to develop a procedure for testing whether it is true or false. This involves changing your independent variable and measuring the impact that this change has on the dependent variable. When you are conducting your experiment, you need to make sure that the only thing you change is the independent variable so that you are only measuring the impact of that single change. All the controlled variables must remain constant.

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**.

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 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 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.

Key Elements of the Procedure for an Experiment

- Description and size of all experimental and control groups, as applicable
- A step-by-step list of everything you must do to perform your experiment. Think about all the steps that you will need to go through to complete your experiment, and record exactly what will need to be done in each step.
- The procedure must tell how you will change your one and only independent variable and how you will measure that change
- The procedure must explain how you will measure the resulting change in the dependent variable or variables
- If applicable, the procedure should explain how the controlled variables will be maintained at a constant value
- The procedure should specify how many times you intend to repeat your experiment, so that you can verify that your results are reproducible.

Where will you conduct your experiment? You may need a lot of room for you experiment or you may not be able to move your experiment around from place to place. If you are working with human or animal subjects, you may need a location that is quiet. You will need to think about these limitations before you start your experiment so you can find a location in advance that will meet your needs.

Your Assignment

Type your materials list and procedure in a word processor.

Grading Yourself

What Makes a Good Materials List?	For a Good Materials List, You Should Answer "Yes" to Every Question
Have you listed all necessary materials?	Yes / No
Have you described the materials in sufficient detail?	Yes / No

What Makes a Good Procedure?	For a Good 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 independent variable and how to measure that change?	Yes / No
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, 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 procedure you have written?	Yes / No
If you are doing an engineering or programming project, have you completed several preliminary designs?	Yes / No

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