

The First Thing A Research Advisor Asks You: Did you run the correct controls?

In the world of experimental science, the notion of controls and variables are essential for obtaining valid pieces of data. Scientific controls are used to study one variable of an experiment at a time. Controls allow for a frame of reference to compare your experiments with, and then you can make conclusions based on your results. Thus, knowing how to create a sound experiment with the proper controls is critical to performing research.

A variable is a factor of an experiment that can be, as the name implies, varied. In order to test one variable, two experiments need to be run, where the only difference is the factor (variable) that needs to be tested, while all other factors are held constant. There are two types of controls: a positive control and a negative control. In a positive control, the procedure is similar to the actual experiment, but whose results are known from previous tests to yield a positive result. Conversely, a negative control yields a negative result.

A somewhat trivial (but relevant) example is the testing of a certain pH paper that only turns red when exposed to an acid. A positive control is to see if dipping the pH paper in a known solution of hydrochloric acid turns the paper red. A negative control would be to check and see if a non-acid solution, such as a base, does not change the color of the paper.

Running the correct controls is critical not just in obtaining data from an experiment, but also to determine what may be wrong when an experiment is not working. For instance, if your experiment is not working, and the positive control is also failing, then something is wrong with the procedure itself, and the data obtained from the original experiment is not necessarily valid. Then with other controls, one may be able to determine the problem with the pro

- So the first part of the assignment is to determine what a positive and a negative control would be for the following experiments (some of the negative controls may be a little tricky):

(1) Using a speed radar gun in order to determine the speed of a baseball.

(2) Testing the effectiveness of a certain headache drug in patients that seems to work better than aspirin.

(3) To see if water is able to dissolve a certain solid powder X.

- In the next part of the assignment, you have to find an experiment that is performed in a scholarly journal article and identify the positive and negative controls that those scientists performed. (Sometimes they may not have presented that data in the paper, and at that point, you can come up with some logical ones of your own)

- In the last part of the assignment, you will come up with your own experiment (it does not have to be complex) and give positive and negative controls for the experiment.