How to Setup a Good Experiment

In an experiment we are looking for "Cause-and-Effect". For any effect (change) we want to know what caused it To do this we have to be able to setup and conduct good experiments.   EVERYTHING in science hinges on (depends on) good experiments.

Let's set up a basic thought experiment to help us understand how good experiments work:
"*Which brand of car wax keeps a car clean longer: WonderWax; EZshine; or Crystal Car?*"

Topic 1—Types of variables

1) **Experimental Variable**—the one you are studying. We change the experimental variable to see if it causes an effect. In the wax experiment: the brand of wax is our experimental variable. We are going to change waxes to see what effect they have on how long our car keeps clean. A good experiment has only one experimental variable.   If you change more than one variable you won't know what caused the effect.

2) **Control Variables**—the ones we keep the same by controlling them. Everything other than the experimental variable in the experiment should be controlled so that they don't have any effect. There should be as many control variables as possible. In the wax experiment: we should use the same car (so it experiences the same driving conditions), the same area of the car (different parts of the car experience different amounts of dirt); clean all parts of the car the same to begin with.

3) **Responsive Variable**—what we are recording to see if it was affected by the experimental variable. In the wax experiment: the amount of dirt is the responsive variable. You want to see how the cleanliness of the car changes over time with each wax. Figuring out how to measure this objectively would be difficult, of course.

Topic 2—Control Setup

A control setup does not have the experimental variable. It is designed to show us whether or not the experimental variable has any effect at all OR has a deleterious (negative) effect.

In our wax experiment: our control setup is a part of the car without wax. It is altogether possible that some (or all) of the waxes could absorb or attract dirt. Without a portion of the car being wax-free, you would not be able to learn this.

Experimental Variable

Control Setup

	WonderWax	EZShine	Crystal Car	No wax ◄
Day 1				
Day 2				
Day 3				
Day 4				
Day 5 (etc)				

Control Variables: John's Ford Mustang (same car); center of hood (same region of car); car cleaned beforehand.

Topic 3—Double-Blind Tests

In a double-blind test neither the test subject nor researcher know which experimental variable is which to remove bias.
In the wax-experiment: a true double-blind setup would hide the name of the brands by labeling them Brand A, Brand B, etc. and take down the data unbiased. Why? What if we've used one of the brands before?   We might be biased to think that it works better than the others just because we use it or like it already. How could we skew (bend) the results? Which one is cleaner is a bit nebulous (uncertain), so we might just think that our favorite brand *seems* a bit cleaner.
Another example would be taste-testing brands of cola. If I asked you to taste-test four different brands of cola to see which one you like best, you would be hard pressed (it would be difficult) to be unbiased. You're inclination would be to like the brand you already drink, so we hide the names behind paper or pour them into unmarked plastic cups. Also, the tester should not know which brand is which or they might give facial signals or gestures to "tip you off" to which is your "believed" favorite or, if they are associated with one of the brands, to prove theirs is the best. To be a good experiment, neither of us should know which brand is which until after you have decided.
If you can't do a double-blind test, then a single-blind can be OK. In the single-blind test, the researcher knows the experimental variable, but not the test subject. Yet, if the test subject is unable to see the researcher (by being blind folded, etc) we should still get good results.
Double-blind tests are not necessary for experiments that record concrete data (measurements with instruments), since the data is not subjective (prone to interpretation and bias).   For bias to exert itself, you would have to actually fake the data.