What follows is certainly not the only way to write a paper, but in my opinion this is a great recipe. To me it comes from experience reading and performing my own projects. Variations on the theme are usually welcome, but the idea is not to become baroque with your writing. Instead, keep the writing simple and the substance of the experiment stirring -- sell the product, not the packaging.

First, define a scientific or engineering problem or question. It is OK for this to be complicated and unanswerable at this point -- not all questions are answerable. Make sure you can describe the reasons why this question/problem is important.

Identify a small hypothesis test that will help better understand the question or the problem. If you have not yet, read up on scientific method. This test should be as simple as possible, because later there will be a flourish of other questions that will spring from this one. Think of it as a small piece of the puzzle, not the entire puzzle. This step is by far the hardest and the most important part of the whole process. One reason is because someone else may be better equipped to perform the test. Another is that you can easily come up with a test that will take you the rest of your life to complete. Another is that someone else has already performed the test or even answered the question -- so read up, search literature, ask experts, and understand the field.

Now design an experiment. The design should be the best way to answer the question, not how to use the equipment you have in the context of the question. Keep it simple. It's time to consider now how you want the figures to look -- what type of figures would you want and expect to see if you were reading someone else's paper that was trying to answer the question? Make a sketch. The best way to approach the problem scientifically is to develop one or more hypotheses that can be rejected. If not, try to frame the experiment as a competition of alternatives -- which one is the winner? Here is the time to consider a really important question: what's the worst possible outcome? If you are going to invest your time, make sure you something to report no matter what.

Now, write a rough (I really mean rough) draft of the Introduction of the final paper you will submit. Make sure you do a literature search to place your contribution in the context of other projects. Here is the structure:

- Paragraph 1 briefly defines the problem and its importance, and at the end you should say briefly that this paper intends to address the problem in a certain way.
- The next paragraphs should deal with the problem and how others might have tried to solve it. What new questions did they uncover? What remains to be looked at and understood? Who do you think is Wrong and why?
- Final Paragraph: Mention what you intend to do. People who have experience reading papers will look for the words, "in this paper..." Mention in one sentence how you will do it, and briefly what the general results were.

At this point you should know what the specific hypotheses are and how you will test them. If they are simple and important, they will be remembered. Ask yourself this: "What simple summary statement might a reader remember this project by?" (This statement can usually be the title of the paper.)

Now stop writing and do the experiment. After the first subject or two, you should be analyzing data. Perhaps you need more trials, more subjects, or better measures. Perhaps the entire thing was a bad idea and you need to take a different tack. Many answers are questionable.

Once you have the data, check the statistical power, and then write the Results section. Keep it brief. Summarize key results as a topic sentence of each paragraph. If there are a lot of complicated results, make a final summary. Use figures whenever possible to communicate results; tables are rarely the best way to do things.

Now write the Methods section. This usually should be done in the following order: Mathematical development and/or models, subject descriptions (e.g., ages), experimental protocol, analytical measures, and statistical procedures.

Now go back and see if the intro needs tuning. It usually does by this point. Work out whether all of the results that you show address the framework and the questions that you raised in the introduction. If not, you must decide whether to embellish the introduction in order to accommodate new results, or trim out the unnecessary results and save them for future manuscripts. Therefore, this is the time when you might go from Introduction to Results to Methods and back several times to get the paper to flow.

Now write the Discussion section. The purpose of the Discussion is to fit your work into the rest of the world's state of knowledge. It structure is much more loose from one discipline to another. Here's a typical structure:

- Start it with a paragraph that summarizes the key results in the context of the question(s) you asked in the introduction. In layman's terms, explain why the results are important. Perhaps tell the reader about the paragraphs to come.
- Compare and contrast your study with others in the literature. What contributions did this paper make? Does it break down a hypothesis or support one?
- List the limitations of the study, and suggest other tests that might resolve them.
- Discuss implications of your study in science, medicine, engineering, etc.
- Many authors discussing what you will do in the future. This is usually a bad idea -- what if you do not do it?
- Hypothesize and speculate on the data. If possible, provide a model for what the data might suggest. This should lead to new questions that need to be answered by more research.

Proofread, check your references do a final literature search to add new information, and submit. Reflect on the process, and let Jim know how he should revise this recipe.