What a Scientific Explanation Looks Like

What do you have to do to be a good scientist? There are a lot of things, but here is one possible list:

- ask researchable questions.
- generate testable explanations.
- collect, represent, and analyze data
- interpret results
- use evidence to construct and evaluate explanations
- communicate findings

That’s a lot of stuff. We will spend time on all of it this year. This document focuses on one part of one of the bullets: the use of evidence to construct explanations.

Some people who spend a lot of time thinking about this kind of thing have suggested that there are 3 major parts to a scientific explanation:

1. They emphasize evidence
2. They are logically consistent
3. They use scientific principles, models, and theories.

This is all well and good, but it’s not really a procedural definition. It doesn’t tell you what you need to do, it really only describes how what you will do must look. Certainly, you are of a high enough ability to probably be able to look at the above three criteria, and develop a process to get you to such a product, but why work harder than necessary? To that end, you will be expected to utilize the following procedure to develop the explanations you will create and utilize in this class:

1. Make a claim about the problem.
2. Provide evidence for the claim.
3. Use reasoning that links the evidence to the claim.

Now we’re getting somewhere. But let’s go even further and take each one of these in depth:

1. Make a claim about the problem
   A claim is a statement of your understanding about the thing you are investigating. You can make claims about the evidence you gather in a lab, or that you learn about in other aspects of this course. You can even make claims about things that aren’t in this course at all (but let’s focus on science-related claims for the purpose of this document). You should expect that your claim will have the following properties:
   - It’s at least one complete sentence in length (it’s probably only one complete sentence in length).
   - It will be the first sentence(s) in your explanation.
   - If it’s a claim about a specific question, it answers that question.
   - If it’s a claim about the relationship between two variables, it will describe the relationship between those variables.

2. Provide evidence for the claim

Adapted by D. Knuffke from Sutherland, McNeill, & Colson in Linking science & literacy in the classroom.
Evidence is data. Data comes from a lot of places. You will gather data in labs, and you will be provided with data that supports all other aspects of this course. Over time, you will learn what types of data are best used to support particular claims. You should expect evidence will have the following properties:

- The evidence will be **sufficient** to answer the claim. In other words, there will be enough of it.
- The evidence will be **appropriate** for the explanation. In other words, it will be connected.
- The data will be **interpreted**, not just listed. An explanation of what the data shows, and how that supports the claim will be provided.
- Superfluous data that may be generated during an investigation will not be used to justify a disconnected claim.

3. Use **reasoning** that links the evidence to the claim

Reasoning is the tricky part of generating an explanation. Anyone can make a claim. And anyone can supply evidence for a given claim. But the ability to use logically consistent reasoning when constructing a claim is what separates good scientists from hacks. You should expect that your reasoning will have the following properties:

- Reasoning will be based on **scientific principles**—accepted understandings in science.
- Reasoning will also show **how** a particular principle connects particular evidence to a particular claim.
- Some folks have suggested that it’s helpful to think of reasoning as a **bridge** that connects the evidence to the claim.

Now we have a procedural process that can be used to generate a scientific explanation. When making an explanation, if you go through 1-3 in sequence, you’ll most likely wind up with a pretty solid, scientifically valid, explanation. But since this is science, there are a few other aspects of your explanation that you should look out for:

- Your language should be **precise**.
- Your language should be **accurate**.
- Your explanation should be appropriate for your audience. An explanation written for me will be different from one written for a fellow student, or a parent, or a sibling. In all cases, you should operate under the expectation that you are writing so that someone who was not present for a particular investigation of the course could still read your explanation and get some idea of what you did and how you did it.

So, that’s the deal. This is the way that you will be expected to make all explanations in this course for the entire year. While I don’t expect you to be perfect at this, even at the end of the year, I do expect that when feedback is provided about your explanations, you will understand what I’m speaking about if I say something like “your evidence is insufficient”, or “this does not seem to be as precise as it could be”. Certainly, if you do have questions about any of this, never hesitate to ask. Now, for instance, would be a great time.

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