Writing the Discussion

> The scientific method does not require researchers to be unbiased observers of nature. Scientists almost always have a theory in mind when they perform an experiment. But the method does require that scientists be willing to change their views about nature when the data demand it.
>
> R.M. Hazen and J. Trefil, 1991. Science Matters

In the discussion, you interpret your results in the context of the specific questions you set out to address in the experiment.

You must consider the following issues:

1. What did you expect to find, and why?

2. How did your results compare with those expected? If you set out to test specific hypotheses, do your data support one hypothesis more than another, or allow you to eliminate one or more of them?

3. How might you explain any unexpected results?

4. How might you test these potential explanations?

5. Based on your results, what questions might you want to ask next?

Very important:

Every experiment that was properly carried out tells you something, even if that something was not what you specifically intended to find out.

Organizing your discussion: an example of how to arrange the paragraphs.

P1. The most important finding goes first, not necessarily the first finding.

Gets the most important point into the mind of the reader before you have a chance to lose them.

P2. The next most important finding goes next, etc.

P3. Next, a paragraph describing your method and its potential limitations/improvements to future studies.

This paragraph keeps you honest and humble to the reader.

P4. Concluding paragraph that summarizes your findings and (i) expresses the benefits of the research, and (ii) proposes future activity.

Pulls the entire study together.
Sets up your thoughts (as well as the reader's) for the next study.

A model for writing your paragraphs: a six-section structure.

1. A general statement setting up the paragraph (sort of like in the introduction)
2. A reference to narrow the focus
3. Explanation of the reference
4. Transition into your new data
5. Your new data
6. Explanation of your new data

Example discussion section:

> The use of rank abundance plots to describe bacterial communities has remained rare, probably due to the complexities involving analysis. A notable exception is the work of Jackson et al. [25] who generated rank-abundance plots based on banding patterns of DNA fingerprints of biofilm succession. They showed overall, that the evenness of the bacterial community became greater as succession progressed. Our observations of forefield succession revealed the opposite trend. In both transects, the slope of the rank-abundance plots significantly increased from the 0-y to 100-y soil (p<0.05) (Fig. 5, Table 2). This data, combined with the band-based estimation of species richness, suggested that not only did the number of dominant organism types decrease with succession, so did the community evenness.

How does this break down? There is a method to the madness.

General statement: The use of rank abundance plots to describe bacterial communities has remained rare, probably due to the complexities involving analysis.

A reference to narrow the focus: A notable exception is the work of Jackson et al. [25] who generated rank-abundance plots based on banding patterns of DNA fingerprints of biofilm succession.

Explanation of the reference: They showed overall, that the evenness of the bacterial community became greater as succession progressed.

Transition into your new data: Our observations of forefield succession revealed the opposite trend.

Your new data: In both transects, the slope of the rank-abundance plots significantly increased from the 0-y to 100-y soil (p<0.05) (Fig. 5, Table 2).

Explanation of your new data: This data, combined with the band-based estimation of species richness, suggested that not only did the number of dominant organism types decrease with succession, so did the community evenness.

Remember:

State your expectations explicitly, and back your statements up with a reference.

Begin your discussion on firm ground.

Another example: shorter but follows the same format.

> While no detailed study of endolithic community structure has relied on molecular analysis, previous investigation of cyanobacterial communities in arid soil crusts on the Colorado Plateau revealed sequences similar to those of several unidentified cyanobacteria as well as the genera *Oscillatoria*, *Chroococcidiopsis*, *Scytonema*, *Leptolyngbya*, *Microcoleus, and Phormodium* (Garcia-Pichel et al. 2001, Redfield et al., 2002). Therefore, it is no surprise that the majority of the organisms detected in the current study following 16S rRNA gene sequence analysis (Table 2) are most similar to those observed previously in environments characterized by similar selective pressures. This data suggests that stresses common to endolithic environments worldwide have selected for a niche-specific assemblage of tolerant organisms.

Explaining Unexpected Results

Don't blame the equipment, partners, or yourself. Do not apologize.

Some type of scientific variability (remember lecture 2?) is likely to blame…but may result in a more interesting story than the one originally intended.

Examine your data; ask yourself "how could this result have occurred?"

Check your methods again.

Example:

> It has been reported previously that a single, highly concentrated application of bacteria resulted in little disruption of the soil microbial community (27, 32). In the current study we observed that daily applications of *P. aureofaciens* for 123 days at rates of 2.8 x 10^6 cfu cm^{-2} resulted in no detectable impacts on the overall soil and thatch bacterial community (Fig. 4). Evaluation of the plant canopy bacterial populations showed that the introduction of *P. aureofaciens* displaced only one member of the native population. **Although we expected a greater impact by the applied community it is possible that the high microbial diversity in the leaf canopy environment may have masked other changes. It is also a possibility that the tremendous bacterial diversity in these systems limits DGGE evaluation of the dominant members of the bacterial community (25).**

When explaining unexpected results:

Always be careful to distinguish possibility from fact.

Use weaker words like *suggest*, *might*, *likely*, etc. as opposed to *show*, *indicate*, *prove*, etc.