Statistics in a Biological Sciences Context

For my biometry (statistics) course my approach is to first describe the epistemological cycle (mostly review material) and discuss how statistics are used to evaluate hypotheses. I typically then introduce data and describe ways that we can summarize centrality and variability, followed by an introduction to useful ways to present different kinds of data visually.

When I next introduce concepts related to probability—how to count the potential number of outcomes associated with an event—students are generally a little perplexed and worried that they will get lost in the mathematics. Most students have an intuitive feel for probability, but do have no idea how to solve probability problems. My approach is to begin with simple examples that allow them to enumerate the total number of possible outcomes of an event—the denominator used to compute probability—and then introduce formulae that can be used to find answers to larger scale, analogous problems. For example, I discuss card games or the number of different kinds of two-scoop ice cream cones that could be constructed from a given number of flavors. I then scale up to more relevant biological problems like, say, how to determine the number of ways subjects could be assigned to various experimental treatments. I typically follow this approach for each new concept or statistical test that is introduced.

Instructors encounter numerous challenges in a biometry class. The students may have a variety of backgrounds in biology—some my be ecologists and others molecular biologists—so that specialized approaches to data collection and the data sets used as examples sometimes encumber the introduction of statistical procedures. In general, students also arrive to class with preconceived notions based on personal experiences, which even with evidence are sometimes not easily changed. Perhaps a greater challenge is the poor set of mathematical skills that some students bring to the class. For instance, some students have forgotten the order of operations used in the evaluation of mathematical expressions. A potential solution to this problem is to use a pretest to determine how well students are prepared for the class or to prepare a packet with a variety of problems that demand the use of mathematical techniques applied in the class, where those students who are unable to answer the questions—perhaps self-determined—might be required to complete additional homework assignments that help them develop the needed techniques. The most difficult challenge for me as an instructor, however, seems to be the identification of data sets or conceptual problems that lead students to recognize problem similarities, situations in which a particular problem is just a variant of a problem they have already solved. Perhaps the use of biological examples—not typically found in textbooks—that are of greater relevance to the daily lives of students might help to strengthen these connections.

The primary aim for my course is to teach students how to apply statistical inference to biological problems and to introduce them to some of the basic statistical procedures that are used. My goal is to provide students with a solid foundation that they can transfer to courses in which more complicated statistical procedures are learned. I hope especially that they remember critical points like, say, how the choice of an appropriate statistical procedure depends on the measurement level of data—nominal, ordinal, interval, ratio—and that statistical inference depends on how subjects are sampled and the use of appropriate controls. I hope too that students apply what they learn in the class to become evidence-based, informed citizens and consumers, as many students may not find themselves in a job that requires the direct use of statistics. For example, I hope that every student who takes my class raises his or her eyebrows a little when they read or hear that this or that drug or diet has been *scientifically proven* to reduce …