FROM THEORY TO HYPOTHESIS TO TEST: APPLYING SCIENCE TO TEACHING BIOLOGY

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ABSTRACT

Producing a scientifically literate society has been a goal of science education since the 1980's. However, numerous authors have shown that such a goal has not been effectively implemented in the pre-college curriculum. Data collected from surveys of the American public have shown that society in general still accepts non-scientific explanations for natural phenomena and that pre-college teachers generally possess an inadequate knowledge of the methods of science. During that same time period scientists and educational researchers have been exhorting science teachers and curriculum designers to teach science like science is done. Students need to learn the tools that will help them judge 1) whether an explanation for some natural phenomenon is indeed scientific and 2) whether a piece of research was done correctly.

For explanations of natural phenomena, a scientifically literate public should be able to recognize the characteristics of a scientific theory and hypothesis. They should realize that theory is more than mere opinion. For experiments they should be able to identify suitable controls and replicates and be able to ask whether the experiment fits the hypothesis. I describe a teaching technique that I used in the lecture and lab portions of an introductory biology class that I taught to majors and non-majors at Dakota Wesleyan University. The technique starts with a theory from which is developed a hypothesis, which is then tested.

In lab: I introduce a theory, explain its nuances and then suggest a hypothesis and show the students how to test it (the theory and test are given in their lab books, but not the hypothesis). The students then carry out the test, after which we discuss the outcome in terms of our hypothesis, accepting or rejecting it. Then I charge them to come up with a hypothesis of their own based on the theory and the test they have completed. In the following week they must have written their hypothesis and described their test and expected outcome. They also must have a copy of one piece of scientific literature that relates to their hypothesis. They set up their experiment, run it, gather data, analyze it and then as a group write a formal paper. The paper is submitted for review, sent back for corrections and then resubmitted for a grade. The papers are graded on style, and experimental design.

In lecture: I propose a theory, give an example from the literature of the test and ask for an expected outcome. Sometimes I will ask groups to select a hypothesis to test, and/or suggest the test and the expected outcome.