THE GENETICS OF LEARNING AND MEMORY

EXPLAINING OUR TEACHING METHOD

WHY SHOULD I TEACH THE NATURE OF SCIENCE?

"Science literacy" can mean different things to different people. Most would agree that an understanding of science should include not only scientific knowledge (photosynthesis, conservation of matter), but also knowledge *about* science, how it works, and what its purpose is – what we refer to as **the nature of science** (NOS). NOS instruction should include discussions of the processes of science and the characteristics of scientific knowledge. The goal of this website is to help you think about and carry out this type of instruction. Our major learning objectives for this curriculum center around two fundamental aspects of the nature of science: that scientific knowledge is both tentative and durable, and that science is a unique way of knowing. These learning objectives are outlined in "Enduring Understandings", which can be found in the Explore!Gallery and in the Teacher Guides.

HOW SHOULD I TEACH THE NATURE OF SCIENCE? DISCOVERING WHAT WORKS

We know that understanding aspects of the nature of science is an important part of scientific literacy. But how should we teach it? Science educators have provided some insight for us here. A complete understanding of the nature of science includes:

- understanding how science is done,
- recognizing the special characteristics of scientific knowledge,
- examining and appreciating the history of scientific endeavors.

Common-sense tells us that in order for students to understand these characteristic of scientific knowledge, they should *do* some science. However, a wealth of research in classrooms has shown that although students may be able to model science in their laboratories or through inquiry activities, these approaches are not particularly effective at helping students understand the nature of science (Lederman, 1992, 1998). (In a like manner, you can go through the process of figuring out and filing your taxes even if you do not understand the tax laws themselves or the philosophies behind them.) Similarly, just because someone *does* scientific experiments in the laboratory does not necessarily mean that they will inherently come to understand the characteristics of scientific knowledge.

LABS, ACTIVITIES & HISTORY ARE IMPORTANT – BUT THEY AREN'T ENOUGH FOR NOS!

Please don't misunderstand us! Laboratories and activities and the history of science are important and can foster a great deal of enthusiasm and learning in a classroom. It makes common sense that that the best way of learning *about* science would be *doing* science. However, a number of classroom studies have demonstrated that doing science or reading about others doing science are simply **not** enough to teach NOS concepts. Instead, NOS concepts must be learned in a more direct manner, so that students (and teachers!) can actually see NOS concepts as pieces of knowledge to be learned, rather than just some "background" information.

THE EXPLICIT, REFLECTIVE APPROACH TO TEACHING NOS

A large number of studies have demonstrated that the most effective way to teach NOS concepts is the **explicit, reflective instructional approach** (Akerson, Abd-El-Khalick, & Lederman, 2000; Lederman & Abd-El-Khalick, 2000). **Explicit** means that in order to teach NOS concepts you have to target these ideas directly, through activities, discussions, and writing. A teacher cannot rely on students to pick up these ideas simply because they *seem* apparent in a body of science content. Instead, teachers must have students talk, think, and debate these ideas in order to make sense of them. **Reflective** means that students need to consider what they know about the topic in order to change their minds or continue learning about it. Instruction should make students aware of what they are thinking and make them aware of how their ideas differ from the scientific way of knowing if there is *any* hope of changing their minds.

TEACHING NOS WITH STILT

Because of what we know about NOS teaching and learning, this web-based curriculum has specific characteristics that facilitate teaching NOS:

1. An automated pretest and posttest that tells students immediately what they think about a topic, in order to allow students to reflect on what they know.
2. Biology based activities that allow both the teacher and students to investigate the NOS concepts found in biological knowledge, allowing instruction to be largely student-centered.
3. NOS prompts throughout the activities allowing instruction to be explicit.
4. Associated assessments and extension activities that allow for further student reflection.

All of these characteristics "stack the deck" so that NOS learning might occur.

FINAL ADVICE, FINAL PLEAS!

We know that NOS learning is hard, but it is important! We've created a curriculum that will provide an optimal chance for such learning to occur. Based upon past research in this area we urge you, implore you, (okay, we're begging): Use the pre and posttests! Use the elaborate activities! Have your students talk, think, and write about NOS concepts! What's exciting about this approach is that students may start wondering, asking, and answering questions like:

"How do we know that?" and "**What can science do for me?"**

Where These Ideas Came From:

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