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6.20.2021

Nature of STEM reflection

When I reflect on my teaching practice I ask myself “What do I want every student to be able to do after being in my class?” While I have goals of the knowledge I wish to impart my personal goals for the development of the student are a bit more humanistic. I aspire for every one of my students to be able to look at the world with curiosity and to engage in a reflective life. Towards that end I seek to help students understand what I consider to be the pivotal concepts of biology and biological understanding.

“Nothing in biology makes sense except in the light of evolution” (1) is a quote by evolutionary biologist Theodosius Dobzhansky. Dobzhansky, in an effort to reconcile religious faith with the scientific evidence supporting natural selection as one of the primary drivers of evolution, suggests that the only way to make sense of the interrelatedness of life is by understanding the fundamental principles of evolution.

Towards that end I strive to make sure that my students understand the fundamental ideas of evolutionary biology. My 7th grade students who are learning anatomy and physiology are introduced to the basics of evolution while my seniors who study Zoology are reading chapters from Darwin’s “On the Origin of Species.”

I strive to have my students look at phenomena in life and to always ask some variation of the question “How does this trait or phenotype improve an organisms probability of survival and/or reproduction?” By asking this question over several years students are able to spend years hypothesizing about structures of life and using their own background knowledge to make a case for why a particular structure might confer some advantage.

The tenet that most resonates with my goals of what I seek to impart to my students is the idea that “scientific knowledge is open to revision in light of evidence” (1) .

I believe that it is valuable to discuss historical scientific theories and explore with students the logic behind the theories at the time and where those theories may have fallen short. For example, in discussing Lamarck and other evolutionary biologists the preceded Darwin we look at Lamarck’s theory of acquired traits. We discuss and seek out examples of why this theory seems to intuitively make sense (why do so many children of actors go on to become actors? Maybe they have inherited some of mom’s skill?) but also try and come up with disproving example as well (If skill was inherently acquired then eventually all athletic competitions would be dominated by the children of the most current gifted athletes).

I strive to impart the concept of scientific and intellectual humility. It would be wonderful if we actually looked at the evidence and tried to come to a conclusion based on the evidence but most people tend to have a conclusion and seek out data that supports their particular biases.

Nobody is immune to having confirmation bias but the scientific method as a way of looking at the world is our best bet to minimize our biases and coming to conclusions that are the best approximates of the truth about life and the universe that we are capable of achieving.

At the end of the school year I consider myself to have succeeded with a student if they are able to do two things:

Enjoy observing life in the world and asking questions about how that life operates in its environment and

Operate in the world with a sense of intellectual humility that whatever conclusions or ideas they have about the world are subject to revision. I would like students to have passion for ideas but be willing to discard them or modify them if life shows them ideas that they feel are better approximations of the truth.

Areas for improvement

Without a doubt my lack of technology and engineering background is the weakest point in my STEM toolkit. The main reason I applied for this fellowship was for the opportunity to work in a laboratory setting and participate in the process of technical exploration.

I will readily admit to certain biases in how I view the world. I am not a technological evangelist nor do I ever see myself becoming one. One of my major concerns with our preoccupation with technology is how we have a tendency to become very enamored of technology and mistake introducing technology as teaching. I recall my first year teaching I was given a donation of a two dozen color palm pilots. They were cutting edge technology and I was proud to have them but I had no idea what to do with them nor did I have the time as a new teacher to figure out how to incorporate them in my class. So the palm pilots sat in the back of my classroom for years collecting dust until they were discarded.

I am clearly not alone when it comes to an unfamiliarity and discomfort in trying to utilize technology in the classroom based on the "Standards for Technological Literacy" quote which states "nationwide most students receive little or no formal exposure to the study of technology. They are graduating with only a minimal understanding of one of the most powerful forces shaping society today (2). It is interesting to consider that we have computers in our pockets that are far more powerful than the computers that were used to land the first men on the moon and bring them back safely. That says something about the technological power we collectively have at our disposal. The fact that we mainly use that technology to watch cat videos, or other such forms of entertainment, tells us something about our collective appreciation of the technological gifts we have available to us.

Another challenge I have regarding technology and our obsession with technology is that we often mistake models for real life. What we often find is that our models do not offer the kind of predictive power we think they do. For example; one of the reasons that so many people

were stunned by Trump's victory in 2016 was because all of the polling data clearly showed that Trump had no chance of winning. That level of confidence in the predictive power of models led to quite the surprise for many people. As a science teacher it does concern me how much faith we put into conclusions that are based on computer models and not on collected and analyzed empirical data.

Despite these concerns I do recognize the value in teaching some kinds of technology. There is significant value in teaching kids how to use Excel, for example. At a practical level it is used in some capacity in every career associated with accounting, management or business. From the standpoint of educational philosophy it is valuable for a student to be able to collect datasets, input them into excel, and quickly derive information from the data they collect. In this regard, my desire to help students pick up practical life skills aligns neatly with the ITEEA standards.

The challenge of incorporating technology into the classroom in an organic and authentic way is one that I am eager to meet. My hope is to continue to explore and find authentic experiences that can allow me to use technology as an enhancement of learning. I was very appreciative of the fact that the learning standards for technology that "technology can not only solve problems but can create new problems" (3) .

I was exceedingly heartened by the example in the book of fourth grade students sketching 18th century farming technology and learning how these technologies worked. That to me is a perfect example of interdisciplinary work that incorporates technology along with art, interviewing, modeling to create meaningful artifacts that students can share with peers. This kind of work very much meshes with my outlook on science as a way of observing the world from the lens of curiosity and appreciation.

- (1) Dobzhansky, T. "Nothing in Biology makes sense except in the light of evolution". The American Biology Teacher. [Vol. 35, No. 3 \(Mar., 1973\)](#), pp. 125-129
Available at: <https://www.jstor.org/stable/4444260?origin=JSTOR-pdf>
- (2) Standards for Technological Literacy: Content for the Study of Technology
<https://www.iteea.org/File.aspx?id=42513&v=2a53e184> – Page 3
- (3) <https://www.iteea.org/File.aspx?id=42513&v=2a53e184> – page 5