Nature of STEM
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Endeavor STEM Teaching Certificate Project
Methods of STEM Education- Summer 2024
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Week 4

The Nature of Science

Content knowledge is not enough to develop a literate citizenry (Peters-Burton 2014), rather science is a way of knowing. This is a very powerful statement. Often, we teach our subjects in isolation. Students need to know how their body works. It is important to know how photosynthesis and cellular respiration are necessary for life. However, according to NGSS Appendix H, the integration of scientific and engineering practices, disciplinary core ideas, and cross-cutting concepts sets the stage for teaching and learning about the nature of science. Science is the pursuit of explanations of the natural world, and technology and engineering are the means of accommodating human needs, intellectual curiosity, and aspirations (NGSS 2013). The questions of "when am I ever going to use this in real life? or why do I have to learn this" is answered for students by the nature of science as a way of knowing.

A Critical Reflection

As I go through this course, and review the "new" NGSS standards, I do engage in the tenets of the Nature of Science. Although I need to incorporate more of the cross cutting ideas and reframe my lessons.

Scientific Observations Use a Variety of Methods

I begin my school year focusing on observation as a science skill by using labs, hidden pictures, acting as an eye witness, and finally solving "The Case of the Missing Computer Chip" by Mike McNabb (ENSI 89), Tom Watts (ENSI 90), and Ruth Willey (ENSI 91). The unit has students observing using their senses, finding measurements, using memory, ratio/ scale drawing, and forming hypotheses and conclusions. The final lab, The Case of the Missing Computer Chip, demonstrates how science/ hypotheses change as more information or evidence is gathered. Students are uncomfortable with this lab because it is open-ended. Students need to gather their evidence and present their hypothesis and their conclusions, allowing other groups to question/ peer review their findings. There is not one correct answer. Throughout the year, students perform controlled experiments and design their own experiments to test. I modified Project Wet's Poison Pump lab. Students are epidemiologists who use the same clues that Dr. John Snow to discover the source of the 1854 London Cholera Outbreak. The topic of evolution also covers the nature of science moving from Darwin's evidence of natural selection to today's evidence of evolution as our tools improve to find molecular evidence.

Nature of Science is Dynamic

The nature of science is dynamic. As technology improves the tools, we use for scientific exploration from the micro to the macro, our understanding of nature changes. The concept, that science addresses questions about the natural and material world, is important but equally important is understanding that not all questions can be answered by science. I believe this is a topic that I can improve upon. In the past, I taught Ethics in Science. I had the luxury of spending a semester investigating case studies with students on ethical issues in medicine, human testing, and genetic technology. I find when teaching AP Environmental Science and Biology/ Living

Environment, I do not discuss ethical issues in depth. I try to stay middle of the road when presenting, finding neutral sources. I do not have class debates. I do have students create PowerPoint/ Google Slides on different genetic technologies. I ask students to explain what they think is ethical or not ethical but I do not take it much more in depth. Part of the reasons are time constraints and other concerns of entering into polarizing topics that I think are science-based but might become political-based. I do believe that students need to engage in more critical thinking with evidence-based material while trying to respect cultural beliefs.

Nature of Mathematics

Matthew Larson blogs, *Why Teach Mathematics?,* on the NCTM site on the nature of mathematics. He describes the reason to teach mathematics is to allow students to function after to high school but most importantly to be active in our democratic society.

> In addition to preparing students for careers and post-secondary education, I believe it means we also teach mathematics in order to equip students for active participation in our democratic society. We accomplish this goal by emphasizing analysis and critical thinking with mathematics so that individuals can identify and interpret claims made by those in power as truthful or false and misleading (

I cannot agree with this more. Students must be able to understand how numbers work or can be used to make sense or to manipulate. Numbers need to be applied accurately to support scientific findings. The scientific literacy of the average person includes interpretation of data which is needed to view the world critically.

The new Life Science curriculum and mathematics are inextricably linked. The standards for Life Science include math standards. Students use mathematical representations of phenomena or design solutions to support claims Students must be able to reason abstractly and quantitatively. (MP.2 & HS-LS2-4).

Students must construct explanations and design solutions in progress to explanations and

designs that are supported by multiple and independent student-generated sources of evidence consistent Model with Mathematics. (MP.4 & HS-LS2-4)

Students select quantities and use units as a way to: i) interpret and guide the solution of multi-step problems; ii) choose and interpret units consistently in formulas; and iii) choose and interpret the scale and the origin in graphs and data displays. (AI-N.Q.1 & HS-LS2-4).

The nature of science is dynamic. The nature of science is a way of knowing. I look forward to reframing my lessons to include the integration of scientific and engineering practices, disciplinary core ideas, and cross-cutting concepts to ensure my students are scientifically literate.

Citations

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