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*I am completing my assignment on t**he nature of science.** Since I do not currently teach science on a daily basis in a regular education setting, I am using my prior experience teaching science in a classroom, the knowledge I have about how science is currently taught to my children by my colleagues, as well as my personal experience with the times I am able to teach science in the after school program setting as the basis for completion of this assignment.*

What are the tenets of science, and how do I currently address them?

In order to list the ways in which I currently teach the tenets of science, I chose to go back and re-read the information on the tenets of science. Through a close reading of this document I found that I greatly missed the mark when it came to teaching the tenets of science. I will address each tenet in isolation as I evaluate how I have addressed the tenants in the past, and how I may address them in the future. Science is tentative, empirical, inferential and imaginative, subjective, and socially and culturally embedded.

To begin with, the first tenet of the nature of science is that science is tentative. The laws and theories taught in science can change as new information is gained. In the way that science is currently taught at the elementary level, I do not feel like this idea is explicitly expressed to students. The laws and theories that are taught at the elementary level are largely taught as concrete facts. The closest I have come to teaching that science is tentative is when talking about the age of the earth or methods of dating and the aging of fossils.

The empirical nature of science implies that science is based on observations of the world around us. This tenet of science is explicitly taught at an elementary level, starting with pre-k and kindergarten students. Starting with the youngest students, science is taught as observing the world and asking questions about what is observed. I think this is a good way to introduce science to the youngest students and this gives students a foundation on this tenet of science. On a personal level, I recently took my after school students outside to the nature trail beside our school. The day before, we had dissected flowers and looked at the different structures and functions of the plant parts, but this day's assignment was to simply observe the natural world around them, including the plants and flowers, but also anything else they may find appealing or anything that might bring up curiosities. This felt like just a "fun" activity and not learning centered, but it actually awoke great conversations both during the experience and in the classroom afterwards.

If science is inferential and imaginative, then students need to take their observations and infer conclusions or answers to what they are observing. This means that students should be given the opportunity to think on their own, rather than merely memorize what is needed for test mastery. In my experience with teaching a science lab, which was not test centered, I was able to allow students to be creative and come up with solutions to questions. In a regular science classroom at the upper elementary level, it feels like this thinking is discouraged. It is more important to teach facts that will allow students to show mastery on tests than to teach the students how to think on their own. This method of teaching science will never develop scientists, because they will not know how to make their own inferences or analyze possible solutions to problems.

The idea that science is subjective is something that makes sense and has really resonated in my mind since I first read this document several weeks ago. In my mind, I knew that science was full of bias, depending on who was delivering the information, but I had never seen any science material admitting this to be the case. Likewise, I recognized the science bias in myself, based on my Christian background. I love science but have always found myself juxtaposed to much of my upbringing and my church. I have said so many times that my beliefs and science have to fit together; they can co-exist. In my classroom, I have never told students that science is subjective depending on who is completing the research. Mostly, because in a general education classroom setting I am teaching science concepts for students to master. I believe it is important for students to understand this so that they can draw some conclusions for themselves. In the future, I must be more comfortable with this notion and with sharing this with students. Science is not necessarily concrete. It is evolving and changing as our world changes and we gain new knowledge. This also means students should do research from more than one point of view when they are seeking answers.

Finally, science has social and cultural implications. The article, “Before today, I was afraid of Trees,” by Larkin, is a great example of this tenet of the nature of science. As stated in the tenets of science article, “As societies change, so do scientific priorities.” I see this all around me with the bigger discussion in the society in which I live about genders and sexuality. I have been bombarded with science articles, TED talks, and even films shown in religious settings about the science behind gender and sexuality. This never would have been discussed fifteen to twenty years ago. As society changes, so does the scientific research carried out by the larger scientific community. An example of this in a general education science setting would be that for several years, as global warming and climate change became buzz words, articles and science textbooks featured lessons about the polar ice caps and questions on standardized testing pulled in these same types of questioning. Most likely, as new science textbooks are being developed for the use in classrooms, there will be articles focused on newer discussions that are taking place in society as a large.

How might I enhance my teaching to address other disciplines?

Upon close reflection of the question, “how might I enhance my teaching to address other disciplines,” I spent time evaluating the continuum of integrated STEM. I considered where on the continuum my current teaching, school, and district would fal diagramsl. As previously mentioned, I do not teach in a regular science classroom currently, but I have access to teaching STEM in the after school program in which I am involved. I switched gears from my planned lessons and began creating some activities that utilize what I am learning in this class. My initial thoughts centered around developing lessons that would be further right on the continuum, followed by the importance of embedding STEM concepts in my ELA courses on a daily basis.

The first lesson I carried out with my after school students, in an attempt to better approach STEM as an integrated concept, centered around flowers. Students were given a flower and set of tweezers and were given the opportunity to closely examine the structures they found inside the flower and imagine what their function might be. This led into discussions about pollination and the need for pollinators to be protected. Students discussed how technologies would need to advance if pollinators died off, in order for planet earth to be able to sustain life. The math connection in this lesson centered around the symmetry of the structures of the flowers as students counted the structures found in the flowers. For example, in many flowers, the number of petals matches the number of stamens. Some students attempted to count seeds that were found in the ovules of the flowers. Students made the connection that if there were seeds in the ovule, then this flower must have been pollinated. Another way in which students integrated technology in this lesson was through the research of large flowers around the world. Students examined how flowers must attract pollinators in order to be able to reproduce. They found images of incredible flowers around the world to analyze how these would attract pollinators through their size, color and fragrances. Getting back to the tenets of the nature of science, students participated in a culminating event in which they took a walk on the nature trail near our school. They were given the task to observe flowers that might still be in bloom, look for pollinators, and to make any other observations they found intriguing. The one discipline that was not an active part of this lesson set was engineering. If time had allowed, students would have used different art materials to create their own free standing flower using all of the structures they observed.

When I reflect on the subject that I teach on a daily basis, reading and ELA, I have been prompted to try and incorporate some of the tenets of STEM into my lessons. One way in which I can do this is by purposely pointing out the same tenets of

science and technology, since the tenets overlap, in our reading material. This can be done by encouraging students to be curious and make observations about the nature of science in what we are reading. For example, when reading about ancient civilizations in the Americas, students were able to make connections between how these ancient people were able to develop technologies to farm and produce crops in the environment in which they lived. Pointing out to students that the Maya, Aztec and Inca all farmed differently according to their land showed a real life application of how their environment and culture affected how they developed technologies to grow food. We discussed the time frames involved in how these ancient peoples made it to the Americas from the oldest civilizations in Mesopotamia and Egypt. We discussed how what scientists know about the ice age has changed over the years and may differ according to which set of research you are studying, because at times science is subjective to personal bias. It was during this time that these people migrated to the Americas. Did this migration happen millions of years ago or did it happen thousands of years ago? What we know about the dating of these people's original existence in the Americas changes as more data is collected and the dating technologies are improved. In closing, through my ancient civilization reading unit, which is the discipline I was teaching at the same time as this Method of STEM course of study was taking place, I was able to enhance my teaching by bringing about the same tenets of science and technology that would be used in a STEM classroom.

STEM must be thought of as an all encompassing subject rather than a subject that is delivered only in a science classroom or lab. By developing students' curiosities through all subjects, all learning has the ability of being enhanced and more engaging to students. Students who are actively engaged and take ownership of their learning, in any discipline, are more likely to retain the information they are being taught and become lifelong thinkers and doers.

How do the tenets of the nature of science and the nature of technology overlap?

For my second article, I read about the nature of technology on pages 21-34 of "Standards for Technological Literacy: Content for the study of Technology; third edition," published by The International Technology Education Association. One will recognize when reading this portion of this publication that the tenets of technology overlap the tenets of the nature of science in several ways. Three of these overlapping areas include the effect of society and cultural influence on the subjects, observing the natural world, and being inferential and creative thinkers.

To begin with, both science and technology are influenced by the atmosphere of society. An example of this would be when an epidemic breaks out in an area. Technologies need to develop as a way to create a solution for this epidemic. New medicines and vaccination processes are researched and developed. As cultures and

societies need them Examples of how technology has advanced in the past according to societal change are as follows: societies developed a need for complex road systems, the ability to build buildings up instead of out leading to the technology of skyscrapers as well as creating room for factories and immigrants, and wars led to the need or implied need for nuclear technology. The situation in society and cultural influences affect the way in which both science and technology progress.

As stated in the text, “students should be actively engaged in identifying the differences between the natural world and the human made world” (pg. 24). This overlaps with the empirical nature of science, which involves making observations and voicing curiosities about the natural world. In order for a young elementary student to begin to grasp the nature of technology, they must be actively engaged in thinking empirically. Once students make observations about the natural world they can begin to question how the natural world is used as technology, to make their lives better.

Similar to the nature of science, the nature of technology also requires inferential and imaginative thinking. In order for technologies to advance, a person must be able to imagine how life could be made easier using the resources available in the natural world. The example given in the text referred to the changing of how music was developed. On page 25, the text stated that students may “trace, for example, the progression of recorded music from cylinders through records, eight track tapes, cassettes, compact discs and laser discs.” This example illustrates for students how this technology in particular was developed as creators used their imaginations to consider ways to make better, more advanced technology. Just like science requires imagination, so does the use of technology.

The influence of the current culture of societies, the necessity for inept empirical skills, and the presence of inferential and imaginative thinking are three ways in which the nature of science and the nature of technology overlap. A close evaluation of the continuum of STEM document shows that in addition to the overlapping tenets of science and technology, there is also overlap amongst engineering and mathematics. I hope that in the future educators will strive to make note of, and utilize all aspects of STEM into every discipline area. When you know better, you do better. The availability and exposure of STEM allows students to become in depth thinkers and will open a world of possibilities for them in their future lives and careers.