It has been very valuable to examine the tenets of the nature of science. It has been a reassurance that I have been incorporating the tenets into my teaching and lessons. This class is helping me understand and focus on how to improve my lessons so that they better embody the STEM ideology.

With the restrictions of Covid it has been very difficult to conduct the usual collaborative group inquiry activities in my middle school. I teach six classes, three 7th grade and three 8th grade. When we came back to hybrid classes in February my classes went from three for each grade to two for each grade so that we could avoid the difficulties of lunch and have a half day of school. The core classes are taught live for one hour each in the morning and then the specials are remote in the afternoon. At the end of April all the students were invited back for in person classes adhering to the same schedule. Some students remained remote so we still have students via Google Meet. The teachers move classes instead of the students so science teachers bring materials to each class. Restrictions have loosened up so recently I was able to have them work together a little in the last weeks of the school year. It definitely was not the most ideal situation, especially with even more students in the class than usual. One of my classes has 45 students (38 in person and 7 remote). This makes planning lessons problematic, especially when trying to incorporate the tenets of STEM.

We have been using the virtual lab, Gizmos, from Explore Learning as a way of conducting investigations in this restrictive situation. Gizmos has been a terrific supplement to hands-on investigations allowing the students to manipulate variables in situations that they would not be able to in the science classroom. For example, the Gizmos-Coral Reefs, Abiotic Factors explores the abiotic factors that affect the Caribbean coral reefs. The students can change the variables of ocean temperature, pH, severity of storms, logging to see how it affects the organisms in the reef and the overall food web. For situations like this you can actually do more virtually without harming real organisms in the process and seeing the big picture as it relates to ecosystems.

The last part of the school year in my 8th grade is exploring physics concepts. I saved this unit for the end in hopes that restrictions would ease and we could do some actual physics. The tenet, “Scientific Investigations Use a Variety of Methods” was one I definitely incorporated in my abbreviated “Covid” physics unit this year. We started off the unit with exploring speed. With the spring weather and the easing restrictions I was able to get my classes outside in smaller groups to measure the distance of the course and run 50 meters. The students recorded their times and calculated their speeds. We took advantage of this outdoor classroom and the students continued their understanding of motion by writing motion stories, acting them out on a marked track

and graphing their movement. The students also completed tracks pre- marked in intervals that would have them moving at constant speeds and accelerating for the same time of 8 seconds. These investigations had the students as part of the experience so the tenet, " Scientific Knowledge is Based on Empirical Evidence" was demonstrated. With the student's motion as the actual data gathered they could make connections rather than just using sample data to analyze, calculate, and graph.

More restrictions in my school eased and for our last activity for the year the students were allowed to work in small groups (with masks) to manipulate a car and ramp to explore kinetic and potential energy. The challenge was to push a stationary car the maximum distance. The students were given parameters and materials and then worked together to add mass and design how and where to attach the mass to the car and how to change the ramp. The students were given practice time to change their designs before the final class challenge. This activity embodied the tenet, "Scientific Knowledge is Open to Revision in Light of New Evidence". The students while waiting for their practice time also were experimenting with a Gizmos activity, "Sled Wars" where they changed similar variables to knock over the most snowmen. The virtual lab showed the students how much potential energy they started with and how it was converted to kinetic energy. It was nice to hear the connections the students made between the virtual lab and the challenge. During their "practice time" I heard them using the vocabulary and comparing the two investigations so that they could design and revise their car and ramp and how they released the car to create the most kinetic energy to move the stationary car.

Before this culminating activity for the school year I had the students explore Newton's Laws. By examining these laws the students were involved with the tenet, "Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena". To make learning these laws fun the students watched clips from Toy Story to find examples of each law to better understand and make connections with each idea. The students were asked to also choose one of these laws and draw an example from the clip and write about to explain the law using new terminology of balanced and unbalanced forces, force, acceleration, friction, etc. This activity was a fun way to learn more about the laws and master new terms that helped them understand the next activities and the laws that govern motion according to Newton.

I believe that the best lessons are fluid to adapt to the different phenonmea of the world around us. I think that my lessons can better address the tenet, " Science is a Human Endeavor". According to the article, The Tenets of the Nature of Science, "All scientific knowledge is produced within a larger society and culture". Society and culture affects science knowledge and the acceptance and importance in the changing world.

This tenet is a good one for class discussions and expression of opinions. I did address this tenet somewhat this year with virtual breakout groups discussing the article, This Bill Gates-funded chemical cloud could help stop global warming**.** The students led discussions and came up with the pros and cons of this topic. The students then presented their ideas to the whole class. At the time we were completely virtual and it was a successful activity since the students were interested in Bill Gates and had prior knowledge of him. The idea of solar geoengineering was fascinating to them because it seemed like something from the movies that could have a big impact on the Earth and their world. I would like to develop more lessons like this to keep the students abreast with what is happening in the world and have them express their opinions about how science is involved in changing the world. There are many possibilities to address this tenet with global warming, alternative energy sources, and even the controversy of how the Covid- 19 pandemic began and the development of the vaccine. It is important to weave the tenets into the curriculum and not make them separate entities. This is something that I hope to address in the coming school year and continue to enhance since science and society are going to continue to evolve.

My science content doesn't just overlap, but is integrated into technology. In today's world our lives are dependent on technology. According to Duggar (2011), "technology is the way people modify (invent, innovate, change, alter, design) their natural environment to suit their own purposes. From the Greek word techne, meaning art or craft, technology literally means the art of making or crafting, but more generally it refers to the diverse collection of knowledge and processes that people use to extend human abilities and to satisfy human wants and needs."

The first of the Standards for Technological Literacy says that "students will develop an understanding for the nature of technology". With science the students can make connections between all the technology that makes understanding easier. This involves using the microscope to examine cells and see the organelles that work together to make a cell function. This could also be using the calculator to compute the speed or acceleration of an object. The Chromebook for science class is an essential tool to help understand the natural world.

Another standard in technological literacy is understanding design. In science experimenting, research, development, and problem solving all involve design. Any tools to aid in the design process help bring the original idea to fruition. Students learn the design process of taking an original idea, making models, research and development, and the revising of models in conjunction with science. The creative process utilizing technology is paramount in working toward desired outcomes. The third standard in technological literacy will develop an understanding of technology and society. This is very important especially today when in science there is a lot of emphasis on the effects of technology on the environment. For the most part technology has had a positive impact on society from the development of therapies and medicines to combat diseases, bringing essentials like electricity, water, and transportation to all parts of a society. There are also negative effects like pollution as a result of technologies that attempt to make our world more desirable.

Science and technology go hand in hand. Incorporating the standards for each discipline into your teaching and lesson plans is a more meaningful, integrated approach. Students will see more meaning in collaborating with their classmates to solve problems based on actual phenomena in the world around them. STEM trains our students to work in a manner similar to professionals in the science and technology fields, while using math and engineering to develop their inquiry into a product that can always be improved. Creativity and innovation should be encouraged to help our students contribute positively in the classroom and in the world around them.

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