

The current NGSS Standards outline the following tenets as the Nature of Science and drive their standards to progress student knowledge in regards to Science Education: Scientific Investigations Use a Variety of Methods, Scientific Knowledge is Based on Empirical Evidence, Scientific Knowledge is Open to Revision in Light of New Evidence, Scientific Models, Laws, Mechanisms, and Theories Explain Natural Phenomena, Science is a Way of Knowing, Scientific Knowledge Assumes an Order and Consistency in Natural Systems, Science is a Human Endeavor, and Science Addresses Questions About the Natural and Material World (NGSS, 2013).

The way that I currently integrate the Tenants of Science directly taken from the NGSS includes encouraging and requiring students to integrate technology, presenting phenomena first and then basing inquiry & explanation on said phenomena, and modeling/creating/displaying information through various media formats. I encourage students to see science as more than just a grade or a class that they are required to take, but a way of being and knowing, and I make sure to show students exactly how science applies to them in their everyday lives, beyond the classroom, through examples such as weather (water cycle), building materials (rock cycle), gravity/day and night/seasons (space), Synthetic materials (atoms and matter), and Food Chains/Webs (ecosystems).

We talk a lot about how science is forever changing and developing, using evidence and data based research to determine what is fact as well as constantly testing and questioning the “norms” to ensure that the most accurate data is being collected. In order to show my students that Science is a human endeavor, I have adopted the task of writing stories either from the perspective of the scientist or about the accomplishments of the scientist, and reading these

stories dramatically during a class period that I call “story time.” I ensure that they know science progresses because of the work of humans.

When it comes to the ways I could enhance these tenets of the NGSS standards, I think I would really focus on Scientific Models and Order and Consistency in Natural Systems, since I think these will be the most difficult tenets for students to get a mental grasp on.

We cover modeling and why models are important in science right off the bat- when we discuss atoms I have my students model atoms using Bohr Models on paper before we start creating models of different molecules. During these lessons, I have my students explain to me why it’s important to use and create models in the scientific process. We talk about how the greater understanding of phenomena comes from seeing and manipulating objects, and how we can’t see atoms with our bare eyes, so they have to create models of what they look like so that we can better understand their contents. I think coming up with a way for each student to model something from each unit would reiterate this point and ensure depth of knowledge when it comes to different types of scientific models.

Addressing order and consistency in natural systems would be something that I would have to incorporate into several of my lessons. We do talk about Earth’s Systems (biosphere, hydrosphere, atmosphere, geosphere), but getting them to understand that science assumes these systems act in a way that is consistent and predictable could pose a challenge for me as a teacher, and could be difficult for my students to understand. This could be a time to introduce students to grade level appropriate examples of scientific studies, peer review, data collection, and show them why we can trust that these systems will continue to act in the way that they have for millions of years.

When it comes to addressing another part of STEM, my content area naturally crosses over into ALL of the letters in the acronym in some aspects. I am lucky enough to teach a non-tested subject where I have more freedom to incorporate these parts of STEM without missing important standards for the test. I currently do my best to incorporate Technology, Engineering, Math, and even Art into my content.

Math is incorporated into my content when I teach Atoms & Matter, we have to calculate neutrons in Elements where students are required to practice rounding and multi digit subtraction. We also look at math when we talk about the geologic record, relative vs. absolute age, distance of planets from the Sun, Revolution of the Moon & other planets, etc.

Regarding technology, my students use chromebooks daily as a resource for research, communication, and assignments. I think technology is always assumed to be electronic devices, but in my eyes I see it as the tools I use for instruction. Enhancing technology to me means providing my students with tools that they can use to emphasize certain phenomena or concepts. My favorite use of technology thus far has been something called a Merge Cube. Students are able to hold and manipulate a cube in their hands, but view it through a screen where it can change into hundreds or different objects.

Engineering becomes integrated when I have my students create and build models of atoms, the solar system, fossils, food chains and webs, and molecules. Students must be active in the participation of the design and creating of these models, where they have to build physical structures around 90% of the time and are required to design/create the models on paper the other 10% of the time.

I, myself, create lots of infographics for my students to use as reference during their learning. I also require my students to create infographics that display the key information about

our topic at hand, including a rubric with a guide that tells them exactly what components need to be present. We design planets from something as simple as the size, all the way down to the specific colors that will be used in order to ensure accuracy, and then they take those colors and they paint an accurate model of their assigned planet. I have my students complete what I call “doodle notes,” which serve as a way for my students to gather information from the whole group lesson, and then they are required to color the images/graphics on the side of the paper with accurate colors to enhance their memory of this content. I base this practice off of the statement “Colour helps us in memorizing certain information by increasing our attentional level” (Dzulkifli & Mustafar, 2013). When students color with a purpose, they are more likely to remember the information, and be able to describe it in detail based on the relation to the colors they used when taking these notes.

Although the acronyms in STEAM aren’t addressed in every classroom, I do my best to cover each letter as thoroughly as I can. In reflection, I think I can incorporate Math and Technology more effectively and efficiently- beyond just using Math in some of my lessons and using Chromebooks, Merge Cubes, and other electronic devices.

### **Bibliography**

Dzulkifli, M. A., & Mustafar, M. F. (2013, March). The Influence of Colour on Memory

Performance. *The Malaysian Journal of Medical Sciences*, 20(2), 3-9.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3743993/>

NGSS. (2013, April 01). *APPENDIX H – Understanding the Scientific Enterprise: The Nature of Science in the Next Generation Science Standards*. NGSS.

<https://www.nextgenscience.org/sites/default/files/Appendix%20H%20-%20The%20Nature%20of%20Science%20in%20the%20Next%20Generation%20Science%20Standards%204.15.13.pdf>