

The primary focus for my exploration is the Nature of Science (NOS). I have chosen this focus because I teach fifth grade science at a rural school in Virginia. While I have been at the school for five years now, this is my first year teaching science. The Nature of Science, according to Appendix H of NGSS states that the eight tenets of science are as follows: 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. In addition, for my exploration, I have focused on the third through fifth grade level.

When I began the journey of being the science teacher for my grade level in August, I went in knowing that I wanted to teach all science objectives with a STEAM focus with as much hands on as possible. I don't believe that I can address how I currently address the tenets through one particular unit I have taught this year, but rather through a variety of units. The first tenet, "scientific investigations use a variety of methods", is one which I feel I have addressed very well. We have investigated science through a variety of methods, tools, and techniques. Examples of this include investigating force and motion through Rube Goldberg inventions, investigating the ocean floor through playdough modeling, and investigating light and electricity through creating a haunted house with a parallel circuit to name a few. This tenet also states science methods are determined by questions. To kick off every unit, after gaining insight on what students already know through pretesting, I have students write down questions they have about our study on the unit. We post all of their questions on a "Wonder Wall" that I create for each unit. We then reflect on how many of our wonders were answered with the investigations we did and how many wonders we still have at the conclusion of the unit. The second tenet, "scientific knowledge is based on empirical evidence", is another principle on which I feel I have addressed fairly well. This year, we have looked at patterns all around us with earth structure, electricity, sound, and rocks. I have also incorporated a variety of tools and technologies such as phenomena and investigations for students to make accurate measurements and observations. The third tenet, "scientific knowledge is open to revision in light of new evidence", has proven to be the most intriguing in my classroom. In every unit, whether it has been force and motion, light, sound, electricity, or earth structures, students have been given the chance to change their thought processes, final products, or investigative data based on new evidence acquired in exploration of concepts, peer collaboration, and literacy connections. The fourth tenet, "scientific models, laws, mechanisms, and theories explain natural

phenomena”, is a tenet which I feel I have just begun to address in my teaching. I feel I have addressed the second part of the third through fifth strand, which is science explanations describe the mechanisms for natural events, but only minimally. Mainly, this was really only addressed in one of our last units, which was on earth structure and rock cycles in which students were able to identify and describe why natural events such as mountain formations, volcanoes, and earthquakes occur in our world. The seventh tenet, science is a human endeavor, is the last of the eight tenets that I feel I have addressed in my current teaching. With this, I reflect on a current unit I am teaching which is the Ocean. After investigating the geological features of the ocean, I used a video clip of the [Deep Sea Challenger](#) and students were able to clearly see how men and women from all backgrounds were able to pursue careers as scientists and engineers. Through this, they were also able to see how scientists and engineers work together in teams and that creativity and imagination are critical to science. This actually inspired several of my students to say they wanted to explore science or engineering careers that would lead to ocean exploration. One of the resources which I use on a continual basis in my classroom is the [FIVE PONDS PRESS](#) science text. This text, while following the Virginia Standards of Learning objectives, actually integrates the tenets of science as well. I was surprised, when just this week, one of the lessons I pulled from the book had a reference to the NOS as it wasn’t until going through this assignment that I can see I truly paid attention to this.

As I continue to reflect on how I address the tenets of the NOS, I can identify that there are three tenets I believe I haven’t even begun to address in my current teaching. Tenet five, which is science is a way of knowing, is the first of these three tenets. The third through fifth understanding of this principle is “science is both a body of knowledge and processes that add new knowledge,” and “science is a way of knowing that is used by many people. I believe that in my class, while we are constantly building on past science knowledge and experience, I haven’t really addressed with my students the multitude in which science is used by many people. I don’t believe that my students really are aware that the knowledge and processes acquired in fifth grade are adding new knowledge to their educational experience. I believe moving forward, incorporating more investigations, utilizing and examining the scientific method, as well as engineering practices based on student inquiry will help to address this tenet. Having students provide evidence based on their observations that shows how science is a way of knowing needs to be a key component in my science class. The sixth tenet in the NOS states that “scientific knowledge assumes an order and consistency in natural systems.” As I look at the understanding of this tenet for third through fifth which states, “science assumes consistent patterns in natural systems,” and “basic laws of nature are the same everywhere in the universe,” it is very

clear that I haven't addressed this at all. However, as I look at the kindergarten to second understanding of this tenet, which states "science assumes natural events happen today as they happened in the past," and "many events are repeated," I can see that my current teaching in this tenet is at this lower, foundational level. Students in my current class are well aware through investigations that natural events such as earthquakes, plates moving, rock breaking down and forming new rocks, and life cycles of plants and animals are occurring today just as these events happened many years ago. In addition, students are able to identify through investigations that these events are often repeated. As we studied earth structure and examined how the plates move, students were able to make observations that the plates moving affect our natural world and this movement is constantly going on. Due to Virginia's limitations of our Standards of Learning, fifth graders don't study the laws of nature and apply them to what we are learning. How can I enhance this tenet with the state's limitations? Digging deeper into learning is a passion of mine and giving student opportunities to explore these laws even though they aren't addressed in the actual standards of learning is going to be critical to their science education and understanding after they leave me. I can enhance this tenet in my future by beginning to name and introduce these laws with my students as we unpack the standards we are responsible for. The last tenet, tenet eight, states "science addresses questions about the natural world and material world." The understanding for third through fifth with this tenet is "science findings are limited to what can be answered with empirical evidence." I realize that while I have used the senses of observation in my class this year, I have fallen short when it comes to the documentation through experimentation.

Through reflection of my current practices, I am seeing how my ideas of the tenets as addressed in the NOS have truly changed. Even though I feel I have made significant gains this year in STEM education with my students, I am skimming the surface of science understanding and knowledge. When studying the eight tenets, it became very clear to me that the standards to which I am tied to correlate to these tenets. Every standard I teach falls into one of the tenets, even though my state isn't truly aligned to the NGSS. I am also realizing that as I understand more of the tenets, providing opportunities for my students that allows for them to be able to transfer the knowledge as explained in the learning outcomes is going to afford them the deeper learning experiences that they need to show mastery of concepts.

I chose to read the Nature of Mathematics, as I am currently part of an innovation team that is looking to change how our students learn at our school by breaking down the traditional barriers of isolated academics (math block, science block, reading block, etc) and moving towards complete STEM integration. In reading the Nature of Math (NOM), I found three ways in which this overlaps with the Nature

of Science. The first overlap I discovered is with tenet one of the NOS. This tenet states that "science investigations use a variety of methods, tools, and techniques." The fifth tenet outlined by the NOM is "use appropriate tools strategically." I believe this overlaps because students must look at and select the appropriate tools in both science and math. The second overlap I found was in the last tenet of the NOM, which states "look for and express regularity in repeated reasoning." This overlaps with the NOS tenet six which states "Scientific knowledge assumes an order and consistency in natural systems" as both of these tenets have students considering the repetitive patterns in the world around them. The third overlap I found between the NOS and NOM is between the second tenet of the NOM, which states "reason abstractly and quantitatively" and the second and eighth tenets of the NOS. The second tenet of the NOS states "scientific knowledge is based on empirical evidence" and the eighth tenet states "science addresses questions about the natural and material world." Both of these science tenets have students reasoning with empirical data just as math has students reasoning with empirical data in the abstract and quantitative (observational) manner.