The Nature of Math (NOM) is an integral part of integrated STEM instruction. Although many educators have placed an emphasis on math and science within STEM, we know that it needs to be a balanced approach. When considering the Nature of Math, focus is on the Common Core State Standards Standards for Mathematical Practice.

The Standards for Mathematical Practice are eight practices that educators should work to develop in their students. These standards are how mathematicians think about, consider and use to make sense of problems. Mathematical Practice Standard 1 Make sense of problems and persevere in solving them discusses how students use multiple strategies to solve problems. Regardless of the level of the student, this entire standard involves the question, “Does this make sense?” When focusing on this standard, students are evaluating their solutions and choices and making changes if necessary.

Mathematical Practice Standard 2 Reason abstractly and quantitatively focuses on students’ ability to decontextualize and contextualize their thinking. Essentially, this focuses on the students’ number sense. Grasping what the quantities mean and how to use different operations to manipulate the numbers. Young students would consider it as solving problems in more than one way.

Mathematical Practice Standard 3 Construct viable arguments and critique the reasoning of others. In this standard, students are asked to justify their thinking. It is an opportunity to pose the question in class, “Convince Me” for students to communicate their thinking and use their foundation of mathematical understanding to strengthen their understanding. Elementary students know this as explaining their thinking to others.

Mathematical Practice Standard 4 Model with mathematics. Students use charts, tables, graphs and pictorial representations to demonstrate their understanding. In addition, they use the data and results to explain their thinking. Students see math in their everyday life and use math to solve everyday problems.

Mathematical Practice Standard 5 Use appropriate tools strategically. Using their existing mathematical knowledge, students determine what tools are necessary to solve a problem. Selecting a protractor to measure angles, a ruler to measure length, and even a calculator to manipulate larger numbers, students can select and use the appropriate tools necessary to solve problems.

Mathematical Practice Standard 6 Attend to precision. This standard is the hallmark of what most educators and community members consider when discussing mathematics. Precision is about solving equations accurately and without errors. It is a shift in thinking that mathematicians can engage and work with problems but perhaps not always focus on correct answers. Students know they need to work carefully and check their work.

Mathematical Practice Standard 7 Look for and make use of structure. This standard is showing students multiple strategies and having the students understand that various entry points to a problem will yield the same answer. This standard asks students to use what they know to solve new problems.

Mathematical Practice Standard 8 Look for and express regularity in repeated reasoning. In this standard, students are determining the reasonableness of their answer. Proficient students constantly look for patterns and whether their answer makes sense. Elementary school students know to look for rules and patterns in the problems presented to them.

Presently, I teach fourth grade in a departmentalized model. I teach Math, Science and Social students to roughly 50 students. When analyzing how I currently address the tenets of the NOM, I work to integrate the Mathematical Practice Standards into my daily instruction. Of course I don't use all 8 standards in every lesson; however, I do look to see how I can infuse them. In addition, I explicitly share with the students what standard we are addressing and try to use both the language of the math practice as well as a statement in friendlier language for ten year olds.

Specifically, for Mathematical Practice Standard 3, I work hard to promote classroom discourse. I give students opportunities to share their thinking through the consistent use of Kagan Cooperative Learning strategies as well as regular use of Flipgrid. In addition, I frequently ask the students, “Convince Me!” This powerful question generates excellent classroom discussions as well as supports all learners as students hear from their peers. Another example of how I presently promote students to share their thinking is through the use of Three Act Math. Started by Dan Meyer, I use the resources from Graham Fletcher to pose a mathematical problem. I ask the students to share what they notice and what they wonder. This allows them to discuss their thinking before they attempt to solve the problem. Analyzing the NOM, I see Three Act Tasks also addressing Mathematical Practice Standard 4 as well as the tasks are rooted in everyday examples of how to find and explore math.

Another example is I use Which One Doesn’t Belong as a math warm up one day a week. I display the selected image on the whiteboard and I always say, “The only way you get this wrong is if you don’t try!” Students love the safe nature of the activity and really stretch themselves to share what they think as opposed to what they anticipate I want to hear. It is a great way to incorporate Mathematical Practice Standard 3 into the daily classroom.

I gave some very specific examples of how I address Mathematical Practice Standard 3 and yet I didn’t address the other standards. I absolutely can enhance my teaching practice by considering the Nature of Math and addressing all of the standards as thoroughly as I do communication. Specifically, for Mathematical Practice Standard 7, I need to leverage ways to empower students to see that they can build upon previous understanding to solve new problems independently. Reflecting on my practice, I need to create opportunities for students to realize they can do this on their own. I tend to “spoon feed” this step for them by asking very leading questions to activate their prior knowledge. Presently, I go as far as making a slide on my daily slide deck that essentially is telling them what prior knowledge they can activate. I need to create a culture where students can do this for themselves to enhance what I am doing.

Another way to enhance what I am doing for the Nature of Math is to integrate science, technology and engineering into my teaching as well. I absolutely have four silos that although I address, I am not integrating them. Specifically, the Nature of Engineering has ways that there is overlap between the Nature of Math and the Nature of Engineering.
Read another “nature of” document from the list and identify 3 ways that there is overlap.

For Principle 1. K–12 engineering education should emphasize engineering design, this principle is open to the idea that there are multiple responses or solutions to a problem. This connects with Mathematical Practice Standard Mathematical Practice Standard 2 Reason abstractly and quantitatively as students work in math to use multiple strategies to solve problems.

For the Nature of Engineering, Principle 2. K–12 engineering education should incorporate important and developmentally appropriate mathematics, science, and technology knowledge and skills. This directly relates to Mathematical Practice Standard 5 Use appropriate tools strategically. In the engineering principle 2 students are expected to use testing and measurement technologies. Mathematical Practice standard 5 students need to select the appropriate tool to solve a problem. Students need to be able to select the appropriate mathematical tool but it also overlaps with the engineering skill as students need to use and select appropriate tools as well.

For engineering Principle 3. K–12 engineering education should promote engineering habits of mind, students work on communication with other students. This overlaps Mathematical Practice Standard 3 which specifically addresses student discourse.

Looking at the first three engineering principles, it is evident that there is overlap between the Nature of Engineering and the Nature of Mathematics.