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Foundations of STEM

8 October 2021

Nature of STEM Assignment

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

• Nature of Technology: https://www.iteea.org/File.aspx?id=67767&v=b26b7852

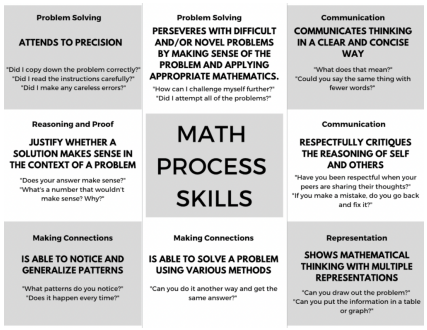
• Nature of Math: Common Core Mathematics Practices into your analysis.

• Nature of Engineering: https://www.nsf.gov/attachments/117803/public/1b--Eng_in_K-12_Ed.pdf

a) engage in a critical reflection of how you address the tenet(s) currently in your teaching. Describe how you currently address the tenets. You may talk about one specific lesson or activity that you use to address the tenet. If you do not address any of them, talk about the way that your curriculum treats the nature of science. (about 1 page)

I taught math for many years up until last year. In our school, we don't follow the CCSS directly, rather we have come up with our own process skills with some influence from the CCSS and the International Baccalaureate (IB) which is a program that I also taught at for many years. We have posted the process skills as posters in the classroom and often address them by pointing and referring to the posters often. When I was teaching within the IB Middle Years Program, it was required that students do assessments called "Investigations." These would require students noticing and describing patterns, communicating their thinking, proving their answer is correct, and reflecting on how they know their answer is correct. This is very much similar to the CCSS process skills.

As a math department, we have created the following process skills that we follow throughout the middle school, 5th-8th grade.



A sample of work that addresses these process skills would be something like this.

Tile Pattern Team Challenge

Your team's task is to create a poster showing every way you can represent the pattern below and highlighting all of the connections between the representations that you can find. For this activity, **finding and showing the connections are the most important parts.** Clearly presenting the connections between representations on your poster will help you convince your classmates that your description of the pattern makes sense.

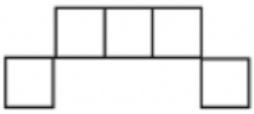


Figure 1

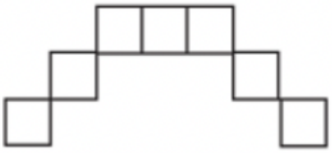


Figure 2

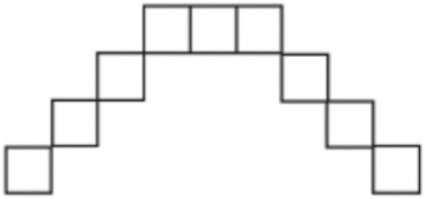


Figure 3

Pattern Analysis:

- **Extend** the pattern: Draw Figures 0 through 4. Then describe (don't draw!) Figure 20. Give as much information as you can. What will it look like? How will the tiles be arranged? How many tiles will it have?
- **Record** your data: Find the number of tiles for Figures 0 through 6. Record your data as a table and a graph.
- What **connections** do you see between the different representations (graph, figures, and table)? How can you show these connections?
- **Describe** in words how the each figure in the pattern changed. (ex.: "Figure 0 had ___ tiles. As the figure number increased by 1, the number of tiles _____ by ___.")
- **Generalize** the pattern by writing a rule (equation) that will give you the number of tiles in any figure in the pattern. Show how you got your answer.

Presenting the Connections:

As a team, organize your work into a large poster that clearly shows each representation of your pattern, as well as a description of Figure 20. When your team presents your poster to the class, you will need to support each statement with a reason for your observations. Each team member must explain something mathematical as part of your presentation.

b) consider how you might enhance your teaching to address the tenet(s) outlined in Appendix H. You may review and cite resources from the course as well as others (please cite them). Discuss specifically how your thinking/understanding of the "nature of" is dynamic. (about 1 page)

Currently, I am teaching Design and Making which has a lot of integration of STEM within the course. Regarding the Nature of Science in particular, I appreciate the investigative process, using science as a way of knowing. Sometimes, students ask me a question and they say, "Will this work?" I respond with, "Why don't you try it?" Sometimes, students are afraid to fail, be it because of judgment, time, or something else, thus they don't try. However, if you give them the space, materials, and support, they may be more willing to try. I also do think about this though because often in the Making Classroom, many students see materials as an unlimited resource since they are not paying for them directly. Thus, I have to encourage the idea of prototyping with cheaper materials or on a smaller scale, so that we are considering the resources we use and may waste while tackling the project or investigation. As students are exploring, they often come up with more questions that they did not consider. Ultimately, even if the students fail, they are learning and that is the ultimate goal.

Something I can do better in my teaching with this is recording their data in a way that they or others can refer to in the future. Often, the students will do and learn but may forget in the future. Having scientific evidence and data will support their conclusions that may in turn help save time for others that may have the same question.

c) read an additional document from the list above that addresses the "nature of" a different discipline. Identify 3 ways in which your content area overlaps with the second area that you selected.

As a recent math teacher, I wanted to go into Design and Making because it incorporates a lot of the applications of mathematics rather than simply studying the theoretical. Often in math class, we talk about units and the idea of degree of accuracy, but when you're actually making something, then you know that it matters.

In reading the Nature of Engineering, two excerpts have stood out to me as I'm working on a currently project called, "The Marketplace."

"The design process, the engineering approach to identifying and solving problems, is (1) highly iterative; (2) open to the idea that a problem may have many possible solutions; (3) a meaningful context for learning scientific, mathematical, and technological concepts; and (4) a stimulus to systems thinking, modeling, and analysis. "(Katehi, 5)

"Engineering "habits of mind" align with what many believe are essential skills for citizens in the 21st century. These include (1) systems thinking, (2) creativity, (3) optimism, (4) collaboration, (5) communication, and (6) attention to ethical considerations." (Katehi, 6)

In this project, students learned how to use various digital fabrication tools including, but not limited to the vinyl cutter, laser cutter, the sewing machine, embroidery machine, and the Cricut machine to design something that someone in our school community will buy. So far, the students have come up with various ideas from stickers to keychains to scrunchies and so much more. Through the process, they have used both, the design process and the engineering Habits of Mind.

As a specific example, one student thought she wanted to make stickers. She came up with this design to begin with and asked for feedback.

At first glance, I read the word “Protest” as an adjective, but she intended for it to be a verb. This was valuable feedback and she decided to ask more people what they read the sticker as. Through this feedback, she was able to iterate on the process and come up with multiple designs, vary the font, colors, and design as you can see below.

As she talked to more and more people, she found that it would be more valuable to actually make a sticker that protested a specific cause. She landed on making stickers to bring attention to the Black Lives Matters movement and to bring awareness to the LGBTQ+ community.

As you can see through this process, she has gone through the “Engineering “habits of mind” which include “(1) systems thinking, (2) creativity, (3) optimism, (4) collaboration, (5) communication, and (6) attention to ethical considerations.” (Katehi, 6)