

June 6, 2020

For this paper I will be writing about the Nature of Science, NOS. And as with all education, the ideas change periodically (a little Chemistry humor) and we teachers need to try and stay abreast of these new developments and ideas. Not that STEM (Science, Technology, Engineering, Mathematics) is new, just that it is coming into its own. In my Chemistry teaching, I do believe I have been doing STEM and following the NOS all along, they just now have a name. In the Tenets of Science we are tasked with bringing the societal/cultural changes into our classrooms and teaching practices, along with keeping the material objective and inferential/imaginative/creative. But everything in life can be very subjective based upon what is going on in the world, who is in charge and how/where you teach. One of the tenets discussed using history to bring the students into an awareness of where things fit into the world view and their view. I love history and so have always discussed the historical background of Chemistry as we learn the material. I encourage them to use their knowledge from their history classes and think about what was going on in the world at the time Mendeleev was working on his Periodic Table of the Elements. How did he get his mail? How did he travel from place to place? How long would it take? What kind of lighting did he write by? And I could go on and on with these examples.

Within my classroom I always have my students make observations about our experiments and the environment around them. One of their first questions is usually, "How many?" and I would answer, "As many as you think you need". And one of my first activities is to give them an ice cream bucket that has material inside of it with a closed lid and ask them to describe the contents

using four of their five senses, (not taste). Many do not even open the bucket while others will ask if they can open it. Once they discover they can open the bucket, most do not dump out the contents so as to count, organize and categorize the materials as a start to describing the bucket's contents. Trying to get them to collect this empirical data is my first step in helping them along their path to becoming observers of their environment and creative investigators.

With this Bucket activity, my students are encouraged to collect their data in any form they wish and to be creative in their reporting out of the results. The second day on the activity, I share with them some of their 'first' impressions and ask questions like, "You say some are red, green, yellow, shiny, S-shaped. So how many of each?" For many, they did not realize that counting was an observation, maybe because it is not the norm to just count. Counting grams, seconds, meters, but packing peanuts? And a number of my students will tell me these are all styrofoam packing peanuts and then we discuss how this is not an observation, but an inference, based upon their past experiences, which are necessary for them to know and use, but not observations.

If I continue using the Bucket example there are a multitude of ways to incorporate the other parts of STEM. Math comes easiest to mind, since I can bring in an algebra/statistics component or a graphing one. For this activity I have had my students redo the activity, now knowing that counting each type, color, and shape should have been done. Then they set up a graph to see what they have observed in another way. We then discuss how this is not the usual type of graph we would be doing in science, since it is a bar graph and can be arbitrarily set up and we discuss that and other examples of graphs they have done over the course of their education. Continuing on, they will calculate percentages which can lead us into percent

composition for our compounds in chemistry class later in the month. Both of these are mentioned in the CCSS for Math under algebra and statistics.

Another piece I could add into this activity would be why we have ‘packing’ peanuts and what their uses are. This would bring in some of the Technology /Engineering aspects by getting more into the Materials Science and the need to cushion products with these materials for the transportation of distances, since we are a global society. I have not done this before, so I would need to think more about what kind of questions to have for them and also for me to know the answers to their questions. This could be part of that ‘phenomena’ piece we discussed with an ‘egg drop’ activity. My only concern there is not being able to answer their questions or being aware of what I should know so that I am well prepared for the discussion that might ensue. This would be an illustration of the dynamic nature of STEM and NOS. I am always changing things up and learning new and interesting ways to ‘snag’ my students’ attention and keep them engrossed and wanting more!

I read all of the “nature’ of documents and saw overlaps in them all. I already mentioned the Math overlaps of algebra, statistics, and percentages. In the Nature of Technology, history is mentioned along with roles of troubleshooting, research and development and innovation and invention. Both Tech and Science have processes we follow: Design Process vs Scientific Method. Neither is the ‘set in stone’ type and both are fluid and can be adjusted and rethought out. But in both we have to think about what it is we want, who in society can use it and how, and the benefits and risks.

NGSS Appendix H – Nature of Science in the NGSS <https://www.sciencelearn.org.nz/resources/413-tenets-of-the-nature-of-science>

NGSS Appendix L: Connections to CCSS Mathematics May 2013, pg 2,3  
[https://www.nextgenscience.org/sites/default/files/Appendix-L\\_CCSS%20Math%20Connections%2006\\_03\\_13.pdf](https://www.nextgenscience.org/sites/default/files/Appendix-L_CCSS%20Math%20Connections%2006_03_13.pdf)

Nature of Math / Math Practices: [https://www.nctm.org/uploadedFiles/Standards\\_and\\_Positions/PSSM\\_ExecutiveSummary.pdf](https://www.nctm.org/uploadedFiles/Standards_and_Positions/PSSM_ExecutiveSummary.pdf)