Mrs. Ingrid Lijoi: STEM and Classically Taught Math

 When I was a high school junior applying to colleges, my Daddy said one sentence to me that has stuck with me my whole life, “MIT, MIT, MIT, then everything else!” You see, he was a systems analyst and would often travel for several weeks at a time, locked under the mountain at NORAD or working on missile guidance systems at NASA in Cape Canaveral, so math and science were subjects very important to him. I didn’t go to MIT. I went to Bucknell where I earned a Bachelor of Science in Mathematics, a concentration in Computer Science, and a minor in Classroom Education. When I graduated, I accepted a position at Shared Medical Systems as a computer programmer and worked there for five years. My husband is a software engineer for Lockheed Martin, and STEM is near and dear to our hearts. For anyone who may not know, STEM stands for Science, Technology, Engineering, and Mathematics. So far tonight, we’ve had an explanation of Classical pedagogy and lessons on literature, history, and grammar. Don’t worry, I’m not giving you a Calculus lesson…tonight… but I would like to touch on why and how we study the fields encompassed by STEM in a Classical school, specifically mathematics, and how that may differ from a more STEM-focused standard education.

 First we address the “why”. Why study STEM and why is it such a big deal? Let me back up a moment and address a more basic question… why do we exist? According to the Baltimore Catechism, we exist to “know, love, and serve God in this world and to be happy with Him in Heaven.” How can we know God? How can we grow to love Him? We can learn about God by studying His creations, and as we learn more about how His creations interact together and study their beauty, we develop patience, knowledge, and wonder and awe for our Creator. We can then take this wonder as a light to others when we share this knowledge and serve our fellow humans. When we study creation, we study the sciences – biology, chemistry, astronomy, and physics. We use Technology to calculate and visualize data, and Engineering to problem-solve and overcome challenges we have. Mathematics is the language used in all these fields to represent and model creation so we can study and predict how things work.

 In a Classical-based study of Math, we capitalize on the strengths of the students in each stage of their development. Elementary math (K-6) focuses on concrete facts and operations, building number sense and using their sponge-like abilities to memorize fact families. Much of this math is demonstrated with real-world examples (counting apples, money, time, fractions as slices of a pizza). We start giving students tools for their toolbox – hammers, wrenches, screwdrivers (they’re not quite ready for the reciprocating saw yet!). In middle school and early high school, depending on the student, they are able to begin abstracting some of the math concepts. With PreAlgebra and Algebra, we take those concrete facts and replace one or more of the numbers with a letter, then re-learn how to do the operations when we are missing some information. We still have the same tools, maybe a few more specialized ones like factoring, but we are learning to use the tools with more finesse which gives us greater capabilities. We use the hammer, not just to bang a nail, but also to tap a chisel and shave down an edge. Finally, in high school, we study topics such as Geometry, PreCalculus, and some also study Calculus. Logic is used to build a system of mathematics from the ground up, just as mathematicians and philosophers have done for ages. We start with a set of basic assumptions and definitions, and from these truths, we ask questions and discover more possibilities, proving that they are true as we go. Students must ask “Why can I do this?”, “Why can’t I do that?”, “What would I need to be able to show…?”. Problem-solving skills are developed as we review what we have learned already and look for new patterns to really internalize all the facts and techniques we have learned. Here’s the reciprocating saw… we now have the maturity and strength to use all the tools together to take apart a deck or build a beautiful headboard, and we know where each tool is best used. I know all their capabilities, what will work, what will not work, and maybe even some unconventional uses for them.

 Let’s compare and contrast the Classical model with a STEM-based standard education. Our basic goals are the same. We want educated students who can be productive members of society, making good lives for themselves and their families, and helping society progress in general. They learn the same math. 1+1 is still 2, the circumference of a circle is 2 pi times the radius, and the derivative is the slope of the tangent line of a curve. Labs are used in science to foster group cooperation and problem-solving. They have the latest and greatest technology – iPads, laptops, engineering labs with all the equipment – to spare them from tedious calculations and graphing. They may have more advanced mathematics available. Calculus might be available to younger students, so they could then progress to Calculus II, statistics, or computer science and programming. There is a great push to learn more content, which means students must jump into PreAlgebra and Algebra at a younger age, perhaps when they are not yet ready to handle the level of abstract thinking needed for success. They are packing the toolbox full of tools, but not leaving students enough time to learn how to use them or their subtleties. Once a student leaves school and enters the work force, this may translate to an employee who wants to program using the hottest new software regardless of whether it is the best tool for the job, develops a solution that fixes a problem but might cause more problems than it solves, be cost-prohibitive, or not a good fit with the architecture of a system, or is incapable of analyzing a problem or developing a solution. By the way, if you notice these examples are all related to computer engineering, that’s because as I was discussing my talk with my husband, he mentioned that he has personally experienced ALL these problems with some of his coworkers. He, and many other leads and managers value workers that can think critically, comprehensively, and robustly, keeping sight of the goal. That’s the difference between a good employee and a great employee.

 While some STEM-based education does do a good job of developing the student, this is where the Classical model excels. We share a desire to develop hard working students who will apply themselves, however our ultimate goal is much higher than mere corporal accomplishments. STEM is critical in our society, but can also be cold and unfulfilling, worshipping the created, not the Creator. Classical education provides the lens through which we view the STEM fields, developing the human and reaching for the divine. It opens us up to develop wonder, awe, and passion for studying the universe, and consequently, a love for the One who created it.