My name is Sonja Civillico. This is my second year at Regina Luminis Academy, and I teach 12th grade Physics. Last year I taught 11th grade Chemistry here. I also teach at two other classical Catholic schools: Martin Saints Classical High School in Oreland (where I teach 9th grade Astronomy and 11th grade Chemistry) and K-8 science at Regina Angelorum Academy in Ardmore. If that alone doesn't convince you that I love classical Catholic education, we also send our four children to Regina Coeli Academy!

I am originally from Texas. I got my bachelor's degree at Baylor University where I majored in Biology and Forensic Science and minored in Chemistry and English. I moved to Philadelphia to pursue my Masters in Biology at St. Joseph's University, spending the majority of my time in a cellular physiology lab working on my thesis. It was there that I really fell in love with being in a lab -- I got to work with different cell culture models as well as transgenic mice and rats, radioactive isotopes, incredible microscopes, you name it. I could hardly believe what I was doing was called work! Once I finished my masters, I took a job doing genomics research and managing a lab at Princeton University. I stayed there for four years before leaving when I had my children.

It was when I started considering where to send my own children that I really dove into the classical education model. I embraced the concept of meeting children where they are in their natural development via the grammar, logic and rhetoric stages. I admired the way each subject intentionally and thoughtfully pursued the good, the true, the beautiful, educating and nourishing both the mind *and* the soul of each child.

So how does one teach science classically? Let me first start by talking about what a classical science education is not.

Perhaps due to the precipitous decline in students pursuing careers in the sciences, our society today is inundated with the idea of STEM all the time. There seems to be an urgent push for schools to be replete with the latest and greatest "maker spaces," robotics programs and computer simulation labs, each flashier than the next. And that's not to say that these things don't have their place -- technology certainly has its uses and is an inescapable and often helpful part of the world around us.

That being said, in the classroom STEM typically looks like a lot of cookie-cutter labs (I hesitate to call them experiments) and a race through a somewhat intimidating curriculum at breakneck speed. On the surface this looks quite impressive. A glance at a STEM-educated child's homework reveals mountains of intimidating calculations and a walk through his classroom shows rows of computers set up for coding and boxes of pre-packaged lab kits. Depending on the school's resources some high schoolers can even opt to take Calculus II, Differential Equations, Genetic Engineering, and Biotechnology courses.

Wow. But wait a moment -- I think we all know that just because you *can* do something doesn't mean you *should*. Racking up a bunch of credits and learning the steps for a DNA extraction or

the code needed to make a robot lift its arm is in no way equivalent to learning how to think and reason critically.

This sort of education is the teaching of a set of complex but still very rote skills. If I'd really wanted to, I could have invited a 5th grader into the cellular physiology lab I worked in for my thesis and, with enough drilling, taught her how to run a polymerase chain reaction. But she would be simply mimicking me without any understanding of the overall point.

Science taught classically, however, has a much loftier goal: to teach and develop the extremely valuable skill of critical thinking. It is hard to do but the results are undeniably worth it.

Acquiring strong critical thinking skills is certainly important for students hoping to become engineers or doctors, but it is just as priceless in students who want to be writers or artists, musicians or philosophers, homemakers, or even priests or sisters. Not only that, but studying nature carefully instills in us a natural love of learning and a closer union with the Divine, be that as we examine atomic structure or point our telescopes at the stars above. Science also helps us flex our math and writing muscles through data collection and interpretation and drafting a well-made lab report.

Yes, of course you can expect your children to become well-versed in the standard knowledge base of chemistry or astronomy or biology, but beyond that they will learn the *whys* behind what they're doing. That includes the history -- the STORY -- of the chemists, naturalists, and astronomers and their discoveries. Most students graduate high school knowing the basic difference between the Ptolemaic and Copernican models of the solar system, but do they know how Ptolemy came to his (later proven incorrect) conclusions? Do they know just how beautiful his system was and how well it fit into the cultural understanding of the heavens at that time?

Most students learn a great deal of the periodic table but how did that table come to be? What is our historical relationship to the elements on that table? God created for us an ordered, rational world that He invites us to explore and wonder at so as to better praise and glorify Him. Memorizing facts is fine, but we push beyond that in the classical science classroom.

Labs here are inquiry-based. What does that mean? It means your students will be given a question and some number of materials and be asked to form a hypothesis and design an appropriate experiment to test it. He will fail at first. That's okay. We will try again. By studying our mistakes critically, we learn better than any lecture can teach us. This is what humanity has done since the beginning -- by trial and error and insatiable curiosity we have made amazing discoveries, all the while standing humbled before God by realizing we just how much more we still have to learn.

Science taught classically connects ideas and concepts between disciplines and guards ourselves against mediocrity. Yes we want to pass a test or get a job, and believe me, if you can

think critically you will get that grade and you will get that job -- but above all we want to train our minds to *think*.

We want our students to get into a lab and pick up a technique easily but also ask "how can I improve on this?"

We want our students to enter the medical field as adept surgeons but also pause to weigh the moral questions that inherently arise.

We want our students, whether or not they end up in a scientific career, to be able to use their critical thinking skills to assess the scientific and technological quandaries that will inevitably arise in their lifetimes -- and that may come in the form of caring for a loved one at the end of his or her life, debating an atheist on the dignity of human life, helping write morally sound legislation, or using robotics to design prosthetic limbs or power sources for impoverished countries.

Now let me give you a brief overview of how this looks in practice. I have the interesting position of teaching every single grade except 10th this year -- from K through 12th, although not, admittedly, all at this school. However, I think since all the schools I teach science at are both classical and Catholic I can use my classes as concrete examples of how we teach critical thinking. [PRESENT SLIDES HERE]