High School Science

— A Curriculum Proposal

The following is a suggestion for those who are motivated to depart from the standard high school curriculum of general science followed by biology, chemistry, and physics. I think some kind of departure is necessary because these courses, as presently offered from the secular press, have so many flaws:

First: The quantity of innuendo about careers and social engineering is a complete waste of time, and the philosophical drift of the texts is anti-catechetical. All this is very annoying to the students who are seriously curious, and it is deeply off-putting to faithful teachers. It is one of the reasons why the classical revival in education is so cold to science.

Second: Whole swaths of the natural sciences — astronomy, geology, and meteorology — are merely introduced in the general science course and then mentioned later. No systematic coverage is offered. This is inexcusable; the students are not being introduced to the natural world as they actually experience it.

Third: The most recent advances in the basic sciences have been incorporated into the texts without a thoughtful regard for the introductory nature of a high school education. People who do not have a long-term interest in the sciences quickly forget "foundational" concepts on which they do not build. I once waited three months for a building to be constructed because the foundations, washed away by repeated hurricanes, had to be excavated a second and then a third time. Foundations, even the best, do not last unless they have roofed buildings on them. If science is to be meaningful within the whole context of life, it is important to provide courses which make the student increasingly aware of the physical world and which arouse new levels of curiosity about what he actually sees day by day. That is what I mean by a roof, and for those who will not go on professionally in the sciences, a simpler foundation and a more prompt roofing job is in order. Even if it turns out later than someone wants to be a scientist after all, it is easier to catch up on the facts than to resurrect a dead curiosity.

Fourth: Beside these topical considerations, the cluttered layout of most textbooks seriously detracts from their educational power.

For some reason, classical educators are skimping on the sciences and taking up the position of despising them as if the fields themselves were responsible for the moral wasteland of the textbooks and of the times. This is cultural suicide. St. Thomas Aquinas was taught by St. Albertus Magnus, the greatest naturalist of his day; for that matter, the great medieval encyclopedia from the mid seventh century until well after the turn of the millennium was written by St. Isidore of Seville. Ignorance of the physical world is not a form of holiness.

I do not imagine that this is the last word on curriculum, but I have worked to make an interesting, comprehensive, and culturally viable suggestion. I begin with some principles and a suggested schedule, then offer more detail and a list of books I have found useful. I trust you will soon find even better books.

Philosophical Principles: Truth, Beauty, and Goodness

Part of the work of the natural sciences is to make the world more interesting by bringing to our notice various things that we have ignored for lack of a name: *The more you know, the more you notice*. Such boredoms as biology texts that concentrate on chemical reactions before chemistry has been studied, and chemistry texts that concentrate on naming conventions before the substances have been identified in the everyday world, or astronomy texts which explain right ascension and declination without teaching a single constellation, all make science seem like something completely arcane rather than something that addresses a common curiosity.

Every illustration in a science text should be both beautiful and intriguing. Beauty in the illustration of concepts and reaction pathways requires some effort, but it is an important part of education, and the suggestion that understanding must be pursued in a dead flatness is harmful and unnecessary. Of course the objects of science themselves — flowers, stars, nebulae, crystals — offer such a wealth of beauty that the use of ugly images is simply perverse and reflects the anti-contemplative bent of the men and women who choose them. The world is full of amazing things! A Catholic science text will make sure that so much is clear even to the casual reader.

Furthermore, in a pro-cultural text, examples of brutality, whether in nature or in man's interface with nature, must not be allowed to overwhelm the presentation of the natural sciences as a place to find beauty, cooperation, insight, and harmony. One of the problems with the concept of evolution as Darwin conceived it is the suggestion that progress is the natural heritage of the brutal, whereas Jesus taught that the meek would inherit the earth. Indeed, it is meekness before truth — the humility of honesty about scientific discovery — which has made the natural sciences the wellspring those innumerable tools of human service which we call technology.

Remember always that the natural sciences are the last refuge, in secular culture, for the concept of truth as a distinct alternative to falsehood. One of the worst effects of the discussion of such things as evolution has been to obscure this mission by constantly harping on topics about which disagreement is widespread, well-known, and of profound cultural import.

Curriculum

If I could write a curriculum, then instead of biology, chemistry, and physics, preceded by a strangely floating year of general science, I would suggest an arrangement such as the following. Note that I have six years here, in case anyone is ready to work on 7th and 8th grades, but the following essay focuses on the high school years.

	First semester	Second semester
7th grade	history of science	
8th grade	patterns in nature and art	
Freshmen	astronomy	magnitudes
Sophomores	biology	meteorology
Juniors	chemistry	geology
Seniors	physics	philosophy of science

Astronomy Books and Resources

H.A. Rey's book, *The Stars*, is an excellent starting point. Yes, this is the author of *Curious George*, and he has written a book called *The Constellations* which introduces the stars to children in elementary school. This more mature book introduces the constellations and the motions of the sun, moon, and stars, through the years and through the ages. The concepts of solar and sidereal day, of precession, and even of right ascension and declination can be challenging and usually belong to junior high or high school; lots of people never understand these concepts, but his illustrations are the simplest and best, which is why this book has been in print for 60 years. It does not address black holes or the beautiful images from the Hubble Telescope and their interpretation.

Sky and Telescope is the best amateur astronomy magazine, and has been for many years. Monthly sky charts will make it clear what is to be found in the sky each night, and interesting articles on both traditional and ground-breaking concepts challenge several reading levels. Beautiful photographs of celestial objects adorn every issue and are themeslves worth the price of the subscription. As an adjunct to Rey's book, it provides a modern view.

APOD — Astronomy Picture of the Day — is a subscription you can get online, free. Each day, a beautiful and amazing image comes to your in-box with a brief explanation that suggests avenues for further investigation.

The *Apologia* text concentrates almost exclusively on the planets and does not give a useful introduction either to the sky we see or to the cosmological topics that are so important to our culture. The author is a creationist, and it is not possible to study the stars seriously without being confronted by the great age of the universe and the impossibility of maintaining a 6,000 or 10,000-year framework in a meaningful way.

Astronomy

I would begin with astronomy because that is exciting to students and always seems like a frontier. I believe part of the excitement is that the viewing of the starry sky always has a suggestion of infinity, and this because the stars have no visual parallax and thus their distance is actually perceived as infinite.

Furthermore, especially in the northern hemisphere, astronomy should be taught in the autumn, first because the skies are clearer and drier than in the spring, and second because there are actually more stars in the sky since August is the month when Earth faces most directly towards the center of the Milky Way. (This second reason applies also to the southern hemisphere.)

Magnitudes

The study of magnitudes organizes all the sciences and provide a non-trivial introduction to its fields in much the way that a time line organizes history. This is an unexpected discovery, but consider that the basic topic of physics is the action of electrons and protons; the basic topic of chemistry is atoms and molecules; that the topic of biology is centered on items that have enough size to build a container for a blueprint and a quantity of water which will support various reactions. Obviously geology and meteorology direct our attention to larger entities; and astronomy still larger ones.

Magnitudes ~ Books and Resources

In the 1940's, Kees Boecke, a Dutch school teacher wrote a little volume called, *Cosmic View: the Universe in 40 Jumps*. In this book, he gave a perspective on the cosmos, from atomic nucleus to the largest known starry realms, by first moving away from and then closing in on the image of a young girl sitting in front of the school house. As each step away was larger by a power of ten, he found that in 40 jumps, he was able to present the known cosmos. This entire (and very simple) text is now available online. You can find it or any of several colorful and well-conceived lovely spin-offs if you run a search for "powers of ten."

Following this lead, I have written a book called *The Universe in My Hands,* which walks you through the various objects that you are likely to find in each size range. It is set up as a 6th grader's course in general science, but it can be pursued at any point, and in fact it is advantageous to pursue it twice, a few years apart, to make the idea clear. Since different individual items may be studied the first and second times through, it need not be repetitive. In fact, certain mathematical concepts that underlie the mangitudes may be a stretch in 5th or 6th grade, (depending on your math program) but will come to life at a later time. That is, the magnitudes can flesh out certain concepts of math whether they are taught before or afterwards.

If the magnitudes are studied in the second semester, the astronomy material from the first semester can be briefly reviewed and incorporated. I would not begin with magnitudes because it is too abstract a topic, and anyway, astronomy takes up so many magnitudes that it's overwhelming if you don't already have some of its basic concepts in mind.

Biology ~ Books and Resources

Whichever book you choose from the poisonous potions generally available as biology texts, I've written *Creator and Creation* to help you navigate the topic of evolution. Kolbe Academy makes it their business to choose the best of the secular materials and then provide a supplemental discussion of the Catholic position on various topics so as to support your faith during these attacks. *A student who is strongly motivated to go on in the life sciences must fully master what is standard in the schools*.

Jay Wile of *Apologia* ministries has a biology text that is very accessible to home educators and free of these secular offenses, but is such a creationist piece that these topics in his books are almost useless. You can skip the worst chapters on *not-evolution*, and the rest may be helpful. What can you do with photosynthesis and the Krebs cycle, after all? Keep in mind that online applets of all such concepts are really excellent: colorful, clear, and engaging.

Botany, which is so full of beauty, is never seriously taught. Get a 4th grade explanation of the cell, of DNA, and of photosynthesis, and skip the rest in favor of this beautiful specialization. *Botany in a Day* by T. J. Elpel is wonderful, having all the information that is really useful for identifying plants and getting a sense of their chemistry and thus also their herbal uses. This is the book I wanted in high school.

You can read *Genome* by Matt Ridley, who is a Darwinian, but who has made the important concept of the genome very accessible.

One important option, about which I have mainly a curiosity and little actual experience, is the work of Michael Baruzzini, a homeschooling father and science teacher. He is composing an online class, and because he has some blogs and other printed material, I know his Catholicism and his science are good. His short course on astronomy looked good as well.

Biology

Biology, chemistry and physics are suggested in the usual order, but each only one semester, constraining the teachers to figure out what is most important.

Biology in particular is the science of life. A student needs to consider what are the functions of life: growth, nourishment, respiration, movement, generation. They need to understand the cell, the forms of the major members of the family tree of life, the workings of inheritance and the genome, the twin miracles of photosynthesis and metabolism.

Meantime, biology texts are full of insufferably casual references to birth control, *in vitro fertilization*, and man as the lowest form of evolving beast along with the ugly images that go with the Darwinian concept of survival of the most brutal. This is very counter-cultural, and even the opportunity to respond to these anti-catechetical biases gets old. .

List the topics found in the table of contents and find them online or in trade books which are constrained by needing to attract buyers. As a last resort, go through a modern biology text and take out all the irrelevant images of career potentials, all the ugly stuff, all the simpering promotion of eugenics, and all the pandering to the neo-Darwinian synthesis.

Do what's left.

Medicine

Medicine stands between biology and chemistry. The pharmaceutical side of medicine is obviously chemistry; the anatomical side is biology; the endocrine systems is entwined with both.

The best of the alternative health community is often insightful about the working of the body; the mainstream medical community has some wonderful writers as well.

It's worth knowing the major nerve, muscle, bone and endocrine systems. In time, everyone confronts medical problems and a little vocabulary helps us navigate the discussion that must take place.

The most useful part of a text is probably the table of contents, armed with which you can find each topic online, in color, and enjoy yourself. Even the trade books at a local public library may be useful. Enchanted learning (online) is a good site for the younger set or for a quick and clear introduction to any topic in the sciences. McGraw Hill has a website http://www.rusd.k12.ca.us/4teachers/science/biology.html which offers "proposed biology standards." This is probably eduspeak for involvement the federal efforts to impose specific curricula, but such standards are not generally bad in themselves; it is the bias in the school texts approach which is hopeless. The up side of a site like this is that you can go and find out what is considered important and then study it: cell biology, genetics, DNA, ecology, and evolution. Note that none of these very interesting things are the things you see when you own a dog, a fish, a cow, or a rose bush. That is perhaps why, when I ask those of my friends whose professions are not involved with life sciences what they remember of high school biology, the answers are not impressive.

Take the responsibility of engaging your student's attention. The local naturalist club or nature walk should provide good resources if they are not completely eaten up by political correctness.

Everything by Oliver Sacks is fascinating and gives a sense of broader vistas. Once, on a mountain climb, he tore his quadriceps and nearly lost his life. His account of the whole adventure leads to many reflections on healing, on phantom limbs, and on the relationship between mind and music. Read *A Leg to Stand On* and then *The Man who Mistook his Wife for a Hat*. His book *Awakenings* was made into a movie.

If you know anyone over 60, read *The Wisdom Paradox: How Your Mind Can Grow Stronger As Your Brain Grows Older* by Elkhonon Goldberg.

Meteorology ~ Books and Resources

For the study of weather, Jack Williams has provided is very thorough and well-illustrated book called *Weather*. If you study a chapter every week or two, you will achieve a comprehensive understanding of the weather that will change the way you look at the skies and will open up the weather maps that have been merely vague diagrams until you learn the meaning *and implications* of their symbols.

There is an amazing web-site belonging to the Cloud Appreciation Society, which has the most beautiful cloud images in the world. It is incomparable and offers various books, calendars and stuff including several books, beginning with *The Cloudspotter's Guide*.

The Weather Identification Handbook is also wonderful.

Eric Sloane's weather books, such as *Look at the Sky and Tell the Weather*, and *Eric Sloane's Weather Book* are back in print from Dover Books. Sloane has such a wise sense of the lore of the past, such graceful sketches of weather forms, and such clear explanations that his work has not been bettered. This early pilot was the original thinker and instinctive teacher behind much of modern weather forecasting. His books are from mid-20th century, so again, don't expect the kinds of information that satellites give us, but expect more about the things you see out your own window.

For the important Coriolis effect, go to my blog, [marydaly.wordpress.com or "notice the universe"], find the page with links for "Corey's Bow" and read the story. It's very important to be aware of the Coriolis Effect, not only for storms, but for any trajectory that goes through the sky, such as a cannon ball.

That was the challenge of writing Corey's Bow, and I think it worked. All math, even trig, is common observation made systematic and easy to extend. It's not supposed to be the only way to express something.

Meteorology (Weather)

Meteorology is the setting for the drama of life. In addition, it is a kind of large-scale physics lab, where pressure and vector motion are always taking place and affect our lives every day. Furthermore, some of the concepts of chemistry are in play, and events of the geological record are now studied as they happen. Above all, this is, once more, the world about us, full of beauty, mystery and challenge. Since it is also where life takes place, it makes a nice semester after biology.

By the way, it is difficult to find a clear explanation of the Coriolis effect, and many, including Jack Williams, have explanations that make me doubt that they actually understand it. It's a complex idea because it involves motions which are traced on a surface that is both round and spinning, so that none of the lines are straight. Illustrating these motions on a flat piece of paper is difficult, and still more so without a clear concept of trig.

Chemistry

Chemistry comes next, and using this scheme, curiosity about this field will have been introduced in the chemical reactions of life, particularly if you read the botany book, which has some chemistry at the back, or if you have read something serious about the chemical systems of life.

A standard chemistry text can be hopelessly dull unless you have enough math behind you and can get an excellent teacher. Find some kind of outside reading to help you along, because a bored child does not learn well and does not remember what he crammed for the test. Don't let science be a bore.

On the other hand, a student who is motivated to go on in the sciences must fully master what is standard in the schools.

Such a motivated student will enjoy books that relate his studies to the world about him.

Chemistry ~ Books and Resources

For chemistry, I've written *Chemistry 001* to get you started on the Periodic Table in an accessible and attractive way.

P.W. Atkins has written an amazing and beautiful little book called *Molecules* to get you into the next larger step of this topic at the Ångstrom and nanometer level of the physical world. It is not a complete text, but I guarantee you will never see things the same way after reading his piece. It's wonderful.

Atkins also wrote *The Periodic Kingdom*, a little volume which should accompany any student through the challenges of a serious high school chemistry course which it does assume. Atkins is a gifted teacher and his presentation of the Periodic Table is unique.

Unfortunately, Atkins is an atheist, and this occasionally intrudes on this work. It's annoying, but he's such a born teacher that I have to recommend him.

Nature's Building Blocks, by John Emsley is an amazing work, full of intriguing information about each element, an indispensable reference, one likely to make chemistry a memorable study. It provides some of the background for *Chemistry 001*. It's just fun to read.

David's Whizzy Periodic Table from the Physics 2000 site is not to be missed.

If you intend to go on in the sciences, you need a standard text, and I refer you to Kolbe or to Michael Baruzzini who also has a chemistry course on line.

Joel Williams, after retirement from Los Alamos National Laboratory, composed a new view of electronic orbits and published his thoughts on a website (http://arxiv.org/html/physics/9909053v3). This is a very serious and important contribution to the geometric discussion of these tiny entities. After all, something that really has no dimensions, as others have claimed, cannot have weight either. Electrons have weight. (See the discussion of philosphy of science, below.

Geology ~ Books and Resources

For geology, I have tried to make a clear introduction in *A Doorway of Amethyst*, offering a Catholic perspective on its major themes. Since geology involves an understanding of the great changes of the earth and therefore its great age, and since it provides evidence for a sequential history of life forms, a secular book can be full of irreligious innuendo.

After some introduction, there are lots of options. There is a series of books, *Roadside Geology of...* [one state after another], which will allow you to get right into your local geology. Not every state has one, but there are quite a few and a neighboring state will give clues to your own if your state is missing from the collection.

Annals of the Former World by John Mc Phee is the next step up, an incredibly literate and far-ranging introduction to geology from the perspective of a trip across the US on Interstate 80. It is actually a collection of five books that McPhee wrote over 20 years, and if you don't want to commit to such a large volume, you can get the book that pertains to your part of the country.

The Seashell on the Mountaintop is a fairly good read about St. Niels Stenson, the father of geology. Pleasant high school read. The author is not Catholic, but not deliberately anti-Catholic. Stenson became a convert and then a bishop, decisions that are hard for a non-Catholic to understand.

Jane Meyerhofer and I have written about *Copernicus, Galileo, and the Catholic Sponsorship of Science*, an essential topic, partly centered in biology, but also concerned with geology and astronomy. When you're ready for more, Stillman Drake's *A [very] Short Introduction to Galileo* is the book. (The same book goes by two titles, one with "Very" and one without.)

Geology

The study of geology concerns the major physical features of the earth -- seas, rivers, lakes, mountains, plains, continents, and islands. As it introduces these forms, it also introduces fossils and the actual evidence for the single family tree of life produced over a long period of time. In addition, it will bring the student into contact with the immense changes in the world over time, and will prevent his caving in to simplistic explanations of climate change. It's a nice semester after chemistry and before physics — again, the erosion of geological forms is partly physics and partly chemistry and is visible, making these other disciplines real.

Physics

Most fundamental of the sciences, physics should be fascinating during this closing year of high school, because other studies have given the student some large scale information to work on. At this point, physics means discovering the foundations and thereby organizing a lot of information that has come up in all the other sciences.

You know your children. *Those who are motivated to engage the world as physicists must fully master the material in standard physics courses*. Those who do not plan to go on should master a text that is appropriate to their priorities. A foundation without a roof is *useless*.

It is well-known that the biologists have, in evolution, a guiding principle with strong philosophical implications. It is not so well known that in 1930, there was a meeting of physicists in Copenhagen, led by Niels Bohr, in which concepts of physics were adopted with equally troublesome philosophical implications. In the Copenhagen Interpretation, a form of philosophical idealism (or perhaps a form of nominalism) was adopted as the standard interpretation of physics.

Perhaps the simplest way to make the issue clear is to point out that, in this interpretation, an electron is thought be (or behave like) a geometric point inhabiting a probability field.

A geometric point has no dimensions, no length, width, or height, only location. An object with no size cannot have weight. An electron has weight. It is not a geometric point.

It is equally problematic that the electron is considered to inhabit a probability field, rather than to have a (rapidly changing) location. Father

Physics ~ Books & Resources.

Meteorology, geology, and astronomy are the great physics labs of the world, setting the stage for this fundamental science; the studies of pattern (below) are also, implicitly, physics.

Apologia will have a creationist version; Kolbe will have something helpful; Baruzzini does not yet have physics (in February of 2011). I assume he will do it in time, but an online course is very demanding.

Lewis Epstein's book *Thinking Physics* gives a good presentation of many physical and mechanical principles and will help correct your thinking in important ways. It's written in the form of questions with multiple choice answers followed by an explanation of the correct answer. Unexpected; delightful!

Light and Color in the Open Air, by Minnaert, is a wonderful old book, reprinted by Dover, with a whole series of home-made experiments involving light and atmospheric effects. Minnaert is here giving the physics of many things that we see every day, as well as a few that are rare. It will change how you notice the world about you.

For electricity and magnetism, the *Physics 2000* site is very good and provides links to deeper information on each topic.

Tom Bethell's *Questioning Einstein* makes a very important contribution to the study of relativity, which Einstein was not comfortable with as its consequences developed. Readable and important.

Joel Williams (http://arxiv.org/html/physics/9909053v3) has a visually accessible concept of the electron and its orbits, which he believes to be specific, and he explains how his ideas work in the lab. He also has an intriguing essay on gravity.

Anthony Rizzi, author of *The Science before Science*, and a physics text, *Physics for Realists*, addresses the issue of philosophical realism. Since I have not finished either book, I should perhaps not bring them up, but he is an eminent thinker, addressing a fundamental problem. Regina Coeli Academy is using his writings in their physics course, not as the main text. but as supplementary material.

Pattern ~ Books and Resources

On pattern, Phillip Ball has written a challenging piece called *The Self-Made Tapestry,* which introduces the basic patterns found in nature, and gives many interesting anecdotes about the history of their discussion and their understanding. Note that even though the book is very challenging to understand in its entirety, it is quite accessible as a discussion of the patterns to be found. If you can't follow an entire line of reasoning or the equations that go with it, you can still see the pattern and acknowledge that it appears frequently in the wide world and has an orderly source, represented by the way that the equation describes an interaction between variables in the world reresented by its letters.

Ball's work is partly based on an earlier work of D'Arcy Thompson, called *On Growth and Form*, which is a little easier to read and much cheaper, being out of copyright, but also less colorful and engaging. Still, that older book and another called *Patterns in Nature* by Peter Stevens offer a swath of unexpected information about patterns, including an amazing discussion of certain architectural wonders based on shell spirals.

At some point, a science or a math course should offer some reflection on the patterns generated by bubbles and their packing rules, waves and their interference rules, the Fibonacci series and the spirals it generates, and the branching rules that govern the growth of plants and also of rivers. These are the fundamental patterns of the universe. They turn up everywhere in nature, and Ball particularly makes the point that in the rush to embrace Darwinism, *the fact that biological entities must obey the laws of physics* is often ignored.

Animal skin patterns, for example, are quite possibly the effect of reactions like the BZ reactions early in the fetal life of the animal, long before it meets any trees or grasses to hide in or any predators to hide from. Ball makes this point very strongly, and it is an implicit critique of causeless Darwinism.

Jaki has made some firm and dismissive remarks about failing to face the difference between what is unknown and what does not exist. Saying that an electron does not *have* a location because *we cannot locate it* is bad philosophy.

You may say (with Bohr) that as long as an electron behaves like a point, why not call it one? The answer is that by choosing this vocabulary, Bohr, and the physics community that followed him, committed themselves to a concept of probability-based physics which, at the fundamental level, denies causality. It's all chance, just like Darwinism.

You may have heard of the famous remark by Einstein that "God does not play dice with the world." The Cop en hag en Interpretation was what he was referring to, and he rejected it, as did other eminent physicists. The issue matters because it bears on the question of how you understand the physical world and whether you think cause must be founded in a First Cause or whether you think it develops, by accident, out of nowhere.

By the way, Democritus thought the cosmos was accidental, and his atomism was long rejected on precisely those grounds.

History of Science

The history of science is an opportunity to reflect on the natural sciences as a human endeavor shaped by philosophy and served by math and by observation. If you had a chance to do history of science earlier or alongside the other sciences, well and good; learn some philosophy of science. If you haven't done the history, now's a nice time and a certain amount of philosophy is implicit. A Catholic history of science must ensure that students understand that this endeavor, a response to the Genesis command to "subdue the earth," is constrained by ethical considerations, and so is the technology that flows from it.

Furthermore, it should be made clear that the progress of science is not independent of a philosophical commitment to honesty and an expectation of finding truth. One pair of recurring themes in the history of science is the problem of dishonesty and pride. It stops progress!

History of Science ~ Books and Resources

Classical educators like to emphasize the history of science. Such an approach illumines the humanity of the scientific endeavor, and may also make clear the *philosophical* context in which various discoveries have been made. These are important values, particularly in a world which has been taught that the Church is the enemy of science. Good resources, however, are hard to come by. Joy Hakim, brimful of secular prejudices, has been hired by Smithsonian to make a 6 volume history which (halfway complete in 2008) is colorful and comprehensive, but also cocky, insulting to Catholic culture, sometimes ignorant, and often fluffy and irrelevant. Nothing else is as comprehensive at the children's level, alas!

Jane Meyerhofer's *1000 Years of Catholic Science*, available from Ye Hedge School, will give you a list of scientists to start with and a sense of the breadth of their accomplishment. Use the library. Jane's is not a complete work, and some important names were not included because of family demands.

Jane Meyerhofer also gave a presentation on Galileo which has since become — *Copernicus, Galileo, and the Catholic Sponsorhip of Science*, which also includes an essay of mine, an edition of Galileo's letter to the Duchess Kristina, and some teacher support material. The Galileo story is of great importance. Get it straight. Read Stillman Drake's *Galileo a [Very] Short Introduction* if you can.

Pierre Duhem, the towering physicist of the first half of the 20th century wrote the entry on the history of physics for the Catholic Encyclopedia of 1913, which is available online. It will provide some interesting insights.

I have worked on a history, but I can't recommend you hold your breath for it. It was interesting to learn, however, that the reason that the Church was opposed to atomism was the Democritus, the founder of the concept, thought the atoms moved without cause!

Philosophy of Science ~ Books & Resources

What is science? What is the nature of the scientific endeavor, and what is its contribution to the pursuit of truth? What is the nature of the error of secular humanism as it has pervaded the sciences? What is the future of a scientific technology pursued without ethical understanding?

At some point in Catholic education, these questions must be addressed. In a good education, of course, they will be addressed all through, but at some point, a systematic consideration is due.

My own *Creator and Creation* addresses the issue of creationism in a full context, thereby including some brief reflections on the nature of science and of truth. Jaki's *Science and Creation* is much more scholarly and demanding, helpful for the interested student, perhaps beyond the reach of a less educated, less motivated, or simply a younger student.

Other important texts are Behe's *Darwin's Black Box* which carefully defines intelligent design, and the recent *Privileged Planet* by Gonzalez and Richards, which makes the case for the unity between designing for life and designing for curiosity and intelligence. Good stuff.

All of Father Stanley Jaki's work addresses philosophical questions. Rizzi's work, mentioned above, addresses issues of philosophy as well as physics.

As this book was nearing press, a wonderful new resource became available, Christopher Baglow's *Faith, Science & Reason, Theology on the Cutting Edge*, which is actually written as a high school text book (with chapter review questions, etc) on the philosophy of science. It covers all the important philosophical and theological topics, thoroughly and lovingly. Baglow depends on a few scientists that I disagree with, but perhaps it is just as well that his science is essentially mainstream. This work will provide Catholic students with the right tools for the challenges they are most likely to meet.

The book is physically beautiful, well laid-out and illustrated with an eye for beauty. It is a treat.

Philosophy of Science

Several issues of philosophy have already been raised: most fundamentally, the question of causality. While the natural sciences devote themselves to evidence that is subject to measure, they should not be made an excuse for the denial of purpose or spiritual life, which cannot be measured.

Indeed, it should be made clear that a universe without cause is a universe which mocks the search for truth; and the progress of science is not independent of an expectation of finding truth. One recurring themes in the history of science is the problem of dishonesty and pride. It stops progress. But how can honesty be important if there is no such thing as truth?

All such philosophical considerations will certainly have arisen from time to time throughout the study of science, but the last semester of senior year is a good time to pull everything together and look at the whole.

That is what a classical education is about, right?

In closing:

Again: this is just a proposal. We need to start a conversation about high school science, and we need to address the anger of the classicists and call them into the sciences where their principles are so deeply needed.

Don't be hamstrung by my suggestions. Change the order, skip what you cannot do; emphasize what your local teachers do best or what your local students are anxious to learn. If you have a farm, by all means study the plants and animals you have, not the ones in books others have chosen. If you live by the sea and have the interest, of course you should take a closer look at marine biology! What do you care what a mint plant looks like? You can learn that some other day. If you love the weather and want to study it for two years, by all means do so; if you wish, you may call the first semester meteorology, the second ecology, the third physics, and the fourth general science. It is perfectly fair.

Alternatively go to your local public or parochial school and take whatever courses you need, using this booklist to encourage your child and to supplement and correct his education.

But don't be hamstrung by the school either. If your child is getting a barely passing grade because his interests don't match the teacher's, think twice before you demand perfect marks. As long as a child is curious and learning, you have a responsibility to protect his life from undue interference.

Well, that's what I think. Adults must navigate between the responsibility to get our children involved in goods they are not old enough to appreciate, while at the same time respecting their individuality.

Do you think Luke Howard would have named the clouds if he had been in a modern school, forbidden to look out the window until he finished his homework? Do you think the Wright brothers would have invented the airplane if their Mom had given in to the neighborhood advice to make her kids more sociable during their after-school hours?

Would you like to read about a solitary little boy who loved God and also had that fire within, that burning to know physics? Michael Faraday was such a child and then such a man, the most extraordinary of men.

The world is beautiful. Look at it.