

INTRODUCTION

WELCOME TO A COURSE ON FAITH AND SCIENCE!

SEEING THE BIG PICTURE

Whether you are Catholic or not, imagine that you never were told or understood that God created everything visible and invisible. Then, maybe because of this, when you first took a **science** class, you weren't prone to wonder how faith in God and science tie together. You may also have wondered about the purpose of studying science. You might have been told: *Learn chemistry so you can graduate. Learn biology so you can know how living things function. Learn physics so you can solve problems.* Ultimately, those answers left you unsatisfied as a student.

But what if you do approach science as a faithful Christian believer in a

science: As it relates to physical science, a broad term to describe the study of nature, the study of creation, the study of the handiwork of God.

God who creates both the **universe** and the heavens? How much more interesting is it for you to glean from science some of the whys and wherefores of your faith? This is really possible despite whatever conflicts you perceive between science and religion or between scientists and believers in God. Any differences between

universe: A consistently interacting totality; all existing matter, space, time, and energy regarded collectively and constituting a systematic and ordered whole.

these two perspectives of science and faith are about to be reworked in this book. We will strive to bring science and faith together. For in fact: *Science is the study of the handiwork of*

God. This one little sentence is very true and can make all the difference in how you think not only of science but also of the connection between your faith and what you learn in science class.

MY STORY AND MY HOPE FOR YOU

Maybe you have already heard people say that science and faith are in conflict. Ever since the rise of modern science, and especially in the last two hundred years, it has become common in our culture for people to say that science and faith are in conflict. By that they mean that only science can give us real answers—physics tells us how objects move, chemistry tells us what makes up matter, biology tells us what life is, cosmology tells us about the universe. Faith, they say, is make-believe because it cannot be measured on a balance. This is the wrong view, one we will thoroughly correct in this book. We will address each of the hard questions you may encounter, and I will show you how to responsibly navigate science in the light of faith. My hope for you is that you understand why studying science is to learn more about God, that learning about science truly causes you to see

the world differently. Maybe you will even be inspired to become a scientist.

Understanding science changes the way you see the world. You will learn to see reality in a bigger, deeper way. When you learn about atoms and molecules, forces and energy, or organelles and cells, you gain an understanding about how God created and sustains life.

Now imagine yourself as a person who always loved science because you were good at it and you were curious about how things work, but you never made a connection about where all the order and beauty at the atomic scale comes from.

Imagine that you were like me and your dream was to do research on artificial photosynthesis so you could capture energy from the sun and turn it into usable energy for industrial processes like plants naturally do.

Then, imagine that you found yourself one day in a panic because you couldn't make your artificial nanocomposites work with even a hundredth of the efficiency of a square millimeter on a single leaf.

Finally, imagine that just as you were about to give up, you looked out your lab window at an old *Ginkgo biloba* tree with thousands of leaves flapping carelessly in the breeze.

You would think I had never seen a tree before at all! Yes, that was really me in my twenties in the Thomas E. Mallouk Chemistry of Nanoscale Inorganic Material Research Group at Penn State University. I was not religious, but after years of loving science but not knowing why, I was afraid to answer the glaring question I found before me in my own laboratory.

Who did all of this?

I almost let myself say, "God," in that moment, but the truth is, my journey to conversion was only starting. I did not convert

to Catholicism until fifteen years later after a great deal of personal reckoning. But I never forgot the insight with that tree; perhaps it was a moment of grace. I had spent my life to that point climbing the mountain of scientific knowledge, driven by a desire I did not understand, to arrive at my dream to be a scientist only to glimpse God and turn away in fear.

I did not get scared because of logic. A chemist does not fear cold, hard truth. It was the personal relationship that I could not face, a personal relationship with the Being known as God and the accompanying expectation to live up to moral standards that I did not completely know or understand at that point. I was afraid I would not be good enough.

Let me explain what I mean with an example. You know how Jesus told his disciples that the very hairs of our heads are all numbered (see Luke 12:7). To a chemist this means that not only does God know the exact number of hairs we have on our heads but he must also know the exact location of all the electrons that are in the atoms of all the molecules of keratin that make up each strand of hair. Chemists do not stop at counting hairs! When I had thoughts such as this, it was overwhelming. I realized that if God knew the physical parts of our bodies in such detail, then it must also be true that God knows every detail of my interior life—my hopes and fears—too. This was scary to me. I was afraid I would fail at being good enough to follow this perfect God. Chemistry had pointed me to God, but it did not provide the confidence that I could lead a life of faith. My confidence that I could both know and follow God came from watching other people actually do it. I knew Catholics, and I wanted what they had—the fullness of the truth. That is why I also believe that good arguments will only get you so far. If you want to effectively evangelize, you also must live a life of faith with the Eucharist as

the source and summit. When people see you doing it, you testify more than a million words could ever get across.

My hope for you as you study about how to navigate science in the light of faith is twofold: I wish for you to gain a bigger vision of reality for yourself *and* to take this vision a step further. You can **evangelize** others through science! I want you to use this new knowledge about science to become confident in your faith, down to the tiniest particle, and then to lead souls to heaven with your joyful confidence.

This is our one purpose in life: to get to heaven.

We are meant to strive to be saints.

By knowing God more, you can love him more and serve him more. You will hear of the mythical faith and science conflict. You will hear people ask how a Christian who believes in God

evangelize: From a Greek word meaning “to bring the Good News of Christ to others.”

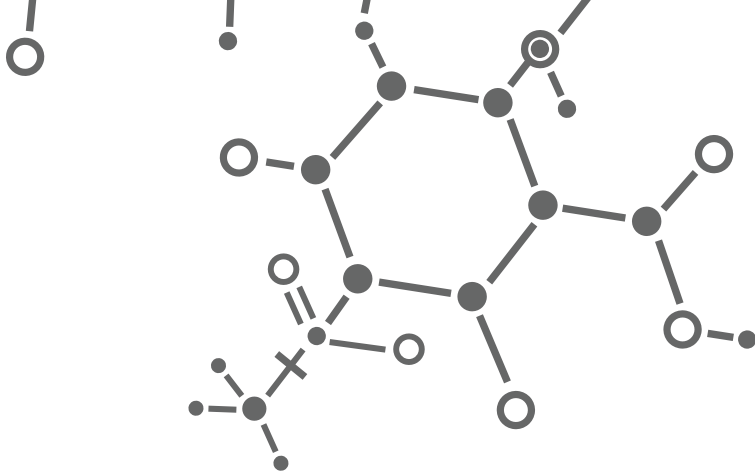
on faith can also accept science based on reason. You will have to answer many questions in life. Be a leader. Turn the conversation around. Figure out how to help your friends and family see the bigger vision of reality too. Lead them to Christ through science.

UNIT I

SCIENCE IN THE LIGHT OF FAITH

Before we start talking about science, we need to define a few major terms. I said before that “science is the study of the handiwork of God” because science studies nature, and nature is creation. But what is the universe? The universe is “strict totality of consistently interacting things.”¹ Within our universe are things small and large—from the smallest subatomic particles to large mammals, including human beings—and all of it is connected in very precise ways (as we shall see) at the atomic level.

Both science and faith seek to help us to better understand ourselves and our place in the universe. They do so differently. Faith does come first, however, before science because faith requires us to assent to what God has revealed before we look out at our universe and analyze it. Science, on the other hand, is concerned with answering the “how” questions of how the universe operates. Rabbi Jonathan Sacks put it this way: “Science takes things apart to see how they work; religion brings them back together to see what they mean.”²



CHAPTER 1

THE NAVIGATION PROCESS

FAITH AND SCIENCE ALREADY COEXIST HOSPITABLY

When Catholics bless our meals, we begin: “Bless us, O Lord, and these thy gifts.” How many of us pick through the food first to decide what proves God’s existence and what does not before saying the blessing?

“Bless us, O Lord, and these thy macaroni and cheese, French fries, pizza, and burgers . . . but not thy brussels sprouts, lima beans, or chicken livers.”

We don’t do that, right? In faith, we begin by acknowledging that God created every raw ingredient that human hands used to prepare the meal. Meals, after all, are magnificent scientific feats down to every last **atom**, innovations wrought by the manipulation of matter in various chemical

atom: The smallest particle of a chemical element.

and physical changes orchestrated to serve up something good for humanity. The harmony of faith and science is the harmony of blessings and meals. Just ask a cook!

“But,” you say, “what about people who do not believe in God?” It is true that people of faith see a meal as a gift from God and atheists do not. But this is the cool part. Though atheists and Christians may view the elements of a meal differently (as the handiwork of God or not), these groups of people can still appreciate the food together in the communion of friendship. This fact reveals something radical about the relationship between faith and science: *Science can be the very venue through which we reach out into the world and shine our faith to illuminate the path to truth.*

Science *should* unite us like that because we all agree that the material realm exists. Our faith can light up the entire discussion. Recent popes, like all their predecessors, agree that faith and science fit together. Pope Francis wrote in his first encyclical, *Lumen Fidei (Light of Faith)*, that faith is born of love and reflects God’s own love: “Far from making us inflexible, the security of faith sets us on a journey; it enables witness and dialogue with all.”¹ For those who have accepted it, faith draws us out into the world to build a place where we can dwell together. This spirit is witnessed in the Pontifical Academy of Sciences, established by Pope Pius XI in 1936 and endorsed by every pope since. The academy invites scientists of all faiths, or of no faith, from around the world to gather into working groups to present papers and compare findings, searching for truth together.

The lesson here is that if faith illuminates the encounter with science and other people, then faith comes first. This order—faith first and science second—should never be reversed. We need faith and reason equally, but when it comes to science, we

must view its discoveries and lessons through the light of our faith in God, the Creator of all.

When my (then) four-year-old son JJ heard me say that everything is made of atoms, he wanted to know if he was eating atoms, and of course, I enthusiastically agreed that he was. He put the idea of “science in the light of faith” into words during our blessing: “Bless us, O Lord, and these thy atoms.” That’s why this book is dedicated to him.

THE FALSE DICHOTOMY: ACCEPTING SCIENCE WHILE REJECTING FAITH

How many times do we hear of teens or young adults saying they have accepted science and rejected faith? This is what is called a false **dichotomy**—that is, a false choice—because you do not have to pick one and give up the other. Nevertheless, we must also admit that there are many scientific conclusions that seem to contradict Christian faith. It can cause a sense of anxiety.

One of the controversies between faith and science that is often cited is the Church’s censoring of the scientist Galileo Galilei in the seventeenth century.

The common belief of the time was that the earth was the center of the universe and that celestial bodies (in the heavens) were

dichotomy: The division of two sharply defined or contrasting things; two mutually exclusive categories.

made from different (divine) material than bodies on land. This knowledge was, of course, incomplete. People were right to maintain faith that God created a celestial realm beyond our imaginations, but they were wrong about how it existed. They were right to maintain that humans were central in the hierarchy of creatures, but they were wrong to think Earth is the center of the universe. Galileo taught that the sun, not Earth, was the center of

the universe. His defense of his worldview seemed to attack Pope Urban VIII, and to make a long story short, the politics of the issue led to his censure. Galileo was more right, but he was still not completely correct about the position of the celestial bodies. Thanks to the efforts of scientists, mathematicians, philosophers, and theologians, however, the Church eventually came to understand a changed worldview where the sun was the center of the solar system (not the universe). In 1992, St. John Paul II formally acknowledged the errors of the Galileo affair.

This entire well-known Galileo affair teaches us an important point: Faith and science are two different manifestations of the same reality. When they seem to have conflicting conclusions, it is because our knowledge is not complete.

THREE STEPS FOR DISCUSSING SCIENCE IN THE LIGHT OF FAITH

There is a natural tendency to dive into a new topic or question feeling either anxious to understand the topic and the answers right away or to dismiss the question because the information seems difficult and hidden behind technical language. Try to temper both extremes.

Learning is difficult if you are not clear about what you know and do not know, and there is no shame in admitting limits. Truly, it is an intellectual virtue to be honest about the limits of your knowledge, and it is quite liberating and clarifying. When you are new to a topic or question, write down what you understand, try to articulate what you think you grasp, and pinpoint precisely where you begin to be confused.

Then, do not rush to form an opinion. The most controversial topics involving science and religion are debated because there are no clear answers. Learn what is known about science,

but remember that science is **provisional**. Something is provisional when it supplies a temporary commodity. We say that food is provisional, for example. Scientific theories and models supply temporary explanations until better ones are discovered

provisional: Something that supplies a temporary commodity but is likely to change.

with more research. To say science is provisional is to say that science is never complete. Try to understand a variety of opinions, note them, and file them away for later if you are not sure how they fit together. If you are not ready to articulate an opinion, do not. If someone presses you, say, “I have not formed my opinion yet, because I am still learning.” You might be surprised at the number of useless debates that such honesty will spare you. Before you begin a journey to gain new knowledge, realize that you are entering a conversation between faith and science that is already in progress. In time, you will form your own views, and you may even alter the future course of this conversation.

St. Thomas Aquinas, citing Aristotle, gave this reminder: “A small mistake in the beginning is a big one in the end.”² If you are going to the store, for instance, and you take the first step in the wrong direction, it doesn’t matter how many steps you take afterwards, you won’t get there. The right first step for discussing science in the light of faith is to allow yourself to experience awe and wonder when you see creation. Develop a view that sees all of creation as the handiwork of God.

Having set the outlook and some parameters, I offer these three steps for preparing to discuss science in the light of faith:

1. Know what the Church teaches.
2. Begin to learn the science.
3. Sort out the “system of wills.”

Each of these steps is explained in the separate sections that follow.

1. KNOW WHAT THE CHURCH TEACHES

According to the *Catechism of the Catholic Church*, Christians are obliged to an “irrevocable adherence of faith” to the truth contained in divine revelation (88). From this teaching, the Church’s **Magisterium** has the authority to define a **dogma** of faith. However, many people misunderstand what a dogma is. A dogma is not an imposing boulder slammed down on its subjects, unyielding for all time. Church teaching is more like a light

Magisterium: The official teaching authority of the Catholic Church as exercised by the pope and college of bishops.

dogma: A doctrine (teaching) issued with the highest authority and solemnity; a core teaching of the Church.

to guide our way. The Magisterium has the job to clear away cloudiness, so the light can illuminate the lives of Christians. Note, however, that no one is able to change “the light” to something else. The *Catechism* explains this understanding in more detail:

Dogmas are lights along the path of faith; they illuminate it and make it secure. Conversely, if our life is upright, our intellect and heart will be open to welcome the light shed by the dogmas of faith.

The mutual connections between dogmas, and their coherence, can be found in the whole of the Revelation of the mystery of Christ. “In Catholic doctrine there exists an order or hierarchy of truths, since they vary in their relation to the foundation of the Christian faith.” (88–90)

Note that the words *dogma* and *doctrine* are both used. It's important to understand the difference. A doctrine is a teaching or instruction. Dogmas are doctrines, but they are more specific and directly connected to **divine revelation**. Other doctrines radiate from dogmas. As theological understanding increases over time, doctrine is developed. The “order or hierarchy of truths” refers to this logical flow.

For example, the doctrine of the Holy Trinity is a dogma because every articulation of that teaching is tied directly to what God revealed in Scripture

divine revelation: The truths of faith revealed by God that reason alone would not discover.

and Tradition. The doctrine of family unity, however, logically follows from the divine revelation of the dogma of the Holy Trinity. The doctrine of family unity holds that we are made in the image and likeness of God to give and receive as completely as we can, creatively, but without becoming the other. That is why families are called reflections of the Holy Trinity—as one body, but many people.

Theologians also have names to distinguish the hierarchy of truths. A doctrine is “of divine faith” (*de fide divina*) if it is explicitly found in revelation.³ These dogmas are of the highest certainty, directly revealed in Scripture and confirmed by Tradition, and they address scripturally attested events such as creation, the Fall, the Old and New Covenants, the Incarnation, and the Resurrection. A faithful Catholic may not deny them, because to deny one of them would lead to a denial of more of them. A doctrine is “of divine and Catholic faith” (*de fide divina et catholica*) if it has also been formally defined for belief by the Church's Magisterium.⁴ Propositions that are “close to the faith” (*fidei proxima*), however, are opinions that are held unanimously

by the Church's theologians and regarded as revealed truth, but not defined as revealed.⁵ But in addition to these high levels of certainty—and this is important—there are grades of theological opinion in the process of development that may be legitimately explored for furthering our understanding of truth.

An Intersection of Faith and Science

Dogmas, doctrines, and the hierarchy of truths impact scientific study too. The dogmas in science are the laws that are observed directly in nature. They cannot be denied if conclusions drawn from them are to be correct. For example, if I do not accept that the acceleration due to gravity on Earth is approximately 9.8 m/s^2 and instead pretend that 1.0 m/s^2 is the correct acceleration, I could have problems if my friend holds a book 100 meters above my head and I stand under it for 7.0 seconds without moving. In this case, I will get a knot on the head because I ignored an objectively true dogma of science. Doctrines of science are also objective statements, such as **physics** equations that are derived from observed laws of nature.

physics: The branch of science concerned with the motion of objects and the properties of non-living matter and energy not dealt with in chemistry and biology.

The hierarchy of truths is important for navigating scientific questions. When you are sorting out challenging questions posed by scientific theory, it is of

utmost importance that you clearly understand the difference between **infallible** dogmas and theological opinions that may legitimately be explored. You can also easily reject scientific conclusions that contradict dogmas. For example, we can never accept a conclusion that the soul does not exist or that God did not create the world with a beginning in time.

When combining scientific discoveries and theological issues, most of the interesting discussion lies in the areas where theological opinions are proposed and science can help deepen comprehension. For example: How do we talk about the emergence and evolution of life? How do we describe the unity of body and soul? How do we think about the human person compared to other creatures?

It is important to know and be able to reference Catholic sources when representing Church teaching. One of the most detrimental mistakes I have noticed in the debates is when a Catholic represents his or her theological or scientific opinion as certain dogma, although it has never been declared so by the Church. This behavior derails productive conversation and can damage souls by sowing discord and confusion.

infallible: Incapable of erring; not liable to prove false. It is a gift given to the Church by Christ whereby the Church is protected from error in matters of faith and morals.

Sources for Doctrine

There are a number of sources for researching the history of Church teaching. The *Catechism of the Catholic Church* is, of course, a good starting place. It is thoroughly referenced to specific encyclicals, councils, writings of the Church Fathers, and Scripture. For detail on the historical development of dogma, Ludwig Ott's *Fundamentals of Catholic Dogma* and Heinrich Denzinger's *The Sources of Catholic Dogma* are trusted resources.⁶ Ott's work identifies each dogma and labels its level of certainty, with a brief explanation about its development. Denzinger's volume is a chronologically arranged compendium of the councils and promulgations throughout the history of the Church.