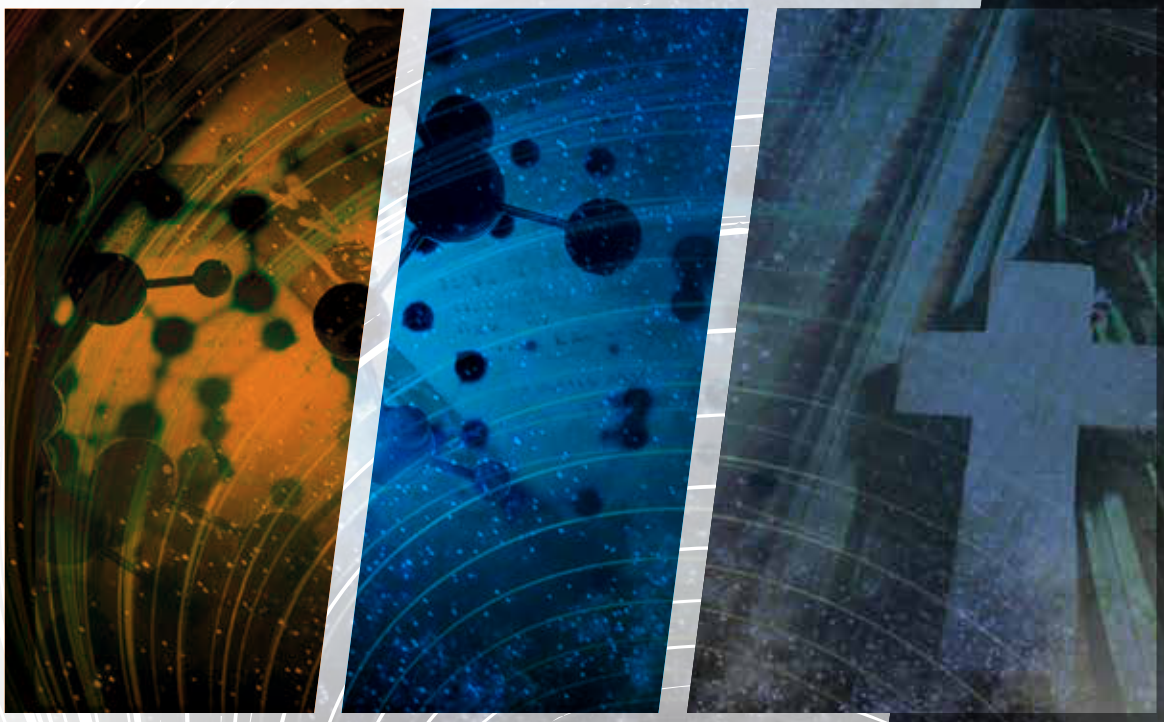

BEST PRACTICES RESOURCE GUIDE

SCIENCE-FAITH COURSES FOR SEMINARIES

A PROJECT OF JOHN CARROLL UNIVERSITY FUNDED BY THE JOHN TEMPLETON FOUNDATION AND OTHERS.

RE-ENGAGING SCIENCE IN SEMINARY FORMATION

MESSAGE FROM THE PROJECT DIRECTOR

OUR BEST PRACTICES

For the past three years, instructors at Roman Catholic seminaries in the United States have been designing, scheduling, and teaching science courses. In that time, 20 Roman Catholic major seminaries and four college seminaries delivered 41 full-fledged, for-credit, new, and sometimes required courses in seminary curricula. The result was far more than we expected, or thought possible.

On-site visits to classes by this project's Core Team, as well as course assessments provided by the instructors themselves, consistently revealed creativity in design, assignments, scheduling, advertising, outreach, student goals, resources, and faculty development. We have gathered some of these discerning pedagogical choices in the pages that follow, designating them "Best Practices" — aware that one size does not fit all yet under the assumption that even seasoned instructors welcome knowing what others have done with some measure of success.

We expect our project's participants to continue fruitful conversation with each other about these practices and other advances as their courses mature. At the same time, instructors at seminaries not involved in our project may be encouraged by the experience and insights of our grantees to initiate and/or strengthen science courses at their own seminaries.

Best Practices is printed with enormous gratitude to contributors who re-engaged science in their curricula with care, devotion, and excellence. To convey their reportage most authentically, we made only nominal edits to the instructors' submissions. You will hear many different voices in these pages, each reflecting a genuine experience of professors committed to the importance of scientific literacy for their student-seminarians.

Doris Donnelly, Ph.D. • Project Director
Re-Engaging Science in Seminary Formation

RE-ENGAGING SCIENCE IN SEMINARY FORMATION
BEST PRACTICES

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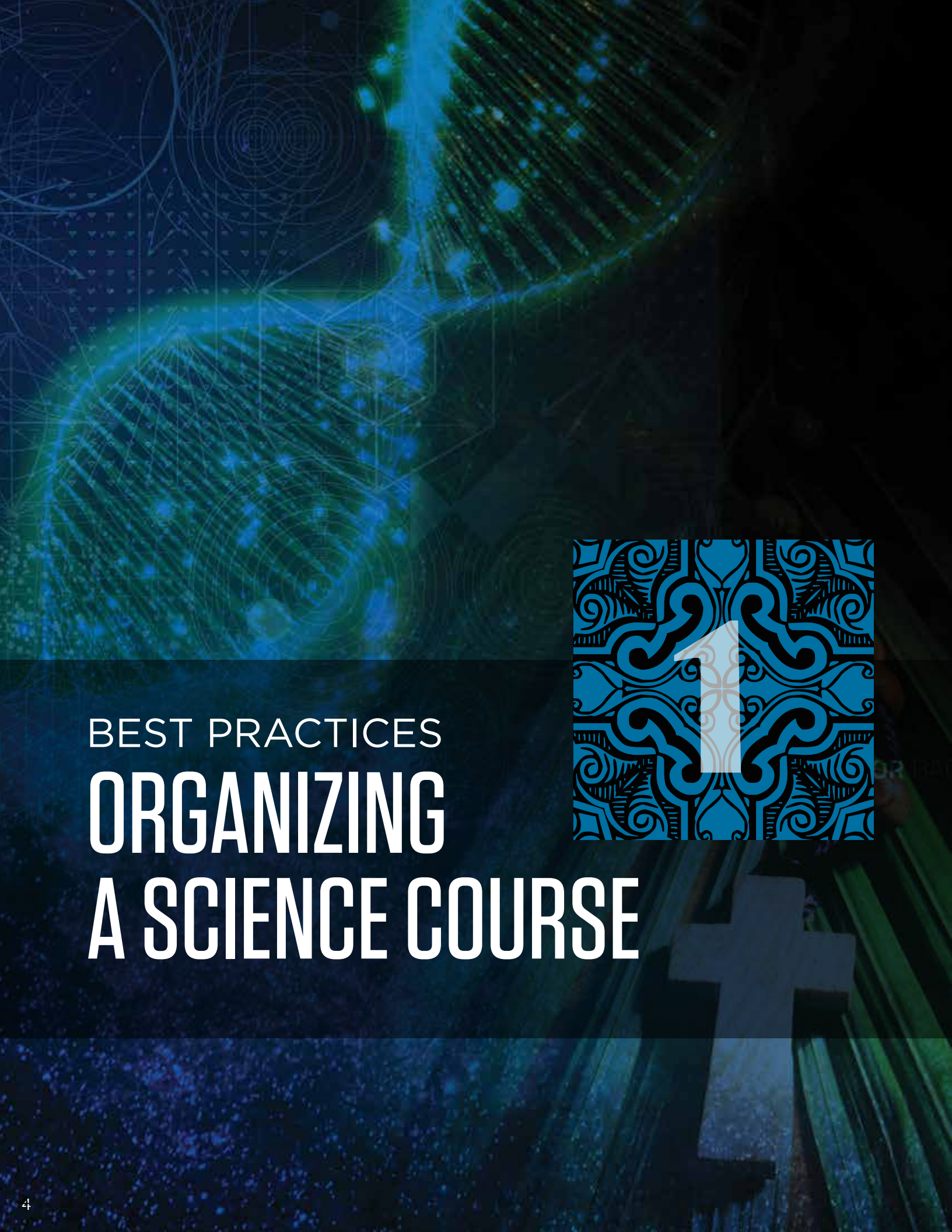


BEST PRACTICES

1 ORGANIZING A SCIENCE COURSE

As future pastors and teachers of the faith, it's important for priests to show that there is, in principle, no conflict between faith and science. Both are gifts from God.

The perceived incompatibility between Christian faith and scientific inquiry is damaging to Christian faith, to science, and to the wider culture. According to the National Study of Youth and Religion, 72% of 18–29 year-old Catholics see science and religion in conflict, and 78% of 18–29 year-old lapsed Catholics cite the "conflict" between science and religion as a reason for their departure. Catholic priests need to be prepared to address topics such as cosmic origins, human evolution, and medical ethics in a way that weds faith and reason, belief and practice.

This section will provide a few quick points to stir your creativity around organizing a science course, and some detailed guidance on how to help students attain a level of scientific literacy that will help them well beyond the course and classroom. Every course will have its own focus and will include common elements from courses that have already been offered successfully at many seminaries.

1 Choose "Hot" Topics

Students more readily see why it's important to develop a deeper scientific understanding of an issue — and are more willing to put in the work — when they can see that the issue has a theological or pastoral impact.

If we only deal with history — things that have already taken place in the relationship between faith and science — students are left without the tools to wade into today's complex scenarios. Yes, they need to learn history. But they also need to learn how to find their way in messy situations where the solution has not already been mapped out. And they need to know how to help others facing novel circumstances. Historical topics are especially helpful for establishing basic principles, and giving students confidence that good solutions can be found with time and effort. We found "Hot" Topics more conducive to teaching students to live in the tension with hope while seeking appropriate solutions.

2 Invite Scientists

Scientists provide first-hand knowledge that theologians and philosophers lack, and present their findings differently.

Students become more attuned when presented with a different perception than that which they are familiar with. Even material that could be presented by theologians or philosophers is received differently when a scientist presents it.

Bringing in scientists also models meaningful dialogue between scientists and theologians (concrete), not just science and theology (abstract).

Allow the scientists to speak not only about their science, but also about their faith.

PROCEDURAL NOTES

Work with visiting scientists in advance to coordinate lectures/presentations. Presentations need to fit with the rest of the course in terms of content, and need to match the students' level of understanding. A great guest lecturer needs to know a) the landscape of the course and b) the landscape of the students' hearts/minds/interests/abilities/concerns.

3 Select Quality Videos to Illustrate Complex Scientific Topics

Much of the scientific material will be unfamiliar to many or most students. Help them out!

Short videos are a great way to introduce concepts, prepare the ground for discussions, and reinforce the core concepts of the course. There's no shortage of material out there! But it takes time and energy to find the best material. Several examples — and good starting points — are provided under "Finding and Using Print and Video Resources."

4 Have Modest Learning Objectives Concerning Scientific Literacy

Narrow it down to essentials. You can't cover everything, and students can't master it all!

A crucial component of the course will be teaching students **how** to lean into things they don't understand, to know **what** they don't know, and be comfortable **admitting** that they need to learn more. That's how it will work in their ministry: People will bring them complex scientific/medical/moral/pastoral cases. They will need to be comfortable leaning into these conversations rather than pulling away from them.

5 Include Faith/Science "Tidbits"

Mix it up!

A course will develop some topics in great depth. In addition, bring in short items — a concept or an article or a historical episode or a video — from areas that you won't cover in depth. These can be just five minutes in length. Through these tidbits, students may learn to be fascinated by other things. You may engender a deeper interest than you anticipated in a student who goes on to study a topic in even more depth later. For example, offer a one-page article on black bears that are actually white due to a recessive gene, or the latest fossil find concerning the evolution of whales, or a short video on CRISPR-CAS9, etc. One good idea is to offer brief, regular updates on scientific developments that occurred in the previous week, such as those available on inters.org.

6 Make Time to Cover the Galileo Affair

Whatever else you may be teaching, students will want to know about this.

People need to know what happened and, just as importantly, what didn't happen. Use Lawrence Principe's video lectures. (See "Print and Video Resources" on page 38.) Have students watch 15-minute segments over the course of four weeks and include a short discussion time in class.

PROCEDURAL NOTES:

A professor noted: "One of the challenges presented by our seminarians concerned questions related to shifting scientific paradigms. It was challenging to encourage them to engage with new evidence from an affirmative posture. One method we found successful was simply to present the evidence as it was understood by its discoverers, then to show competing interpretations that themselves were worked through over time. Presenting how serious scientists and philosophers dealt with new evidence over the last 100, 500, and 800 years became an important tool for encouraging students to treat emerging scientific claims with a meticulousness they were eager to employ."

7 Require Students to "Own" the Material Through Presentations

Review the "Student Learning Pyramid" (below).

Students remember more when they have to teach others. Build time into your course that allows them to do this. Their ability to learn one concept well enough to teach it will give them confidence that they can learn other concepts.

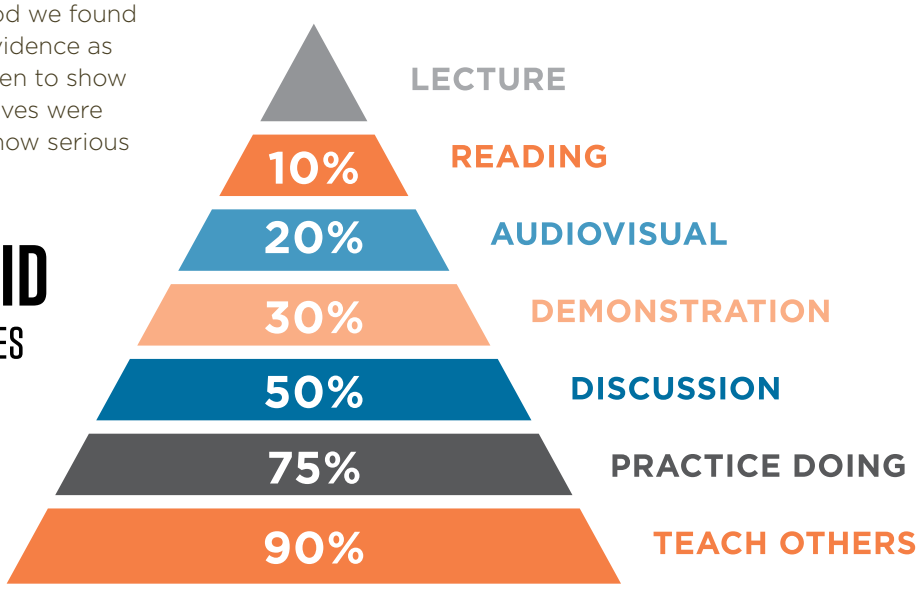
8 Teach Students How to: 1) Understand a scientific paper in its own terms, 2) Evaluate it for consistency with the faith, and 3) Present these ideas to a general audience

Sometimes we're tempted to think that theology students don't have time to acquire the ability to read scientific material from primary sources. Not true!

Reading scientific papers simply requires the discipline to comprehend words with precise technical meanings, and follow a highly organized argument. Theology students are particularly well-suited for this task! They already have the skill to read the organized theological documents of the Church, which are

LEARNING PYRAMID

AVERAGE STUDENT RETENTION RATES



chock-full of technical terms. They can already read the structured, logically rigorous questions and answers of theologians like St. Thomas Aquinas, who was himself deeply familiar with Aristotle's methods of scientific inquiry — do your students know this? Teaching students to read scientific papers is a matter of transferring those analytic skills to a new type of document.

Here's a method for doing it, one step at a time.

PHASE I

UNDERSTANDING A SCIENTIFIC PAPER

Teach students individual parts of a scientific paper. Compare it to similar parts of an article in the *Summa Theologiae*. First, have them concentrate on the *Abstract*, and caution them not to get lost in the *Methods*.

1) Primary Layer: Task each student to find three good scientific papers, and to write a one-paragraph summary of each of their three papers.
2) Secondary Layer: Choose one of those three papers, and find and read at least three of the *references* from this paper. Write a one-paragraph summary of each Secondary Reference.
3) Tertiary Layer: Choose one of the Secondary References. Find and read at least three references from this secondary source. Write a one-paragraph summary of each Tertiary Reference.

PHASE II

EVALUATING A SCIENTIFIC PAPER VIS-À-VIS FAITH

1) Provide students with one example of a scientific paper that is consistent with the faith. (See "Print and Video Resources" on page 38.) Have them write a one-paragraph summary of the paper on its own terms. Teach them how to evaluate its consistency with the faith — what are the philosophical and theological implications of the science?
2) Provide students with one example of a scientific paper that is inconsistent with the faith. Have them write a one-paragraph summary of the paper on its own terms. Teach them how to evaluate its inconsistency with the faith — what are the philosophical and theological implications of the science?
3) Provide students with one example of a scientific paper that is neutral with respect to the faith. Have them write a one-paragraph summary of the paper on its own terms. Teach them how to evaluate its neutrality with respect to the faith — what are the philosophical and theological implications of the science?

PHASE III

PRESENTING A SCIENTIFIC IDEA TO A GENERAL AUDIENCE WITH RESPECT TO ITS FAITH IMPLICATIONS

Students research a scientific idea or field of their own interest (i.e., space, genetics, robotics). Start with one good scientific paper. Have them assemble papers to the "three-deep reference" level. This will add up to 7–10 papers in the one field.

1) Students write a one-paragraph summary of each paper on its own terms.
2) Students analyze each paper in terms of its relation to the faith.
3) Students write a paper that explains their findings to a general audience.
   - Have fellow students "peer review" each others' papers, concentrating on how well it "translates" for a general audience.
   - After peer review, students will present their papers in class. Provide ample time for discussion and question and answer.

BEST PRACTICES

2 ENCOURAGING INTEREST IN SCIENCE COURSES

Good marketing of seminary science courses highlights the harmony between faith and reason and promotes scientific literacy. Encouraging seminarians to study the sciences is in no way a threat to their faith, as Pope St. John Paul II points out in *Fides et Ratio*: "The unity of truth is a fundamental premise of human reasoning, as the principle of non-contradiction makes clear. Revelation renders this unity certain, showing that the God of creation is also the God of salvation history." Theological truths and the truths of the natural order, discoverable by the sciences, cannot, in principle, conflict.

While many seminarians and faculties will be enthusiastic about a seminary science course, others may be apathetic or resistant. Therefore, how you market the course to seminarians and the broader seminary community will depend upon the ethos at your institution.

This section provides some basic guidance about marketing. These strategies reflect tried-and-true practices from faculty members who have promoted and taught science courses at seminaries. The strategies below may be adapted to fit your seminary's needs.

1 Get the Faculty on Board

If the faculty is supportive of and excited about the course, then seminarians will be, too.

1) Meet with the Rector to discuss the importance of scientific literacy among seminarians and to share your vision for the course.
2) If this is the first time science is being integrated into the curriculum and you suspect that the faculty may be resistant or apathetic, offer a short presentation at a faculty meeting to explain the course and your rationale for teaching it.
3) Organize and facilitate faculty events on themes related to science and theology, such as reading groups, movie nights, and outings to science-related events. Faculty may be busy and not look forward to adding another event to their calendars, so if your budget allows, offer them something "extra" for coming — a meal out, a visit to a museum or botanical garden, etc.
4) Be sure to extend faculty a personal invitation to attend the lectures. Additionally, you may also invite them to join you for dinner with the speaker, introduce the speaker, handle the Q&A after the lecture, or to offer a public response to the lecture. This kind of involvement does not require much work from other faculty members, and it allows them to be part of the "team."

2 Integrate the Course into the Curriculum

One guaranteed way to get seminarians to take a science course is to make it part of the required curriculum.

1) Meet with your Academic Dean in order to see what your options are and to discuss your target audience for the class. Are you marketing to college seminarians, pre-theologians, or theologians? Will the course be required or an elective? How often will the course be offered? At what time of day might the course be offered in order to optimize enrollment?
2) You may consider running the course for both the college seminarians and the theologate, albeit with different expectations (e.g., writing, presentations, etc.) for each group of students.

3 Spread the Word to Seminarians

Seminarians need to know about the course in order to have the desire to take it. There are numerous ways to get the word out to seminarians and motivate them to enroll in the course:

1) If this is the first time science is being integrated into the curriculum, offer a short presentation to the seminarians on the importance of the dialogue between science and theology in the context of evangelization. Dive into some of the encyclicals and texts from our recent popes that discuss the sciences and the relationship between faith and reason.
2) Table talk! Meal times are great opportunities to talk about issues at the intersection of science and theology. If seminarians already see the importance of scientific literacy because of conversations they've had with you and because of the general ethos at the seminary, they'll be more disposed to take the course.
3) If the course is an elective, send the syllabus to seminarians a while before they register for classes. That way, they can see what topical subjects and texts will be covered and perhaps be inspired to enroll.

SEMINARIES PARTICIPATING IN OUR PROJECT

MAJOR UNITED STATES/ROMAN CATHOLIC SEMINARIES/THEOLOGATES

ATHENAEUM OF OHIO/MOUNT ST. MARY'S SEMINARY OF THE WEST
Cincinnati, Ohio • athenaeum.edu/Seminary

BOSTON COLLEGE SCHOOL OF THEOLOGY AND MINISTRY
Chestnut Hill, Massachusetts • bc.edu/schools/stm.html

DOMINICAN SCHOOL OF PHILOSOPHY & THEOLOGY
Berkeley, California • dspt.edu

HOLY APOSTLES COLLEGE AND SEMINARY
Cromwell, Connecticut • holyapostles.edu

IMMACULATE CONCEPTION SEMINARY
South Orange, New Jersey • shu.edu/theology

KENRICK-GLENNON SEMINARY
St. Louis, Missouri • kenrick.edu

MOUNT ANGEL SEMINARY
St. Benedict, Oregon • mountangelabbey.org/seminary

MOUNT ST. MARY'S SEMINARY
Emmitsburg, Maryland • msmary.edu/seminary

NOTRE DAME SEMINARY AND GRADUATE SCHOOL OF THEOLOGY
New Orleans, Louisiana • nds.edu

OBLATE SCHOOL OF THEOLOGY
San Antonio, Texas • ost.edu

SACRED HEART SEMINARY AND SCHOOL OF THEOLOGY
Hales Corners, Wisconsin • shsst.edu

SAINT CHARLES BORROMEO SEMINARY
Wynnewood, Pennsylvania • scs.edu

ST. JOHN VIANNEY THEOLOGICAL SEMINARY
Denver, Colorado • sjvdenver.edu

ST. JOHN'S SEMINARY
Camarillo, California • stjohnsem.edu

SAINT JOHN'S UNIVERSITY SCHOOL OF THEOLOGY AND SEMINARY
Collegeville, Minnesota • csbsju.edu/sot

ST. JOSEPH'S SEMINARY
Yonkers, New York • dunwoodie.edu

SAINT MARY SEMINARY AND GRADUATE SCHOOL OF THEOLOGY
Wickliffe, Ohio • stmarysem.edu

ST. MARY'S SEMINARY & UNIVERSITY
Baltimore, Maryland • stmarys.edu

ST. VINCENT DE PAUL REGIONAL SEMINARY
Boynton Beach, Florida • svdp.edu

UNIVERSITY OF SAINT MARY OF THE LAKE/MUNDELEIN SEMINARY
Mundelein, Illinois • usml.edu

COLLEGE SEMINARIES

BISHOP SIMON BRUTÉ COLLEGE SEMINARY
Indianapolis, Indiana • bishopsimonbrute.org

BORROMEO SEMINARY
Wickliffe, Ohio • borromeoseminary.org

ST. JOSEPH SEMINARY COLLEGE
St. Benedict, Louisiana • sjasc.edu

ST. PIUS X SEMINARY
Dubuque, Iowa • loras.edu/spiritual-life/st-pius/

4) Books can be expensive. If your budget permits, offer to pay for all the books used in the course and distribute them throughout the semester.

5) If possible, integrate a science-related outing into the course, and let the students know that you'll be taking "field trips." Students enjoy off-campus visits and benefit from interacting with experts in their natural habitat! Take the class to your local science museum or planetarium, NASA, or a public lecture in the sciences at a nearby university.

4 Develop Marketing Materials

If your course isn't required, you may need to use some explicit means to market your course to the community — word of mouth just won't cut it in this tech-savvy age.

- Create and post flyers around the seminary. These materials should be modern, clean, and attractive. They should state only relevant information, along with your contact information. A "busy" flyer is distracting! If your budget permits, hire a professional to design it. Otherwise, create your own using free programs like canva.com.
- Develop social media graphics for your course and post them online. Top social media sites for "getting the word out" include: Facebook, Twitter, and Instagram.
- Advertise the course on the seminary website. This strategy has the added advantage of demonstrating to the wider public the seminary's commitment to scientific literacy and its vision for the harmony of faith and reason.
- Become a resource. One course featured a lecture attended by 300 members of the public. The event was live-streamed on Facebook and appeared on the school's YouTube channel. The Facebook video has already been viewed by more than 1,000 people.

5 Give the Course an Interesting, Perhaps Provocative, Name

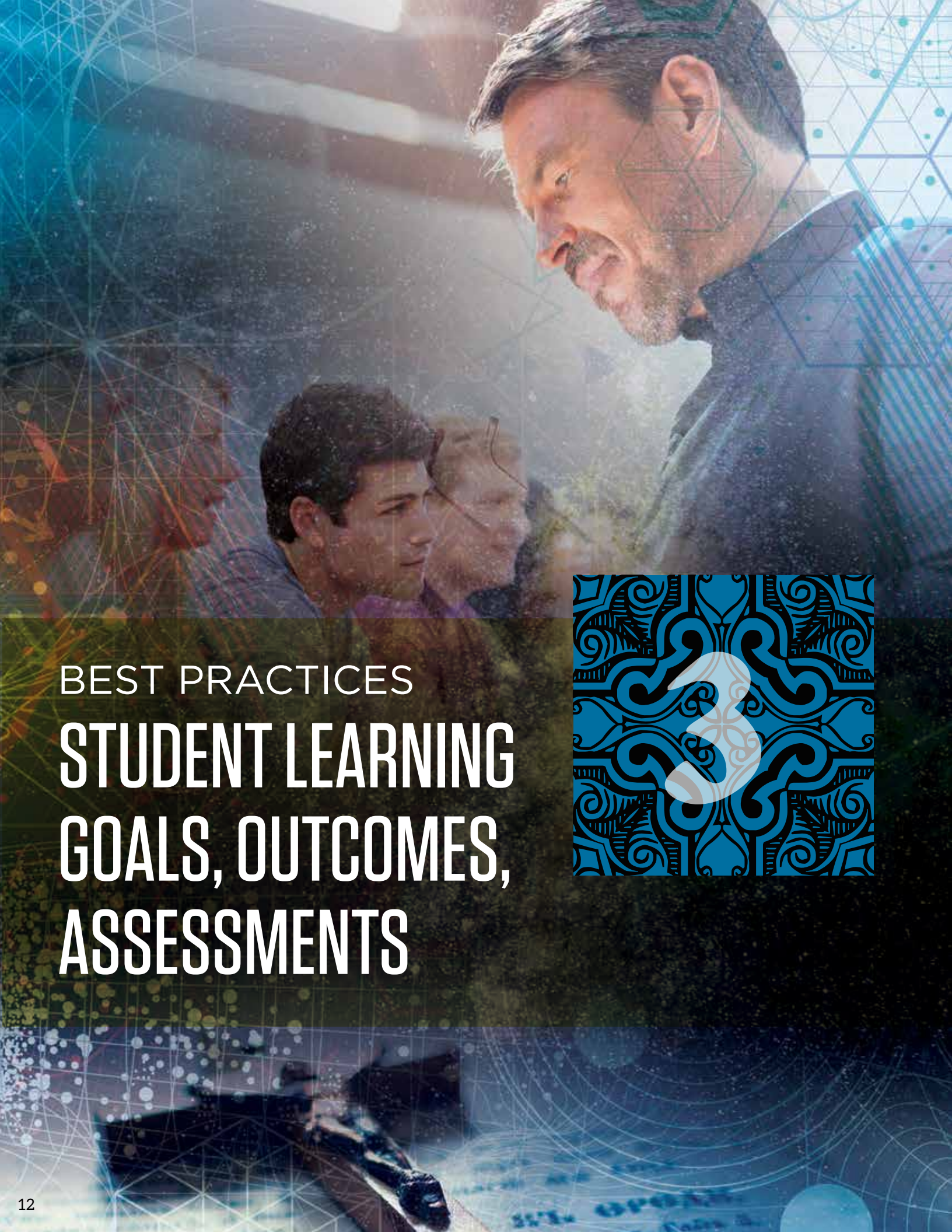
The name of the seminary science course should be informative and enticing!

Names like "Seminary Science" and "Science and Theology" convey little information as to the course's content and do not inspire seminarians to enroll. What about:

- "Our Universe: When It Began, Will It End?" (Cosmology)
- "Is God Monkeying Around With Us?" (Evolution)
- "Space Enough For Faith" (Op-Ed Assignment)
- "How Agribusiness is Destroying Lives in Inner-Ring Suburbs" (Capstone Presentation)

FROM THE VERY BEGINNING OF HIS PAPACY, JOHN PAUL II WANTED TO ESTABLISH A DIALOGUE BETWEEN THE CULTURE OF RELIGIOUS FAITH AND THE CULTURE OF THE NATURAL SCIENCES. ... JOHN PAUL II SUPPORTED THAT TO THE HILT RIGHT FROM THE START.

From an interview with Rev. George V. Coyne, S.J., Winter 2018 Newsletter. Available at **semscience.net**



BEST PRACTICES

STUDENT LEARNING GOALS, OUTCOMES, ASSESSMENTS

3

Most teachers spend a good deal of time and energy thinking about the curriculum of content they will convey in their courses. Far fewer devote significant time and energy to thinking about the curriculum of habits they are building in their students, and the methods by which they will do so. The best courses are deliberate about both.

The most important step in building good student learning goals may also be the easiest: talk to people who work in assessment! They can help you be both more deliberate and more creative in thinking about the curriculum of habits you're trying to instill.

The following steps provide a scaffolding for building good student learning goals, outcomes, and assessments. When the syllabus is finished and the course is being taught, the scaffolding will disappear. These steps will help to ensure solid design.

For those who need one more incentive, here's an interesting tidbit: the most creative assignments tend to come from instructors whose student learning goals deliberately reflect various levels of Bloom's taxonomy.

1 Think About What Habits You Are Trying to Instill

After you have sketched a basic outline of your course content, think about what habits you are trying to instill. Make a rough draft of the curriculum of habits that your course will build. Then ask yourself: Are these the habits they will most need?

2 Check the Habits Against Bloom's Taxonomy

Once you have a rough draft of your curriculum of habits, check them against Bloom's taxonomy. (One version of Bloom's taxonomy is reproduced at right. Many more are available online.) What levels are you hitting and what levels are you missing? Try to have student learning goals/outcomes that address all of these levels, not just the first two or three.

Remember: Bloom's taxonomy is not the last word in outcomes. But it can be a helpful tool.

3 Think About Whether Your Assessments Address Different Learning Styles

For example: 1) Are your assessments primarily written or spoken? 2) Are your assessments longer or shorter? 3) Are your assessments focused on research or argument?

Designing assignments that highlight different learning styles allows students to shine where they are strongest, and work on what needs strengthening.

4 Create Simple Rubrics

Rubrics help you be precise in your grading. They also help students understand the underlying habits you want them to display.

If you are doing classroom presentations, have students grade each other. This gives students practice in looking for the habits — first in others and then, by extension, in themselves.

You don't have to be a slave to a rubric! There are always other factors that come into grading that don't fit neatly into the rubric. You can always add those in "Further comments."

Here's an example of a simple rubric for an in-class oral presentation:

Presenter: _____

Did the presenter observe the **time limit**? (10 minutes)

1 2 3 4 5

Comments:

Was the presenter's **focus/topic** well chosen?

1 2 3 4 5

Comments:

Was the chosen topic **well explained**?

1 2 3 4 5

Comments:

Did the presenter give a fair presentation of an **alternative explanation**?

1 2 3 4 5

Comments:

Did the presenter **respond adequately** to the alternative explanation?

1 2 3 4 5

Comments:

Did the presenter **relate** well to the audience?

1 2 3 4 5

Comments:

Overall Score: _____

Any Final Comments:

5 Examples of Course Objectives Reflecting Various Levels of Bloom's Taxonomy

Students will be able to:

Articulate why people might think science and religion are incompatible.

Define key scientific terms and relevant theological claims.

Analyze and respond to the alleged conflict between science and religion, broadly construed, as well as particular issues at the intersection of science and religion.

Illustrate concretely the ways in which science can enrich theology.

Summarize, interpret, and critically analyze articles in reputable science publications.

Communicate effectively in writing and speech about issues in science and religion.

Students will be able to:

Evaluate philosophies of science on the basis of the history of science.

Evaluate similarities and differences between theological and scientific method.

Explain and respond to major scientific proposals that challenge the theological notions of creation and design — e.g., bouncing universe, eternal inflation, many-worlds quantum theory, etc.

Explain and incorporate key discoveries in cosmology that support the theological notions of creation and design — e.g. symmetries, Tolman's limit, the BVG theorem, etc.

Analyze common objections to the idea of evolution and scientific responses to those objections.

Compare evolutionary theory to the biblical account of God's dealing with humankind.

Formulate a theology of suffering that synthesizes scientific and biblical elements.

Students will be able to:

Demonstrate a working understanding of the core aspects of evolutionary theory as an organizing framework for all of the life sciences, and apply it to a scientific narrative of the emergence of the human species.

Analyze the philosophical arguments on which the notion of the human person as a uniquely rational animal are based and synthesize these with a modern scientific account of the human being as the product of natural evolutionary processes.

Analyze and interpret the biblical creation accounts and the doctrines of divine providence, the human person as image of God, and the Resurrection of Christ as the fulfillment of human history in the light of the scientific and philosophical perspectives on human origins and the human person.

Differentiate and compare the methods, tools, and boundaries of scientific, philosophical, and theological inquiry regarding the emergence of the human being as complementary ways of attaining insight into human origins and the human person.

Students will be able to:

Acquire scientific literacy to discuss current biotechnological developments.

Identify and analyze challenges and implications for medicine, society, and religion raised by contemporary biotechnological developments.

Engage in dialogue with scientists working in these areas of biotechnological research.

Address challenges and implications by relying on contributions from science and religion.

Integrate these challenges and implications in an articulated pastoral approach to evangelization.

Identify and distinguish accurately the central components within commonly asked questions or statements arising from the faith/science dialogue:

- What issues are primarily epistemological (related to how we perceive or understand)?
- What issues are primarily theological/ontological (questioning qualities about God's action or existence)?
- What issues are primarily scientific (questions related to the intrinsic nature of matter)?
- What issues are primarily ethical or social (how people use information)?

Students will be able to:

Describe contemporary advances in neuroscience that have led to its dialogue with theology, spirituality, and ritual practice, resulting in the development of a multidisciplinary field of inquiry — neurotheology.

Connect the philosophical examination of human consciousness, cognition, and meaning to the biological explorations of neuroscience and psychology through the examination of theories of knowledge found in Christian epistemology, anthropology, and ethics as these relate to the discoveries of brain science.

Recognize and analyze (i.e., discern) the phenomenological and physiological components of transcendent encounters (i.e., religious or spiritual experiences) based upon principles forged in the Christian liturgical and mystical traditions and, in turn, relate these to contemporary neuroscience and psychology.

Identify and integrate the scientific, philosophical, and spiritual components of neurotheology that support an understanding of human transformation which integrates science and theology.

Experience ritual and spiritual practices as a part of the course and then, examine and appraise these in light of the fundamental insights proposed by neurotheological studies, liturgical theology, and the Christian mystical tradition, so as to be able to apply their learning outcomes to future transcendent encounters beyond this present study.

Students will be able to:

Communicate well the relationship between reason (science) and faith (theology), as St. John Paul II described the two: "two wings on which the human spirit rises to the contemplation of truth" (*Fides et Ratio*, 1998). Students are encouraged to develop a strong understanding and appreciation of the relationship between science and faith/theology.

Demonstrate an understanding of food science, food chemistry and nutritional science, and ecology, and to apply such knowledge to various food and nutrition topics, including diet and health, food stability and quality, food addictions, and malnutrition and hunger.

Formulate a comprehensive framework of food, particularly from a scientific, theological, cultural, social, and ethical standpoint.

Search and critique the peer-reviewed literature on food science and theology.

Develop working strategies to improve feeding the poor and hungry, enhance food security and sustainability, and provide better nutritional quality of food.

Contextualize critical thinking and theological reflection of food and eating for personal well-being and practical ministry. Develop and identify well-balanced diet(s).

BEST PRACTICES

CREATIVE ASSIGNMENTS

4

In addition to the usual exams and papers, instructors of seminary-based science-faith courses offered some creative assignments that also functioned as ways to assess student learning. These examples may stir your own creativity!

1 Elevator Speech

A great way to get students thinking about how to make an impact in short interactions that aren't too intimidating in scope.

Have each student respond to one (or both) of the following scenarios:

1) You're in an elevator when someone notices your clerical collar, and says: "Surely, Father, you don't believe in evolution. After all, isn't evolution opposed to the Bible?" You have 60 seconds. Respond.
2) You're in an elevator when someone notices your clerical collar, and says: "Surely, Father, you're not opposed to evolution. After all, we don't read the Bible literally." You have 60 seconds. Respond.

PROCEDURAL NOTES

Devote classroom time to this exercise. Have a few students present their responses, then stop and reflect. Ask them what they noticed – what worked and what didn't. After students have time to express their observations, provide feedback. Then ask several more students to present their responses. Stop and reflect again. Has anything changed in light of their earlier thinking? Let the conversation develop. Repeat until all student responses have been considered.

2 Article Analyses

To help students develop the skill of scientific literacy.

Decide how many article analyses will be due during the semester. For example, each analysis will be approximately 500 words in length. Students must attach a copy of the original article to each analysis.

Find an article in a popular, and reputable, scientific journal, such as *Nature*, *Nature Communications*, *Philosophical Transactions of the Royal Society*, *PLOS ONE*, *Proceedings of the National Academy of Sciences*, *Proceedings of the Royal Society*, *Science*, and *Scientific Reports*. If a student wishes to use an article outside of one of these publications, be sure to review the article first.

- Identify the central hypothesis or claim the author(s) is making.
- Identify the methods used to gain evidence for the claim.
- Summarize the central pieces of evidence used to support the claim.
- Offer personal analysis of the conclusions the author(s)/investigator(s) wish to draw from their study.

PROCEDURAL NOTES

For this assignment, publicizing the criteria will enable seminarians to make good choices for scholarly-based articles. Just as there is good and bad theology, there is good and bad science. Encourage students to utilize a few well-known criteria to distinguish between the two. Seminarians may also use these criteria to refute "bad science" presented to them by parishioners.

- Is the article from a reputable source (*Journal of the American Medical Association* vs. *People*)?
- Is the scientist reputable (from a university with a reputation in this area)? When his/her name is searched for on Google: how many articles have been published by this person in this discipline and how recently?
- Is it possible to find out who funded the study? (Note: A recent widely-acclaimed article on the benefits of daily alcohol consumption from a highly regarded source came under new scrutiny when it was revealed the study was heavily underwritten by four major alcoholic beverage companies.)
- A very basic understanding of key statistical terms should be understood: mean, average, statistical deviation, and margin of error. A study purporting to prove a wide-ranging thesis must survey or test a large enough population over a long enough period of time to be statistically significant.

3 Op-Ed Assignment

Students practice the kind of thinking and writing they will need as pastors.

Compose an op-ed essay addressing one of the following two topics: 1) Does science prove that religion (theology) is false? In other words, are they necessarily in conflict? OR 2) Choose a particular topic in which science and religion appear to conflict, e.g., evolution and the historical Adam, the existence of the universe, etc.: Does the scientific claim x show that the theological claim y is false, or vice versa? Can the conflict be resolved?

The essay must be 1,000-1,250 words in length, not including footnotes/endnotes. The intended audience is a general community of parishioners. Op-eds will be evaluated on:

1) **Choice of content:** The essay is relevant to some topic at the intersection of science and religion. Author demonstrates his awareness of the present state of the debate on the topic.
2) **Argumentation (Logos):** The author takes a clear stand on the issue and offers plausible premises, supported by evidence, to back up his conclusion. Where appropriate, the author makes use of philosophical concepts to make the argument more precise.
3) **Sincerity and personal investment (Ethos):** The author, while not being expected to be an expert on science or religion, demonstrates his credibility and trustworthiness in the essay. He evinces his own personal take on the issue by means of concrete examples and/or personal anecdotes.
4) **Style (Pathos):** The author writes in a clear, conversational (but non-bloggy) tone. Philosophical concepts are defined to bring clarity to the issues. The op-ed is well-structured, non-repetitive, and supports a strong conclusion that is moving to the reader. Relevant sources must be cited in e.g., Chicago/Turabian style at the end of the essay using endnotes.
5) **Overall convincingness:** The op-ed lays out an interesting debate, makes a good effort to change the minds of readers, works well as a whole, and generally improves readers' thinking on the topic.
6) **Comments:** The op-ed will be submitted in two drafts. Students will be required to submit constructive comments on a classmate's op-ed in writing. Classmates' comments will be judged as well as their own op-ed pieces and should contain the following:

* Quantity: There must be at least four well-considered comments, each one approximately one to two paragraphs in length. Additional comments of shorter length may also be offered, as long as at least four substantive comments are made.
- Engagement and relevance: The commentator shows an understanding of the overall argument/position. Comments discuss an objection, question, example, or new application that is relevant to the piece. Comments are sensitive to the overall persuasiveness of the op-ed and the author's use of logos, ethos, and pathos.
- Usefulness: The commentator adds insight to the topic at hand in a way that improves the piece and helps the author to gain clarity.
- Civility: The commentator shows respect for the author and his viewpoint and encourages rational and useful discussion aimed at truth. For example, saying, "That was a ridiculous point on page two," is not a civil comment.
- Philosophical acuity: The commentator demonstrates philosophical adeptness in his comments, relating what he says back to key points and concepts from class and/or the present state of the debate.

SAMPLE RUBRIC

FIRST DRAFT DUE _____ (100 points)

FINAL DRAFT (2 COPIES) DUE _____(150 points)

COMMENTS ON ANOTHER STUDENT'S OP-ED PIECE DUE _____ (50 points)

4 Capstone Presentation

This is a longer, synthetic presentation that more clearly mirrors parish dynamics.

Seminarians will be assigned into working pairs by the instructor.

1) Each group will be responsible for producing a 45-minute presentation intended for a parish setting on basic scientific literacy concerning human evolution and how that perspective is compatible with and complementary to a

Catholic philosophical-theological view of the human person as imago Dei.

2) The project will consist of full presentation scripts (i.e. whole lectures, not outlines) as well as either physical or electronic audio/visual components that will accompany the lectures as enhancements.

3) The lecture component of each presentation must be 8-10 double-spaced pages (Times New Roman, 12 pt. font, not including endnotes and bibliography). Coupled with the audio/visual component (see below), a good presentation should take about 45 minutes to an hour.

4) The required audio/visual component for each presentation may consist of physical pictures, diagrams, etc., and/or electronic slides and other visuals delivered by way of a program like PowerPoint or Keynote. The audio/visual requirement is of crucial importance in the seminarian's presentation of the scientific evidence provided by paleoanthropology, genetics, and archaeology.

5) This project will measure the seminarian's ability to integrate the course content into an effective and coherent teaching tool for his present pastoral assignments and future priestly ministry. The presentation will be evaluated in the following areas: focus and organization, support and elaboration, accuracy of information, visual style, and oral conventions.

6) The final component of the project will be a 500-word outreach strategy developed by each seminarian identifying two to three potential opportunities for delivering the presentations in his home diocese within 12 months of course completion, including names and contact information of appropriate pastors, principals, and/or diocesan officials. After the course, instructors will contact the vocation directors of all seminarians who successfully complete the course informing them of the seminarian's project and inviting them to promote the presentations.

PROCEDURAL NOTES

All of the criteria by which the instructor will grade and critique the presentation will be guided by and rooted in the question: "How well will this project work as an actual parish presentation?" Guided by this postulation, the instructor will look for the following:

- Is this information (scientifically and theologically) accurate and of sufficient depth so as to be fruitful for a diverse audience?
- Is the presentation accessible, keeping in mind that the audience will likely consist of a majority of non-specialists?
- Is the presentation geared towards bold oral delivery, i.e., to be heard (not just read)?
- Do the audio/visual components serve the presentation's accessibility and aid the intended audience's comprehension (e.g., as illustrations or examples of key ideas/facts), or are they "filler"?
- Do the scientific and theological elements of the presentation function as a mutually illuminating whole?

5 Parishioner Interview

A professor wrote, "By far this was the students' favorite part of the course."

Students will conduct an interview with a parishioner of their choosing in which they discuss questions and concerns that person has regarding any aspect of the interaction between faith and science. Students will meet in small groups to evaluate their interviews. They are to identify:

1) The fundamental scientific issues that are being raised (e.g., the accuracy of Galileo's astronomical observations and how well supported were his conclusions based on the quality of his data).

2) The implicit (or explicit) assumptions about faith and believers that are being expressed (e.g., the conviction that the Catholic Church always feels threatened by scientific discovery).

3) The accuracy of the statements being made (e.g., whether or not Galileo was actually tortured by the Inquisition).

4) Any underlying personal attitudes or experiences of the speakers (which they themselves explicitly allude to in their interview) which might help explain their expressed attitudes toward faith and/or science (e.g., someone might indicate that they see the Church's views toward science to be "just as backwards and close-minded as its views towards other things").

Based upon their own observations and small group discussion, each student will write a two-page paper briefly summarizing what they observed and

proposing how they might engage the parishioner in a follow-up, one-on-one conversation to help bring them to a fuller and more accurate understanding of the relationship between faith and science.

PROCEDURAL NOTES

Students will be assessed on the accuracy and fairness with which they evaluated the positions expressed in the interviews as well as on the scientific/theological accuracy and pastoral effectiveness of their proposed response.

6 Scientific Method Interview

A great way to get students to interact with scientists.

The class will collaboratively develop interview questions to pose to professional scientists about the scientific method. Afterwards, responses will be compared to a sampling of textbook accounts from a variety of disciplines. Students will collaborate in small groups to develop an artifact that addresses the question, "How should we conceive of the scientific method?"

7 Presentation to Outside Group / Day of Reflection

While this was originally proposed as an hour-long presentation geared toward a popular audience, course results revealed that in some instances it developed into a full day of reflection which was then offered at a local retreat center.

1) Each student is to prepare a 60-minute presentation that may be offered to an outside group, such as a retreat day/day of recollection, parish adult faith formation group, medical caregivers in various settings, etc. The presentation must be based on elements of science and theology from the course.
2) For classroom purposes, the final presentation is to be given in class during the final two sessions in an abbreviated 25-minute time frame. Materials for the entire presentation to an outside group must be submitted to the course instructors. The focus and place for the outside presentation must be approved and developed in consultation with the professors by mid-semester. Written instructions and guidelines for the final presentation will be provided by course instructors. Depending upon the size and abilities of the class, actual presentations to outside groups will be undertaken in consultation and collaboration with the professors.

8 Visit to a Children's Science Museum, Science Fair, and/or Public Attraction

A refreshing way to both learn and teach scientific concepts and interact with youth.

1) Seminarians engage with young people in a non-traditional, informative setting. Students and children alike can share delight in exploring "hands-on" how simple concepts of physics (levers), chemistry (pH), and electro-magnetism (hair-raising), are demonstrated with common objects and familiar activities.
2) Students attend a local university (or even magnet high school) science fair and engage actively by asking the participants questions. Interviewing young people who are excited about science and can talk about their projects can help seminarians discover their own enthusiasm, and exhibit to lay students a theologian's interest as topics beyond religion, breaking down stereotypes both groups may have about the other.
3) Where geographically possible, visit Greenfield Village in Dearborn, Michigan, or a plant that produces solar panels, or an engineering department of a university that invents robotics for the medical industry. Some large hospitals have small medical museums on site. Tucson Electric Power (Arizona) and Portland General Electric (Oregon) offer group tours of alternative power facilities and have guides who are used to explaining technology to non-engineers. Zoos may offer small group tours of veterinary or conservation labs involved in preserving endangered species.

9 Chemistry and Carbon Dating

Introduces students to a topic still under vigorous debate in both scientific and religious circles.

Students investigate the numerous attempts to explain the Shroud of Turin: what attempts have been made to date the shroud, how theories about the shroud have evolved over time, and what is known regarding its provenance. If we could somehow "prove" whose image is preserved through chemical or other scientific methods of analysis, what effect would that have or should that have on its veneration? What does it mean if no "proof" can be established after employing every scientific procedure available?

10 What's Faith and Science Got to Do With Food?

The activities below are only a sample of ideas that lend themselves to social justice issues already of great interest to seminarians. What projects might students design that could benefit their parishioners directly?

1) Visit an organic farm and then a food factory (farm-to-table vs. mass-production).
2) Invite a shochet (Jewish ritual slaughterer) and a Muslim imam to explain the meaning and production of kosher/halal meat. Discuss dietary restrictions for religious, not health, purposes (including fasting) shared by Judaism, Islam, Catholicism, etc.
3) Investigate and discuss the ethics of agribusiness, the farm labor movement, and social justice for undocumented workers.
4) Investigate and discuss the pros and cons of factory farming, and the commodification of non-human sentient creatures for human use/exploitation.
5) Investigate and discuss how overgrazing led to the Dust Bowl of the 1930s and its effect on population migration and the marginalization of Native Americans. Was that inevitable?
6) Investigate and discuss the positive and negative effects of genetically modified foods and artificial additives on the environment and in the human body. Is a "hamburger" grown in a lab from soy and pea proteins "meat" and should we have any qualms about producing it, or is this a great way to stop killing animals?
7) Grow a community garden and invite community members to a meal.
8) Recreate Gregor Mendel's genetic pea plant experiments.

IF YOU ACCEPT THAT TRANSCENDENCE, GOD'S LOVE FOR ME AND MY ATTEMPT TO RETURN IT, AS THE PERSONAL GIFT OF GOD — IF YOU ACCEPT THAT, THEN THE WAY TO ENRICH FAITH, TO MAKE IT RICHER AND EVER MORE CHALLENGING, IS BY TRYING TO INTEGRATE IT WITH WHAT WE KNOW. FROM SCIENCE, FROM THE ARTS, FROM PHILOSOPHY. IT'S MAGNIFICENT! IT'S A GREAT JOURNEY.

From an interview with Rev. George V. Coyne, S.J., Winter 2018 Newsletter.
Available at **semscience.net**

BEST PRACTICES

PUBLIC OUTREACH

5

Seminary science courses are immediately aimed at giving men in formation for the Catholic priesthood or religious life an opportunity to learn about, discuss, and reflect on issues at the intersection of science and theology. A further aim of these courses is to foster a culture of learning within the entire diocese and to promote the harmony of faith and reason among laypeople.

Forming scientifically literate seminarians is, in itself, a form of public outreach to laypeople, insofar as these future priests will have more tools with which to evangelize. Scientific literacy can impact their preaching and the counsel they offer. Seminaries committed to integrating science into the curriculum may also directly reach out to the public in order to share intellectual resources directly with laypeople.

This section suggests some ways to reach out to the public directly. Every seminary and every diocese has its own needs, resources, and budgets. The suggestions listed here are public outreach strategies used in many places and may be adapted to fit the particular needs of your seminary and diocese.

These suggestions are organized into three categories based on who is doing the outreach:

- Students
- Individual faculty members
- The seminary as an institution

1 Student Outreach to the Public

Students may communicate with the public on themes pertinent to science and theology either in speech or in writing. There are many opportunities within the diocese for them to write and speak. For example:

- Have students give talks on topics pertaining to science and theology at local parishes and schools.
- A first step for the course instructor and for the seminarian is to investigate which schools (grade school and high school) and parishes are interested in hosting such a talk. Parishes with youth and young adult groups may especially welcome a seminarian speaking on a science-related topic.
- The student should give his presentation in class prior to giving it in public so that he may benefit from the feedback of the instructor and his peers.
- Have students write bulletin inserts for their home parishes on topics pertaining to science and theology.
  - The student's essay should be peer-reviewed and reviewed by the course instructor prior to being submitted to the parish bulletin.

2 Faculty Outreach to the Public

The faculty may communicate with the public on themes pertinent to science and theology either in speech or in writing. The following are examples of public outreach activities that faculty might consider:

- Give a talk on a science and theology theme at a parish, school, or a "Theology on Tap" event.
- Write an op-ed for a local newspaper or the diocesan newspaper.
- Contact the local Catholic radio station to ask whether they would interview you about the Church's teaching on faith and reason.
- Engage with faculty members in the sciences at local universities.

3 Seminary Institutional Outreach to the Public

Many seminaries have successfully brought in speakers to give public lectures. These lectures, if advertised well, can bring many guests from a wide range of backgrounds to the seminary. Not only are these lectures informative for all who attend, but they also may raise the public profile of the seminary.

What follows is a step-by-step guide to organizing a public lecture at the seminary.

1. INVITE A SPEAKER

Collaborate with fellow faculty members to make a list of possible speakers, and brainstorm about topics for the speaker to discuss. Before reaching out to a speaker, be aware of the budget for the event. Expenses include:

- The speaker's travel expenses
- The speaker's accommodations and meals
- An honorarium, the value of which can vary and is set in consultation with the speaker.

When you make an initial contact with a lecturer (e-mail is recommended), make it clear how much you can offer as an honorarium and that travel expenses will be reimbursed. If your funds for the event are minimal, consider reaching out to a local scientist, as this will save on travel expenses and accommodations.

2. ADVERTISE THE EVENT

Given that public lectures are aimed at a diverse audience, including seminarians, faculty, benefactors, and the public at large, advertising strategies must be equally diverse. Consider employing the following strategies:

- Design clean, modern, and attractive flyers for the event. If your budget allows, hire a professional or a local design student to do the work. Otherwise, get creative using free online tools at sites like canva.com. Post event flyers around campus.
- Invite seminarians, faculty, and seminary benefactors with a personal note or e-mail. Attach the flyer to the note or e-mail.
- Enlist the help of the diocesan communications office. They may be able get the word out to more local media, like public radio stations.
- Create social media graphics using canva.com (or the like) and post them on social media. Students are often very plugged into social media, and they may be happy to help you promote the event online. Post on sites like Twitter, Instagram, and Facebook.
- Advertise on local Catholic radio. Some Catholic radio stations will mention your event free-of-charge or will add it to their online events calendar.
- If your budget allows, advertise the event in the local newspaper and the diocesan newspaper.
- Ask area pastors to include a notice about the event in their parish bulletins.
- Word of mouth and personal invitations go a long way. Talk about the event whenever you can. Your enthusiasm can be contagious.

3. GET THE FACULTY INVOLVED

Encourage the faculty to familiarize themselves with the speaker and her work. If your budget allows, purchase and distribute the speaker's latest book, or distribute copies of an article written by the speaker. Depending on the speaker and the topic, consider asking faculty members to assign a reading from the speaker in their classes.

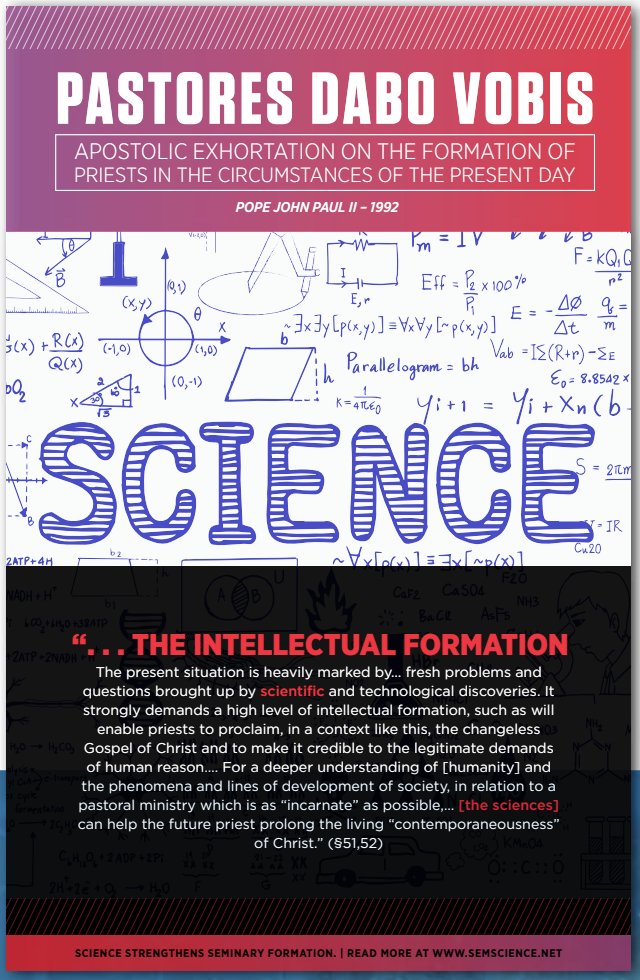
Invite the faculty to enjoy a meal with the speaker, either at the seminary or off the premises. Ask them to introduce the speaker, handle Q&A, or be a respondent to the lecture. These activities allow the faculty to get involved with the event, which is a desired outcome of your effort.

1) **Record the lecture; it's very important to keep records of these events.**

   If you record the lecture, it can be shared with a wide audience via the seminary website and social media. Of course, you must obtain permission from the speaker prior to recording and posting the lecture.

2) **Media coverage during and after the lecture**

   Media coverage of public lectures at the seminary raises awareness among the public about the seminary and its initiatives. You may consider, for example, asking for coverage from your local or diocesan newspaper, or having a student write a short piece for the seminary newsletter. Ask a student to take pictures during the event so that you can post these later or add visual interest to an article about the event.



Engage in dialogue with students and faculty using church documents and other sources on the importance of science in seminary formation. View and download the posters at

semscience.net/posters

POPE FRANCIS

EVANGELII GAUDIUM

NOVEMBER 24, 2013

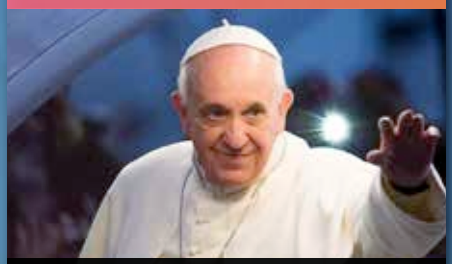
"DIALOGUE BETWEEN
science and faith also belongs to the work of evangelization at the service of peace." (§242)

SCIENCE STRENGTHENS SEMINARY FORMATION. | READ MORE AT WWW.SEMSCIENCE.NET

PAPA FRANCISCO

EVANGELII GAUDIUM

24 DE NOVIEMBRE 2013



<<EL DIÁLOGO ENTRE
ciencia y fe también es parte de la acción evangelizadora que pacifica.>> (§242)

LA CIENCIA FORTALECE A LA FORMACIÓN SEMINARISTA. | LEER MÁS: WWW.SEMSCIENCE.NET

GAUDIUM ET SPES

CONSTITUTION ON THE CHURCH IN THE MODERN WORLD

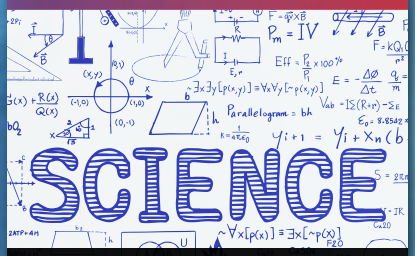
"LET THOSE WHO TEACH THEOLOGY
in seminaries and universities strive to collaborate with [those] versed in the other sciences through a sharing of their resources and points of view." (§62)

SCIENCE STRENGTHENS SEMINARY FORMATION. | READ MORE AT WWW.SEMSCIENCE.NET

PASTORES DABO VOBIS

EXHORTACIÓN APOSTÓLICA SOBRE LA FORMACIÓN DE LOS SACERDOTES EN LA SITUACIÓN ACTUAL

PAPA JUAN PABLO II – 1992



<<LA SITUACIÓN ACTUAL,
marcada gravemente por... los problemas y nuevos interrogantes provocados por los descubrimientos científicos y tecnológicos, exige un excelente nivel de formación intelectual, que haga a los sacerdotes capaces de anunciar—precisamente en ese contexto—el inmutable Evangelio de Cristo y hacerlo creíble frente a las legítimas exigencias de la razón humana... Aunque sólo sea en el ámbito muy concreto de las ciencias positivas o descriptivas, éstas ayudan al futuro sacerdote a prolongar la «contemporaneidad» vivida por Cristo.>> (§51,52)

LA CIENCIA FORTALECE A LA FORMACIÓN SEMINARISTA. | LEER MÁS: WWW.SEMSCIENCE.NET

GAUDIUM ET SPES

CONSTITUCIÓN SOBRE LA IGLESIA EN EL MUNDO ACTUAL

<<LOS QUE SE DEDICAN
a las ciencias teológicas en los seminarios y universidades, empéñense en colaborar con [los quienes son] versados en las otras materias, poniendo en común sus energías y puntos de vista.>> (§62)

LA CIENCIA FORTALECE A LA FORMACIÓN SEMINARISTA. | LEER MÁS: WWW.SEMSCIENCE.NET

BEST PRACTICES

FACULTY DEVELOPMENT

The "Re-Engaging Science and Faith in Seminary Formation" program seeks not only to promote scientific literacy among seminarians, but also seeks to engage the entire seminary faculty in activities that deepen their scientific literacy as well as their ability to see the harmony between Catholic faith, philosophy, and modern scientific insights.

The program lays the groundwork for an ongoing transformation of discourse and teaching across the seminary curriculum, not confined to the specialization of one or a few faculty. It is responsive to a standard for Christian discourse set by St. John Paul II when he observed that "The contemporary vision of the cosmos, the concept of time and space, the ever-multiplying discoveries of physics, of chemistry, of biology…demand a renewal of philosophical thinking among Christians" (September 5, 1986).

Specialized competence, a positive force for good and a sign of excellence, often requires an entire academic career to achieve, leaving little room for exploring other disciplines. The specialization of seminary faculty in areas such as philosophy, theology, and formation means that a basic scientific literacy cannot be presumed. Because of this, many faculty members find themselves unprepared to elaborate scientific findings, methodology, or even the relationship between the Catholic faith and modern science accurately. The effect is a gap too often filled by pseudo-science, separationism, and even creationism. Therefore, faculty development, as well as one's own scientific literacy, is important. The following summary of faculty development activities comprises a range that can be grouped into three major areas:

1) Personal self-development activities undertaken by course instructors
2) Faculty-wide lectures/presentations
3) Faculty-wide discussion groups

1 Personal Faculty Development

Personal faculty development (hereafter referred to as PFD) refers to research activities engaged in by course instructors who received grants for the courses funded through the program.

Many PFD activities for these courses, like any others, are largely hidden "behind the syllabus"; e.g., the ordinary textual research that goes into preparing any course. While such preparation is essential, for instructors without science backgrounds this can be largely hit-or-miss, only as helpful as their ability to grasp concepts and forms of communication in which they have no formal training.

- As one instructor noted, "My best-practice takeaway is that on my own I lack sufficient scientific expertise to take the class beyond a certain point with the science/philosophy/religion engagement."
- As another instructor recommends: "Engage your own professional development seriously. My experiences [at scientific museums and a conference] were pivotal for me. I quickly discovered that just reading would not cut it; you need to check your book-learning by living experts, and the more of them the better. It is easy to think you understand, but I found that I had a lot to learn about concepts that I thought I had mastered. At the gathering after the conference I attended, I happened to meet a paleoanthropologist who wasn't a presenter but who was really able to put a lot of my reading and listening into a new perspective."

Those who took the humble approach to the scope of their own knowledge and turned course preparation into a personal learning experience found that doing so paid dividends for their courses.

Many course instructors sought PFD opportunities that brought them into contact with professional scientists and well-respected scientific institutions. The following are examples:

1. MUSEUM EXHIBITS

Course instructors discovered and attended numerous permanent exhibits for their courses, including:

- The David H. Koch Hall of Human Origins (Smithsonian Natural History Museum, Washington, DC)
- The American Natural History Museum (New York, NY)
- The Oxford University Museum of Natural History (Oxford, UK)
- The New Wessex Gallery of Archaeology (Salisbury, UK)
- Cresswell Crags (a Neanderthal and Cro-Magnon site near Nottingham, UK)
- The Human Evolution Gallery (Natural History Museum, London, UK)
- The Anesthesia Museum (London, UK)
- The Florence Nightingale Museum (London, UK)
- The Royal Hunterian Museum (London, UK)
- The Alexander Fleming Museum (London, UK)

Because these exhibits are geared toward the general public, they provide an excellent starting-point for course preparation, highlighting the points that an introductory course should include. They are also a goldmine of instructional resources such as videos, posters, replicas, etc., as well as books for further PFD.

2. SCIENTIFIC EVENTS (CONFERENCES AND LECTURES)

Course instructors attended professional scientific gatherings as well as science education events. Such events allowed instructors to hear lectures and engage in conversations with experts:

- An instructor for a course with a significant component on paleoanthropology attended an Oxford conference entitled "Human Evolution in Structured Populations" (Oxford, UK: August 29–September 5, 2016) with papers by experts in paleoanthropology (Chris Stringer and Alison Brooks), paleoclimatology (Peter deMenocal), and human genetics (Lounes Chikhi).
- Another instructor teaching a course on genetics and biotechnology attended the 17th National Conference and Global Forum on Science, Policy and the Environment (Washington, DC, January 24–26, 2017), an event organized by the National Council for Science and the Environment. This allowed her to interact with scientists, activists, academics, and politicians who are engaged in addressing issues that expanded her ability to address issues in her course.
- Two instructors attended a retreat for seminary professors sponsored by the Science for Seminaries Program of the American Association for the Advancement of Science (Southport, ME, August 2–5, 2016). Presenters included a NASA astronomer (Jennifer Wiseman), a neuroscientist (Nancy Adleman), and a biologist (Daryl Domning). Special sessions were devoted to meeting with presenters to review syllabi, an invaluable aid to course development.

As one professor noted: "I learned I need to pay more attention to the science component of the course, as my natural inclination is to veer off into philosophy. I learned that on my own, I lack sufficient scientific expertise to take the class beyond a certain point. These courses really can't be done without engaging professionals and colleagues who are experts outside the philosophy/religion departments."

In conclusion, instructors who informed students of their PFD endeavors found that it bolstered student confidence in their ability to teach their respective courses. Students are rightly curious (and perhaps dubious) regarding an instructor's ability to teach subjects outside his/her expertise. A narrative of steps taken in PFD should be offered to the students so that they are aware of the process that has been taken to offer a sound and well-researched course.

2 Faculty-Wide Events: Lectures and Presentations

Outside of the course experience itself, the program's greatest impact is the promotion of scientific literacy among seminary faculty.

For those who will intellectually shape countless seminarians, this secondary outcome is highly significant for improving the culture of scientific literacy within seminary programming.

- Instructors and administrators noted some key characteristics of successful science presenters. Successful presenters were able to communicate scientific concepts clearly at a level that non-scientists could understand. One instructor offered this rule-of-thumb: "Choose lecturers who are dynamic! Some theologians, philosophers, and scientists are absolutely brilliant and are top in their respective fields, but they're not engaging presenters." Obviously, a program that aims to promote scientific literacy among seminary faculty requires setting a realistic bar. Lectures and presentations that offer a basic understanding and/or summarize relevant high-level data and discoveries are indispensable for success.
- Another highly desirable characteristic of invited lecturers is a willingness to talk about their scientific work as a personal vocation. Seminary formation is all about discovering a sense of purpose in God's call for one's life, and it is very helpful to have lecturers who can speak of the meaningfulness of their scientific careers to themselves and to humanity in general. When both instructors and lecturers are capable of appreciating the value of meaning beyond their vocational spheres, that shared commitment makes an enormous impact on students. One instructor shared this as a best practice for course lectures, and it is equally applicable to faculty development: "Allow scientists to give a personal witness to their empirical pursuit of truth and their steadfast faith in God."

- Finding presenters who will specifically and expertly address questions and objections that some faculty may have to modern science is important and could be the difference in whether the lecture or presentation actually has an impact. As one instructor shared:

  > "Based on feedback from the faculty, I asked [the guest lecturer] to 1) focus on the web of evidence for evolution, 2) discuss evolution and its relation to the theology of creation, and 3) address philosophical objections among (some) Aristotelian-Thomists on the possibility of evolution. The talk was entitled "Why Would Have God Chosen to Create with Evolution?" In the talk he addressed the following questions: "What is evolution?" "What is God and how does He act?" "Why did God choose to create through evolution?" "Philosophical objections to evolution?" The talk was extremely well received and sparked much interested discussion over dinner. In the following week, much appreciative feedback was given to me from the faculty."

- Some institutions wisely leveraged funding in such a way that faculty development was merged with public outreach, and many hosted presenters who were also presenting within the courses themselves. This had the advantage of initiating ongoing discussion between faculty and students because they all heard similar or even the same presentation(s).

- The "Re-Engaging Science and Faith in Seminary Formation" initiative made possible a number of lectures for faculty development. Here is a list of the scientists who presented (or who are scheduled to present in Spring 2018) as part of faculty development:

  - Rev. Nicanor Austriaco, O.P. – Cell Biologist; Professor, Biology & Theology, Providence College, Providence, RI
  - Br. Guy Consolmagno, S.J. – Research Astronomer; Director of the Vatican Observatory, Castel Gandolfo, Italy/Mount Graham International Observatory, AZ
  - Julie Exline, Ph.D. – Psychologist; Professor of Psychology, Case Western Reserve University, Cleveland, OH
  - Agustín Fuentes, Ph.D. – Primatologist and Biological Anthropologist; Professor of Theology, University of Notre Dame, South Bend, IN
  - Andrew Newberg, M.D. – Neuroscientist and Director of Research, Marcus Institute of Integrative Health, Philadelphia, PA
  - Christian Smith, Ph.D. – Sociologist; William R. Kenan, Jr. Professor of Sociology and Director of the Center for the Study of Religion and Society, University of Notre Dame, South Bend, IN
  - Rev. Robert Spitzer, S.J. – President, The Magis Center, Garden Grove, CA, and President, The Spitzer Center for Visionary Leadership, Ann Arbor, MI
  - Stacy Trasancos, Ph.D., M.T.S. – Holy Apostles Seminary, Cromwell, CT

3 Faculty-Wide Discussion Groups

A third faculty development activity, and one that was widely adopted at participating seminaries, was discussion groups around seminal works related to course topics or to faith-science dialogue more generally.

Many of the same criteria that make for successful guest lecturing are also applicable to making the right choice of works for discussion, accessibility to non-scientists, non-technical language for educated beginners, direct engagement of matters of central importance to seminary formation and personal vocation, and/or topics that respond to misunderstandings of science or of the faith-science relationship. Participants also built faculty discussions around films, of scientific literacy across the seminary curriculum, and, in one case, a novel was selected.

The strength of this approach is that it engenders ongoing conversation in a direct way, and hopefully stimulates a dialogue that can be continued beyond the grant period. While lectures have the potential of immediate impact in faculty development, sustained discussion has the potential of prolonged impact and of creating a culture of dialogue that will benefit the faculty even beyond the promotion of scientific literacy.

Although no participants shared the methodology employed for generating discussion, a healthy attention to group dynamics is essential to the success of this form of faculty development. In a seminar learning experience, faculty bring what they have learned from reading into a common dialogue, and learn to synthesize and draw conclusions together through this dialogue. Moderators facilitate these discussions rather than present to participants, helping faculty more fully understand the work(s)

under discussion. This dialogue creates a community that extends beyond usual categories of experts and participants. Above all, it brings the entire group into dialogue with the great thinker(s) whose work(s) are being studied.

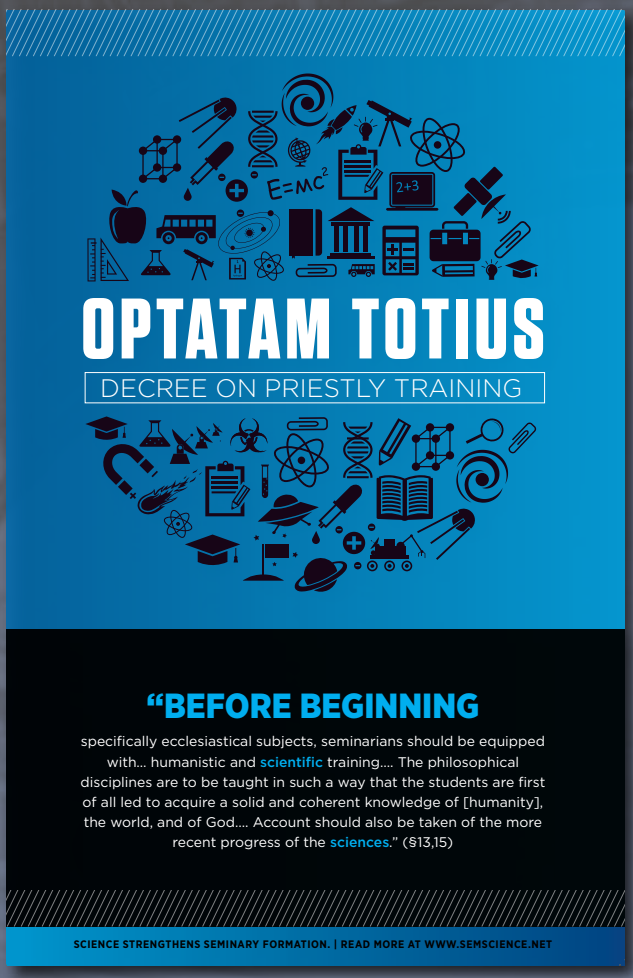
The following works/topics/films were chosen by participants for discussion by faculty:

- Mark Salzman, *Lying Awake* (Vintage: 2001) – A novel about the price of faith was accompanied by three journal articles that offer a critical analysis of the science and spirituality described in *Lying Awake*.
- YouTube science videos (miscellaneous) – Faculty met monthly over lunch to watch and discuss short videos that touch upon faith and science.
- *Logan's Run* (1976) – A movie set in a superficially utopian future society, revealed as a dystopia where the population and the consumption of resources are maintained in equilibrium by killing everyone who reaches the age of 30.
- *Inherit the Wind* (1960) – The film adaptation of the 1955 play of the same name regarding the Scopes Trial.
- E.O. Wilson, *The Meaning of Human Existence* (Liveright: 2015) – The Pulitzer Prize-winning biologist grapples with existential questions, examining what makes human beings supremely different from all other species.
- John F. Haught, *Science and Faith: A New Introduction* (Paulist: 2013) – One of the preeminent American theologians in faith-science dialogue lays out three distinct ways of responding to the main theological concerns and religious difficulties raised by the natural sciences today: conflict, contrast, and convergence.
- John F. Haught, *Resting on the Future: Catholic Theology for an Unfinished Universe* (Bloomsbury: 2015) – In this work, Haught argues that, if we take seriously the fact that the universe is a drama still unfolding, we can think new thoughts about God, and indeed about all the perennial themes of theology.
- Peter Harrison, *The Territories of Science and Religion* (University of Chicago: 2015) – Harrison dismantles the conflict model of science and religion, then brings them together in a "provocative, productive new way."
- Malcolm Jeeves and Warren S. Brown, *Neuroscience, Psychology, and Religion: Illusions, Delusions, and Realities about Human Nature* (Templeton: 2009) – The authors introduce key terms, thoroughly chart the histories of both neuroscience and psychology, with a particular focus on how these disciplines have interfaced religion through the ages, and explore contemporary approaches to both fields, reviewing how current science/religion controversies are playing out today.

Conclusion

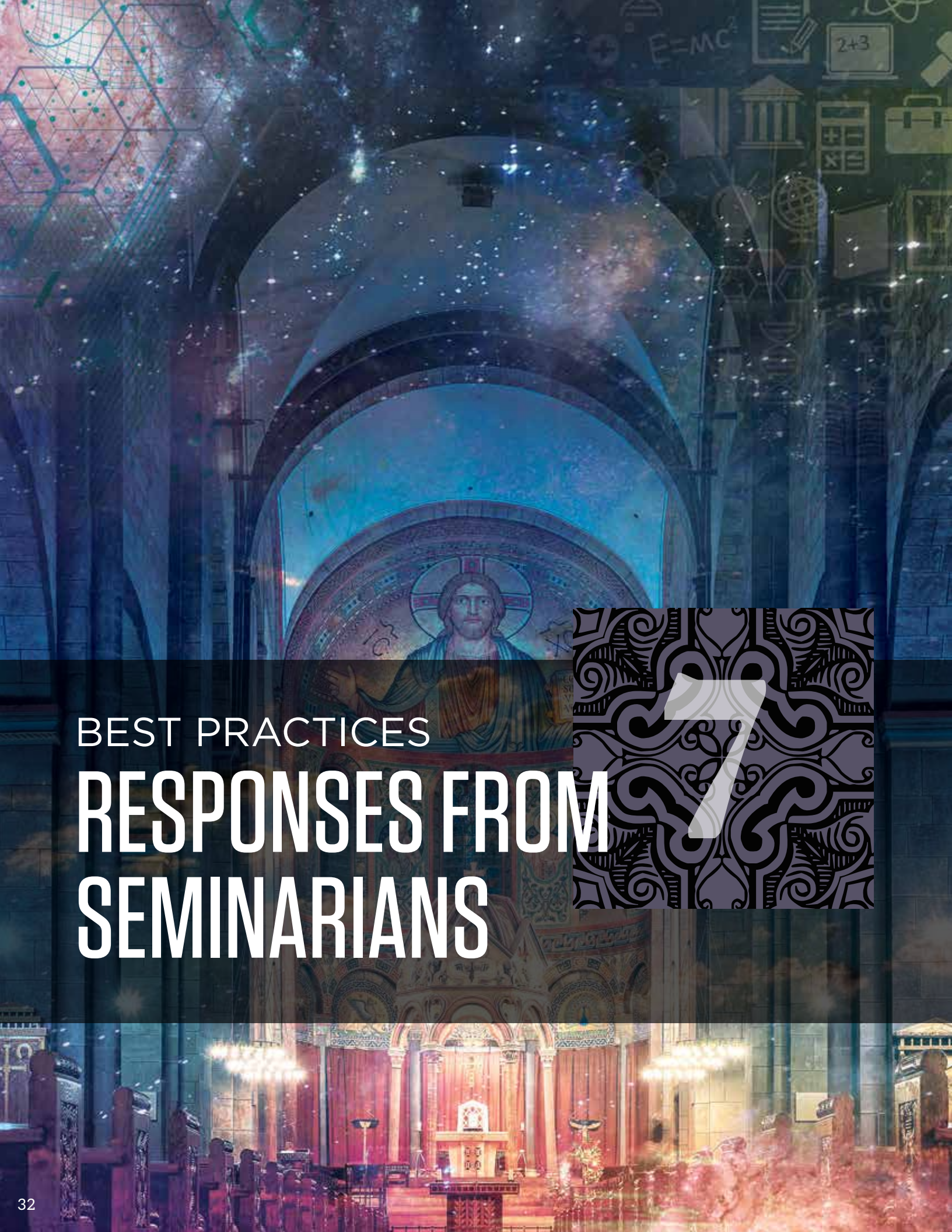
The faculty development component of "Re-Engaging Science and Faith in Seminary Formation" yielded significant opportunities and varied methods of approach in the engagement of faculty members. Beyond personal faculty development, an essential first step, it moved scientific literacy outside the classroom and into the wider cultures of the seminaries involved in the program, teaching the teachers and not only those seminarians who had the benefit of the courses.

It is recommended that all future endeavors to promote scientific literacy in seminaries adopt faculty development as a significant secondary outcome that is integral to any promising theory of change.



Engage in dialogue with students and faculty using church documents and other sources on the importance of science in seminary formation. View and download the posters at

semscience.net/posters



BEST PRACTICES

7 RESPONSES FROM SEMINARIANS

As St. John Paul II once observed, "Christians will inevitably assimilate the prevailing ideas about the world, and today these are deeply shaped by science. The only question is whether they will do this critically or unreflectively, with depth and nuance or with a shallowness that debases the Gospel and leaves us ashamed before history."

Although the dialogue between scientists and theologians at a high scholarly level is important for addressing this concern, even more important is that the depth and nuance of this assimilation be reflected in the engagement of the faithful by pastors. For this task, scientific literacy is an essential quality to cultivate for future priestly ministers.

Therefore, a primary goal of "Re-Engaging Science and Faith in Seminary Formation" is to promote scientific literacy among seminarians in a way that offers them a deeper understanding for future theological studies and ultimately for ministry. In the words of the program website, "The goal is not to make seminarians into scientists but rather to provide a challenging, increasingly necessary, rewarding, and very doable effort towards scientific literacy."

Therefore, feedback from seminarians who participated in one of the 41 grant-funded science courses is a hallmark of the success of the program, and provides insights into best practices for future efforts to integrate scientific literacy into seminary curricula.

The following account of seminarian feedback is grouped into three categories:

- **Scientific Literacy**, which offers the seminarians' feedback regarding their growth in understanding science, both generally as an approach to understanding reality, and specifically in regard to course content.
- **Faith-Science Integration**, which refers to feedback about how the Catholic faith and modern science can be brought into a "relational unity," to borrow another concept from St. John Paul II.
- **Pastoral Relevance**, which involves feedback from seminarians as to how the course prepared them for their future task of priestly ministry, especially the ways their course experience and learning can aid them in preaching and teaching the faithful. These areas are deeply interconnected; growth in scientific literacy blossoms into integration, which then equips these seminarians for successful pastoral ministry.

1 Growth in Scientific Literacy

As St. John Paul II noted in a famous letter to the Director of the Vatican Observatory, the task of scientific literacy is a crucial undertaking for all theologians today. In his words, "Theology will have to call on the findings of science to one degree or another as it pursues its primary concern for the human person, the reaches of freedom, the possibilities of Christian community, the nature of belief and the intelligibility of nature and history." In fulfillment of this observation, seminarians who enrolled in grant-funded courses expressed significant growth in understanding modern science.

A NEW PERSPECTIVE ON MODERN SCIENCE

In one course which focused on cosmology and evolution, students appreciated the new perspective developed in both areas. In the words of one seminarian:

> "This course opened my eyes to the bigger picture of the 'science world.' At first I was overwhelmed at how much science there was to learn and how much was expected of me in the course. Yet at every turn, I met terms that were in common conversation among friends and other students. The course gave depth to contemporary concepts and, though a challenge at times, I was able to appropriate enough understanding to convince me that every seminarian should have the background in modern science that I was exposed to in this course."

Another in the same course came away with an appreciation for having "a better idea of what evolution is," and still another praised the "huge amount of knowledge" gained. And still another noted: "While we spent a good deal of the semester on major questions of contemporary interest, equally as fascinating and important were the reviews of Galileo and contributions of scientists from earlier periods. Our course had scope and breadth taught by a professor we never knew had such an interest and competency in the field of science."

DEEPER APPRECIATION OF SCIENTIFIC METHODOLOGY

Another common experience of seminarians involved a new (or renewed) appreciation of scientific methodology. In a course entitled "Science and Theology in Dialogue," one seminarian noted how helpful it was that the course began not with scientific content but with an understanding of how science works: "I like the idea of beginning with

methodology, since it seemed to lay the groundwork for everything else." Both science and faith have distinct methodologies but their "end," uncovering truth, is the same. Noting the differences and the alignment of purpose/goal was very instructive, a student reported during an in-person interview.

For another, it was precisely the focus on the distinct methodology of science in the course "Creation and Science" that allowed him to see that the conflict/warfare thesis of science and religion is false: "The class had also taught me that due to science's reliance on measurement and change there is no way for there to be conflict between creation and science."

ENGAGEMENT IN SPECIFIC SCIENTIFIC TOPICS

Another impressive testimony to increased scientific literacy had to do with specific topics examined in courses. In a course on human origins titled "The Emergence of the Image: Human Evolution from Biological, Philosophical and Theological Perspectives," a seminarian reflected how beneficial a basic familiarity with the science of human evolution can be:

> "This course challenged me to step out of my comfort zone. Evolutionary theory, especially human evolution, is not something I had much knowledge of prior to this class. That said, this course helped me to be more open minded in this area of study and realize that people need to have rational conversations about the topic. I have been aware of how volatile conversation about evolution can be, with some ridiculed for dismissing it altogether and others ridiculed for giving it credence."

In another course, "Liturgical Piety: Anthropological Foundations of Catholic Worship," a similar sentiment was offered with specific reference to the heart of priestly ministry, i.e., the celebration of the Church's liturgy: "The material engaging contemporary scientific studies [on neuroscience and prayer] was very helpful for formulating objective conclusions about the experience and the effects of liturgy." Another made a similar connection: "Seeing contemporary research on emotions is helpful to my research into the natural foundations of worship."

Seminarians expressed gratitude for new knowledge of the history of science that was emphasized in more than one course since it relates to Christianity. Following is further feedback:

- "We (student-seminarians) were introduced to the tradition of scientific discovery and development within the Catholic Church, both historically and in recent times. We were treated to background, "behind the scenes" details on legendary scientists, their philosophy of science, as well as their actual contributions. Some of these giants, as members of the Church, were responsible for changes in scientific method and how our world is perceived."
- "It is amazing how Christianity has stimulated the emergence of the natural sciences. This of course is something that we do not hear about very often in the newspapers or other forms of media. I was grateful to this course for the review of popes, teachers, and scientists who have been committed to science for centuries."
- "What I appreciated most is how many Catholic priests contributed their time to the study of science over the years. I was not aware of the involvement of the Catholic Church in science and of the contribution clergy made — and are still making — to science."

2 Integrating Faith and Science

In his aforementioned letter, St. John Paul II proposed "relational unity" as the primary goal for faith-science dialogue.

He summarized the nature of such a unity as one that begins with recognizing the differences between both approaches to reality, and then discovering the ways in which they mutually enrich each other. The goal reaches beyond cultural and societal harmony into the human heart:

> "But why is critical openness and mutual interchange a value for both [science and religion]? Unity involves the drive of the human mind towards understanding…When human beings seek to understand the multiplicities that surround them, when they seek to make sense of experience, they do so by bringing many factors into a common vision. Understanding is achieved when many data are unified by a common structure. The one illuminates the many; it makes sense of the whole. Simple multiplicity is chaos. An insight, a single model, can give that chaos structure and draw it into intelligibility. We move towards unity as we move towards meaning in our lives."

This sense of unity and harmony between science and religion permeates the feedback of seminarians about their experiences in grant-funded courses; it was the most frequently mentioned "takeaway" from the courses.

- "The integration of modern science and traditional Church teaching in a convincing and open-minded way was the strongest aspect of this course."
- "This course gave me the tools to engage science and look at its engagement with religion for deeper illumination of both disciplines."
- "This course gave me confidence in discussing science-faith issues. I am aware that I do not have all the answers, but I am equipped with enough knowledge to refer myself or others for fuller understanding."
- "Where to begin explaining the value of this course? Maybe by simply saying it's an 'eye-opener' and something that should be part of our studies."
- "This course extended my understanding of the relationship between science and the Church. In fact, science is enriched by faith, and faith is enriched by science."
- "With very little background in science, I had enrolled in 'Science and Creation' with much eagerness and curiosity. I must admit that I thoroughly enjoyed every lecture. The classes helped me to understand the teachings of the Church better, and that science is not an enemy of religion."
- "The course lecturers included a diverse range of real-world scientists who are able to see the beauty of life in their work, and naturally incorporate theological concepts into the presentations. It opens up a person's eyes to not only how faith and science can be complementary, but also to the fascinating and relevant topics that are impacting the world."
- "The variety of lecturers was an excellent witness to those in the scientific field who harmonize their work well with the faith. This makes each lecture both informative and inspiring."
- "The course addressed the integration of faith and science respectfully without compromising either subject."
- "Confidence. Not cocky confidence but rather a nice layer of confidence about subjects that my family and friends outside seminary are talking about and expect me to have something to say about."
- "I will be forever grateful for this course. Such a chance to further the process of integration and personalization of theology and science."
- "I am really grateful to have learned some of the new science that informs theology and pastoral practice today."
- "This course was about a 'harmony' between modern sciences and the Church's teaching regarding human origins. It was an interesting interdisciplinary exercise."
- "It allowed me to understand the theory of evolution and how it is compatible with faith and reason."
- "This class helped me develop a fundamental understanding of evolution and its relationship to the faith and for that I am eternally grateful. I feel more confident in the truths of the faith as a result of this class which only serve to reinvigorate my desire for priestly ministry."
- "It broadened my thinking in all areas: philosophy, theology, and science. I am better prepared and have a more robust language to dialogue about these topics now."
- "This course has prepared me to deal with the perennial question asked by most Christians: 'Can I be Christian and still hold the evolutionary origin of man?'"

Words such as "convincing," "illuminating," "enriching," "inspiring," and "reinvigorating" indicate the power of faith-science integration, and the importance of promoting it within seminary curricula. In fact, such words are often used to describe effective priestly ministry, especially in the areas of preaching and teaching. This brings us to the final category of seminarian feedback.

3 Pastoral Relevance

It is not unusual for seminarians to approach seminary courses with a kind of litmus test: "Do I really need to know this to be a good priest?"

In extreme cases, such an approach can lead seminarians to dismiss courses that do not seem immediately relevant, especially when the material is more intellectually challenging and seems for that reason to be remote from pastoral engagement. However, it is an important question, and one for which a good answer should be discoverable, lest seminarians lose sight of why intellectual formation is essential and how it can help them serve the faithful.

For St. John Paul II, the effort to forge a relational unity between science and religion is an utterly necessary endeavor for future priests to engage in for the sake of responding to the faithful. In his words, "Science can purify religion from error and

superstition." For this reason alone, helping the faithful appreciate the harmony between faith and science is essential for pastoral leadership in the modern world. In his apostolic exhortation on proclaiming the Gospel, Pope Francis identified scientific literacy and faith-science integration as key components of the crucial task of proclaiming the Gospel at this stage of human history:

> "Proclaiming the Gospel message to different cultures also involves proclaiming it to professional, scientific, and academic circles. This means an encounter between faith, reason, and the sciences with a view to developing new approaches and arguments on the issue of credibility, a creative apologetic which would encourage greater openness to the Gospel on the part of all. When certain categories of reason and the sciences are taken up into the proclamation of the message, these categories then become tools of evangelization; water is changed into wine. Whatever is taken up is not just redeemed, but becomes an instrument of the Spirit for enlightening and renewing the world."

The grant-funded courses, therefore, addressed a crucial aspect of priestly formation, and many seminarians offered feedback about the pastoral relevance of the grant-funded courses, especially in the areas of evangelization, dialogue with scientifically literate non-believers, and religious instruction of the faithful. Here are some sample comments:

- "This course answered so many questions. I believe the best preparation for answering other people's questions about faith and doctrine is to answer your own. I mean, I'm not about to lose my faith because I don't see how science and faith work together in a given situation, but if I just leave it at happily ignorant, 1) I'm not going to be able to help anyone else and 2) I'm not doing myself any favors either. I'm sure that this was one of the most urgently needed classes for helping ministry (which is why I added it to my full schedule), and I learned so much."
- "The course helped me understand that evolution does not pose a threat to faith. I now think I am able to express this to others."
- "This is an amazingly pastoral class that will address the questions of people in the pews and give them solid answers in line with the science they already know."
- "This should be a mandatory class for all seminarians because this issue of faith and science is so pressing in the world today."
- "On a personal and professional level, I found the course to be exactly what I needed in my pursuit of a sound theological foundation for my ministry within the Church's directive of the New Evangelization."
- "There have been several ways that I have found the information presented in this science class to be helpful in my pastoral ministry. The most significant way though has to be the way that the information allows me to present a proper understanding of the Catholic idea of creation to those who question it."
- "As a Salesian [i.e. a member of the Society of St. Francis de Sales, a religious order], my ministries are oriented toward the young. The science and religion question comes up quite frequently, although I do see a more general openness now from others in how science and religion complement one another. This class has provided me with an abundance of 'evidence' to show how the Church is not opposed to science but is actually one of its most integral supporters. I look forward to sharing this knowledge to young people especially."
- "With the expanded view offered by neuroscience and how our brains are affected, I know that I can make use of this learning to projects at the parish and in particular to incorporate this knowledge into homilies."
- "This experience helps me to engage a wider audience and stay abreast of contemporary concerns."
- "This will help me address those difficult questions that come up in ministry such as: What's the position of the Church on evolution? How can we say that God created us when evolution seems to provide an alternative explanation to our creation? Knowing how to handle the relationship between science and faith can help us engage and inform conversation with others."

Conclusion

In summary, seminarian feedback demonstrated that courses promoting scientific literacy were effective in preparing men for the priesthood. By coming to understand modern science, both as a method but also in regard to the picture of the universe it provides, seminarians were challenged to go beyond their ordinary avenues of study and to think in fresh ways. They were able to unite the scientific perspective with the philosophical and theological approaches as complementary ways of knowing. Finally, this integration led them to see whole new dimensions of their future priestly ministry.

TURNING TO THE RELATIONSHIP BETWEEN RELIGION AND SCIENCE, THERE HAS BEEN A DEFINITE, THOUGH STILL FRAGILE AND PROVISIONAL, MOVEMENT TOWARDS A NEW AND MORE NUANCED INTERCHANGE. WE HAVE BEGUN TO TALK TO ONE ANOTHER ON DEEPER LEVELS THAN BEFORE, AND WITH GREATER OPENNESS TOWARDS ONE ANOTHER'S PERSPECTIVES. WE HAVE BEGUN TO SEARCH TOGETHER FOR A MORE THOROUGH UNDERSTANDING OF ONE ANOTHER'S DISCIPLINES, WITH THEIR COMPETENCIES AND THEIR LIMITATIONS, AND ESPECIALLY FOR AREAS OF COMMON GROUND. IN DOING SO WE HAVE UNCOVERED IMPORTANT QUESTIONS WHICH CONCERN BOTH OF US, AND WHICH ARE VITAL TO THE LARGER HUMAN COMMUNITY WE BOTH SERVE. IT IS CRUCIAL THAT THIS COMMON SEARCH BASED ON CRITICAL OPENNESS AND INTERCHANGE SHOULD NOT ONLY CONTINUE BUT ALSO GROW AND DEEPEN IN ITS QUALITY AND SCOPE.

PASSANDO A CONSIDERARE IL RAPPORTO TRA RELIGIONE E SCIENZA, C'È STATO UN MOVIMENTO BEN DEFINITO, ANCHE SE FRAGILE E PROVVISORIO, VERSO UN NUOVO E PIÙ VARIATO INTERSCAMBIO. ABBIAMO COMINCIATO A PARLARCI L'UN L'ALTRO A LIVELLI PIÙ PROFONDI CHE IN PASSATO, E CON MAGGIORE APERTURA VERSO I PUNTI DI VISTA RECIPROCI. ABBIAMO COMINCIATO A CERCARE INSIEME UNA COMPRENSIONE PIÙ PROFONDA DELLE RISPETTIVE DISCIPLINE, CON LE LORO COMPETENZE E CON I LORO LIMITI, E SOPRATTUTTO ABBIAMO CERCATO AREE SU CUI POGGIARE BASI COMUNI. NEL FAR QUESTO ABBIAMO SCOPERTO IMPORTANTI DOMANDE CHE CI RIGUARDANO AMBEDUE, E CHE SONO DI IMPORTANZA VITALE PER LA PIÙ AMPIA COMUNITÀ UMANA DELLA QUALE SIAMO AL SERVIZIO. È D'IMPORTANZA CRUCIALE CHE QUESTA RICERCA COMUNE, BASATA SU UNA APERTURA ED UN INTERSCAMBIO CRITICI, DEBBA NON SOLO CONTINUARE MA ANCHE CRESCERE ED APPROFONDIRSI IN QUALITÀ E IN AMPIEZZA DI OBIETTIVI.

FROM A LETTER OF POPE JOHN PAUL II TO REVEREND GEORGE V. COYNE, S.J.

Director of the Vatican Observatory • June 1, 1988

BEST PRACTICES

PRINT AND DIGITAL RESOURCES

The following list identifies resources used in assignments and class exercises, not just listed on bibliographies. It does not claim or aim to be comprehensive.

In addition to a focused bibliography, providing a glossary of scientific concepts and terms relevant to your course helps students stay oriented during discussions of complex topics.

General Works

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Galileo

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Sloan, Philip R., ed. *Controlling Our Destinies: Historical, Philosophical, Ethical, and Theological Perspectives on the Human Genome Project.* University of Notre Dame Press, 2000.

Journals

The following sites have good free articles reviewing the background of different fields of research as well as summaries of current research.

Quanta Magazine: https://www.quantamagazine.org/

Live Science: https://www.livescience.com/

World Science Festival: https://www.worldsciencefestival.com/

Smithsonian Magazine: https://www.smithsonianmag.com/

Neuroscience

Beauregard, Mario and Denyse O'Leary. *The Spiritual Brain: A Neuroscientist's Case for the Existence of the Soul*. Harper Collins Publishers, 2007.

Burns, Charlene P.E. "Cognitive Science and Christian Theology," in *Soul, Psyche, Brain: New Directions in the Study of Religion and Brain-Mind Science*, ed. Kelly Bulkeley. Palgrave Macmillan, 2005. Pp. 174-196.

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Schlegel, Alexander, et al. "Hypnotizing Libet: Readiness Potentials with Nonconscious Volition." in *Consciousness and Cognition* 33 (2015): Pp. 196-203.

Schwartz, Gary E. "Consciousness, Spirituality, and Postmaterialistic Science: An Empirical and Experiential Approach," in *The Oxford Handbook of Psychology and Spirituality*, ed. Lisa J. Miller. Oxford University Press, 2012. Pp. 584-597.

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Shimamura, Arthur P. and Stephen E. Palmer, editors. *Aesthetic Science: connecting minds, brains, and experience*. Oxford University Press, 2014.

Sheridan, Kimberly M. and Howard Gardner, "Artistic Development: the three essential spheres." in Shimamura, Arthur P. and Stephen E. Palmer, editors. *Aesthetic Science: connecting minds, brains, and experience*. Oxford University Press. 2014. Pp. 276-296.

Siegel, Dan, *"Reflections on the Mindful Brain,"* in *Measuring the Immeasurable: The Scientific Case for Spirituality*, ed. Daniel Goleman. Sounds True, Inc., 2008. Pp. 61-83.

Philosophy of Science

Burtt, E.A. *The Metaphysical Foundations of Modern Science*. Dover, 2003.

Godfrey-Smith, Peter. *Theory and Reality: An Introduction to the Philosophy of Science*. The University of Chicago Press, 2003.

Okasha, Samir. *Philosophy of Science: A Very Short Introduction*. Oxford University Press, 2002.

Quantum Physics

Kuhlmann, Meinard. "Quantum Physics: What is Real?" *Scientific American* 309 (2013): Pp. 40-47.

Stress

Karren, Keith, N Lee Smith, and Kathryn Gordon: *Mind Body Health,* 5th ed. Pearson, 2014.

Folkman, Susan (ed.): *The Oxford Handbook of Stress, Health, and Coping.* Oxford University Press, 2011.

Southwick, Steven and Dennis Charney: *Resilience: The Science of Mastering Life's Greatest Challenges*. Cambridge University Press, 2012.

O'Connor, Richard: *Undoing Perpetual Stress.* Berkley, 2005.

Video Resources – Various Topics

Awe: "Why do we feel awe?" http://www.slate.com/bigideas/why-do-we-feel-awe

Brain: www.brainmadesimple.com

Complexity: "Complexity: A Guided Tour." [video: Santa Fe Alliance for Science, 2013].

Carroll, Sean. "God is Not a Good Theory." [video: *The Philosophy of Cosmology Project*, 2013].

CRISPR-Cas 9 Genome Editing: https://www.youtube.com/watch?v=2pp17E4E-O8

DNA: "Cracking the Code of Life." [video: PBS Nova, 2001].

DNA—Secret of Life: episode 1, https://www.youtube.com/watch?v=d7ET4bbkTm0

"Double Slit Experiment": https://www.youtube.com/watch?v=Q1YqgPAtzho https://www.youtube.com/watch?v=A9tKncAdlHQ

"Emergence": https://www.youtube.com/watch?v=aEaZHWXmbRw

"Evolution and the Catholic Faith." Lecture by Stephen Barr at the *Lumen Christi Institute*. February 2, 2017.

Contains a very nice treatment of the notion of secondary causality as central to a Catholic position on evolution. Also provides answers to common objections.

"In the Beginning": (Voice of Light Productions) https://binged.it/2HJBj8M

"Particles, Fields, and the Future of Physics": (Sean Carroll) [video: Fermilab, 2013] https://www.youtube.com/watch?v=gEKSpZPByD0

Science and Religion

Gould, Stephen Jay, "Rocks of Ages: Science & Religion in the Fullness of Life," Ballantine Books, NY 1999.

12-part course by Dr. Lawrence Principe. From The Great Courses.

Students in one course were tasked with critiquing the "non-overlapping magisteria" hypothesis. Students who were comfortable separating religion and science became much less comfortable when it came to light that this wasn't nearly as clear cut as they had thought.

Test of Faith

This section of The Faraday Institute for Science and Religion website contains explanations of matters from eminent scientists who are Christians. http://www.faraday.st-edmunds.cam.ac.uk/index.php http://www.testoffaith.com/

The Society of Catholic Scientists (The site has recordings from their first conference in 2017.) https://www.catholicscientists.org/

Stacy Trasancos: 10 Point Primer on Faith and Science http://www.ncregister.com/blog/trasancos/a-10-point-primer-on-faith-and-science/

44 Catholic Scientists Quiz http://semscience.net/icebreaker/

Warfare between Science and Religion

For a good, quick treatment (31 minutes) of the origin of the "warfare thesis" watch lecture #2 of Dr. Lawrence Principe's Science and Religion (The Teaching Company, 2006). He gives a clear treatment of the two men who created this thesis in the late 1800s, the reasons why they did so, and the circumstances under which the conflict model became popular.

PROCEDURAL NOTES

The best bibliographies will be carefully targeted for their courses. Teachers are tempted to include everything they have read, and anything that might possibly be relevant. But students' eyes glaze over when they read such a bibliography. The more targeted you are, the better.

Another helpful practice is to have a non-scientist, non-seminary friend or colleague look over your selections before using them in your course. By this method, you may weed out some selections that are too technical or assume too much background knowledge. Remember: Seminarians are not fresh out of lower-level undergraduate science courses.

BEST PRACTICES

COURSES AND INSTRUCTORS

The Transfigured Brain: The Relationship between Brain Science, Ritual and Mysticism

SPRING 2016, FALL 2016, FALL 2017

Saint Mary Seminary and Graduate School of Theology, Wickliffe, OH

Edward Kaczuk, Ph.D. Music Theory & Composition (Kent State University)

Rev. Michael G. Woost, S.T.L. Theology (Catholic University of America)

Creation and Science

SPRING 2016, FALL 2016, SUMMER 2017

Immaculate Conception Seminary, South Orange, NJ

Rev. Joseph Laracy, S.M. Engineering Systems (Massachusetts Institute of Technology), S.T.L. Theology (Pontifical Gregorian University)

Darwin and Naturalism

FALL 2016, SPRING 2018

Mount St. Mary's Seminary, Emmitsburg, MD

Christopher Anadale, Ph.D. Philosophy (Emory University)

Theology of Marriage and Human Sexuality

FALL 2016, FALL 2017

St. John's Seminary, Camarillo, CA

Rev. Luke Dysinger, O.S.B., D. Phil. Theology (Oxford University), M.D. (University of Southern California)

Catholicism in an Evolving World

FALL 2016

Oblate School of Theology, San Antonio, TX

Sr. Linda Gibler, O.P., Ph.D. Philosophy and Religion (California Institute of Integral Studies – CIIS)

Scott Woodward, D. Min. Theology (Oblate School of Theology)

Integral Anthropology: Evolution in Dialogue with Catholic Theology and Philosophy

FALL 2016, SPRING 2018

St. Joseph Seminary College, St. Benedict, LA

Cory Hayes, Ph.D. Theology (Duquesne University)

Science: A Theology of Creation

FALL 2016, FALL 2017

Mount Angel Seminary, St. Benedict, OR

Br. Louis de Montfort Nguyen, O.S.B., M.D. (University of California, Davis)

What Does Science Prove? Topics at the Intersection of Science and Religion

FALL 2016, FALL 2017

Borromeo Seminary, Wickliffe, OH

Beth Rath, Ph.D. Philosophy (St. Louis University)

The Emergence of the Image: Human Evolution from Biological, Philosophical and Theological Perspectives

SPRING 2017, SPRING 2018

Norte Dame Seminary and Graduate School of Theology, New Orleans, LA

Christopher T. Baglow, Ph.D. Theology (Duquesne University)

Only Wonder Comprehends

SPRING 2017

Athenaeum of Ohio/Mount St. Mary's Seminary of the West, Cincinnati, OH

Marco Caggioni, Ph.D. Physics (Harvard University)

Giorgio Ambrosio, Ph.D. Applied Science (at Fermilab, Chicago)

Deacon Tracy W. Jamison, Ph.D. Philosophy (University of Cincinnati)

Virtues, Vices, and Addiction

SPRING 2017

St. John's Seminary, Camarillo, CA

Rev. Luke Dysinger, O.S.B., D. Phil. Theology (Oxford University), M.D. (University of Southern California)

Statistics and the New Evangelization

SPRING 2017

Mount St. Mary's Seminary, Emmitsburg, MD

Layton Field, Ph.D. Sociology (Texas A&M University)

John D. Love, Ph.D. Theology (Pontifical University of St. Thomas Aquinas, Rome)

Fundamentals of Science at the Foundations of Faith

SPRING 2017, SPRING 2018

University of Saint Mary of the Lake/Mundelein Seminary, Mundelein, IL

Rev. John Kartje, Ph.D. Astronomy and Astrophysics (University of Chicago), S.T.D. (Catholic University of Ohio)

Liturgical Piety: Anthropological Foundations of Catholic Worship

SPRING 2017

Dominican School of Philosophy & Theology, Berkeley, CA

Rev. Christopher J. Renz, O.P., Ph.D. Microbiology-Immunology (Northwestern University), M.A. Theology (Holy Apostles College and Seminary)

Science in the Light of Faith

SPRING 2017

Holy Apostles College and Seminary, Cromwell, CT

Stacy Trasancos, Ph.D. Chemistry (Pennsylvania State University), M.A. Theology (Holy Apostles College and Seminary)

Human Genetics and Biotechnologies: Challenges for Science and Religion

SPRING 2017

Boston College School of Theology and Ministry, Chestnut Hill, MA

Rev. Andrea Vicini, S.J., M.D. (University of Bologna), Ph.D. Theological Ethics (Boston College)

Science and Theology of Food

FALL 2017

Immaculate Conception Seminary School of Theology, South Orange, NJ

Rev. Gerald Buonopane, Ph.D. Food Science (Pennsylvania State University)

Cosmos and Creation: Perspectives on Scientific Discoveries and the Intelligibility of Human Experience

FALL 2017

Saint Charles Borromeo Seminary, Wynnewood, PA

James Despres, Ph.D. (ABD) Philosophy (Catholic University of America)

SELECTED GUEST SPEAKERS IN SCIENCE COURSES

FROM MAJOR UNITED STATES ROMAN CATHOLIC SEMINARIES

Nicanor Austriaco, O.P., Ph.D.
Professor of Biology
Providence College

Guy Consolmagno, S.J., Ph.D.
Director
Vatican Observatory

Michelle Francl, Ph.D.
Professor of Chemistry
Bryn Mawr College

Agustín Fuentes, Ph.D.
Professor of Anthropology
University of Notre Dame

Aaron D. Kheriaty, M.D.
Director of the Bioethics Program University of California, Irvine School of Medicine

Andrew Newberg, M.D.
Director of Research, Marcus Institute of Integrative Health
Thomas Jefferson University and Hospital

William Newsome, Ph.D.
Vincent V.C. Woo Director
Stanford Neurosciences Institute

Matt J. Rossano, Ph.D.
Professor of Psychology
Southeastern Louisiana University

Christian Smith, Ph.D.
Director of the Center for the Study of Religion and Society
University of Notre Dame

Stress & Resiliency: Scientific and Pastoral Approaches

FALL 2017

St. Mary's Seminary & University, Baltimore, MD

Patricia Fosarelli, M.D. (University of Maryland School of Medicine), D.Min. Spirituality (Wesley Theological Seminary, Washington, DC)

Science and Theology: In Dialogue for the New Evangelization

FALL 2017

Kenrick-Glennon Seminary, St. Louis, MO

Edward Hogan, Ph.D. Systematic Theology (Boston College)

Science, Faith, and Knowledge

FALL 2017

St. Pius X Seminary, Dubuque, IA

Jacob Kohlhaas, Ph.D. Theology (Duquesne University)

Christoffer Lammer-Heindel, Ph.D. Philosophy (University of Iowa)

Theology and Scientific Methodology

FALL 2017

St. Vincent de Paul Regional Seminary, Boynton Beach, FL

Antonio Lopez, Ph.D. Philosophy (Fordham University)

What is a Human Being? Evolution's Gift to Theology for Responding to this Question

FALL 2017

Saint John's University School of Theology and Seminary, Collegeville, MN

Vincent M. Smiles, Ph.D. Theology (Fordham University)

Science and Forgiveness

FALL 2017

Sacred Heart Seminary and School of Theology, Hales Corners, WI

James Stroud, S.T.D. Moral Theology and Ethics (Catholic University of America)

Jeremy W. Blackwood, Ph.D. Religious Studies (Marquette University)

Brian Yong Lee, Ph.D. Theology (University of Notre Dame)

Patrick J. Russell, Ph.D. Religious Studies (Marquette University)

Can the Mind be Reduced to the Brain?

FALL 2017

Dominican School of Philosophy and Theology, Berkeley, CA

Marga Vega, Ph.D. Philosophy (Universidad de Valladolid)

Behavioral Ecology

SPRING 2018

Bishop Simon Bruté College Seminary, Indianapolis, IN

David Benson, Ph.D. Zoology (Washington State University)

Mark Reasoner, Ph.D. New Testament & Early Christian Literature (University of Chicago)

Man and Woman He Created Them: What Science Tells Us about Gender

SPRING 2018

Kenrick-Glennon Seminary, St. Louis, MO

John D. Finley, Ph.D. Philosophy (University of Dallas)

Divine Action in the Natural World

SPRING 2018

St. Joseph's Seminary, Yonkers, NY

Michael A. Hoonhout, Ph.D. Systematic Theology (Boston College)

Cosmology: Scientific, Philosophical and Theological

SPRING 2018

St. John Vianney Theological Seminary, Denver, CO

Thomas McLaughlin, Ph.D. Philosophy (University of St. Thomas, Houston)

Joel Barstad, Ph.D. Medieval Institute (University of Notre Dame)

In the Image of God: Toward an Adequate Anthropology of the Person as the Image of the Divine

SPRING 2018

Mount Angel Seminary, St. Benedict, OR

Br. Louis de Montfort Nguyen, O.S.B., M.D. (University of California, Davis)

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