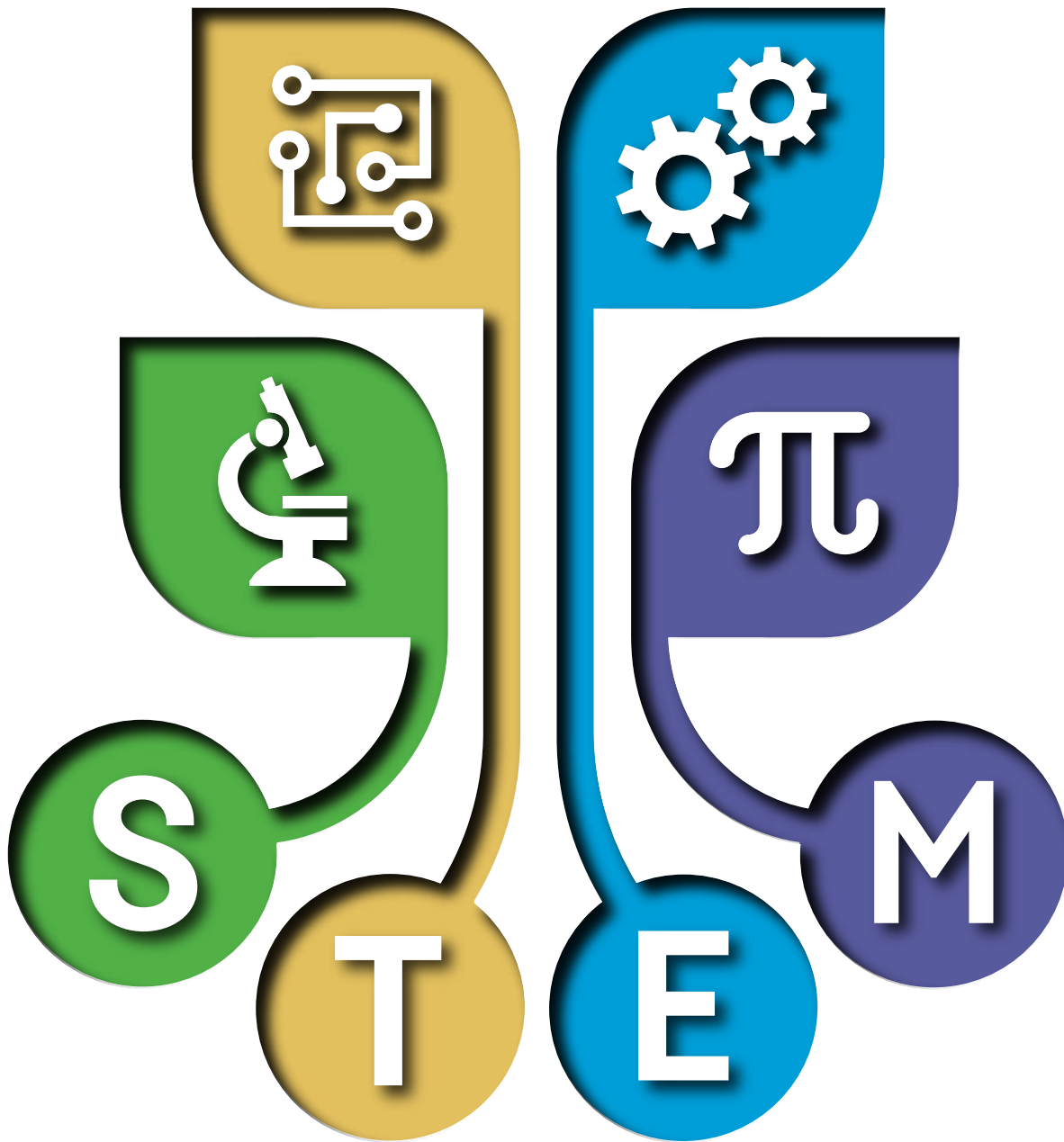


ADVENTIST EDUCATION



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Monica Jackson
Nudd

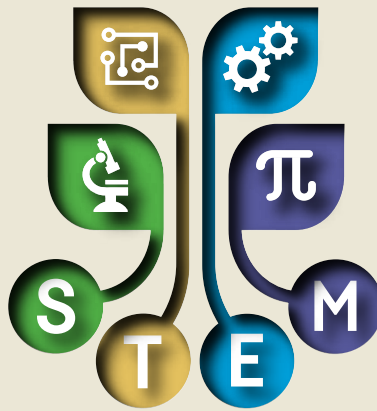
“Why Do I Need to Know About STEM?”

I Don’t Teach Science, Technology, Engineering, or Math!”

We live in a changing world. The COVID-19 shutdowns illustrated just how quickly life can change. Many educators were forced into distance or hybrid learning with little time to prepare or plan. They continue to implement safety protocols that are constantly evolving, illustrating the adaptability and professionalism of teachers. Concurrently, the education pendulum continues to swing, drawing our focus toward various aspects of teaching and learning, despite the global pandemic.

The current trend of integrating STEM throughout the curriculum was not common in education when I started teaching in 2005; however, today most educators are familiar with STEM and related terms such as STEAM or STREAM.¹ Whether or not teachers teach a STEM subject, most agree that they want their students to be successful, both now and wherever God leads them in the future. They want their students, regardless of chosen occupation, to understand advances in science and participate in making decisions and ethical choices that will impact society. How do we, as educators, achieve these goals when we don’t know what jobs or societal challenges will exist in the future? Can we prepare our students to be dedicated, Bible-believing Christians as well as great scientists? STEM is essential, just as reading, writing, and history are essential; we must equip students to succeed in a changing world.

Advances in travel capability and technological innovations have exploded in recent history; thus, students’ need for strong STEM skills is evident. For example, if we think back to the time when Jesus lived, most people traveled by foot, on an animal, in a chariot,

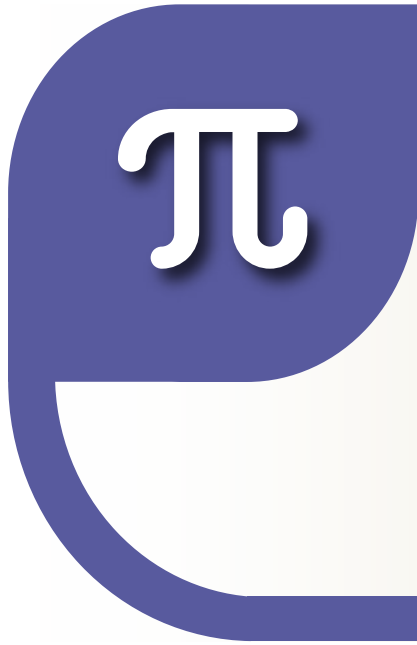


and by boat. Fast forward to the Age of Discovery and Exploration (the 1400s-1600s). Although explorers had begun to traverse distant seas, most people still traveled by foot or small animal-drawn carts. Only a few traders, missionaries, and explorers traveled to faraway places by boat. By the 1800s, train travel became an affordable option for many²; however, it wasn’t until the 1920s to 1950s, as automobiles and commercial airlines became popular and accessible, that large numbers of people began regularly traveling greater distances.

Technology has changed significantly in recent years. It has only been within the past 40 years that computers have downsized from huge mainframes owned only by large companies to small hand-held smartphones that fit in our pockets. Today, information is shared so quickly and easily that misinformation spreads faster than ever before. As a result, the need to equip critical thinkers who can analyze information, check sources, and solve problems in creative ways is also greater than ever.

Training students to be resilient problem-solvers, effective communicators, and creative thinkers can occur in any class, no matter the subject content or grade. Project-based learning is one example of a teaching method used across the curriculum and at various learning levels. Students can work together on meaningful projects that address real-world problems and, in the process, learn how to collaborate and work cooperatively. This process also helps them sharpen their inquiry and listening skills. In addition, many laboratory experiments conducted at the tertiary level require collaboration with a lab partner. Perhaps due to limited resources, schools at all levels encourage students to work together in groups to share expensive

Continued on page 51



Understanding and Cultivating Mathematical Resilience in Students

Jackson¹ has never really liked math. In class, when he doesn't understand a concept (which is often), he usually makes a joke, distracts a friend, or finds some other way to disengage from the discussion in the classroom. His sporadically turned-in assignments receive poor grades, and he performs poorly on assessments.

Jennifer sits a few seats over from Jackson but completes her work without complaint. She doesn't enjoy math either, seeing it as pointless, but she doesn't want to earn a bad grade. For her, math is just something she must get through to have time to do other, more interesting things.

Marcus, who finds math extremely easy, sits at the back of the class. Because he is rarely challenged, he usually gets his work done quickly and moves on. He doesn't see much use for mathematics, but he can get a solid grade easily because he's "good at it."

Part of the role of mathematics educators is to instill in students an interest in their subject, an understanding of its applicability, and con-

fidence that they can achieve mastery of the topic. As educators, we must instill a mathematical resilience that will support students in future mathematics courses² and future careers—indeed, their entire lives.

Each of the three students in the paragraph above displays behavior indicative of low mathematical resilience. Some students show their lack of resilience in overt ways, as in the case of Jackson, who acts out when facing a concept he believes he cannot master. Other students' lack of resilience is more covert than Jennifer, who doesn't display any poor behavior but regards math as "pointless." Some students do not display their lack of resilience until they enroll in future courses when concepts may not come so easily, like Marcus.³

Borman and Overman⁴ define resilience as a developmental process that leads to increased academic performance despite the adversity working against it. Many authors have offered similar definitions for resilience and shared ideas on how to overcome it.

Several concepts are important to consider when developing mathematical resilience in students. First, it is es-

sential to recognize that resilience is not something a person either has or does not have. It can be either fostered or hindered based on interpersonal relationships and social support.⁵ As teachers, we bear the greatest responsibility for developing academic resilience in our students, as we are the direct interpersonal contact they have in our classrooms. Other educational personnel, adults in students' lives, and peers also play a significant role.⁶

Second, we differentiate between a fixed mindset and a growth mindset. A fixed mindset holds that each person has an unchangeable capacity to learn. This view is often pervasive with regard to mathematics and recognizable and disparaging statements such as "I'm not a math person" or "I'm never going to get this." A mathematically resilient student displays a growth mindset and believes that his or her current lack of understanding has the potential to change and that this change can occur as the result of working to acquire greater expertise.⁷

Third, resilience develops in the

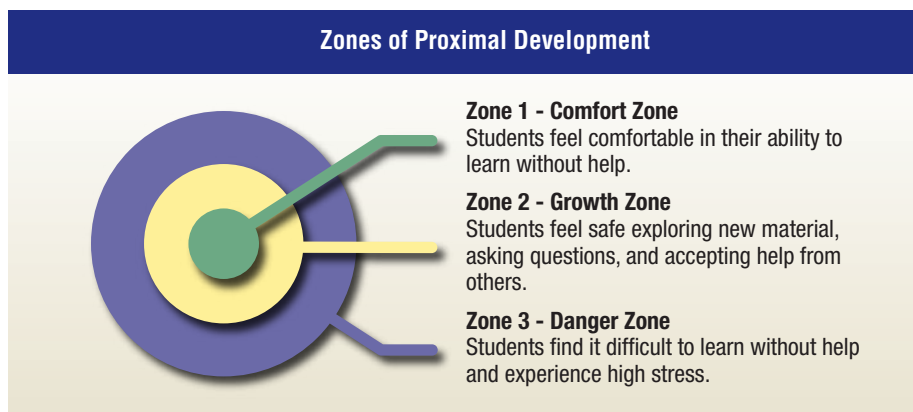
ANTHONY BOSMAN and ADAM HECK

presence of adversity. A course that does not significantly challenge students and expose them to problems they do not immediately know how to solve will not produce the “stick-to-it-iveness” needed for higher-level problem-solving.

Goodall and Johnston-Wilder⁸ have identified three zones (based on Vygotsky’s Zone of Proximal Development) that are helpful here. The innermost zone, called the “comfort zone,” is the safe zone where a student isn’t challenged and feels comfortable navigating the material with little help from others. The outermost zone, classified as the “danger zone,” is characterized by extreme difficulty and high stress for the learner. It can often lead to a fight, flight, or freeze response. Neither of these zones leads to the development of resilience—or much learning, for that matter. It is in the space between these two zones, called the “growth zone” by Goodall and Johnston-Wilder,⁹ where learning happens, and resilience develops. The growth zone provides sufficient academic challenge and an environment that allows for safe exploration of a topic as well as the freedom to ask questions. [See Zones of Proximal Development chart].

Resilience rarely develops in hostile environments. A student who feels threatened, judged, inadequate, or disliked by the teacher will have little desire to put in the work needed to develop mathematical resilience. However, students who attend a school marked by a safe and orderly environment and who have a positive relationship with their teachers tend to develop higher levels of resilience.¹⁰

In the following paragraphs, we offer ideas for activities and practices that may produce academic resilience in students. As you read these, keep in mind that more important than any activity or practice is the development of a safe, caring, and orderly environment where a student can learn. No activity or practice can ever replace a teacher who makes a student feel loved and valued.



Zone 1 - Comfort Zone

Students feel comfortable in their ability to learn without help.

Zone 2 - Growth Zone

Students feel safe exploring new material, asking questions, and accepting help from others.

Zone 3 - Danger Zone

Students find it difficult to learn without help and experience high stress.

1. *Mathematical Resilience Scale.* The Mathematical Resilience Scale is a research-validated survey to assess student attitudes that contribute to mathematical resilience.¹¹ It has students indicate their level of agreement with statements about their perception of the value of mathematics, the necessity of struggle in learning mathematics, and the possibility of growth in mathematical ability. Value statements include “Math courses are very useful no matter what I decide to study” and “Mathematical thinking can help me with things that matter to me.” Struggle statements include “Everyone struggles with math at some point” and “Making mistakes is necessary to get good at math.” Growth statements include “Anyone can learn math” and “Everyone can get better at math.” Educators can use such tools to help gauge students’ attitudes toward their classes and the effectiveness of various interventions.

2. *Low-floor, High-ceiling Tasks.* A low-floor, high-ceiling task is an activity designed to be accessible to all students (low-floor) while also extending to high levels (high-ceiling). The activity allows students to work at different paces and boosts their confidence as they make meaningful contributions to the problem and deepen their conceptual understanding.¹² For example, one might present students with a 4 x 4 grid and ask them to count the number of ways to travel from the bottom left to the upper right. All students can engage this problem by thinking about a systematic way to count the paths and looking for patterns. The problem also invites generalization to challenge students in appropriate ways: consider a 5

x 5, 6 x 6, or more generally, an n x n grid, or even a rectangular m x n grid. Note that low-floor, high-ceiling tasks are designed so that “everyone can get started and everyone can get stuck.”¹³ Thus, all students have an opportunity to experience mathematical struggle and develop mathematical resilience. Several tasks for various grade levels are available at youcubed® (see <https://www.youcubed.org/>).¹⁴

3. *Growth-focused Grading.* Educators can help students develop growth mindsets that promote resilience.¹⁵ For instance, mastery-based grading shifts the attention from earning points to mastering the course objectives by the end of the term, giving students multiple opportunities to demonstrate mastery. This principle can be introduced into a course with a traditional grading system by allowing students to reattempt missed problems on assignments or exams for partial credit or through digital-learning platforms that give students instant feedback and allow multiple attempts. Similarly, second-chance grading allows students to retake alternative versions of quizzes/exams throughout the semester to demonstrate mastery.¹⁶

Teachers should encourage a growth mindset when discussing grades with students. Low performance on math assessments is often related to mathematical anxiety and can lead to avoidance.¹⁷ Educators can intervene by reminding students that there will be additional opportunities to demonstrate their mastery, encouraging them to focus on learning from their mistakes rather than interpreting them as a sign of their lack

of ability. One author of this article (A.H.) has made *successful failure* a small portion of his overall course grade (5 percent). Students earn these points at the end of the semester by writing about a time they faced a setback or disappointing failure in the course and telling how they overcame and grew from it. Knowing that completing this assignment is necessary to earn full points for the course helps students anticipate setbacks and appreciate the essential role of resilience in learning.

4. *Character Statement.* One of the authors of this article (A.B.) has his students recite together and sign the following character statement before every exam:

- I will persevere on this exam, giving my best effort.
- I will exercise integrity, not giving or receiving any unauthorized aid on this exam.
- I will learn from my mistakes, reviewing the graded exam when it is returned to me.
- I will trust that I am worth infinitely more than any exam score, for I have been redeemed at infinite cost (1 Corinthians 6:20).

The character statement reminds students, at a high-stakes time, of their commitment to integrity,¹⁸ persistence, and growth—but above all, their inherent value. Educators can craft their own statements, borrowing or adopting the above language, or develop a statement with their class as part of a lesson on mathematical resilience at the beginning of the term. This statement might then be included on significant assignments and displayed on a classroom poster. 📌

This article has been peer reviewed.



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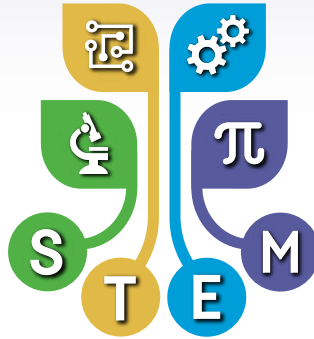
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EXSEED



EXcellence in STEM Experiential EDucation

Imagine a classroom abuzz with activity—students clustered in corners, gathered at desks pushed together and in groups on the floor, engaged in sharing ideas, tossing out solutions to problems, asking probing questions, and discovering answers. Imagine a multigrade classroom in Washington State where students connect with peers in Texas and Michigan. Imagine a group of teachers from across the North American Division (NAD) collaborating to develop a shareable lesson plan. Imagine a group of students in a small school in Tennessee connecting with students in Australia while learning from a geology professor at Loma Linda University (LLU) in California.

You've just experienced the essence of the Loma Linda University EXSEED program (EXcellence in STEM Experiential EDucation). EXSEED aims to build a collaborative system that connects small classrooms with acad-

emies and Adventist higher education institutions. We are developing a process by which teachers and schools come together and assist one another in producing instructional materials, conducting joint research, solving problems, and using existing products more efficiently. We plan to stimulate collaboration—the sharing of ideas and resources—in a network of educators and schools that will profoundly impact the future of our students.

EXSEED's History

What began as musings by Loma Linda University President Richard Hart more than a decade ago on the state of Adventist education became the catalyst for developing the EXSEED program. In the November 2009 issue of the *Adventist Review*, Hart outlined the need for change as evidenced by the downward enrollment trend of Adventist students attending denominational elementary and secondary schools and colleges and uni-

versities in the NAD in recent years.

At LLU, our commitment to Adventist education runs deep and extends beyond our campus. We believe a Seventh-day Adventist Christian education provides a foundation that cannot be developed outside the denominational experience. President Hart wrote, “Our theological perspectives, understood early and well, can provide a framework for facing life issues that will make everything else make sense. This is a gift that no amount of public education can replace, regardless of the quality of lab equipment or class size. . . . This wholistic view of the human experience, grounded in an essentially Adventist view of Scripture and education, yields a solid, sensible worldview that no other educational system can offer.”¹

President Hart's reflection reminds us of guidance from Ellen White: “The precepts and principles of [true] reli-

MELISSA AREE and CHARITY ESPINA

gion are the first steps in the acquisition of knowledge, and lie at the very foundation of true education. Knowledge and science must be vitalized by the Spirit of God in order to serve the noblest purposes. The Christian alone can make the right use of knowledge. Science, in order to be fully appreciated, must be viewed from a religious standpoint. Then all will worship the God of science.”²²

After the article’s circulation, LLU board member Tom Zapara and his wife Vi, a former teacher, challenged President Hart and Loma Linda University to be part of the change. With enthusiasm and generosity, they later offered a \$5-million-dollar grant to develop programs and resources to address the need for STEM integration in Adventist education. The funding was designed to last eight years, but through in-kind services—time of administrators, faculty, and staff—from LLU, the grant monies extended beyond the initial timeframe, and the EXSEED program still has a solid financial footing.

But the Zaporas have contributed more than just money. One of their greatest joys has been attending the last day of each Summer EXSEED Conference to be part of the closing ceremonies. They have been a driving force to push EXSEED beyond its present form—and even today, in their mid-90s, they are still encouraging us to be innovative with ideas and resources.

Recognizing our collaborative spirit, the Versacare Foundation also became a strategic partner and an early supporter of EXSEED, supplying additional funding for the program. Historically, the Versacare Foundation has been a strong sponsor of Adventist STEM education, contributing hundreds of thousands of dollars in grant money to K-12 teachers in the North American Division.

As a next step, LLU President Hart and Provost Ron Carter consulted with a group of secondary-level science teachers during an annual Pacific



Tom and Vi Zapara, founding EXSEED grant donors.

Union Conference curriculum meeting held in southern California in 2010. The teachers boldly expressed their needs and a strong desire for change. Carter and Marilyn Eggers, associate provost, have been sharing the responsibility of directing the program over the past 10 years with a team of additional LLU staff.

EXSEED Collaborations

EXSEED organizers strongly believe that collaboration is the heart of innovation and that successful innovation comes only from a team of people sharing ideas, skills, and resources. EXSEED has had the privilege of collaborating with Andrews University (Berrien Springs, Michigan), Burman University (Alberta, Canada), Kettering College (Kettering, Ohio), La Sierra University (Riverside, California), Pacific Union College (Angwin, California), Southern Adventist University (Collegedale, Tennessee), Union College (Lincoln, Nebraska), Walla Walla University (College Place, Washington), and other Adventist schools.

For two consecutive years, the Oregon Conference brought its teachers to

LLU for the Summer EXSEED Conference as part of its plan to have all teachers EXSEED trained. The Alaska Conference also brought its teachers for the EXSEED experience, and other conferences have expressed the desire to join the summer conference. In addition, some EXSEED administrators traveled to Jamaica and the Caribbean to establish a network of STEM project-based learning (PBL) resources.

Mission-focused Learning With EXSEED

The overarching goal of the EXSEED program is to enhance science, technology, engineering, and math (STEM) education in Adventist K-12 schools within a context of mission-focused learning (MFL). Such an environment fosters the highest commitment to analytical and critical thinking, advocates the maximum ethical and professional standards of practice, values the creation of new knowledge, and promotes the faithful transmission of best practices within professional and scientific disciplines. It provides a learner-centered educational environment that facilitates the

absorption of knowledge and perfection of skills while blending evidence-based decision-making with transformative learning events (“teachable moments”). It develops a culture of service while encouraging the pursuit of wisdom through the example of Jesus Christ, who lived to bring hope, healing, and happiness to humankind. View the Loma Linda University Mission-focused Learning webpage³ for more details.

Project-based Learning With EXSEED

From the beginning, the EXSEED team has invested time, energy, and resources as part of program offerings to train teachers in the Project-based Learning (PBL) approach to teaching STEM. Strong evidence shows that students learn best when they actively engage in the learning process through meaningful projects, solving real-world problems, and answering complex questions.⁴ This type of engagement allows students to demonstrate knowledge and skills through collaboration, creativity, and communication, emphasizing active learning experiences. At EXSEED, our PBL instruction integrates faith and service learning with a STEM focus. Organizers have seen teachers and schools transform their classroom instruction using PBL lessons, as shown in the examples below.

- **Collegedale Academy Elementary School (Tennessee, 2016): Health Fair** – Shortly before attending a Summer EXSEED Conference, Norma Collson, 4th-grade teacher, was diagnosed with diabetes. With her medical challenges in mind, she was inspired to organize a health fair with her students. She collaborated with local nursing students to help the 4th graders research their subjects and make project boards. She also contacted her local conference to borrow colorful health banners and medical-education equipment and supplies and invited the local community-outreach center to participate by passing out brochures. The health fair hosted 200 guests in the Collegedale elementary school gym.



Collegedale Academy Elementary School's health fair, 2016.

- **Cochise Seventh-day Adventist Christian School (Arizona, 2017): Gardening and Agriculture Project – From Dirt to Plate** – Led by Teaching Principal Susan Suntag, students participated in all levels of the gardening project, from helping to build the school's greenhouse, learning how to

compost and care for the worm farm, to managing both the school and community gardens. They moved inside to examine organisms from the garden under microscopes, used the seed library to check out seed packets, and learned how to replenish the supply from garden plants that go to seed. One



Cochise Seventh-day Adventist Christian School's garden project, 2017.

of the most exciting takeaways was preparing food with ingredients harvested from the garden. [Watch the video.](#)

• **Columbia Adventist Academy (Washington, 2018): LLU Student Visit** – High school biology teacher Larry Hiday brought eight students from his anatomy and physiology class who were interested in health careers to Loma Linda University for a three-day intensive visit to observe the inner workings of a large teaching hospital. The students were inspired by the embryology museum and the human cadaver lab, a hands-on den-

tistry workshop, and conversations with medical students, nurses, and research scientists, an experience that helped shape the students' career choices. [Watch the video.](#)

The EXSEED Experience

EXSEED's face-to-face conferences, which began in 2011, are organized around building experiences and preparing teachers to return to their classrooms with easy-to-use, well-developed ideas. Completing the summer conference and a special classroom STEM PBL project with their own students over the following aca-

ademic year earns teachers graduate-level academic credit to satisfy continuing-education requirements for credentialing. And true to the EXSEED mission to push forward and encourage the use of technology, each conference attendee from 2012 to 2019 received an iPad to be used for classroom projects with students. The iPads provided access to inexpensive technology that allowed teachers and students to produce high-quality, creative content.

But teachers leave EXSEED conferences with more than just new gadgets and academic credits:

Berkel Williams, a science teacher at Crawford Adventist Academy in Toronto, Canada, reflected, "It's not just about coming here [the EXSEED summer conference], it's about the support



Students from Columbia Adventist Academy visit Loma Linda University, 2018.



Teachers collaborate during the "How to Make Your Classroom Come Alive With Hands-on PBL."



Participants in the "Engineering Is Elementary" workshop for elementary schools.

that you will get even after you leave. When you come to this conference, you will be inspired to truly impact the lives of your students in a different way, in a very positive way.”

After 33 years of teaching, Greg Reseck, Cedarbrook Adventist Christian School in Washington state, found that “EXSEED inspired me to be creative and look for new things that I could do with my students. And I can still come up with new things that I’ve never done before.”

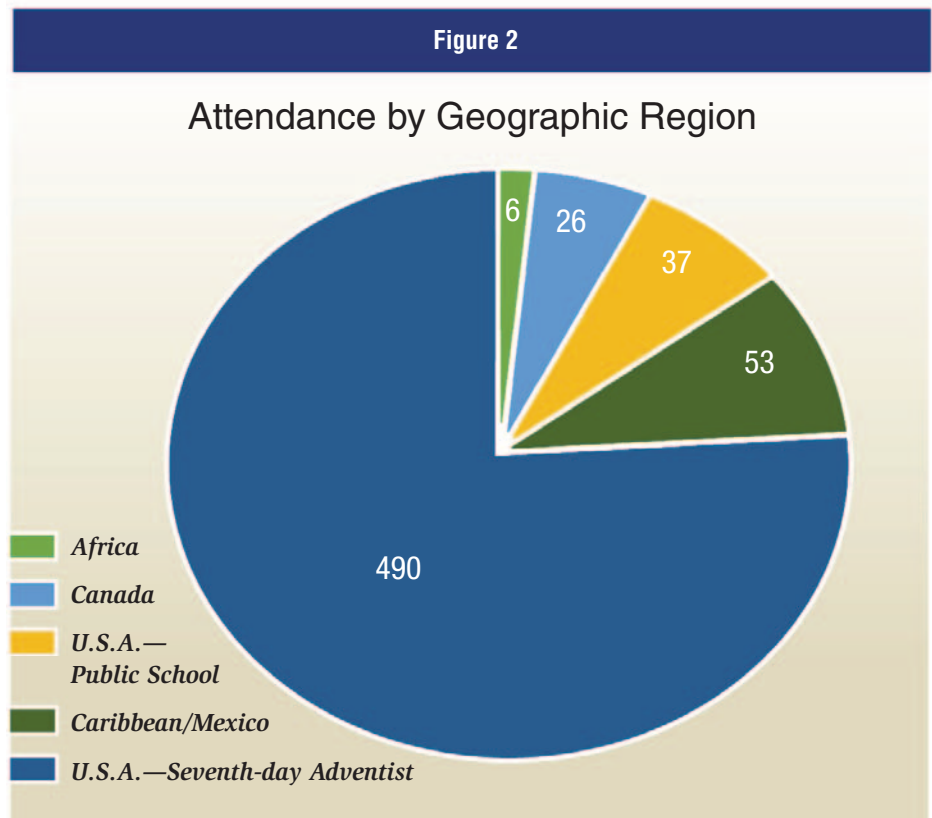
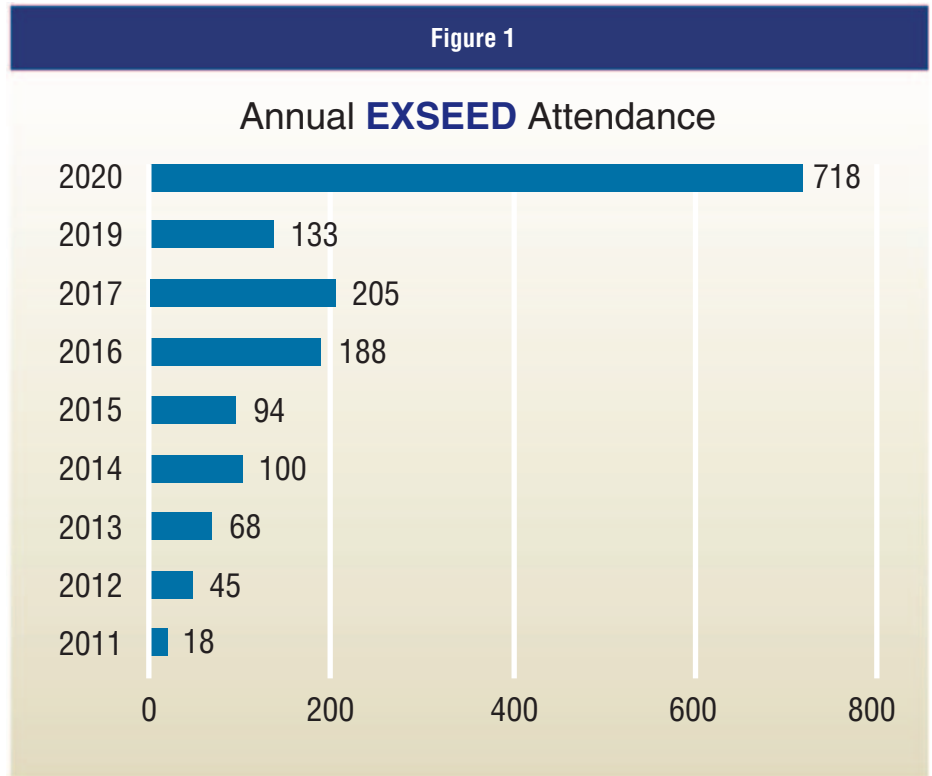
Craig Mattson, principal of Northwest Christian School (Puyallup, Washington, U.S.A.), said, “There is widespread agreement that we have a deep value for what EXSEED has done for the teachers who have attended from our conference. Teachers who are EXSEED-trained are doing things at a higher level when it comes to STEM education.”

Marilyn Eggers, LLU associate provost, has observed the impact of the EXSEED program on conference attendees: “It is amazing to see the transformation in the teachers who attend the conference. They come in after a year of pressures, often dejected due to dealing with challenging parents, tired, and with feelings of inadequacy. But they leave standing up straight, feeling energized, ready, and empowered to share what they’ve learned with their students. Our faculty presenters let them know how important they are and what amazing work they are doing to prepare Adventist children, youth, and young adults for bright futures.”

The Future of EXSEED: Collaboration and Innovation

The growth and success of the EXSEED program can only be attributed to God’s leading, grace, and power. EXSEED program developers quickly acknowledge God’s providence and His guidance during the first 10 years of what has proved to be a highly effective program. And program organizers are excited to see where God will lead in the next decade as they plan new initiatives and opportunities for educators and students worldwide.

Currently, organizers are working



on several new opportunities for educators: (1) a STEM certification for educators, leaders, and schools that commit to excellence with continuous improvement in STEM content and de-

livery; (2) free monthly webinars and podcasts covering STEM PBL teaching, learning topics, and successes; (3) engaging, interactive, topic-specific,

ready-to-use STEM modules developed in collaboration with specialized teachers from across Adventist education; and (4) a STEM Master's degree, a joint program with participating Seventh-day Adventist universities.

After two years of hosting a virtual conference, organizers see the value in a hybrid approach. The summer conferences will continue in an annual face-to-face format on the LLU campus. Additionally, organizers will provide a virtual conference open to the world church and other EXSEED collaborators each June. The virtual conference will expand its focus to include the needs and interests of our international partners, with a commitment to make the online conference engaging and equitable for everyone with a HyFlex format—plenary sessions and learning activities offered in person, and synchronously and asynchronously online. In addition to the general summer program, EXSEED program organizers will launch a STEM Summer Intensive Program for experienced STEM teachers. These interactive intensives will emphasize project-based learning and STREAMS: science, technology, faith-based religion, engineering, art, math, and service-learning.

In addition, EXSEED organizers will collaborate with, support, and promote STEM-related clubs, projects, science camps, and pathway programs throughout the Adventist educational system, develop new ways to include minority students in the LLU pipeline and pathways programs, and will develop on-campus, project-based science engagement.

An expanded and reorganized leadership team is working to accomplish these goals and will include a new executive director and additional staff to operationalize enhanced services and products.

Conclusion

Those who come to EXSEED realize that Loma Linda University is dedicated to collaborating with the entire Adventist education network and is intentional about developing STEM K-12 education. Through God's provision,

EXSEED organizers are at a pivotal point to initiate changes that will encourage strong cross-educational collaboration and provide substantial resources. They desire to lend support throughout the Adventist educational system to strengthen connections with teachers from kindergarten through the graduate level and across conference and union lines for a global reach that will stretch, empower, and transform both teacher and student.

Visit the EXSEED program website to learn more about EXSEED and its conferences and initiatives: <http://llu.edu/exseed>. ✍



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The banner features a dark blue background with a network of orange and yellow lines. The word "EXSEED" is written in large, bold, white letters. Below it, "Summer Conference" is written in a slightly smaller, white font. A horizontal line with a circle at each end is positioned below the text. Underneath the line, the text "For updates and registration:" is written in white, followed by the URL "llu.edu/exseed" in a larger, bold, yellow font. On the right side, there is a red square containing the Loma Linda University logo, which includes a shield with a cross and a book, surrounded by a laurel wreath, with the motto "TO MAKE MAN TRULY" below it. The words "LOMA LINDA UNIVERSITY" are written in white at the bottom of the red square.

SURPRISE VISITS:



When God Speaks Through Nature

It was a beautiful spring day in North Carolina. Tammy¹ was 18, about to graduate from the academy, and life was good. This particular Sabbath, however, found her alone and nurturing hurt feelings. Tammy's young boyfriend had awkwardly uninvited her to Sabbath dinner with his extended family. He explained that the patriarch of the

family did not believe high school-aged teens should date. On that sun-filled Sabbath, with her friends traipsing off to enjoy various adventures and her boyfriend sheepishly leaving campus without her, Tammy felt abandoned and very sorry for herself.

God met with her that day. Later, Tammy didn't remember the morning sermon. She didn't remember Bible class from the week before, although it was probably meaningful. She

didn't even remember vespers from the previous evening. But that Sabbath afternoon, on a blanket in an old orchard and surrounded by overgrown grasses, buzzing insects, and the sweet scent of apple blossoms, God and Tammy made a memory together. She sensed God's presence as she communicated her hurt and poured out her heart to her Creator.

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Nature can connect us with our Creator. “As we come close to the heart of nature,” Ellen White wrote, “Christ makes His presence real to us, and speaks to our hearts of His peace and love.”² We want our loved ones and our students to know God passionately. Nature is one of God’s best avenues for having a heart-to-heart encounter with Him. Nature is where all our senses take in stimuli that can relax and open us to reflective thought.³ In nature, we can be more in tune with God than in any other place—physically, cognitively, emotionally, and spiritually.

This article will show how nature is God’s direct path for us to achieve a deep and personal experience with Him. Additionally, we will appeal to fellow educators and policymakers of the Seventh-day Adventist Church to revisit the denomination’s educational mission and to provide a setting where students in our schools can encounter their Maker as intended in the Eden School.

Nature in Context

In 2005, Richard Louv’s best-selling book, *Last Child in the Woods*, sounded a warning: Our children are disconnected from nature. American young people are spending less time in nature than ever in history. To meet added academic mandates, schools nationwide are dramatically cutting back recess time. Afterschool programs keep most children busy and off the streets, where real and perceived danger prevents outdoor play in the form previous generations of children took for granted. Young students may be learning about the rainforest in school, but they seldom, if ever, venture into the forest or wooded areas near their homes.⁴

More than 15 years after Louv’s warning, and despite continuing research and discussion on the importance of outdoor activity in childhood,⁵ schools in the United States and Canada largely keep to their restrictive schedules and curricula.⁶ However, the news about the need for recess and active play is slowly getting

out. Some families limit screen time, and parents generally believe it is essential to encourage their children to be more active. But getting children outside and active often proves difficult for parents to accomplish.⁷ In the United States, schools are still churning out schedules, programs, and priorities that keep children indoors nearly all day.⁸

Many other countries are looking for ways to address academic curricula that keep children indoors. In Finland, considered by many to be progressive in its approach to education, some are concerned that students do not get enough physical activity.⁹ “The biggest challenge at the moment,” says researcher Nicole Ridgers, “is that time allocated to recess and lunchtime is decreasing in schools.”¹⁰ Some Adventist schools are in danger of tagging along with this trend.

There is, however, encouraging news. Northern European countries such as Denmark have a long tradition

of nature-based preschools and kindergartens. Finland, Germany, and the United Kingdom have in recent decades embedded nature awareness and early-childhood forest programs into their ethos for education,¹¹ as have countries such as Japan and South Korea.¹²

In 2008, the Forest School methodology arrived in South Korea. It was soon recognized as a solution to a population of students who, though academically strong, frequently experienced depression and burnout throughout their education. The South Korean government adopted the Forest Kindergarten concept to connect children with nature and provide high-quality early-childhood experiences. Jiyoun Shin, chair of the Early Childhood Education Department at Sahmyook University (Seoul, South Korea) and vice-chair of the South Korean Forest Kindergarten Association, is the founder and principal of Sahmyook University Lab Forest Kindergarten. Shin is passionate about



nature experiences for children. Seventh-day Adventists, says Shin, already have the message and are well-positioned to adopt a nature-based approach to education.¹³

Healthy Brain, Healthy Minds, Healthy Hearts

Meanwhile, research has been accruing. When people spend time in nature, whether relaxing or engaging in active recreation, their health improves. Nature exposure has been shown to lower heart rate and blood pressure.¹⁴ It decreases cortisol in our bodies, allowing natural killer cells to increase in number and effectiveness. This, in turn, assists the immune responses and helps prevent cancer generation and growth.¹⁵ Trees emit phytoncides, volatile compounds that are antimicrobial and could explain some of the health benefits of *Shinrin-yoku*, or Forest Bathing, the Japanese practice of taking in the forest atmosphere during a quiet, observant walk.¹⁶ Nature abounds with benefits for health, many of which we are entirely unaware of, even while we enjoy them.

Nature experiences also calm us and make us more focused. Spending time in forest settings has been shown to relieve tension, depression, anger, and confusion¹⁷ and promote a sense of wellbeing.¹⁸ In children, outdoor activity is associated with improved cognition, better test scores, increased social skills, confidence, positive school engagement, and reduced attention-deficit/hyperactivity disorder (ADHD) symptoms.¹⁹ Additionally, active play is necessary for optimal child development and academic success.²⁰ The research is clear: Exposure to nature and natural views helps keep us healthy, clears our thinking, and lifts our mood.

Spirituality and Relating to God

It would be a leap of logic to conclude that health and inner peace automatically translate to a relationship with God. It does appear, however, that God designed nature to predispose us toward a state of being that lends itself to enhanced spirituality.

What is spirituality? Defining it can

be difficult because it is a concept and can mean different things to different people.²¹ Usually, when attempting to define spirituality, people use language such as imagination, human creativity, or relationships.²² Others use terms such as *mystery*, *transcendence*, *interior life*, or *awareness*, and note that spirituality can refer to both the religious and non-religious experience.²³

History is rife with people groups who adopted a nature-focused spirituality out of harmony with God's plan. Like all gifts of love from the Creator to His children, true spirituality has its counterfeits. The children of Israel discovered and often answered the call of idolatry, practicing evil arts within groves of lofty trees. Today, people worldwide practice spirituality in forms that do not mirror God's intent. Counterfeit spirituality is available at

every bookstore, at the touch of a smartphone screen, and even in some churches. Now more than ever, we need to provide our students with the real thing, an authentic walk with God that is relevant, Bible-based, and sparked with frequent, joyful encounters with the living God.

The Original Plan

We can look to the Bible for a pattern to follow for genuine spirituality. In the creation story, God is pleased with His work and initiates a Sabbath day for celebration, rest, and communion with His children. There, we are told, in the schoolroom of the Garden of Eden and with the Creator as the instructor, "The book of nature, which spread its living lessons before them, afforded an exhaustless source of instruction and delight. On every leaf of the forest, every stone of the mountains, in every shin-



ing star, in earth and sea and sky, God's name was written."²⁴

Throughout the biblical record of redemption, we find humans encountering God in nature: Moses at the burning bush; Elijah listening for God in a whirlwind; David singing of God among his sheep. God repeatedly brings us truths about Himself with illustrations from nature. "Where were you when I laid the foundation of the earth?"²⁵ God asked Job and outlined in incredible detail the vastness and the minuteness of His creative works. "As for man," wrote the psalmist, "his days are like grass; As a flower of the field, so he flourishes. For the wind passes over it, and it is gone, And its place remembers it no more. But the mercy of the Lord is from everlasting to everlasting."²⁶ These lessons are not contained in dry, intellectual verbiage. The biblical narratives speak of powerfully emotional experiences: Moses' astonishment and curiosity; Job's placing a hand over his mouth in awe and dismay; Elijah's dramatic search rewarded in a still, small voice; and David's restfulness beside still waters.

If we conclude that God offers nature as an avenue to know Him better, and if we hope to help our students connect with Him in nature, we must carefully consider the approaches we take to facilitate spiritually loaded moments outdoors. The truth is, we cannot make lesson plans that guarantee our students a personal connection with God. Nor can we give grades on a report card that reflect what our students have achieved in their personal walk with God. However, we *can* provide the time and place for time outdoors and reflection. We can structure our schools, curricula, and schedules to ensure that nature becomes a daily part of what we do. We can use nature to teach anything and everything, and we can intentionally plan reflective moments that provide an opportunity for God to work.

Tammy's afternoon with God in the orchard more than 30 years ago was not an isolated event. It followed Bible classes and worship talks. It resulted from a childhood spent playing outside

Links to Forest School and Outdoor Education Resources

The **Outdoor Education Resources** search page on CIRCLE links to more than 25 planning, managing, and instructional resources by Adventist educators for Adventist educators: <http://circle.adventist.org/browse/251/>.

The **Lester Coon Adventist Forest School** Facebook page showcases an active Adventist Forest School. It links to training for teachers and various activities that will be helpful to anyone looking to start a forest school: <https://www.facebook.com/LCAForestKindergarten/>.

The **Alberta Teachers' Association Forest School Guide** provides links to books about forest schools, activities and lessons, outdoor classroom design ideas, teaching tips, and the philosophy of outdoor school: <https://teachers-ab.libguides.com/c.php?g=712400&p=5078151>.

Graduate Outdoor Education offered at Southern Adventist University provides Adventist educators with further training and degree options: <https://www.southern.edu/academics/edpsych/graduate-outdooreducation.html>.

North American Association of Environmental Education is a national organization for environmental education that offers an abundance of EE materials: <https://naaee.org/>.

Natural Start Alliance is branch of NAAEE specializing in early-childhood education: <https://naturalstart.org/>.

Project Wild is an interdisciplinary conservation and environmental-education program with curriculum for K-12. Its goal is to develop awareness, knowledge, skills, and commitment to wildlife and the environment: <https://www.fishwildlife.org/projectwild>.

and wandering the woods. That afternoon was the culmination of many smaller parts. It was a 1st-grade teacher sending children outside during morning worship to find illustrations of God's love. It was keeping a nature journal and mapping birds' nests as a young teen. It was nature walks and fireside songs, ant farms, and polliwogs. It was exposure to nature in the context of God as Creator, Friend, and Savior.

To be outdoors in nature is to experience it with all our senses, to be awake in every sense of the word. With our feet planted on the earth and with life stretching and growing around us, we are in God's classroom.

Through His creation, we learn about Him and connect with Him. Intentional, spiritual encounters with God in nature are powerful and personal, and they can add up to a lifetime of deep friendship with God.

We hear many challenges in the words "Adventist education." An important one is to be at the forefront of a trend that harkens back to the Eden School, as described in the book *Education*. Outdoor education is in the collective DNA of the Seventh-day Adventist Church. For more than 100 years, we have known that "Next to the Bible, nature is to be our great lesson book."²⁷ In nature, we find illustrations of the story of redemption. We see Jesus on the mountainside—not at the syn-

agogue or even a rooftop, but on a hillside—engaged in a heartfelt conversation with His Father. Our Bibles contain His words in red: consider the lily, a seed, a sparrow. What lessons about God does nature hold for us? How can our students find Him? We propose a simple but effective method: *Take our students outdoors.* ✍

This article has been peer reviewed.



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Essential Elements in the Philosophy of Adventist Education

What makes Seventh-day Adventist education distinctive? While there are many distinguishing features, these merge into a single defining construct—the *philosophy of Adventist education*.

At first glance, Colossians 2:8 seems perplexing: “Beware lest anyone spoil you through philosophy or vain deceit . . .” (NIV).¹ Based on this statement, it would appear as if philosophy itself would be off-limits. Philosophy, however, is but “a set of ideas about how to do something or how to live.”² It is derived from the Greek *φιλοσοφία* (*philosophia*), which in literal terms means “love of wisdom.”³

The problem, then, is not in having a set of guiding principles about how we conduct education, nor is it in seeking after wisdom. After all, Scripture reminds us that “wisdom is the principal thing; therefore, get wisdom” (Proverbs 4:7, NKJV).⁴

As Paul points out, the problem is from *where* we obtain that “set of ideas.” It is where we head in our

search for wisdom. He warned, “Beware lest anyone spoil you through philosophy or vain deceit, after the *tradition of men*, after the *rudiments of the world*, and not after *Christ*” (italics supplied).

In essence, one can formulate and implement a biblical God-centered philosophy of education. Or one can adhere to its antithesis, a secular approach that strikes God from the equation, whether through a traditional or contemporary philosophy of education. Therein, the danger.

It is vital that we, as educators, clearly understand the biblical philosophy of Adventist education. Ellen White wrote: “Teachers need to become acquainted with true philosophy, and where can this be found more perfect and complete than in the Word of God. This Word opens a sure path, in which our feet can travel with safety.”⁵

Seventh-day Adventist educational philosophy is based, then, on the bedrock of Scripture. It is also guided by the writings of Ellen G. White, particularly in works such as the book *Education*.⁶ And it is expressed succinctly in *General Conference Working Policy*,⁷ section FE 05 10 (see Figure 1

on page 19). Based on these sources, this article will highlight seven key components that serve as essential elements of an Adventist philosophy of education.⁸ These interconnected elements help us to identify the purpose, product, paradigm, perspective, process, power, and priority of Adventist education.

1. The image of God

At creation, human beings were formed in God’s image, after His likeness (Genesis 1:26, 27). Being created in God’s image, *imago dei*, provides us with the capacity to love (John 3:16, 17; 1 John 4:16), the ability to relate and communicate (Genesis 1:3, 26-29; 2:18, 23; 3:8), the aptitude to administrate (Genesis 1:28; 2:15), and the facilities for creativity, decision-making, and rational thought (Genesis 2:16, 17; Joshua 24:15; Isaiah 1:18). Consequently, whenever we make a friend, hug a child, name a pet, paint a portrait, or send a text message, we proclaim that we are made in God’s likeness.

However, the foremost feature of the “image of God” is found in our spiritual and moral nature (Genesis 9:6; John

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4:24). We can communicate, develop relationships, exert leadership, and evidence creativity. But unless these are guided by moral values derived from principles embodied in God's character,⁹ the result will not be God-like.

Consider, for example, dominion—the ability to govern (Genesis 1:26-28). Whether self-serving or focused on selfless service, the *manner* of our rule is ultimately of greater consequence than the mere *fact* of such rule.

Our God-given abilities, then, are not ends in themselves. Instead, they provide us with the capacity to make ethical decisions and live moral lives. Consequently, it is in the moral realm, in character, where the image of God is most clearly revealed.¹⁰

Scripture states that we have been *rescued* “from the dominion of darkness” (Colossians 1:13)¹¹ and that the Lord *restores* our souls (Psalm 23:3). Why are redemption and restoration necessary? Included in the *imago dei* is

volition, the ability to make decisions. This freedom of choice includes the ability to love or not to love, to trust or distrust. It includes the ability to choose good or evil, godliness or ungodliness.¹²

Tragically, the first human beings distrusted the Creator and chose to reject a relationship with God. As a result, all human beings “fall short of the glory of God” (Romans 3:23; 5:12). Throughout human history, people progressively lost their likeness to the Creator, and the image of God has become increasingly distorted and deformed.

The good news is that restoration is possible! How does it happen? Paul points out that by looking to Jesus, by contemplating His life and teachings, we are changed into His likeness (2 Corinthians 3:18). This restoration brings about a re-formation of our lives, a metamorphosis (Romans 12:2), in which old things are passed away and “all things are become new” (2 Corinthians 5:17, KJV).

Ellen White affirmed that “the true object of education is to restore the image of God in the soul.”¹³ Consequently, the “image of God” component of the philosophy of education highlights the *purpose* of Adventist education and leads to the following implications:

- Students are God's creation and thereby possess inherent value.
- As educators, we are to express in our lives the attributes of God.
- Adventist education is to lift up Jesus so that students may see who God truly is and be transformed into His likeness.

2. Whole-person development

Luke 2:52 states that “Jesus grew in wisdom and stature, and in favor with God and man.” This multifaceted growth incorporated four crucial dimensions: intellectual, physical, spiritual, and social development.

Similarly, Ellen White, in the opening paragraphs of the book *Education*, wrote that “true education is the harmonious development of the physical, mental, and spiritual powers.”¹⁴ She then added that such a learning experience “prepares the student for the joy of service in this world and for the higher joy of wider service in the world to come,” emphasizing the socio-emotional component.

Whole-person development describes the *product* of Adventist education. In the mental arena, the educational experience is to impart wisdom, a correct application of knowledge that seeks to glorify God and bless those around us. It contributes to higher-level thinking: analysis, evaluation, and creative thought and action. Fundamentally, it seeks to frame a biblical worldview, where each aspect of life and learning is viewed through a biblical lens, with students endeavoring to understand the discipline and its applications as God sees them. The physical component incorporates a healthy lifestyle, a solid work ethic, and recreation as re-creation—a change in routine that contributes to restoring God's image. The spiritual focus encompasses Bible study, the development of

Figure 1. General Conference Working Policy, FE 05 10 – Philosophy of Education

The Seventh-day Adventist philosophy of education is Christ-centered. Adventists believe that, under the guidance of the Holy Spirit, God's character and purposes can be understood as revealed in the Bible, in Jesus Christ, and in nature. The distinctive characteristics of Adventist education—derived from the Bible and the writings of Ellen G. White—point to the redemptive aim of true education: to restore human beings into the image of their Maker.

Seventh-day Adventists believe that God is infinitely loving, wise, and powerful. He relates to human beings on a personal level, presenting His character as the ultimate norm for human conduct and His grace as the means of restoration.

Adventists recognize that human motives, thinking, and behavior have fallen short of God's ideal. Education, in its broadest sense, is a means of restoring human beings to their original relationship with God. Working together, homes, schools, and churches cooperate with divine agencies in preparing learners for responsible citizenship in this world and in the world-to-come.

Adventist education imparts more than academic knowledge. It fosters a balanced development of the whole person—spiritually, intellectually, physically, and socially. Its time dimensions span eternity. It seeks to develop a life of faith in God and respect for the dignity of all human beings; to build character akin to that of the Creator, to nurture thinkers rather than mere reflectors of others' thoughts; to promote loving service rather than selfish ambition; to ensure maximum development of each individual's potential; and to embrace all that is true, good, and beautiful.

a personal and corporate relationship with God, and the formation of moral character. The social dimension features service, witness, and orienting life and vocation as a response to the divine calling. In all, a “harmonious development”¹⁵ that prepares the student for life here and “in the world to come” (see Figure 2).

This key concept has several implications:

- Students are to experience whole-person development at each educational level.
- As educators, we are to incorporate key spiritual, physical, and social goals throughout the program of studies in a balanced approach that further develops cognitive competencies.
- Missional experiences and service learning are to be hallmarks of Adventist education.

3. All truth is God’s truth.

Scripture makes it clear: “Every good gift and every perfect gift is from above, coming down from the Father” (James 1:17, NKJV). “The Lord gives wisdom; from His mouth come knowledge and understanding” (Proverbs 2:6). “Grace and truth came through Jesus Christ” (John 1:17).

God, then, is the Source of truth, revealing facts and principles through Scripture, His created works in the physical world and human society, and creative and reflective thought processes. However, each of these must point toward and function in harmony with its Source. And among these, we must recognize Scripture as the clearest and most comprehensive revelation of God’s truth (see Figure 3).

The role of the Word in the teaching and learning process is highlighted throughout the Bible. David declared, “The teaching of your word gives light” (Psalm 119:130, NLT).¹⁶ And Christ prayed, “Sanctify them by the truth; your word is truth” (John 17:17).

What, then, is the place of the Bible in Adventist education? It is not to be a slice of the curriculum, one subject among many, competing for the student’s time and attention. Instead, the

Word of God is to be core to every subject area (see Figure 4 on page 21).

Ellen White underscored the role of Scripture as the great unifying factor in the program of studies: “The Bible should be made the foundation of study and of teaching.”¹⁷ Martin Luther, the Protestant Reformer, stated it this way:

“I am much afraid that the universi-

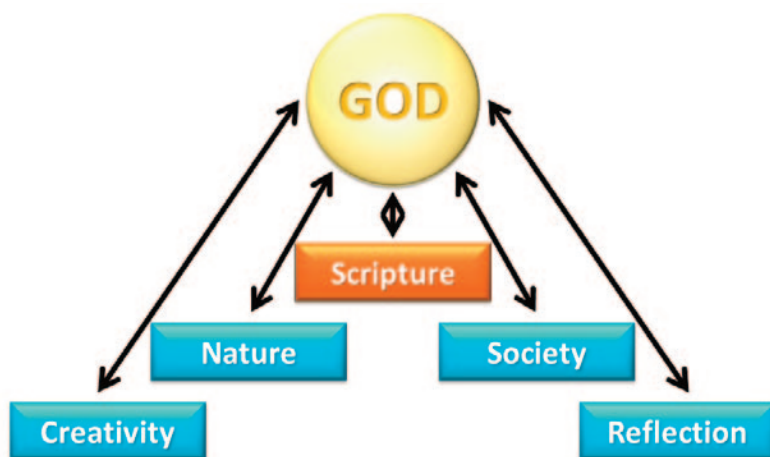
ties will prove to be the great gates of hell, unless they diligently labor in explaining the Holy Scriptures, and engraving them in the hearts of youth. I advise no one to place his child where the Scriptures do not reign paramount. Every institution in which men are not unceasingly occupied with the word of God must become corrupt.”¹⁸

Figure 2. Dimensions of Whole-person Development



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Figure 3. God, the Source and Reference of Truth



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Recognizing God as the Source of all truth is a sustaining *paradigm* in Adventist education and leads us to the following implications:

- Students should interact personally with God’s Word in each subject area.
- As educators, we are to intentionally connect all knowledge to its Source.
- Adventist education is to make the Word of God the foundation of all academic endeavors.

4. A comprehensive spiritual framework.

Likely from ancient times, we have inherited the problem of dualistic thinking. We create false dichotomies: love vs. authority, mercy vs. justice, theory vs. practice, student vs. subject.

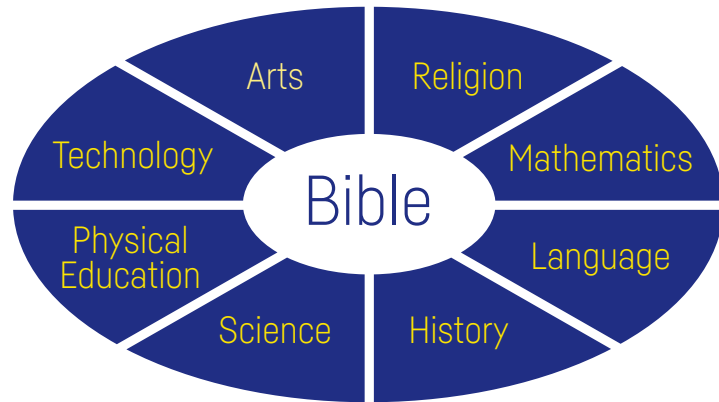
The most problematic, however, is the spiritual-secular divide. We label some aspects of life as spiritual—such as attending religious services and conducting personal devotions—while we consider the rest secular, without reference to God or His plan for our lives. The same dualism can enter education, where the religion course, the Week of Prayer, or a devotional thought is viewed as spiritual, after which we get on with the rest of learning from a secular frame (see Figure 5).

Scripture, however, holds that a spiritual perspective is to permeate all. “Whether you eat or drink, or whatever you do, do all to the glory of God” (1 Corinthians 10:31, NKJV). “Whatever you do, whether in word or deed, do it all in the name of the Lord Jesus” (Colossians 3:17).

Paul further affirmed that we must “take captive every thought to make it obedient to Christ” (2 Corinthians 10:5). A program of studies is made up of courses comprised of topics that consist of concepts. If all thoughts acknowledge the Lordship of Christ, this means that all concepts, topics, courses, and, in fact, the entire educational program must recognize that Jesus is Lord.

A comprehensive Spirit-filled *perspective*, then, encompasses Christian life and learning (see Figure 6). Paul wrote, “Put on the new self, which is being renewed in knowledge in the

Figure 4. The Bible as the Core Curriculum



Note: The list of subject areas is not exhaustive.

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Figure 5. The Great Divide in Life and Learning

Spiritual	Secular
<ul style="list-style-type: none"> • Religious services • Personal devotions • Returning the tithe 	The Rest of Life
Spiritual	Secular
<ul style="list-style-type: none"> • Religion class • Devotional thought • Week of prayer 	The Rest of Learning

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Figure 6. Resolving the Divide in Life and Learning



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image of its Creator” where “Christ is all, and is in all” (Colossians 3:10, 11). Notice that the restoration of the image of God involves a renewal of the mind, of our view of life and learning. “Let this mind”—this attitude, this perspective—“be in you, which was also in Christ Jesus” (Philippians 2:5, KJV).

In this vein, Ellen White reminded educators, “Bible religion is not to be like a dash of color brushed here and there upon the canvas, but its influence is to pervade the whole life, as though the canvas were dipped into the color until every thread of the fabric was dyed a deep, fast, unfading hue.”¹⁹

The implications of the all-encompassing spiritual perspective include the following:

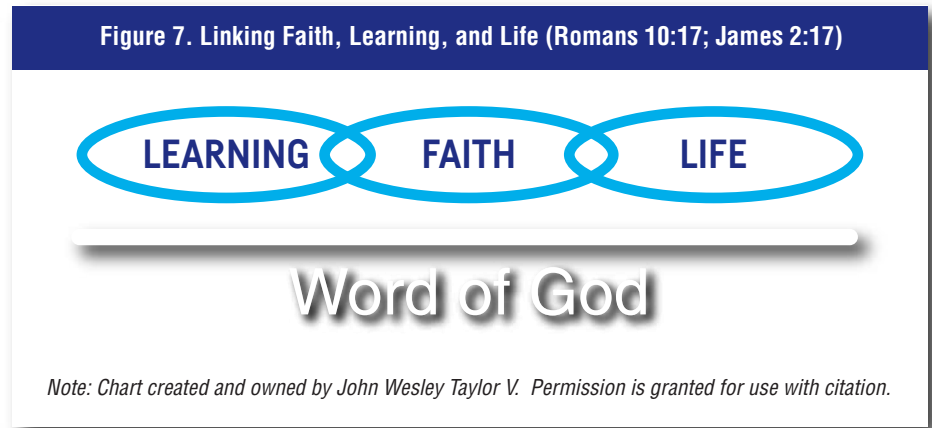
- As Christians, we must think Christianly—endeavoring to view all things from God’s perspective.
- The biblical worldview brings a unified approach to life and learning, precluding a spiritual/secular dichotomy.
- As educators, we must ensure that a spiritual focus frames each academic subject and topic.

5. Nurturing faith.

In Scripture, faith, learning, and life are linked. Paul declared, “Faith comes by hearing, and hearing by the word of God” (Romans 10:17, NKJV). Faith, then, is connected to learning about God and His plan for our lives. This is essential but insufficient. Faith must also link to life. As James asserted, “faith by itself, if it is not accompanied by action, is dead” (James 2:17). This faith-integrative process in learning and life is itself anchored in the Word of God (see Figure 7). We will briefly consider these elements.

Faith. Jesus asked, “When the Son of Man comes, will he find faith on the earth?” (Luke 18:8). Faith is trust in something or someone. There are three key dimensions: (1) faith in God, both knowing about God and knowing Him experientially; (2) faith

Figure 7. Linking Faith, Learning, and Life (Romans 10:17; James 2:17)



in the divine revelation—trust in God’s message and confidence in the divine plan; and, perhaps the most difficult at times, (3) faith in persons, in the potential of others and of ourselves, by God’s grace.

Learning. Jesus declared, “Come to me . . . and learn from me” (Matthew 11:28, 29). There are two essential aspects in this process: (1) learning to think Christianly—a change of mind, and (2) learning to live by faith—a change of life. The change of mind involves internalizing the attitudes and priorities of Christ. The change of life involves trusting the divine plan and reflecting that commitment in our choices and actions.

Life. Jesus announced, “I have come that they may have life, and that they may have it more abundantly” (John 10:10, NKJV). This “abundant life” encompasses both a meaningful life and an eternal life. It provides focus and direction in our lives. And the eternal dimension begins as we accept Christ as Savior. “This is eternal life: that they know you, the only true God, and Jesus Christ, whom you have sent” (John 17:3).

What then is the unity of faith, learning, and life? It is when biblical beliefs and values provide the bedrock for the academic endeavor, which, in turn, seeks to relate Christianity to the full range of the human experience. It is more than just a mixture or a chance encounter. It is when faith is the great integrating factor of all learning and life.

Nurturing faith is then the integra-

tive *process* in the philosophy of Adventist education. Ellen White wrote, “The students in our schools and all our youth should be given an education that will strengthen them in the faith.”²⁰ This faith-affirming focus leads to the following implications:

- Students must personally experience faith, developed through a relationship with God.
- Teachers are to nurture faith, seeking a transformation in both mind and life.
- An overarching goal of Adventist education is to form persons who trust God’s plan for their lives.

6. Spirit-filled teachers.

The Holy Spirit is the *power* of Adventist education (Acts 1:8). “The Helper, the Holy Spirit, whom the Father will send in My name, He will *teach you all things*” (John 14:26, NKJV, italics supplied). Ephesians 4 reminds us that Spirit-filled teaching is a divine gift, granted to “prepare God’s people for works of service” and to edify the body of Christ “in the faith and in the knowledge of the Son of God” (vss. 11-13).

In Adventist education, teachers must be competent—demonstrating solid content knowledge and effective teaching skills, serving as caring mentors, and committed to professional growth. While competence is vital, it is nonetheless insufficient to accomplish the task of Christian education. Just as the Earth is surrounded by a

life-giving atmosphere, so competence must be enveloped in commitment.

The concept of commitment is biblical. Paul wrote to Timothy, “The things that you have heard from me, commit these to *faithful* witnesses who will be able to teach others also” (2 Timothy 2:2, NKJV, italics supplied). Jesus further clarified that “a faithful and wise servant” is one to whom the master can give the responsibility of managing his household (Matthew 24:45).

Ellen White affirmed that “It is not enough that the teacher possess natural ability and intellectual culture. These are indispensable, but without a spiritual fitness for the work he is not prepared to engage in it. He should see in every pupil the handiwork of God—a candidate for immortal honors.”²¹ And we are promised, “Just as surely as the educators of the youth are consecrated to God, so surely will their efforts be crowned with success, in this life and the future life.”²²

Such commitment involves whole-hearted consecration to God and to

fulfilling the mission that He has entrusted. It includes dedication to the salvation of our students, faithfulness to the biblical worldview, and devotion to a life of witness and service. It means that we seek to represent the Master. “We are therefore Christ’s ambassadors, as though God were making his appeal through us” (2 Corinthians 5:20). “If anyone speaks, he should do it as one speaking the very words of God” (1 Peter 4:11).

In sum, Adventist educators are to be Spirit-filled—both competent and committed. This unified responsibility is to be our personal priority. Further, the integrated elements of competence and commitment are to guide the institution in the process of hiring, in nurturing the continued growth of its staff, and throughout the personnel assessment process (see Figure 8). Some implications:

- The Holy Spirit is essential to the success of the teaching-learning experience.
- As educators, we are to view our profession as a divine calling, focused on the salvation of our students.

• Christian educators are to be faithful, as God’s representatives.

7. Educating for eternity.

Sometimes, as educators, we adopt a restricted vision of what students can become and focus largely on helping them pass the subject or on seeking to ensure that they can graduate. At times, that vision is expanded by endeavoring to prepare students to be successful in the broader context of life—in their professions, their relationships with friends and family, and as responsible citizens. Adventist education, however, envisions a broader scope: Educating for eternity (see Figure 9 on page 24).

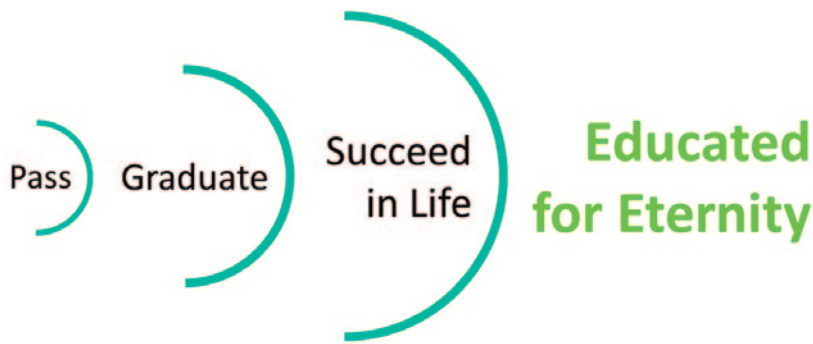
The concept of education with a view of eternity is embedded in Scripture: “Most assuredly, I say to you, he who believes in Me has everlasting life” (John 6:47, NKJV). But “how can they believe in him if they have never heard about him? And how can they hear about him unless someone tells them?” (Romans 10:14, NLT). Believing, then, depends on hearing the Word; and hearing is contingent upon

Figure 8. Competent and Committed Teachers



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Figure 9. Extending Our Horizons



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the writings of Ellen White provides distinctive traits of Seventh-day Adventist education. This educational philosophy enables us to clearly define the purpose, product, paradigm, perspective, process, power, and priority of Adventist education (see Figure 10). These elements, in turn, are essential in carrying forward The Great Commission (Matthew 28:19, 20) through the ministry of education.²⁹

Ultimately, the philosophy of education that we implement represents a personal, but crucial choice. To paraphrase the words of Joshua 24:15, “Choose you this day whom you will serve—whether the gods of traditional education that your mentors served, or the gods of this secular age in which you now live.” Those perspectives are not the only options, however. There is a higher calling—a Bible-based, Christ-centered, heaven-directed philosophy of education. As Seventh-day Adventist educators, may we affirm, “As for me and my classroom, as for me and my school, we will serve the Lord!” ✍

one who shares the Word.

“The true science of education,” Ellen White wrote, “will fit the youth for eternal life.”²³ To this end, she encouraged teachers to “Educate as for eternity.”²⁴

Salvation is to be at the heart of the Adventist philosophy of education. “The great Teacher calls for every youth to learn the true philosophy of education: What shall I do to be saved?”²⁵ Consequently, the ultimate priority of Seventh-day Adventist education is that each student may personally experience God’s saving grace in his or her life. “The work of education and the work of redemption are one.”²⁶

Because a God-like character is the only asset “that we can take from this world to the next,”²⁷ character formation is paramount in Adventist education. Ellen White asserted that “The great object to be secured [in the education and training of the youth] should be the proper development of character, that the individual may be fitted to rightly discharge the duties of the present life, and to enter at last upon the future, immortal life.”²⁸ Witness and selfless service are tangible expressions of Christian character, both now and throughout eternity.

The **priority** of educating for eternity provides us with implications for Adventist education:

- Every student is to understand

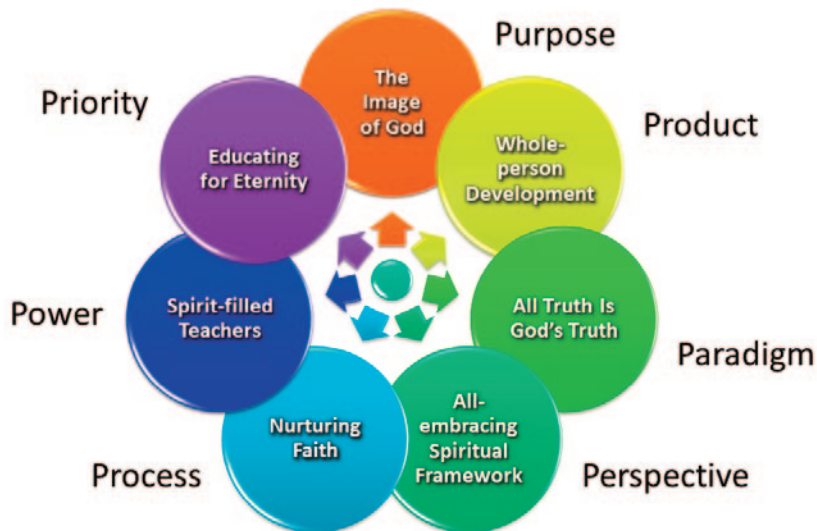
the true philosophy of education, including its eternal dimension.

- As educators, we are to see our students as God sees them, candidates for heaven.
- Adventist education must prioritize character formation, building a life commitment to witness and service.

Conclusion

The philosophy of education described in Scripture and delineated in

Figure 10. Essential Elements in the Philosophy of Adventist Education



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This article has been peer reviewed.



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2. *Merriam-Webster Learner's Dictionary*: <https://www.learnersdictionary.com/definition/philosophy>.
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4. Quoted from the *New King James Version* (NKJV). Copyright © 1982 by Thomas Nelson, Inc. All rights reserved.
5. Ellen G. White, “The Bible in Our Schools,” Manuscript 69, June 17, 1897 (hereafter abbreviated Ms.).
6. _____, *Education* (Mountain View, Calif.: Pacific Press, 1903).
7. *General Conference Working Policy* (Nampa, Idaho: Pacific Press, 2020). Another clear articulation of the philosophy of Seventh-day Adventist education may be found in “Journey to Excellence 2.0,” developed by the Education Department of the North American Division (<https://journeytoexcellence.com/why>).
8. An expanded discussion of the philosophy of Adventist education, written by George R. Knight as a three-part series under the title “Redemptive Education,” may be found in a special issue of *The Journal of Adventist Education* (73:1), available through these links: <http://circle.adventist.org/files/jae/en/jae201577040404.pdf>; <http://circle.adventist.org/files/jae/en/jae201073012217.pdf>; <http://circle.adventist.org/>

files/jae/en/jae201073013823.pdf. Knight also explores the contours of Adventist educational philosophy in his book *Educating for Eternity: A Seventh-day Adventist Philosophy of Education* (Berrien Springs, Mich.: Andrews University Press, 2016).

9. Biblical values lay the foundation for the formation of moral character. “He has showed you, O man, what is good; and what does the Lord require of you, but to do justly, and to love mercy, and to walk humbly with your God?” (Micah 6:8, NKJV). Character, in turn, orients moral reasoning. God’s instruction to the Levites can be applied to the work of Christian teachers today: “They are to teach my people the difference between the holy and the common and show them how to distinguish between the unclean and the clean” (Ezekiel 44:23, NIV).

10. See, for instance, Leviticus 19:2; 20:26; Isaiah 43:15; Ephesians 4:24; 1 Peter 1:16.

11. Unless otherwise indicated, all Scripture texts in this article are quoted from the *New International Version* of the Bible. Copyright © 1973, 1978, 1984, 2011 by International Bible Society.

12. The following passages, among others, highlight the human capacity of free will: Numbers 17:5; Deuteronomy 12:11; 30:19; Joshua 24:15; 1 Chronicles 21:10; Proverbs 1:29; 3:31; Isaiah 7:15-16; 56:4; 65:12.

13. Ellen G. White, *Mind, Character, and Personality* (Nashville, Tenn.: Southern Publishing Association, 1977), 1:359.

14. _____, *Education*, 13.

15. The concept of harmonious development in the writings of Ellen White is further examined in an article by the author: “Ellen White and the Harmonious Development Concept,” *The Journal of Adventist Education* 76:5 (Summer 2014): 16-19: <https://circle.adventist.org/files/jae/en/jae201476051604.pdf>.

16. *New Living Translation* (NLT), copyright © 1996, 2004, 2007, 2013, 2015 by Tyndale House Foundation. Used by permission of Tyndale House Publishers, Inc., Carol Stream, Illinois 60188. All rights reserved.

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18. Quoted in J. H. Merle d’Aubigné, *The History of the Reformation of the Sixteenth Century*, 190 (Whitefish, Montana: Kessinger Publishing, 2003). Note: French edition published in 1835. English edition published in London in 1846.

19. Ellen G. White, Letter 2, March 4, 1895 (hereafter abbreviated Lt.). Written “to those who work at Cooranbong” (Australia) who were endeavoring to establish an Adventist college, now Avondale University.

20. _____, “A Plea for Loyalty,” Ms. 106, November 20, 1905.

21. _____, *Counsels to Parents, Teachers, and Students* (Mountain View, Calif.: Pacific Press, 1943), 229. She further stated, “Those who are engaged as teachers in our schools should reach a high standard of consecration.” “No Other Gods Before Me,” *The Advent Review and Sabbath Herald* 84:24 (June 13, 1907): 8.

22. _____, “True Education,” Ms. 135, October 19, 1898.

23. _____, “What Is Higher Education?” Ms. 1, January 19, 1909.

24. _____, “Diary/The Use of Means and Family Responsibilities,” Ms. 204, October 20, 1903. Referring to the educational work at what would become Loma Linda University, she stated, “We want in every way, everything possible done to have the educating power there that shall be of a sanctified order. We want not trivial work done there. We are working for eternity” (“Sermon/Thoughts on Exodus 19,” Ms. 187, May 19, 1907).

25. _____, *Special Testimonies on Education* (1897). No imprint. (Reprint, Payson, Ariz.: Leaves-of-Autumn Books, 1978), 240.

26. _____, *Education*, 30.

27. _____, *Messages to Young People* (Nashville, Tenn.: Southern Publishing Association, 1930), 100.

28. _____, *Mind, Character, and Personality*, 1:361. Ellen White further emphasized the primacy of character formation in the following statement: “True education does not ignore the value of scientific knowledge or literary acquirements, but above intellectual acquirements, it values character. The world does not so much need men and women of great intellect as of noble character. . . . Character building is the most important work ever entrusted to human beings; and never before was its diligent study so important as now. Never was any previous generation called to meet issues so momentous; never before were young men and young women confronted by perils so great as confront them today” (*Education*, 225).

29. As Ellen White noted, “Those who . . . are not willing to learn from the great Teacher the true philosophy of education . . . should never be entrusted with the work of teaching the youth” (“Education,” Ms. 141, October 24, 1898).

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Desmond Hartwell Murray

Can Research Be Sacred Ministry?



Before sin entered our world and our human consciousness, before the cherubim and flaming sword, when God saw that everything was good, Genesis recounts Adam discovering and naming God's creation. I imagine Adam and Eve walking about Eden, in awe and wonder, amongst a perfect creation of light and sky, air and water, plants and animals. There was no recorded Word of God then; their knowledge of God came partly from His works. As they went about seeking and contemplating the works of God, I imagine the process was deeply spiritual and profoundly relational, as it would have revealed the power, providence, majesty, and might of the Creator, to whom they owed their first and every breath.

As a practicing scientist, this resonates deeply with me. For here, at the very beginning of our human sojourn, a sense of wonder and reverence is embedded regarding the living presence and testimony of God's works. Without God, neither the works nor our human observation of them is possible. Indeed, "in him we live, and move, and have our being" (Acts 17:28, KJV). So, from my perspective, research is an intensely sacred calling that combines inspiration, revelation, and imagination. Research is fundamentally a journey of discovery, including self-discovery, as implied by the Middle French root word *recherche*, which means "to go about seeking."¹

Seeker is our earliest human archetype. Our innate curiosity, the foundation of all learning, is embedded in our God-given genes and neurotransmitters.² Curiosity helps us to be conscious of and to participate in the sentience of the universe. From the very foundations of the Earth, humans have been explorers and

seekers. Indeed, as children, before we read, write, and count, we "go about seeking." Research is foundational; it is the fourth and motivating "R" (the three R's refer to basic literacy skills: reading, 'riting, and 'rithmetic). We search inward to discover and create methods of communication, art, and music. We explore the heavens for life and meaning and the Earth for elements and atoms.

"To go about seeking" is a universal drive not limited by educational level, gender, age, ethnicity, or field of study; it is not limited to science, technology, engineering, and mathematics. Seeking encompasses all areas of human inquiry, activity, creativity, and curiosity; it is expansive and not exclusive. It is our human legacy, our God-given birthright, and our inheritance.³

Research Is Sacred, Too

How, then, has research ("seeking") become mislabeled and narrowly defined as a solely secular, mechanistic activity rather than being regarded as sacred and spiritual? Why do so many automatically view research in a negative light? Why, for some, is research regarded as antithetical to and incompatible with belief?

Often, we lose sight of the perspective that embedded in research is the potential for both good and evil. Our labels of sacred and secular are often reflexively and mistakenly applied to research based on traditional constructs of the ecclesiastical and scientific communities. Whatever the reason, I believe it is time to redefine the popular perceptions and understandings of research as a primarily secular enterprise. Thus, this article's underlying intent and motivation is to provide a full, forthright, and courageous enun-

ciation of why research can be a sacred endeavor (see Sidebar 1). I believe God has set before us open doors into His works, and no one should be allowed to shut them or define them. I believe research is sacred for the following 10 reasons:

1. Research is a calling from God to ask, seek, and knock (Matthew 7:7, 8).

For me, this is the Researcher's Creed, the Seeker's Motto. Indeed, God placed within us the capacity to do these very things. He created us at the psychological, physiological, and molecular levels with the capacity "to go about seeking." This constitutes a *de facto* invitation for us to be curious and observant and to research and know the works of God. This invitation says, in part, "Behold, I will do a new thing; now it shall spring forth; shall ye not know it?" (Isaiah 43:19, KJV). Washington Adventist University Professor Olive J. Hemmings explains, "This word *behold* comes from the Greek word *βλέπω*—'I see.' The word from *βλέπω*—as it appears in the text means to see in the deepest sense. It means discover or perceive or take careful notice—as though you had not seen it before. Look beyond the 'obvious' and superficial."⁴ The word *behold* appears well over 1,000 times in the Bible. God must want to get our attention. He calls us to go deep beyond appearances, cursory glances, and hasty speculations. His is a repeated and insistent call for deep beholding, for deep research. Behold, behold, behold! Herein lies the essence of seeking, of research: It is beholding "in the deepest sense" the Word and the works of God. In and through this process, we will be changed.

2. Research is a sacred struggle with God, His Word, and His works that brings forth the blessings of revelation.

Research is akin to the archetypal struggle of Jacob with God. Furthermore, this sacred struggle is continuous and lifelong. We all stand humbled and in eternal ignorance in God's presence and blistering inquisition, as recorded and demonstrated in Job chapters 38 to 41 (KJV). We fall short in our knowledge of God's works and are forever in a sacred struggle as we seek and pursue knowledge and revelation. We are essentially only eavesdroppers into the secret councils of the Trinity and the deep mysteries and unfathomable wisdom of our eternal God. To me, this mystery is best illustrated by the enigmatic electron. Much of our technological civilization relies on the electron, its behavior, function, and manipulation. Yet the electron defies complete definition, visualization, and a simple answer to the question, What is an electron really?⁵

3. "Research is formalized curiosity. It is poking and prying with a purpose."⁶

Zora Neale Hurston (1891-1960), an African American novelist and anthropologist, wrote this statement that succinctly sums up the relationship between research and curiosity. I believe that our God-given curiosity is as fundamentally a human need as hunger and thirst, a higher-order need not satisfied by food, water, and biology but by knowledge. In a world filled with stimuli, some of which are harmful and threatening to our survival, knowledge is needed to make intelligent responses, and curiosity is the survival mechanism that

seeks and searches for that knowledge. I believe we are divinely wired this way in our higher-level processes and our genes and neurotransmitters. For example, it has been investigated and established that dopamine, the brain's reward chemical, is intricately linked to the brain's state of curiosity and happiness.⁷ Curiosity, seeking after knowledge through revelation and research, can help keep us alive and happy!

4. Research is "power" and is "in the purpose of God."

The following statement affirming science appears in Ellen White's book *Christian Education*: "A knowledge of science of

Sidebar 1. Series Overview

This article is the first of two on the theme of research addressing underlying spiritual principles and motivations for research, when research should begin, and how research can be done across the educational spectrum. This series seeks to provide (a) theological and philosophical tenets for research as sacred ministry, (b) justifications for early research, interlevel collaborations, and specific recommendations to elevate and sustain research as a ministry of the Seventh-day Adventist Church.

Part 1, entitled "Can Research Be Sacred Ministry?" makes the following assertions:

1. Research is human activity engaging the use of God-given gifts and abilities.
2. It is time to intentionally recapture the sacredness of research.
3. Research can be a sacred ministry.



all kinds is power, and it is in the purpose of God that advanced science shall be taught in our schools as a preparation for the work that is to precede the closing scenes of earth's history."⁸ Given that scientific knowledge is derived primarily by observation, experimentation, and evidence, it stands to reason that research is also "in the purpose of God." This advocacy for advanced science is tied not only to epistemology but also to eschatology, not only to knowledge but also to mission. That is, research should be done not just for its own sake but also for a broader mission and a deeper purpose. Another significant implication here is that the imminence of the Second Coming is no excuse but should provide motivation for seeking new knowledge, enlightenment, and engagement in research. Indeed, Ellen White reminds us that seeking research will continue beyond time, into eternity.⁹

5. Research can be about entering into the mind, heart, and soul of God.

Through researching and seeking after God's Word and works, our students and we are empowered to enter into the very imagination of God. God's imagination is made manifest in His Word and His works. For me, the iconography of the temple veil being ripped asunder speaks to God's willingness to let us in, even into the

"inscrutable mysteries" of His works and His Word. It is an invitation for our eyes to see, our ears to listen, and our hearts to be moved by His creation and imagination.

Research can probe and mine the riches and mysteries of God's Word and His works. It is one way our mortal eyes can behold the glory of the Lord in our own flesh. As referenced in *Education*, "The mind of man is brought in communion with the mind of God, the finite with the Infinite. The effect of such communion on body and mind and soul is beyond estimate."¹⁰ The Bible says, "Let this mind be in you, which was also in Christ Jesus" (Philippians 2:5, KJV). So research can expand, elevate, deepen and ground our understanding in the consilience of knowledge of God's Word, His works, and His acts of creation and revelation. Conducting research under the gaze of God, with a consciousness of the divine—of someone and something bigger than oneself—brings purpose, humility, wonder, and mission to the practice and practitioner of research.

6. Research is an endless assignment.

Our seeking and the sought-after are unlimited and unbounded by geography and temporality. We will never come to the end of knowing God, His Word, and His works. It is a false prophet who declares and predicts there will be no more to learn, no more to know.

More than that, such an attitude and state of mind borders on blasphemy, for it presumes limitations upon God and His future words and works. God has new thoughts! He has plans for new things! (Isaiah 43:19). Indeed, each birth is evidence of this. As Emily Dickinson wrote, “This World Is Not Conclusion.”¹¹ Consequently, there is no end to the Internet, the universe, knowledge, and God, for whom there is neither beginning nor end. In 1888, Ellen White penned, “There can be no greater peril to the souls of those who profess to believe the truth, than to close their research for light and knowledge from the Scriptures.”¹² I think it is not too presumptuous to add to the end of this passage the words “and from the book of nature.”

7. Research is consistent with two facts of human existence: (a) We do not know it all and never will, for we see through “a glass darkly,”¹³ and (b) Knowledge and truth most often come to us not all at once but by rolling disclosure and from persistent pursuit.

Omniscience belongs to God; everyone else must seek. The idea of our mortal human intelligence is expressed in 1 Corinthians 8:2: “And if any man think that he knoweth any thing, he knoweth nothing yet as he ought to know” (KJV). In 1952, *Ministry* magazine published a collection of quotations from the writings of Ellen White on “Advancing Truth.”¹⁴ These included the following: “The truth is an advancing truth, and we must walk in the increasing light”¹⁵; “There are mines of truth yet to be discovered by the earnest seeker”¹⁶; and “There is no virtue in ignorance, and knowledge will not necessarily dwarf Christian growth.”¹⁷

Indeed, the phrase “mine(s) of truth” and the word *mining* are used repeatedly in Ellen White’s writings as metaphors to capture the idea of undiscovered or hidden truth that needs to be sought after. Similarly, other phrases in her writings, such as “deep research,” “careful research,” “individual research,” and “diligent research,” create a narrative in favor of and encourage the activity and process of research in the context of the Bible, health, and nature. There are no statements of disparagement toward research or hints that it is an intrinsically secular process. Her enlightened views on research¹⁸ are in very sharp contrast to the anti-re-

search statements of some of the Christian Church Fathers, such as Tertullian and Augustine.¹⁹

In a recent *Adventist Review* article, Andrews University Seminary Professor Martin Hanna wrote: “Clearly God is not intimidated by increasing knowledge; and His people should not be intimidated by it either.”²⁰ An example of the “increasing knowledge” paradigm is the development of quantum mechanics and the Standard Model, among the most successful and fundamental scientific theories ever conceived. They are answers, still incomplete, still emergent—and perhaps ultimately unknowable—to humans’ fundamental questions that have spanned millennia: What are we made of? What is the universe made of? What are its fundamental building blocks?

Indeed, our commitment to seek, search, and research is a *de facto* witness, a living testament of our intention to grow in understanding, truth, and ministry. Our commitment to research must not be just intellectual assent but also manifested in our curriculum, pedagogy, practice, and investment across our global Adventist educational system. It should not be limited to existing knowledge and understanding, but also expand to intentionally and proactively seeking new knowledge, truth, and revelation. Research should become a hallmark of Adventist education at all levels and in all dis-

Sidebar 2. Culture of Research

Building a research ministry would require us to create a global research culture or ecosystem in all our institutions: churches, schools, and hospitals. It will also require the education of clergy and laity, the pulpit and the pew, administrators and practitioners, and teachers and students. To achieve this, I propose the following:

1. Emphasize research (seeking) as a core sacred/spiritual value at all levels of all our institutions;
2. Incorporate research (seeking) as a theme in Pathfinders and Master Guide programs;
3. Use research (seeking) as a theme in our (a) Morning Watch/Devotionals and (b) Sabbath school lessons from primary to adult.

I envision that creating this global Adventist culture of research would, in generations to come, produce men and women who are practitioners of the dual modalities of God’s Word and God’s works. They will be part of the long tradition of ministers and priests, from Mendel to Polkinghorne, grounded experientially in God’s Word and works. We would produce clergy and laity, teachers, and students who approach faith and science, and revelation and research, not as antagonists, but as seekers after their consilience.

ciplines (see Sidebar 2). A commitment to research is also one to inspiring and mentoring the next generation of passionate and skilled seekers of God's Word and works.

8. Research can enlighten human ignorance and dispel darkness.

Enlightenment is an undertaking with urgent societal relevance to dispel a 21st-century noxious blend of baseless conspiracy theories and viral misinformation. The creation of light was an act of God, a preamble to the rest of His creation. It was His first "let there be." In the biblical tradition, light preceded human knowledge and was necessary for revelation. Research is itself an instrument for enlightenment that brings knowledge, revelation, discovery, and light to darkness, ignorance, myth, and conspiracy.

The field of spectroscopy literally uses light of every wavelength to probe, reveal, and help us understand our material universe. From CT scans to MRIs to security sensors and touchless digital thermometers, the entire edifice of modern diagnostics is based on this use of light. I believe research's ability to enlighten is part of the Matthew 5:15 tradition and obligation to which we are all called, to let our light shine and to share our light for the benefit of everyone. Here, too, is an implication of a calling to communicate and publish our research and knowledge freely as light to the world—not for fame, professional advancement, or personal gain but for the upliftment of others and for the greater good. Research can be the bearer of good news, including research pedagogy that engages and inspires our students "to go about seeking," shining, and sharing.

9. Humans, not robots or algorithms, conceive of research.

Research is not just a stoic straight-line, mechanistic adherence to the scientific method's principles, processes, sequences, and steps. Instead, it is impacted by all aspects of our humanity and involves the wholistic use of mind, body, and spirit. We should resist the notion that there are sharp demarcations between spirit and science. Research uses all our God-given powers, including curiosity, observation, intuition, reasoning, mental acuity, and creativity. It is also enhanced by a

While some may not regard research as a religious activity, it most assuredly is an engagement that comes from the depths of the human spirit. There are inescapable existential facts of the human spirit and human consciousness that engage in seeking.

spirit of humility, openness, reverence, exuberant curiosity, and persistence.

In personal communications with me, Andrews University senior research professor of anthropology Oystein LaBianca wrote, "What I like to emphasize is that of all God's creatures, humans were made in His image—to be creative; to discover and to come up with new creations. In other words, as we do research, we affirm that God has made us in His image. Thus, research becomes an act of worship in the sense that as we do research, we affirm being 'made in His image.'"²¹ This concept—that research is a divine derivative gifted to humans—is a powerful one that again suggests

that research can be redemptive and can facilitate the restoration of God's image in us.

10. Research is not inherently secular.

While some may not regard research as a religious activity, it most assuredly is an engagement that comes from the depths of the human spirit. There are inescapable existential facts of the human spirit and human consciousness that engage in seeking. Our full humanity cannot summarily disentangle "objective" from "subjective" or be automatically switched on and off when we go about seeking. Our desire and decision "to go about seeking" do not come from lifeless molecules, biochemical pathways, or chemical reactions. Instead, they come from our emergent humanity, consciousness, and soul, from which we experience awe, wonder, reverence, purpose, persistence, and faith. From this mix, "we live, and move, and have our being" (Acts 17:28, KJV). We seek, research, and engage the world with our whole selves.

Also, since nature does not reveal her secrets all at once, we must be patient and persistent. We must have fortitude so that when we face failure or setbacks, we don't wither or wane in pursuit of purpose but steadfastly persist against the odds. We learn, we adapt, and we innovate. This is not the result of a secular, cynical mindset but the product of optimistic realism, hope, and faith. As genuine seekers and dedicated researchers, we can hope that the best is always yet to come, and we must pass this spirit of optimism and faith on to every new generation of researchers.

While the nature and process of research can be

sacred, as outlined above, the *attitude* and *meaning* that the researcher brings to it can be secular, lacking in divine consciousness, awareness, awe, and purpose. It is our own values and our humanity that determine whether research is perceived, defined, and utilized as solely sacred or secular. I pray we have within us the unrelenting persistence of Jacob as he struggled with God, as described in Genesis 32:22 to 32 (KJV). May our seeking and our struggle bring us the blessings of greater revelation of the mysteries of God.

Can research be sacred? Yes. I hope we learn that truth lies waiting for the persistent seeker and that research—the seeking and the struggle—is its own blessed and sacred reward.

Research Is Ministry, Too

Traditionally and generally, we have limited the meaning and practice of ministry to pastors, doctors, nurses, and teachers, while intellectually assenting to the fact that ministry can be done in a diversity of ways and through multiple professions. However, research is generally not the first thing that comes to mind when speaking of ministry and ministers. This dissonance between belief and behavior, philosophy and practice, actually presents Adventism with an opportunity to re-examine and redefine ministry and what it means to be a minister. The opportunity to intentionally expand and elevate our corporate and institutional understanding of research as ministry can lead to broader impact and greater good as we seek to redeem and change the world in the 21st century.

In the most profound sense, I believe research is ministry, not just philosophically but pragmatically, in the following practical ways: (1) it is and has been an indispensable service in advancing the standards of living across our world, (2) it improves human life and well-being, (3) it saves lives here and now, and (4) it helps us to be better stewards of God's works, including our environment. Through research, we can become more knowledgeable and capable co-workers with God in restoring and redeeming our world. Through research, we can probe cells and molecules to learn how and why we make decisions and where our memories and forgetfulness come from. We can discover precision-targeted medicines; and innovate how best to administer and

individualize the dosages for improved patient care. Research can assist us in developing greener agricultural processes that result in abundant, high-quality food sources to feed a growing world population. Through research, we can address hunger, poverty, and our growing global water crisis; we can proactively deal with future microbial outbreaks and pandemics.

Imagine our world without the benefits of research—a world without refrigeration, aspirin, gasoline, penicillin, vaccines, cellphones, airplanes, personal protective equipment, electric power, blood transfusions, air conditioning, or batteries. It would be a world without the complete and growing revelation of God.

While there may be some debate regarding the usefulness of specific types of research, this in no way undermines the overall value of research. Nor does it diminish the inherent value of seeking after God in His Word and His works. It is good to have accountability, including peer review, in the research enterprise to ensure that investments are worthwhile, that money expended is not wasted, and that real-world applications and benefits are delivered to all society and not just to the powerful and privileged. This accountability can enhance the potential that research remains a ministry, and not a vanity.

Some point to using science and research for evil intent and with harmful consequences as a reason to distrust and discredit the entire process. However, secular and ecclesiastic history testify that the corruption of the good is pervasive throughout every human era and endeavor. The Holy Scriptures reveal that even when given a flawless, perfect Eden, humans turned it into their


Sidebar 3. Implications

Seventh-day Adventists are known for our global education, healing, and literature ministries. This series of articles proposes a fourth—the ministry of research. Indeed, the research ministry can independently and synergistically support, empower, and further enhance all our other ministries. Broad consequences arising from the realization and recognition of research as a ministry should include:

1. Institutionalization of the ministry of research within our church;
2. Formal recognition of researchers as ministers alongside pastors, teachers, doctors, and nurses;
3. Intentional investment and budgeting to provide hands-on, minds-on research opportunities at all levels of our educational institutions.

own downfall. Research is no exception, for it too can be and has been used for evil, such as developing and using chemical and biological weapons. Research can and has been conducted in unethical, immoral, and inhuman ways, such as in the Tuskegee Experiments.²² Also, the Martin Shkreli case²³ shows that research can also be motivated by pure avarice, greed, and profit. These and other examples of the corruption and abuse of research do not suggest that research cannot be sacred or be used for good and ministry.

Our choice of research topics can also bear witness to our faith and mission. Many pressing challenges and problems in our world would benefit from discoveries, developments, and innovations that can arise from research in areas such as agriculture, food, water, health, pollution, urbanization, climate change, medicines, neuropsychiatric disorders, and infectious diseases, to name a few.

Considering the global reach of both Adventist education and health care it makes sense that Adventist health-care and education systems engage in research together—intentionally, closely, and collaboratively. With more than 8,500 schools, colleges, and universities, 650 hospitals, clinics, and dispensaries, and seven medical schools²⁴ together, these entities can seek knowledge, develop innovations that alleviate human suffering and pain, and promote new approaches to learning and public-health education (see Sidebar 3). In so doing, we will bear witness and bring healing, Christ-like servant leadership, faith, and values to our world—right here and now. Researching God’s Word and works must be our sacred ministry, from elementary through university levels. I pray we let it be so.²⁵ 

This article has been peer reviewed.

Dedicated to my parents, Auldith and Hartwell Murray, my first and forever teachers. They nurtured my inward hunger and curiosity and were my first examples of seekers and innovators.

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Gary Bradley



Norma Collson

Starting and Sustaining a **STEM** Program in the Multigrade Classroom



Remember that great science demonstration or activity that you did with your students? Students at each grade level were engaged, focused on learning, and you were the STEM (science, technology, engineering, and math) hero. What if you could do this throughout the month, semester, or entire year? Starting and sustaining a STEM program is easier than you might think.

The projects in a STEM program make learning fun and memorable.¹ They integrate content from multiple subjects, saving teachers time in the long run.² This is especially true for the multigrade teacher, who is already time-pressed to include all the required subjects and standards. Often, teachers can meet both math and science standards within the same STEM project. STEM is an application of the facts, terms, and procedures that reinforces learning at the higher levels of cognitive thinking.³

Students, using their own initiative, quickly become invested in their projects, making them the focus of their time and attention. It is amazing how soon they will start inventing, building, and creating their projects. This greatly simplifies classroom management, allowing teachers to work with each group throughout the class period. A STEM program supports students in creating an artifact that they can share with their classmates, families, and the community.⁴ In fact, families often become more connected with their children's classroom and the school as they support and celebrate the successful completion of the STEM projects.

The good news about starting and sustaining a STEM program is that a significant part of the work might already be underway. Do students already take

care of plants or a school garden? That's a great STEM project. Students can measure and monitor growth, fertilizer, water, and the amount of sunlight their plants receive, and then compare that with the recommended norms. Have students document their progress with photos and host a harvest celebration when the plants mature.

If students have made bread, cookies, or pies in school, that's STEM, too (see Photo 1). Measuring, mixing, following the recipe directions, and adjusting



baking times and temperatures are great ways to cover multiple content standards. Plus, all those science demonstrations, nature walks, and projects from *ByDesign Science* (North American Division [NAD] science curriculum) or *Big Ideas* (NAD K-8 math curriculum) have important aspects of a STEM program and spiritual application embedded. You may also be doing the vital work of connecting these STEM topics with spiritual applications. Ellen White wrote: “Let the children learn to see in nature an expression of the love and the wisdom of God; let the thought of Him be linked with bird and flower and tree.”⁵

An essential component of a successful STEM program or even a simple STEM project is to create an atmosphere where students feel free to try something new.⁶ For many students, this may be the first time they have made a model airplane, boat, robot—or anything (see Photo 2). Inevitably, something will go wrong, and seemingly insurmountable challenges will arise as students work on their projects. However, as Albert Einstein said, “Failure is success in progress.”⁷ Work with your students to identify what went wrong and what they need to do to get it right; together with the students, plan the resources, skills, and time required to complete the project successfully. This problem-solving activity is an incredibly valuable skill set that cannot be learned from books, regardless of your students’ grade level.

Consider having your students keep a journal of the problems they encountered and how they solved them.⁸ Ask them to share their problem-solving stories with parents and classmates when presenting their projects. When students are in an atmosphere where they are free to fail and learn from their failures, they are likely to choose ever more challenging projects, making learning fun and memorable.⁹ (see Photos 3 and 4).

To sustain a STEM program in a multigrade school, teachers will need to create time and space for it. Consider running a STEM program once or twice a



week for an hour or two. Some STEM projects take additional time for set-up and clean-up, so feel free to adjust STEM time as schedules allow. The important element is to select the same time slot each week (i.e., Monday morning or Friday afternoon), so students know when they can plan to work on their projects. You may want to give your students the option of working on their STEM projects after completing their other daily assignments. This can be a great way to use those extra minutes in the school day when students can feel less than productive.

Create a space in the classroom for STEM materials and student projects (see Photos 5 and 6). Use attractive bins and boxes to organize the materials students will use to create their projects. Set up a table in front of these storage areas to give students a place to gather the supplies they need for their projects. Consider decorating this space with bright, colored graphics or photos of STEM projects students have already created.

A STEM space is also a great place to put materials if a Makerspace¹⁰ exists in the classroom or is planned for additional projects. The STEM/Makerspace pictured in Photo 7 cost about US\$200 in bins and boxes.

The heart of a successful STEM program is gathering and identifying resources. An excellent way to think about your resources is to group them into three tiers:

- Tier 1 includes durable items and materials that cost a little more money than Tier 2 or Tier 3 items. The high-end items can include the Spike Lego Robotics Set,¹¹ a 3D printer, electronics kits, a hydroponic growing system, and electrical (engineering) and woodworking tools. These items may come from school funding for special projects or parents and church members who want to buy a specific item for your class. Funding can also come from Versacare¹² for up to \$5,000 per school.

- Tier 2 includes items and materials easily purchased at craft stores, hardware stores, or online: popsicle sticks,



hot-glue guns, balsa wood, dowels, scissors, paints, batteries, DC motors, propellers, battery packs, LED lights, wires for sewing, and textiles.

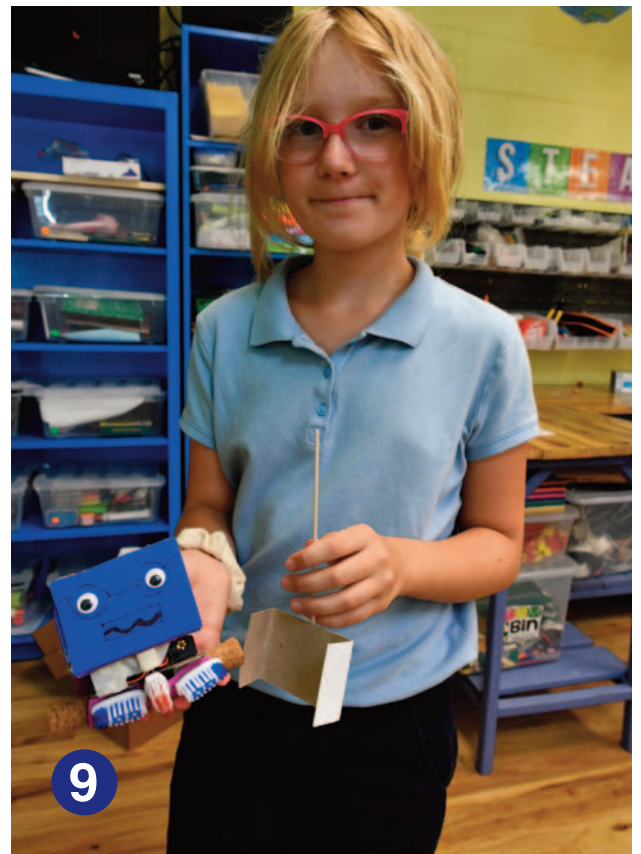
- Tier 3 materials include items usually found in the recycle or trash bin but which are valuable STEM items. These include old computers and monitors, newspapers, paper-towel rolls, cardboard, as well as plastic or cardboard drink containers (see Photos 8 and 9 for examples of toothbrush robots made from motors, toothbrush bristles, and cardboard). Have students (with permission from parents or family) go through their trash at home looking for STEM building materials. This is a valuable way for families to become involved. Also, consider online resources such as “How to Stock Your Makerspace for \$100”¹³ and “Teachers Pay Teachers.”¹⁴

The NAD’s *ByDesign: A Journey to Excellence Through Science* curriculum¹⁵ and *Big Ideas* math curriculum¹⁶ have some valuable STEM-type projects that teachers can use or modify. Other useful resources require minimal expense or are free. *Instructables*¹⁷ is a website with numerous STEM projects organized by grade level or topic. It lists materials and instructions, and contains lots of photos so students can see how their project can progress. Scrib-

ble-Bot¹⁸ and Bristle Bots¹⁹ are great resources that can be used to start a STEM program. Students can independently create toothbrush bugs and robots using inexpensive motors and batteries because these activities come with instructions. A website for computer coding and 3D printing is Tinkercad.²⁰ Many of these resources include science and math content standards, which are easily identified in the NAD math and science standards.²¹

Teachers will need to work together with their students to select projects that aren’t overly complex or time-consuming. Grade level, skill level, and performance on previous STEM projects will help guide teachers and students as they select their projects. Teachers may want to consider having their students choose one or more individual STEM projects and then include an additional project to complete in a group. This way, students from multiple grade levels can participate and present their STEM projects. *Dream Big*,²² *20 STEM Challenges Bundle* for grades 3 to 8,²³ and *Steve Spangler Science*²⁴ list numerous STEM projects that can be used as is or modified to meet specific grade and skill levels (see Photos 10 and 11).

STEM conferences are excellent sources of STEM activities. The Loma Linda University EXSEED Con-



ference²⁵ is held annually in June of each year, and the Andrews University Engineering and Inventing²⁶ workshop is full of great ideas and STEM-project demonstrations. In addition, numerous state and regional STEM conferences are held throughout the year in-person and via Zoom with minimal cost to participants.

Family buy-in is an essential part of sustaining your STEM program. As already shared, parents or families (and even church members, retirees, craft and supply stores, and local organizations or businesses) may want to become financially involved with the school's new STEM program. Parents are often more willing to purchase individual items than to simply donate money toward a general STEM program. They may also willingly participate in helping to build STEM projects such as an above-ground garden, a hydroponics system for plants, rainwater recycling, or even a do-it-yourself solar oven. Some may have specialized training and skills as well as their own great ideas for STEM projects and would be happy to share these ideas if asked. With more involvement, parents will become more invested in the success of their children, the STEM program, and the school.

Holding a STEM event at the end of the semester is a great way to celebrate the time and effort students put into their projects. Invite families, friends, and church members to see the STEM projects and interact with students. Students can present one at a time to a seated audience or stand by their posters and answer questions from visitors. The diverse ages and interests in a multigrade classroom mean that the students' STEM projects will vary considerably in design and complexity. The important thing to do is to celebrate each student's project.

STEM projects offer multiple ways to integrate faith and learning. Students can journal their response to guiding questions such as, "What did you learn about God's creation as you created your project?" or "How does the time and attention you put into your project reflect the time and attention God shares with His creation?" Guide students back to the numerous Bible texts that connect STEM to the Creator God, such as, "The heavens declare the glory of God; and the firmament shows His handiwork" (Psalm 19:1, NKJV).²⁷

K-8 teachers can start and sustain a STEM program by creating a classroom atmosphere where students are encouraged to learn and try new things, and learn from their failures. Here are a few suggestions:

- Provide time and space for a STEM center.
- Identify the financial and material resources your students need for STEM projects.
- Work with parents to identify how they can help

their children with the projects.

- Celebrate each student's success with photos, videos, and a STEM parent night.
- Help students see the connection between STEM content and the Creator.

The book *Education* shares that "The susceptible mind, brought in contact with the miracle and mystery of the universe, cannot but recognize the working of infinite power."²⁸ Starting and sustaining a STEM program will provide an opportunity for students from all grade levels to enjoy a fun, memorable, and faith-based learning experience; this will bring rich rewards of enthusiasm and engagement. ✍



This article has been peer reviewed.

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27. Quoted from the *New King James Version* of the Bible. Scripture taken from the New King James Version®. Copyright © 1982 by Thomas Nelson. Used by permission. All rights reserved.

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Lisa A. Ahlberg



G. Brendan Cross

Hands-on STEM:

Chemistry, Physics, and Other Science Resources for K-12 Education



STEM (Science, Technology, Engineering, and Mathematics) education is essential to understanding science in modern society and preparing a new generation to fill necessary technical roles and participate in decision-making and discourse about advancements in science and its impact on society.¹ The complex science of

COVID-19 and the resulting pandemic has underscored the need for basic science literacy and its role and function within K-12 education.² For teachers, preparing materials to engage and encourage students in STEM can be challenging. This article provides resources to help make preparation and planning easier for elementary and secondary educators.



With basic science literacy needs comes a secondary goal of STEM education: the preparation of future STEM teachers, who, in turn, will inspire curious students.³ For Adventist education to reach this goal, we need to foster the development of more female faculty in the fields in which they are underrepresented at our institutions.⁴ This starts in high school because STEM at this level is pivotal for increasing the number of women in STEM fields. For young women, hands-on experience in these fields during high school has been shown to increase the pursuit of STEM careers by females.⁵ In general, the use of inquiry activities, hands-on activities designed to encourage students to explore the concepts being taught, stimulates curiosity and engagement among all students.⁶ Combining these activities with active learning increases the performance and retention of students who are underrepresented in STEM.⁷

Our Experience

The Andrews University Department of Chemistry and Biochemistry recently (July 2021) hosted a Chemistry Activities Teachers Workshop funded through Loma Linda University from the Versacare Foundation.⁸ We were able to host the workshop remotely after providing the participating teachers with a boxed lab-supplies kit. Several lab activities described below were part of the workshop, during which presenters performed the experiments together with participants while highlighting ways to approach the activity with a classroom of students.

Of the participants responding to the after-workshop survey, 80 percent indicated (1) that it was helpful to see and do the activities live with the workshop instructor; and (2) it was helpful to have a remote opportunity for teacher development in the summer (80 percent indicated they would not have been able to participate otherwise). Of the respondents, 80 percent felt that their ability to share science/chemistry experiments and activities with their students grew from participation in the workshop.

Faculty in the Andrews University Department of Chemistry and Biochemistry continue to look for

A great place to start the experimentation for educators and students alike is with something familiar: food. Many teachers have already started exploring this area by growing familiar food-producing plants with their students.

more opportunities to offer this experience to teachers! We (and other STEM departments) are planning another summer workshop session while we look again for funding. We encourage field trips to our campus and have visited other campuses with hands-on activities.

A great place to start the experimentation for educators and students alike is with something familiar: food. Many teachers have already started exploring this area by growing familiar food-producing plants with their students. Experiments can be designed that not only explore the biological process of plant growth but also, by adding different substances to the plants and changing the

environment, explore the effects of too much or too little water, nutrients supplied, light conditions, or air conditions. Another part of the scientific process also occurs when students record notes and observations. When there are several “subjects” in the same group (such as multiple plants, or several students replicating the same conditions for their cookie experiment), there is a real-life opportunity to help students apply statistical analysis to the results.

Another example of food experimentation is analyzing different sweeteners. A classroom of students can be asked to taste sweeteners after they have predicted sweetness levels (masking the identity of which sweetener a student tastes allows for an unbiased analysis). This activity and a related one on enzymes (e.g., spitting in a bowl of pudding to see what happens to the consistency) were modified (see this activity: <https://sites.google.com/andrews.edu/k-12-educational-resources/resource-links>) with permission from Cordelia Running at Purdue, who has created a wonderful set of college general-science education experiments.⁹

Molecular gastronomy enthusiasts will be familiar with sodium alginate polymers and the interesting way they are used for food applications; this can lead to excellent science teaching opportunities. A recent publication by Corcoran et al.¹⁰ documents some experiments that can be used with students from elementary through high school levels and highlights sustainable practices to add to a discussion with students. The al-

Continued on page 45

Additional Resources

Below are several additional links with useful correlations and experiments that can be used in chemistry, physics, and other science classes. A good place to begin is with a correlation between the Next Generation Science Standards (NGSS) (K-12 science standards) and *ByDesign: A Journey to Excellence Through Science* textbooks. This link provides an NGSS and *ByDesign* correlation to activities: <https://docs.google.com/spreadsheets/d/1xsKODZ0DAAbMVb9oArEiU3NN8KY-U6Z598fFLkyt9rQ/edit?usp=sharing>.

More links for chemistry, physics, and other sciences are listed below:

CHEMISTRY

Science Correlation Standards

<https://docs.google.com/spreadsheets/d/1xsKODZ0DAAbMVb9oArEiU3NN8KY-U6Z598fFLkyt9rQ/edit?usp=sharing>

American Chemical Society

“Inquiry in Action”: <https://www.acs.org/content/acs/en/education/resources/k-8/inquiryinaction.html>

“Adventures in Chemistry”

<https://www.acs.org/content/acs/en/education/whatischemistry/adventures-in-chemistry.html>

ChemMatters Magazine

<https://www.acs.org/content/acs/en/education/resources/highschool/chemmatters.html>

Middle School Chemistry

<https://www.middle-school-chemistry.com/>

Exploratorium: “What Is a Science Snack?”

<https://www.exploratorium.edu/snacks>

Steve Spangler Science

https://www.stevespanglerscience.com/?gclid=Cj0KCQjwiNSLBhCPARIsAKNS4_czQQ1qxYfAMI-Tmlj3tRLdGp2yHG-pZYtT13wJRXTJXFDRgL1TrJUkaAsF_EALw_wcB

Royal Society Science

Primary School Science at Home

<https://royalsociety.org/topics-policy/education-skills/teacher-resources-and-opportunities/resources-for-teachers/science-at-home/primary/>

Royal Society of Chemistry: Steps Into Science Resources

<https://edu.rsc.org/primary-science/find-resources>

Secondary Resources

<https://edu.rsc.org/resources/secondary>

PHYSICS

About Hyperphysics

<http://hyperphysics.phy-astr.gsu.edu/hbase/hph.html>

Hyperphysics-Chemistry

<http://hyperphysics.phy-astr.gsu.edu/hbase/Chemical/chemcon.html#c1>

ComPADRE: Resources and Services for Physics Education

<https://compadre.org>

Science Buddies: Elementary School Physics Lesson Plans

<https://www.sciencebuddies.org/teacher-resources/lesson-plans/subjects/physics/elementary-school>

American Physical Society Resources for High School Teachers

<http://www.aps.org/programs/education/highschool/teachers/index.cfm>

American Physical Society: Resources for Teachers in Grades Kindergarten-Middle School

<http://www.aps.org/programs/education/k8/index.cfm>

Adventures of Cyberbee: Physics Is Fun

http://www.cyberbee.com/physics_sites.html

SCIENCE

National Science Foundation Classroom Resources

<https://www.nsf.gov/news/classroom/index.jsp>

Hyperphysics: Biology Concepts

<http://hyperphysics.phy-astr.gsu.edu/hbase/Biology/biocon.html#heacon>

PhET Interactive Simulations

<https://phet.colorado.edu/>

Share My Lesson: Science

<https://sharemylesson.com/subject/science>

ginate worms experiment¹¹ from the Royal Society is an excellent, succinct classroom activity.

Resources

Below is a discussion of each resource with links. This website (<https://sites.google.com/andrews.edu/k-12-educational-resources/home?authuser=0>) provides all the links AND attempts to correlate the resource to chapters in *ByDesign: A Journey to Excellence Through Science* textbooks produced by the North American Division for grades 1 to 8. While it may not be necessary to make a direct parallel with the textbook topic and the activities suggested, it's often helpful in creating a connection between the teacher and the students. Grades 9-12 textbooks in use are more variable; there is not yet a set of curricular connections available for them.

Teachers should feel equipped to do hands-on curiosity-driven experimentation. The resources listed below are free or available at a moderate cost. There are books and other materials for purchase, but the freely available Web information offers perhaps more activities than time available.

Chemistry

Inquiry in Action, Grades K-5¹² by the American Chemical Society (ACS) is a collection of resources aligned to the Next Generation Science Standards (NGSS) (K-12 science standards).¹³ These lessons provide activities that help connect students and teachers to everyday things. But more than that, they provide science background information to aid teachers who feel they need a little more information, perhaps a refresher on the concepts.

A favorite simple activity uses M&M candies to investigate dissolving properties and can be used for many different grade levels. This activity makes it possible to encourage students to ask their questions about M&Ms and colors and even explore those questions. Further help for K-5 teachers is available at the Adventures in Chemistry website, which features hands-on activities, videos, and games.¹⁴

A favorite simple activity uses M&M candies to investigate dissolving properties and can be used for many different grade levels. This activity makes it possible to encourage students to ask their questions about M&Ms and colors and even explore those questions.

Another resource aligned with the NGSS from the ACS is Middle School Chemistry, Grades 6-8.¹⁵ This Web resource contains many tools for the teacher, including background information, student readings, test questions, and activities. Each activity includes the layout of more formal experimentation with sections that include objectives, evaluations, and safety information. Further alignment with Common Core English Language Arts (CCELA) (K-12 literacy standards)¹⁶ makes this Web resource particularly helpful.

An example from this resource, Chapter 5, Lesson 6: "Does Temperature Affect Dissolving?" allows exploration of the effects of energy on dissolving properties of M&Ms. Again, this is an illustration of

using everyday materials for something highly relatable for teachers and students alike.

The ACS also provides resources for the next grade group, 8-12, using the *ChemMatters* magazine.¹⁷ While a subscription to the magazine is not free, many articles can be accessed for free on the website. More than just articles on some interesting topics in chemistry, the magazine site includes teacher's guides with worksheets and answers, connections to concepts and science standards, background information for the teacher, and a list of sources and further information. These articles and the teacher's guides that accompany them are an amazing resource for the 7th/8th grade or high school teacher. This author (L.A.) has used some of these articles in her 7th/8th grade AND general-education college-level chemistry course. Another resource is an article on Edutopia listing websites for science teachers¹⁸; notably, No. 8 is a link to a Periodic Table of Videos!¹⁹

Other available resources are listed in the references below, and one of the authors (L.A.) is collecting all of this information in this evolving website: <https://sites.google.com/andrews.edu/k-12-educational-resources/home>. They include links to websites from museums, other chemistry societies, and individuals who have freely provided ways to get kids doing science (often with things one can purchase).

Physics

There are many sources for aggregated resources for physics education. We will give a summary of some of the more interesting ones we have found and currently use.

Compadre is the education tool hub for the American Association of Physics Teachers (AAPT).²⁰ This AAPT digital library has many simulations and tools that are free to the public. The American Physical Society (APS), has collected information for K-8 and high school teachers, and is one of the primary hubs for physics research in the U.S.²¹ CyberBee is an independent aggregator with a simple interface but limited selection, although it is curated by former teachers.²² Last, we have selected Science Buddies as a resource for elementary teachers. This site includes relatively easy demonstrations for teachers to perform or lead, and discussions about the physical phenomena being demonstrated.²³

The other physics resources listed here are collections of materials produced by HyperPhysics. Developed by Rod Nave at Georgia State University, HyperPhysics is a digital textbook that provides a quick summary of most topics in the field. It provides a quick refresher for teachers preparing a lecture on a topic about which they feel rusty. Originally designed for physics, it has since been expanded to include biology, chemistry, and geology, in partnership with other institutions.²⁴

PhETs are simulations of physical situations. They can be used as demonstrations during lectures, as the basis of an inquiry activity during class, a virtual experiment from which to collect data, or as an example to refer to during homework. These versatile animations were developed by the University of Colorado at Boulder. Nobel Laureate, Carl Wieman began this project in 2002 as a teaching tool, and it has grown into a great place to find resources to help keep lectures interesting.²⁵

Other Sciences

As mentioned above, HyperPhysics has branched out into chemistry, biology, and geology, creating a great reference link for teachers to access refreshing topics.²⁶ The National Science Foundation provides a list of links at some different sites for various grade levels.²⁷ While much of the NSF site is dedicated to research, some of the material is written at a popularized level to try to increase public appreciation of science. Share My Lesson is a teacher-sharing website where teachers can upload their lessons and share them with others.²⁸ If a starting point is needed to plan a lesson on a difficult topic, the Share My Lesson site is a great resource to see how other teachers have tackled it. Another site with a list of links is from Common

Sense Education,²⁹ providing resources from biology to chemistry to physics. ✍

Resources in this article have been peer reviewed.

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Alastair Noble

The Scientific Study of **Life**

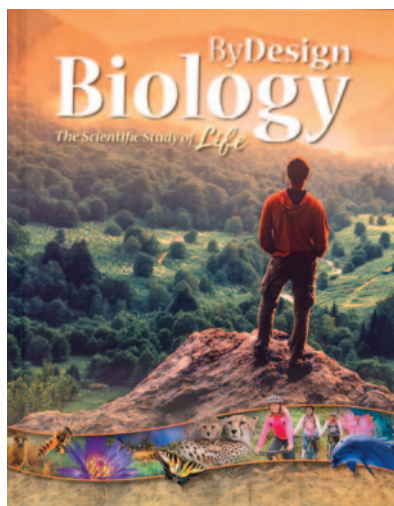
Of all the textbooks I have seen in my career in science education, this one is certainly a contender for being the most impressive and comprehensive. It is beautifully written, thoroughly researched, impressively illustrated, and provides an exhaustive treatment of all the key aspects of the biology of life. It is a great resource for high school, college, and university students, although it was created for use primarily in the secondary-level biology class. It is also an invaluable reference book for teachers and lecturers. Beyond the formal study of biology, this is a book that, arguably, should be available to every family library for reference and the sheer enjoyment of exploring biology!

The layout of the book is most attractive. Its content is descriptive, analytical, and occasionally controversial. The language is straightforward and easy to read. For each topic it provides introductory and background material, deals with the subject in an appropriate level of detail, and gives useful short summaries, reviews, and self-check tests. It is among the most accessible textbooks I have seen.

The sweep of this 700-

page book is breathtaking. It covers all relevant aspects of biology in some detail. From the macro through the micro to the molecular, it provides a comprehensive treatment of biological systems in a way that is readable and informative. You could not open this book without learning something about biological systems that you have almost certainly not encountered before.

The treatment of biology is broad and diverse. It deals with plants, animals, and microbes, describing their structure from the visible through the hidden to the microscopic and molecular. It also covers topics such as taxonomy, cell structure, and genetics. In fact, I was unable to find any specific biological subject that was not treated to some degree. As a chemist by training, I was particularly intrigued by the detailed treatment of the molecular basis of life, as for example in DNA and RNA, and the intricate structure of proteins and the other macromolecules of life. There is also a full treatment of the history of life on Earth and, in some detail, of the fossil record and the issues associated with it, considering both the possibility of gradualism and catastrophism.



North American Division Office of Education, *ByDesign Biology: The Scientific Study of Life* (Dubuque, Iowa: Kendall Hunt, 2020). ISBN: 9781792425424, 1792425422 (Print). 709 pages. Student Edition + Four-Year License (Print and eBook): US\$83.95; Lab Resources (Print): US\$30.00. Teacher Edition Digital Package (includes Teacher's Edition eBook, Teacher Lab Resources and Student Lab Resources): US\$186.84. To order, call 800-770-3544 or visit <https://rpd.kendall-hunt.com/content/29729/prog-feature/>.

In addition, this text also deals fairly and objectively with contemporary and sometimes controversial subjects like ecology, climate change, conservation, care for the environment, population pressures, use of natural resources, pollution, and biotechnology. All in all, it is hard to imagine a more comprehensive treatment of biology.

The scientific method is also carefully described, showing how experiments are designed, data are examined, and conclusions are drawn, sometimes tentatively, until confirmed or refuted by later discoveries. It gives fascinating accounts of the work of famous scientists, both historical and contemporary, and shows how they came to their conclusions, sometime in the face of opposition from the establishment.

However, what makes this textbook refreshingly different from all the others I have seen is that it tackles the controversial but vital topic of the existence of design in biological systems. Some would argue that this is an obvious deduction from the intricate and complex systems encountered within living organisms. However, the opposing position of scientific naturalism denies that this is so. This textbook faces fairly the whole question of how our worldview or philosophy can influence the conclusions we draw from the scientific evidence.

Most scientific textbooks, in line with the current scientific consensus, are constructed on the assumption that scientific investigations and conclusions are completely unbiased—and this becomes most apparent in the study of origins. The almost-universal Darwinian view of the origin and development of living things is that the processes involved are entirely natural and random, and that no agency beyond nature can be contemplated. This position is maintained even when it is obvious, for example, that the evolutionary account of origins has no credible explanation for the appearance of first life.

This assumption was elaborated by the late distinguished scientist Richard Lewontin who asserted dogmatically that in science, and especially in the study of origins, “we cannot allow a divine foot in the door.”* This reveals that the default position for the current scientific study of origins is not logical deduction, but an assumed philosophy—that of naturalism or materialism. In plain language, scientists are not always without bias and do sometimes allow a worldview—an essentially atheistic one—to override the evidence.

This textbook recognizes this anomaly and seeks to explore gently the opposing and intuitive position that a Designer may be at work. It addresses this question

thoroughly and ably, considering, without bias, the two sides of this argument. It may come as a surprise to many students that the evidence for design in biology and more widely in nature is, for scientific reasons, utterly compelling. Even if you are not initially inclined to consider this conclusion, you owe it to your intellectual integrity to give this matter, raised in *ByDesign Biology*, fair consideration.

This textbook also gives proper place, briefly and fairly, to the traditional view of Christian theism and its implications in science. It deals with the biblical creation record in a respectful and non-dogmatic way and also considers the possible implications of Noah’s flood. All in all, it is a refreshing change from the suffocating pronouncement of secular Darwinists who brook no criticism of their positions.

However, it is important to stress that this textbook is about very much more than the important exploration of origins. It deals exhaustively with all aspects of academic and practical biology about which students need to be aware and does so in a most accessible and satisfying way.

Whether you are studying biology formally for examinations and qualifications, or are just an interested reader, this book will meet your needs. It is also a fabulous resource for teachers and will refresh their courses, lectures, and lessons. I cannot commend it too highly. ✍

Alastair Noble, PhD, is Director of the Centre for Intelligent Design UK (C4ID) in Glasgow, Scotland, U.K. He holds a doctorate in chemistry from the University of Glasgow and was formerly one of Her Majesty’s Inspectors of Schools for Scotland. Dr. Noble taught high school chemistry for several years and served as an educational administrator; he also served as Education Officer for the British Broadcasting Company. He has published widely on the topic of Intelligent Design and through his work at the C4ID advocates for research and public debate on Intelligent Design.

Recommended citation:

Alastair Noble, “Book Review of *ByDesign Biology*,” *The Journal of Adventist Education* 84:1 (2022): 49-50.

NOTES AND REFERENCES

* Richard Lewontin, “Billions and Billions of Demons” (review of *The Demon-Haunted World: Science as a Candle in the Dark* by Carl Sagan, 1997), *The New York Review of Books* (January 9, 1997), 31.

Guest Editorial *Continued from page 3*

equipment while doing science. But what few realize is the value of cooperative learning experiences. God's Word is clear, "Two are better than one, because they have a good return for their labor: if either of them falls down, one can help the other up" (Ecclesiastes 4:9, 10, NIV).³ Do you provide your students regular opportunities to work collaboratively in project-based learning experiences so that they can sharpen their communication and cooperation skills?

Many business professionals suggest that critical skills such as teamwork, organization, decision-making, and communication are needed to succeed; these are referred to as "soft skills." Although these skills aren't measured on standardized tests nor usually assessed on a report card after kindergarten, they are essential because most jobs require working with others. In the book *The Global Achievement Gap*, Tony Wagner, former professor at Harvard University, outlines seven skills teens need to succeed today.⁴ Many of these skills—along with design thinking⁵—are incorporated into the *Mission: Invent*⁶ project, which the STEM Division of Andrews University (Berrien Springs, Michigan, U.S.A.) has designed for Adventist educators.

The *Mission: Invent* initiative provides free curriculum and resources to Adventist educators so that they can do more collaborative problem-solving with their students. *Mission: Invent* incorporates elements of the traditional science fair with trifold boards and judges, but participants must work in teams using engineering design processes. Groups of students tackle a real-life problem, designing and building a prototype of a possible solution to their chosen problem. This opportunity builds 21st-century skills and focuses on integrating STEM with Bible classes and the humanities. I hope you will consider being a part of *Mission: Invent* in the future. If you are interested in learning more, check out this website: <http://andrews.edu/go/invent>.

Great teachers are always learning. They have a growth mindset and are willing to take on challenges. They are open to new methodologies, activities, and curriculums because they want the best for their students. Exceptional teachers want their schools to be communities of active learners engaged in excellence in all areas of education, including biblical studies, the humanities, the sciences, arts, collaboration, and service-learning.

The theme of this issue is revitalizing Adventist education through STEM. We want our students well prepared to succeed at the next level, whether the next grade up, academy, careers, college, or graduate and professional schools. In this issue and the next, you will find various topics geared for small schools and others that can be adapted for use by any K-16 teacher. We hope

this issue will equip teachers and parents with additional tools to implement in their classrooms. If you have a growth mindset, you will doubtless be able to glean gems from any of the articles to implement immediately, whether or not you teach a STEM subject. ✍

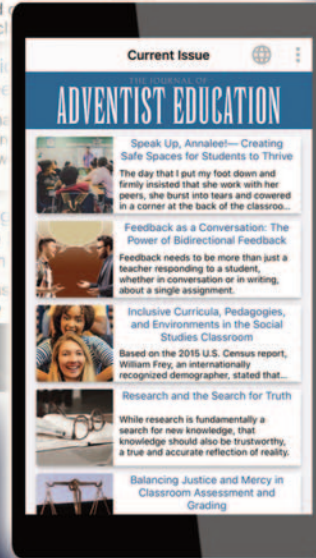
Monica Jackson Nudd, MEd, is the STEM Coordinator for the College of Arts and Sciences at Andrews University (Berrien Springs, Michigan, U.S.A.), and the Coordinator for this special issue. She earned a Master's degree in curriculum and instruction with an emphasis in math from the University of Maryland and previously served as a teacher and principal in Adventist elementary and middle schools. Her areas of interest include problem-based learning and building support for STEM at all levels.

Recommended citation:

Monica Jackson Nudd, "Why Do I Need to Know About STEM? I Don't Teach Science, Technology, Engineering, or Math!" *The Journal of Adventist Education* 84:1 (2022): 3, 51.

NOTES AND REFERENCES

1. There are several acronyms used throughout this issue and in the literature on this topic: STEAM includes the arts, and for this issue, agriculture. STREAM includes reading, and for this issue, religion.
2. World Railroad Records and Firsts (2022): https://www.railservice.com/stats_records/railroad_firsts.html.
3. Ecclesiastes 4:9, 10, *New International Version* (NIV). Holy Bible, New International Version®, NIV® Copyright © 1973, 1978, 1984, 2011 by Biblica, Inc.® Used by permission. All rights reserved worldwide.
4. Tony Wagner, *The Global Achievement Gap* (New York: Basic Books, 2008). Wagner lists seven key survival skills for the new world of work: critical thinking and problem-solving; collaboration; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analyzing information; and curiosity and imagination.
5. "Design thinking" is one of the latest buzz phrases in the education world. This new teaching strategy doesn't fall under STEM, although engineers tend to use design thinking in their processes. Nor does design thinking fall under humanities or the arts; it is a business principle. We don't teach business at the elementary or secondary levels. However, design thinking requires collaboration and problem-solving skills, creative thinking, and grit, which will be well worth your time investment—and your students will reap the benefits.
6. The *Mission: Invent* program seeks to engage K-12 Adventist educators in STEM by providing training, support, and nurture as they seek to equip students to think critically, solve real-world problems, innovate, and create opportunities for entrepreneurial endeavors. For more information, visit <https://www.andrews.edu/cas/stem/invent/index.html>.



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