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Starting and Sustaining a **STEM** Program

in the Multigrade Classroom

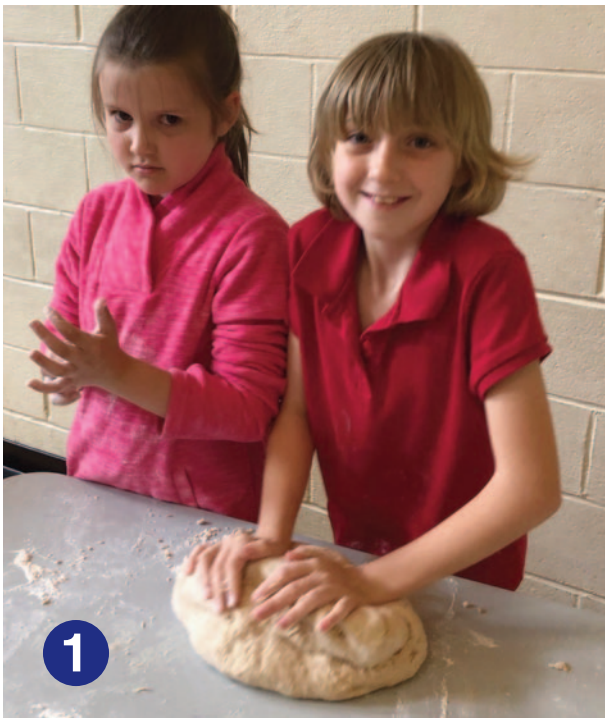
Remember that great science demonstration or activity that you did with your students? Students at each grade level were engaged, focused on learning, and you were the STEM (science, technology, engineering, and math) hero. What if you could do this throughout the month, semester, or entire year? Starting 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 Makerspace[10] 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 Versacare[12] for up to $5,000 per school.
- Tier 2 includes items and materials easily purchased at craft stores, hardware stores, or online: popsicle sticks,

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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* curriculum[15] and *Big Ideas* math curriculum[16] 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. Scribble-Bot[18] and Bristle Bots[19] 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-


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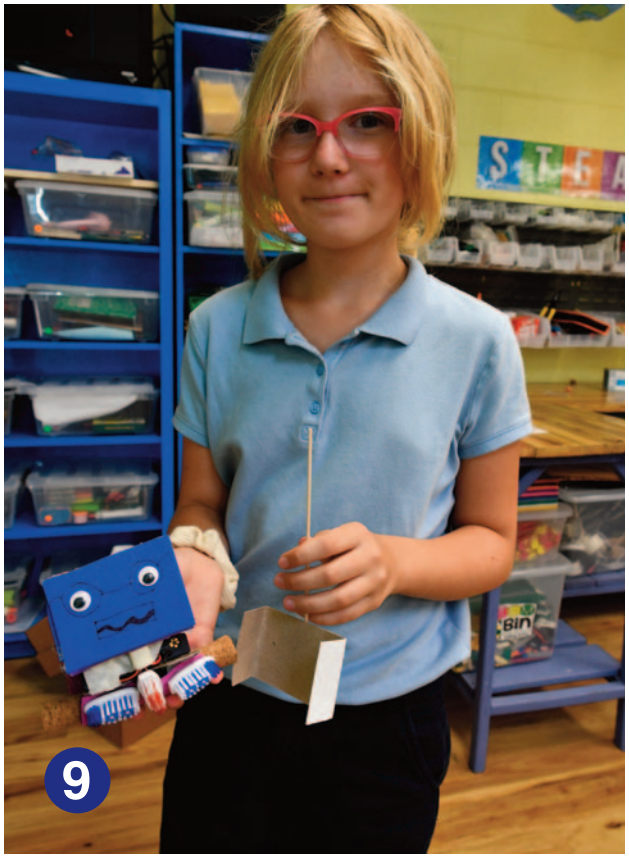
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ference[25] is held annually in June of each year, and the Andrews University Engineering and Inventing[26] workshop is full of great ideas and STEM-project demonstrations. In addition, numerous state and regional STEM conferences are held throughout 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.


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This article has been peer reviewed.

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25. Loma Linda University EXSEED Conference: https://home.llu.edu/education/office-of-provost/departments-and-divisions/e-x-s-e-e-d.

26. Andrews University offers several teacher-training opportunities and STEM courses. See "Engineering, Inventing, and Design Thinking": https://www.andrews.edu/cas/stem/work shops/index.html; also, visit http://andrews.edu/stem/teachers/ for additional links to guest speakers, courses, and workshops.

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.

28. White, *Education*, 99.