

F 32

Engineering the

Future Milan Dau, left, and Sadhika Prabhu, students in the Salk Middle School STEM magnet, work on a CAD program as part of their design curriculum.

THE BRIGHTLY FROSTED CUPCAKES SITTING ON THE TABLE SEEM OUT OF PLACE IN THIS HARD-WORKING **JUNIOR HIGH** THAT EMPHASIZES **SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH.**

Shouldn't these kids be working at tilted tables with T-squares?

Or be parked in front of the latest CAD program?

Or attempting to make a three-dimensional print of their hand?

Nope. The cupcake making at **Salk Middle School** in Elk River, Minn., just outside Minneapolis, is actually a delicious chemistry lesson combined with a learn-to-bake class. Because what is dough of all kinds other than a chemical reaction?

Salk is a magnet school that ties all its curriculum, even physical education to STEM learning. It can be challenging, in a fun way, and eye-opening for the students, says Teri Ann Flatland, the curriculum integration coordinator. She also teaches seventh grade English.



NEW
PROGRAMS
KEEP **STEM**
EDUCATION
IN FOCUS FOR
STUDENTS
BETWEEN
ELEMENTARY
AND HIGH SCHOOL.
BY JEAN THILMANY

HOLDING UP THE MIDDLE

Take seventh grader Sadhika Prabhu. When she was in fourth grade at Weaver Lake Elementary in the Minneapolis suburb of Maple Grove, she was already thinking about middle school. As the daughter of a medical doctor and a computer engineer, she had always loved science, technology, engineering, and math classes, often referred to as STEM. The problem was—as it is for many students throughout the U.S.—carrying the STEM emphasis over into middle school can be difficult, as not many schools at that level emphasize that type of learning.

When it was time for sixth grade, Prabhu moved to Salk Middle School to take advantage of a recently inaugurated STEM magnet program.

Magnet schools are public schools that tie curriculum to a certain theme: in Salk's case science, technology, engineering, and math. The schools offer choice to a diverse population by drawing interested students from surrounding districts, Flatland said.

"If I wanted STEM to continue, I knew Salk was a good idea," Prabhu said. She rides the bus about one



Chemistry of cupcakes The Girls in Engineering, Math, and Science club at Salk learns about chemical reactions that take place during baking, above. Below, club members test what they've learned by baking cupcakes.



"I'M THINKING OF BECOMING A BIOMEDICAL ENGINEER SO I CAN MAKE INVENTIONS THAT HELP PEOPLE."

hour to get to school each day, but doesn't begrudge the journey.

"I'm thinking of becoming a biomedical engineer so I can make inventions to help people," Prabhu said. If that doesn't happen, she says engineering is still likely in her future, as she really loves it.

Milan Dau is also in seventh grade. She's always been good at math and has plans to become a pharmacist to create medications to help people.

"My parents thought that a good junior high with a good magnet program would build the foundation for high school and college and help me with tests further down the road," she said.

Elk River, Minn., home to Salk Middle School, is about 30 miles up the Mississippi River from Minneapolis.



Science Fairgrounds All Salk students participate in the annual science fair, which can take on the appearance of a technical conference poster session.

ANSWERING A CALL

Salk is one of about 40 STEM programs in schools across Minnesota. The STEM initiatives are spreading nationwide, spurred by an increased call for science and math skills, and pressure to fill a future job market that is expected to be short of engineers and science-savvy workers.

But not many middle schools across the nation have embraced the STEM trend, and that can be hard for students who don't want to lose that focus between elementary and high school, Flatland said.

Salk kicked off its magnet program in the 2007 school year. That first year, only a cluster of students within the school took the STEM curriculum. It hadn't yet been opened up to the whole school, Flatland said.

Students from eight surrounding school districts could apply to be part of the STEM cluster and they were selected by lottery. Students within Salk's district still automatically attend the school, because it's one of their district middle schools.

In the 2010 school year, Salk opened its STEM program, and now all its students follow the STEM curriculum.

"The cluster was doing so well we wanted to open up the program-



After-school club Milan Dau, left, and Sadhika Prabhu work on their science fair project during a Girls in Engineering, Math, and Science meeting.

ming for everyone,” Flatland said.

The first year saw a greater percentage of boys apply than girls, Flatland said. To remedy that, Flatland and her team started a club called Girls in Engineering, Math, and Science (GEMS), hired more female teachers, and began advertising to reach girls in the surrounding districts. Now the numbers are fairly balanced; the 859 student population is 51 percent boys and 49 percent girls, Flatland said.

Dau, Prabhu, and Flatland say Salk Middle School isn’t some kind of anomaly where every activity centers around engineering or science.

“There’s been lots of big changes at this school, but it’s really still just a normal school with a yearbook and English classes and after-school clubs,” Flatland said.

Of course, GEMS is one of those after-school clubs. A University of Minnesota food scientist recently came to a GEMS meeting to talk about genetics, including the DNA of a strawberry.

And, like most middle schools, you’ll find students working on their science fair projects after school. At Salk, those projects can center on building robots, helmet safety, or dissolving pills.

CRUCIAL TIMING

According to Flatland, middle school is the perfect time to emphasize STEM, as students of that age are particularly eager and ready for science, technology, engineering, and math classes.

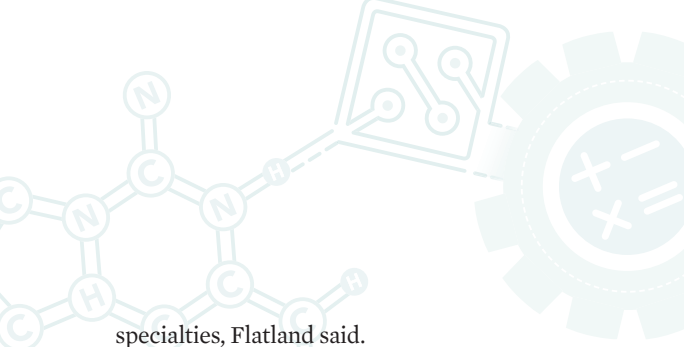
“All our projects are inquiry based, which is also how kids learn independent skills and learn to communicate,” she said. “That’s how

critical learning happens in middle school. They identify questions, find answers, and collaborate. We tell them STEM professionals work just like this.”

Salk calls upon the Project Lead the Way curriculum as its main curricular program. Project Lead the Way, based in Indianapolis, is a nonprofit organization that designs STEM education programs for elementary and secondary schools. The activity, project, and problem-based curriculum aligns classes along technology, engineering, design, robotics automation, and other STEM



Distinguished guest Minnesota Senator Al Franken meets students during a tour of Salk Middle School..



specialties, Flatland said.

The STEM curriculum touches all classes, no matter how far afield a subject may seem. It's a family life class that teaches cupcake making. Kids in phys ed class pay attention to how their bodies move as they run. Writing an essay in English class involves asking questions, doing research, proposing a hypothesis, testing and analyzing, and drawing a conclusion.

"The students are hearing that same decision-process language in all their classes. All the traditional classes integrate STEM," Flatland said.

Take her own experience. Flatland is a middle school English teacher by training. But she came to the school in 2007 prepared to teach English and help implement the new STEM curriculum.

"Some teachers think you can't do English and STEM at the same time, but I wanted to prove it could be done," she said. "For English, we research by reading nonfiction books related to science. Then, of course, the writing process aligns directly with the scientific decision-making process: brainstorming, writing, revising, and prototyping."

In Flatland's English classes, students identify a problem or idea to write about, make a prototype by writing a first draft, test it by reading it back through, and redesign it by editing.



Space Camp Every other year, students at Salk take a field trip that makes several stops and includes activities at the Space Center in Huntsville, Ala..

For a science fair project, students might see if they can walk and read at the same time. Dau is excited about the prospect of building and programming robots for the science fair next year. The programming is reserved for eighth graders, which makes it highly anticipated.

National Engineers Week, held the third full week of February, is a big deal at the school. "It's not lecturing. It's hands on and it mixes technology," Flatland said. Two years ago, the Solar Tiny House, created by the Minnesota Renewable Energy Society, spent a week at the school. Students toured the house to learn more about how solar power heats a home.

Students also have a hand in choosing the technology they use. They investigate options, with an eye on how software will improve learning. They're



STEM EDUCATION FROM KINDERGARTEN THROUGH HIGH SCHOOL ISN'T A TREND.

MSA sees great interest in the STEM middle school magnet, an age range often neglected by past programs. School leaders now realize STEM education shouldn't lag in those middle years, and that junior high curriculum needs a special focus, Thomas said.

"A lot of elementary STEM magnets are getting kids interested. And high school STEMs are more like career techs in that they specialize in health care or biotech or computer science. They split it up more," he said.

Fourteen years ago, Project Lead the Way Inc. of Indianapolis developed Gateway, a specialized STEM middle school curriculum. For the 2013-2014 school year, about 2,100 U.S. schools used the curriculum, made up of eight nine-week units. Schools that use the curriculum are required to implement the design and modeling and the automation and robotics units. They can then choose among other units, said Jennifer Cahill,

SPECIAL PROGRAMMING

The number of U.S. STEM middle school magnets grows every year thanks in part to a curriculum from Project Lead the Way. Another explanation for growth in this sector is "because middle school is this funky level," said Scott Thomas, executive director of Magnet Schools of America, an advocacy organization in Washington, D.C.

also looking at whether a computer program is just temporarily popular with kids or touted in education circles and isn't particularly useful, Flatland said.

"We talk about this stuff with kids, 'What is the benefits of this program over this one?'" she said. "So Google Docs can be used across the school with teachers and we can communicate with the family with it."

Annual field trips touch on many aspects of engineering and science, Flatland said. Space Camp, which happens every other year, alternates with a trip to Washington, D.C., to check out science and engineering marvels close up. In the nation's capital, students visit the Smithsonian National Air and Space Museum, the Smithsonian National Museum of Natural History, the Natural Museum of American History, and the Washington Monument. They are continuing research that began in the classroom on specific science and engineering subjects found in the museums and monuments.

This year Space Camp happens over a whirlwind five days in June and includes a stop at the Gateway Arch in St. Louis, then the Huntsville, Ala., Space Center, Mammoth Cave National Park in Kentucky, and the Shedd Aquarium in Chicago.



Exploring the capital Field trips to Washington include the science museums of the Smithsonian Institution and other sights. Here, teacher Ron Hustvedt and student Sam Kirscht take a pencil rubbing from the wall at the Vietnam Veterans Memorial.

Because the middle school kids are in their early teens and because the Salk magnet program is only a few years old, there is no information on how many students will go on to make a career within the STEM professions. Many students will try to enter Blaine High School, a STEM magnet in a nearby district. Entry to the program is also lottery based.

Prabhu and Dau both hope to go to Blaine High School and then on to college and their chosen careers. But meanwhile, they're distracted by something much more pressing, the colorful and sweet cupcakes they helped bake. **ME**

JEAN THILMANY is an associate editor of *Mechanical Engineering*.

senior director of media.

Students in junior high already involved in STEM subjects need additional exposure to math, science, and engineering before high school, said Cathy Kindem, coordinator of innovative educational programs in Minnesota's School District 196. Her district includes a STEM elementary, middle, and high school.

Gateway middle school units focus on engineering design, sustainable energy solutions, aeronautics, astronautics, and green architecture, said Cahill. All units tie into the high-school curriculum available through Project Lead the Way, she added.

Salk Middle School uses the Gateway units and incorporates STEM programming into the other subjects such as English and physical education, said Teri Ann Flatland, curriculum integration coordinator.

STEM education from kindergarten



Project Lead the Way, which has developed STEM education programs for middle and high schools, has added a curriculum for kindergarten through fifth grade.

through high school isn't a trend, said Cahill. With that in mind, Project Lead the Way launched a kindergarten to fifth grade curriculum program, being tested in the 2013-2014 school year. It will be fully implemented in the upcoming year, when the curriculum will be available for students in kindergarten through high school.

"We believe it's critical for students as early as preschool and kindergarten to get

involved in STEM education," Cahill said. Studies show students, especially girls, make decisions about STEM as early as third grade. "Unfortunately, those decisions are 'I'm not good at math,' or 'science isn't for me.'"

Students exposed early to a STEM curriculum often follow it through high school. The growth in middle school programs lets them do just that, Cahill said. ■