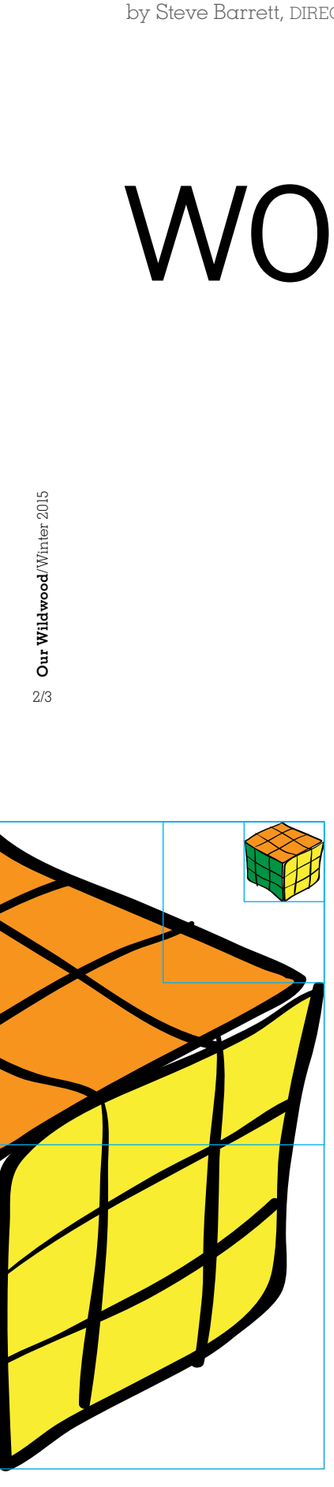
by Steve Barrett, DIRECTOR OF OUTREACH

How **STEM** learning explains the physical world works **this** way



This fall, Wildwood launched a 6th grade STEM class. It's one of three schoolwide initiatives designed to integrate learning about science, technology, engineering, and math into every student's experience.

One goal for the 6th graders: demystify the engineering behind everyday objects. Arlën Vidal-Castro and Katie Boye have been guiding students as they meticulously measure the dimensions of small objects—tea bags, Rubik's Cubes, Wi-Fi dongles, and playing cards. Angling rulers and tape measures, teams of students write down numbers and pen sketches to capture each ordinary object's dimensions and features.

"This helps the students see the invisible thought that makes these items functional," Katie says. It's also a way for students to apply their working knowledge of decimals and proportion through engineering. "They choose an everyday object," Arlën says, "take its measurements, and then build a scaled model—either up or down."

Students say the measuring makes the STEM connections very clear; this is the initial work of any engineering project. Sixth grader Benny O. found himself measuring a Wi-Fi dongle and quickly came to understand the significance of scale.

"You can see how small this is," he says. "I'm not totally sure of my scale factor but, because of the size, I'll definitely be scaling up."

For Arlën and Katie, these lessons are essential for students to develop an appreciation of the role that math and science play in the design process.

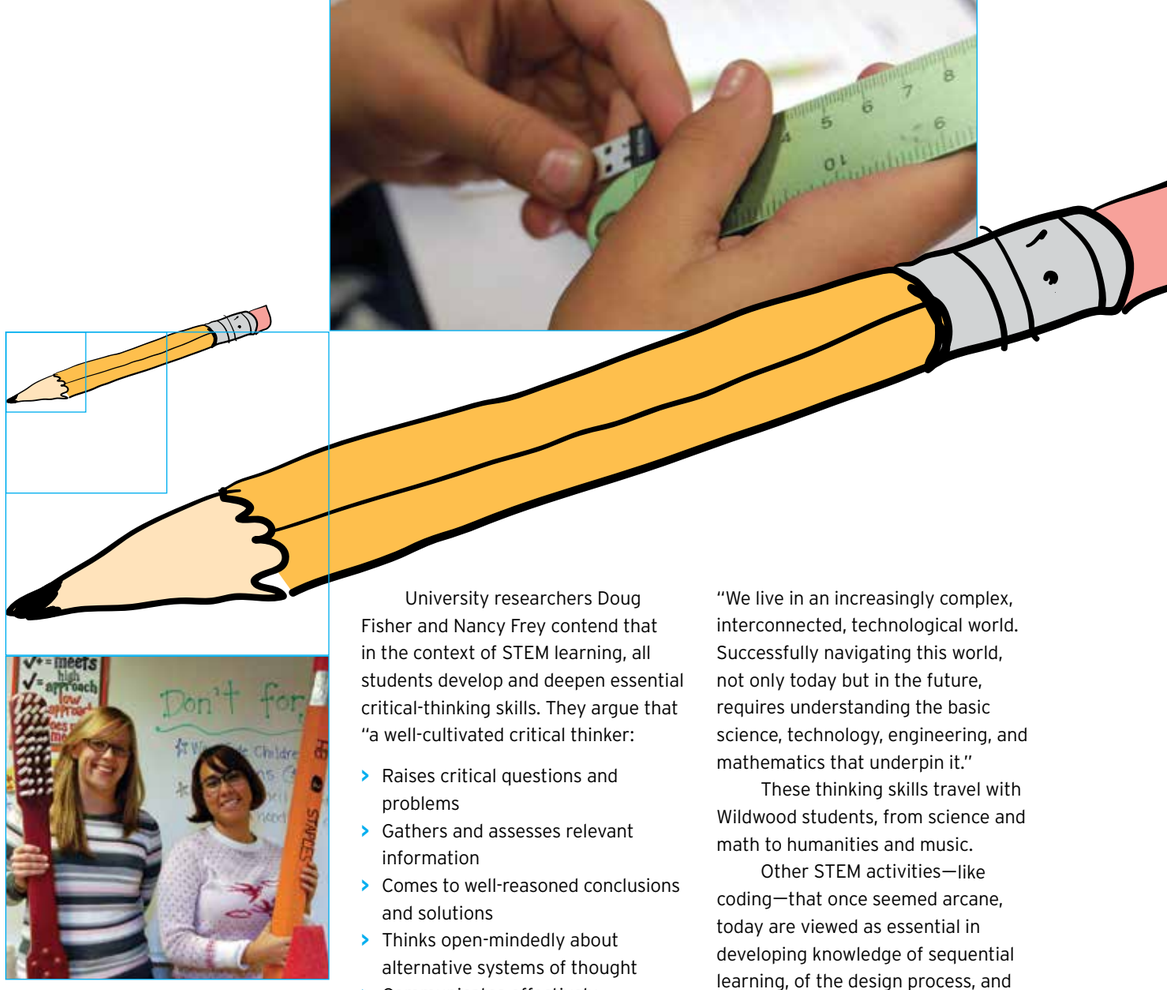
On shelves and tables around the classroom, there's even more seemingly prosaic stuff—but these objects are comically oversized: giant pink erasers, a 7-foot toothbrush, and a 9-volt battery the size of a cereal box. The objects look like props for an old episode of Pee-wee's Playhouse, but it's all part of the output for this learning about scale.

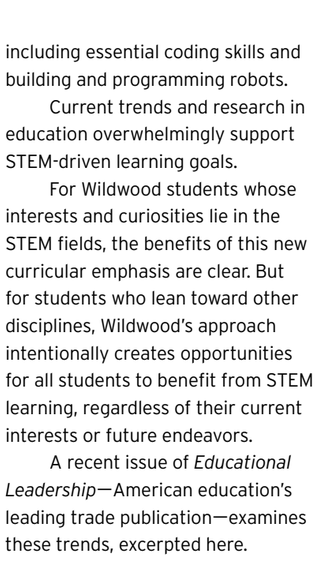
WILDWOOD BUILDS A STEM CULTURE SUPPORTED BY RESEARCH

The new 6th grade class is just one on a broader continuum of new STEM learning initiatives at Wildwood. Each complements other essential elements of Wildwood culture—educating students through the lenses of Life Skills and Habits of Mind and Heart, Systems Thinking, and project-based learning, among others.

At the start of this academic year, Wildwood also opened the Tech D.E.C., a new maker space on our elementary campus, and launched the Wildwood Institute for STEM Research and Development (WISRD), a student-driven real-world research program in our upper school. (See page 11.)

"Our goal at Wildwood middle school is to encourage brave learning by providing STEM learning experiences for all students," says Dan Glass, director of middle school. "These experiences are not just for students with an affinity for math or science." With this approach, every Wildwood student will enter the upper school with years of STEM learning, including essential coding skills and building and programming robots.





Current trends and research in education overwhelmingly support STEM-driven learning goals.

For Wildwood students whose interests and curiosities lie in the STEM fields, the benefits of this new curricular emphasis are clear. But for students who lean toward other disciplines, Wildwood's approach intentionally creates opportunities for all students to benefit from STEM learning, regardless of their current interests or future endeavors.

A recent issue of *Educational Leadership*—American education's leading trade publication—examines these trends, excerpted here.

University researchers Doug Fisher and Nancy Frey contend that in the context of STEM learning, all students develop and deepen essential critical-thinking skills. They argue that "a well-cultivated critical thinker:

- Raises critical questions and problems
- Gathers and assesses relevant information
- Comes to well-reasoned conclusions and solutions
- Thinks open-mindedly about alternative systems of thought
- Communicates effectively with others to figure out solutions to complex problems."

Robert N. Charette, a leading computer systems engineer, believes learning through a STEM lens provides essential skills students must develop as informed citizens. As an engineer and entrepreneur, Charette attests: "We live in an increasingly complex, interconnected, technological world. Successfully navigating this world, not only today but in the future, requires understanding the basic science, technology, engineering, and mathematics that underpin it."

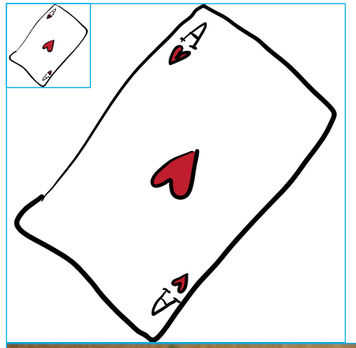
These thinking skills travel with Wildwood students, from science and math to humanities and music.

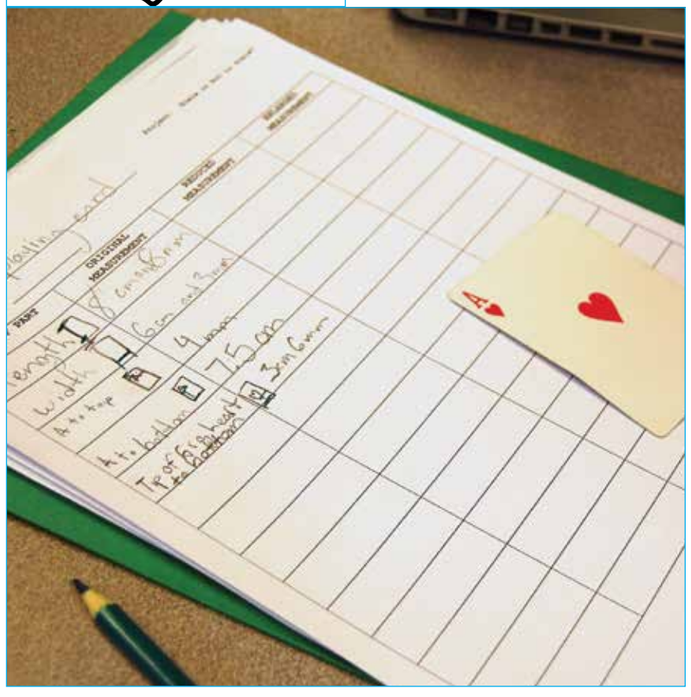
Other STEM activities—like coding—that once seemed arcane, today are viewed as essential in developing knowledge of sequential learning, of the design process, and myriad other learning experiences. As a cohort of UCLA researchers point out, "computer science relies on problem-solving and computational practice that are important for everyone. These include using abstraction; automating; creating algorithms; collecting and analyzing data; implementing, testing, and

debugging designs; and engaging in creative, critical, and innovative thinking."

The virtues of STEM learning also apply to teachers. Carol Ann Tomlinson, an educational researcher and professor at the University of Virginia, argues that great STEM teaching isn't just limited to the STEM fields. Because STEM learning crosses multiple disciplinary boundaries, she finds great teaching anywhere it elicits deep, inquisitive thinking. "Give me teachers who relentlessly cause kids to wonder why?" she states, "and how did that happen? and what if? As though those questions were the lifeblood of learning."

These deep questions are what drive the Wildwood faculty's work with students—regardless of age or subject.





NEW APPROACH, NEW TEACHING TEAM

At Wildwood middle school, STEM learning is the result of an organic and intentional evolution. Last year, Arlën and Katie laid the groundwork for a transdisciplinary course that would require their 6th graders to apply the knowledge and skills from both of their existing classes and grapple with authentic problems and real-world projects.

Now the wall that used to separate their classrooms is gone, replaced by a floor-to-ceiling folding partition—covered with whiteboards and opened up to create a cavernous learning space and host to 28 students.

Last December when the two approached Dan, his curiosity was piqued. "They pitched an idea for this brand-new class," he says, "one that tapped into both their interests and talents. I saw the potential benefits for our students immediately."

For the past several years, Arlën has been the only 6th grade math teacher at Wildwood and Katie the sole 6th grade science teacher. They'd often conferred with each other about the work that students were doing in their respective classes, and as their professional friendship grew, they realized the potential benefits in doing more planning and work together.

Because Katie and Arlën hold credentials in math and science—and their classrooms were adjacent, separated by only a wall—merging was relatively simple.

"Removing that wall turned out to be the only challenge in making the STEM class a reality," Dan says. "Arlën and Katie did all the difficult legwork. They crafted the course proposal, did the research, and plotted out a year-one curriculum."

For Dan, having teachers who take such initiative reminds him of why he loves working here. "It really makes me appreciate Wildwood and the innovations that it embraces when we can move from idea to action in only a few months," he says. For him, it's also being in the position of having teachers who are creative and bold enough to generate a plan and then act on it. "All I needed to do was ask them, 'How can I help?'"

Katie and Arlën are now part of the effective team-teaching corps at Wildwood's middle and upper campus—joining the arts, P.E., and humanities teachers. "Now we have two more teachers at Wildwood who envision themselves beyond the bonds of a single discipline," he says. "This allows teachers to be even more creative, which results in more authentic project-based learning for students."

SCALING UP THE BENEFITS

Back in Katie and Arlën's STEM class, students are busy finding solutions to their real-world scaling problem. Scale their objects up too much, and run the risk of not being able to get their finished projects in the classroom door. (It's happened, Arlën cautions her students.) Scale them down too far, and students come up against the limitations of their available measuring tools. (How will you measure in micrometers?)

Sixth grader Ava T. explains taking the measurements of a playing card (the ace of spades), of which she anticipates building a scaled-up version. Talking through her process, Ava first defines and records the dimensions of the card. Then she takes on the more challenging task of identifying the card's details—the size of the spades on the card's face and, on the obverse, measuring the margin between the card's design and edge. She repeatedly references a giant, scaled-up playing card, perched on a classroom shelf—an example of student work from prior years. "I want mine to look as good as that one," Ava says.

The class makes it clear that it's not just classroom knowledge that's emphasized here—applications matter. "Constructing the scaled-up objects requires the students to learn and apply design and engineering skills," Katie says. "To construct their oversized objects in the correct proportion to the original, they need to understand how it works in real life."

At Wildwood middle school, STEM learning is the result of an organic and intentional evolution.

For Arlën, a fresh look through a STEM lens has afforded her the opportunity to rethink the scaling project—which she'd taught solo as part of the discrete math curriculum for years.

Katie offers another example: "Arlën used to have students measure their objects using inches and fractions. But in 6th grade science, we use the metric system—so we've adapted the project to provide students an opportunity to integrate this new content."

Students are also aware of several other benefits of the new class and its structure.

"Having two teachers is really helpful," 6th grader Gage D. says. "If you're stuck and need some help, either Katie or Arlën will be right there for you."

The teachers concur on this account. Katie says, "Having both of us in the room makes it so much easier for us to consult one-on-one with a student, to make sure that he or she is getting everything needed for success."

"It's just easier on the brain," Myles S. says. "You always know that you'll be doing something interesting in class. It's not always math, and it's not always science." His tablemate, Imani G., says, "Learning the two together just makes more sense. And there are projects where we get to use what we're learning; we get to go deeper."

An additional benefit accrues to the girls in 6th grade STEM. "We're two females in a field still dominated by men," Arlën says, "and that makes a difference. It sends a powerful message to our girls that science and math are accessible to females—and are enjoyable."

"Our colleagues at the elementary campus have laid the groundwork for us," Katie adds. "Anna Boucher and Christie Carter have been team-teaching the sciences for years. So when students get to 6th grade, they see women in these fields as something natural."

We know our Wildwood graduates will pursue a huge range of professional and personal endeavors in the future, and developing a capacity for STEM thinking will be of value to all. Minds trained to think critically, draw well-reasoned conclusions, and always ask *why?* can map their understandings onto innumerable experiences. Tomorrow's most important questions won't have easy answers, and Wildwood STEM students are working hard today developing the requisite skills to place them in positions of thought leadership that our world will need.