Swimming in Science

By Peter Grier

AFA's Teacher of the year is Margaret Spigner.

When Margaret Spigner was in high school, the ocean became her playground. That's because her father was in the Navy and they were living at the US Naval Station in Guantanamo Bay, Cuba, where opportunities for land-based excursions ended at the wire fence. So she learned to scuba dive and sail and spent hours exploring Guantanamo's beaches and the waters offshore.

"It's quite interesting tacking a sailboat in front of those monster Navy ships," Spigner said.

One day, while diving, she and her brother realized they were being followed by a barracuda. As they escaped to shore Spigner wondered what had attracted the predator: a fish they'd speared, the vibration of her shaking limbs, or even her beating heart.

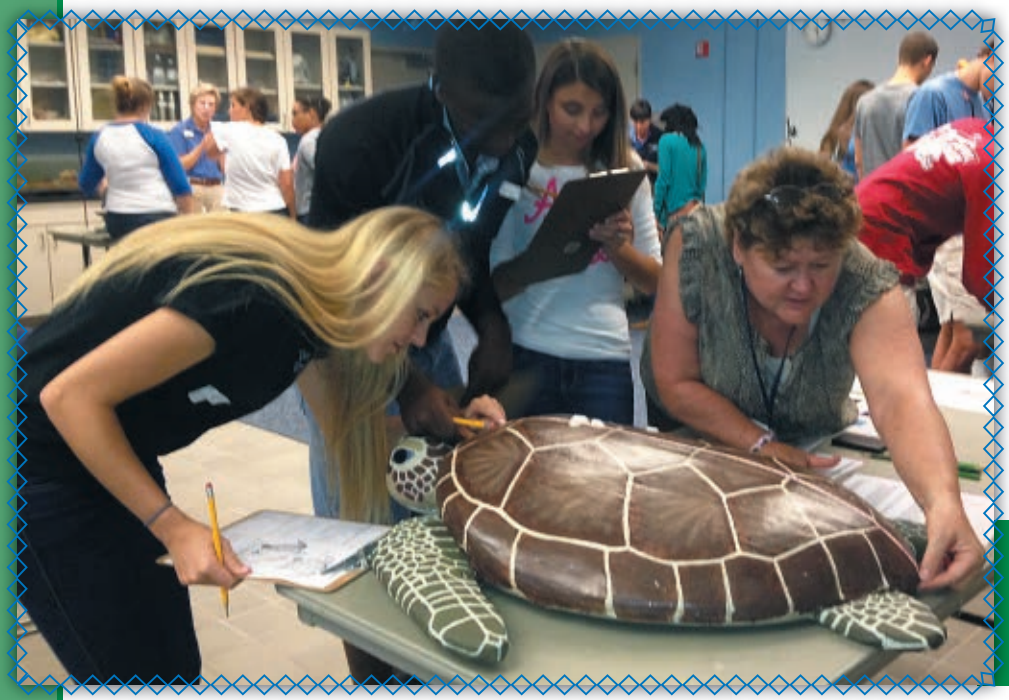
The incident hasn't deterred her from going back in the water. Instead, it pushed her to learn more about the water's life. And the more she learned, the more she wanted to tell others; the more she wanted to teach.

I didn't realize then how much influence my experience with the ocean would have on my career now," she said.

Spigner has been an educator for 31 years. For the last 26 years she's taught marine science, biology, biotechnology, and other science-related classes at what is now West Ashley High School in Charleston, S.C.

Last August the Air Force Association named her the 2013 AFA National Teacher of the Year. AFA cited her for her leadership in science, technology, engineering, and math, her emphasis on real-world learning experiences for her students, and the motivation that has landed her classes more than $140,000 in grant money during her career.

"This is a true lifelong teacher who is still empowering our students with knowledge and the drive to go on to college and continue the management of the planet," wrote retired Maj. Gen.



Margaret Spigner (right) works with (l-r) Shelby Geiger, Alusine Kamara, and Savannah Canaday on a project at the South Carolina Aquarium.

Arthur J. Rooney Jr., South Carolina State AFA President, when nominating her for the association's award.

Projects are the foundation of Spigner's educational approach. Consider the activities of a recent crop of students, who named themselves the WATER (West Ashley Team of Environmental Researchers) Wildcats, after their feline school mascot.

In 2012 the WATER Wildcats started the year by walking around the school looking for environmental problems to solve. One thing they discovered was that the maintenance crews were using a chemical to aid in scraping wax off floors. The crews then poured the used chemical-wax mixture down storm drains, which led to water detention ponds next to the school building.

"The kids were all, 'Oh, no, our poor fish. We can't let that happen,'" said Spigner.

So they put up signs next to the drains asking workers to refrain from dumping. They planted grasses around the two ponds—which total about three acres in surface area—to slow polluted runoff from reaching pond water.

The crews kept using the drain, though, and other workers kept mowing down their plants. So the students hatched another plan to help the ponds sustain plant and animal life: a floating wetland.

They engineered and built the wetland themselves. It consisted of round, floating circular pods lashed together in the shape of a big paw, in recognition of the "Wildcats" school team name.

"It's really cute seeing it from Google Earth as a paw print on our pond," said Spigner.

One day, disaster struck when a big storm deluged the pond, ripping the wetland loose from the ropes that had been attached to cinder blocks to anchor it at the bottom.

The students themselves had to figure out how to corral the runaway wetland (more ropes and a truck) and how to fix the problem. They engineered a flexible system so that the wetland could rise and fall on its restraints, dependent on water levels.

They then monitored water quality to see how or if the wetland was changing its surroundings. For additional fish habitat, students designed an underwater reef using AutoCAD. They produced a prototype on a 3-D printer and then tweaked their reef in a 50-gallon fish tank until it achieved optimum attractiveness to fish.

Subsequent classes have continued to work on the detention pond project. This year Spigner's students are constructing small underwater remotely operated vehicles that will be used for pond research, among other things. One ROV will sample water. Another will carry a plankton-catching net. A third will be equipped with a camera so that students can finally see for themselves whether fish are aggregating around the underwater reef.

"The things the students have done have been effective in terms of habitat for wildlife. We had had mallard ducks come in and nest," said Spigner. "We think our fish population has increased. Our data is supporting that conclusion."

STILL HAVING FUN

Like many educators, Margaret Spigner did not go straight into teaching after graduating from college. Her undergraduate degree from Radford University in Virginia was in interior merchandising, with a minor in art. Once out of school, she got a job designing and selling kitchen renovations. Then one day she went to a local high school that needed a redo for its home economics kitchen. The teacher she worked with on the job convinced her she'd be a great teacher herself.

She started the process of obtaining state certification. She thought she'd be able to teach home economics and design, but it turned out she couldn't, because she didn't have the proper educational credentials. She'd taken a number of science courses in college, however, particularly chemistry, which is applicable to art. The state of South Carolina needed science teachers.

"They said, 'We'll certify you in either biology or chemistry,'" Spigner recalled.

In 1982 she started as a novice teacher at Trident Academy in Charleston. Five years later she switched over to Middleton High School in West Ashley, one of six major areas within Charleston city limits. She's been there since. (In 2000, Middleton combined with another public secondary school to form West Ashley High.)

"They didn't have marine science as a course at Middleton when I first started teaching. We introduced it," she said. "It was just a perfect fit in Charleston, partly because we're so close to the ocean."

Along the way she's picked up a master's degree in teaching secondary education, with an emphasis on biology and marine science, from The Citadel. She's accumulated more than 85 hours of postgraduate schooling at area universities in STEM leadership education.

Technically, she is retired. But the state still needs science teachers, so she is in a "carry program" where she is offered retirement but is able to bank that offer and continue working for five years.

"As long as I'm still having fun, I think I'll stay," she said.

Spigner says that one of the best parts of teaching is seeing kids create and design. It's extra special if she sees that experience help them be successful later on.

Recently she shepherded a team through a regional round of the SeaPerch Challenge, a competition for small underwater ROVs. For SeaPerch, students build me-

Rear Adm. Brian Brown (l) and team mentor Walter Runck (from SPAWAR, the Navy's Information Dominance systems command) pose with Spigner's SeaPerch team. The students are (l-r) Chandler Burt, Matthew Heidtman, and Emilie Lombardi.

Spigner accepts her Air Force Association Teacher of the Year award from AFA Board Chairman George Muellner (l), Vice Chairman for Aerospace Education Jerry White (c), and Vice Chairman for Field Operations Scott Van Cleef (r) at AFA's National Convention in September 2013.

chanical "fish" from similar kits, perfect them, and then battle head-to-head in a series of events, such as obstacle course navigation or the retrieval of weighted objects.

One of the 25 judges at this event attended Spigner's classes as a youngster. After high school, this woman eventually earned a doctorate in marine science and went to work for the National Oceanic and Atmospheric Administration. She'd designed a method of measuring water quality with small clams.

"That was my student," Spigner said proudly.

Her current students did very well in the competition. West Ashley kids took first, second, third, and overall, among 52 schools. (The fact that one of the judges was an alumna had no influence on the outcome, Spigner hastened to add.)

SeaPerch is popular with her classes, Spigner said. It's another example of her belief in project-based learning. Students assemble the ROV kits themselves, learning wiring and soldering. Then they go through an engineering process to try and determine which shapes are the most hydrodynamic.

They learn a number of physics concepts while they're enjoying building their remotely controlled mini-subs. Then they get to put them through their paces in a contest against other teams.

When the contest is over, students can adapt SeaPerch ROVs for real-world uses. The ROVs that Spigner's kids are using in their detention pond are former SeaPerch kits.

"We're always trying to develop new ways to play with our toys," she noted.

When the Deepwater Horizon oil spill in the Gulf of Mexico was in the news in 2010, it prompted lots of discussion in Spigner's classes about ROVs and their use in underwater environmental disasters. In 2014, with the mysterious disappearance of Malaysian Airlines Flight 370, the class has once again had an opportunity to talk about the possible uses of underwater ROVs in real-world searches.

"It is STEM, SeaPerch," observed Spigner. "We've been doing that since I started in teaching 30 years ago. We just never named it STEM."

GOOGLE IT

Spigner added that within STEM education the teaching of teamwork is almost as important as the teaching of scientific skills. There aren't too many science or engineering jobs where people work as individuals. Most involve teams. Indeed, most jobs of all sorts require teamwork.

Before the WATER Wildcats start on a major project they will spend four to five days on team-building exercises. They do "crazy things," said Spigner, such as seeing which teams can build the tallest structure out of a box of forks.

"We build a comfortable relationship in the team before we begin a challenge," noted Spigner. "If you do that as a teacher—get them to feel safe and comfortable in a team—it is amazing what you can bring out in individual students."

In Spigner's classes, students take on roles within projects that imitate roles they might gravitate toward in a professional career. There are student project leaders, communications liaisons, design and engineering managers, support staff, and so forth.

There is even a student grant-writing team. It has won donations totaling more than $10,000 for the school from a wide variety of organizations. The WATER Wildcats have been named Overall Champions of the Environment by South Carolina's Department of Health and Environment Control. They've been featured in a TV commercial promoting the state.

Spigner herself has picked up grants from NOAA, Walmart, and Boeing, among others. She and her students go to elementary and middle schools in the area to show off their work and talk about the environment and the pollution around them.

Due to her work, "thousands of students have benefited and come to have a better understanding of the world they live in," wrote Charleston Mayor Joseph P. Riley Jr. in a letter supporting Spigner's award candidacy.

One thing that's changed a lot over the decades of Spigner's career is technology. Every kid now seems an expert in tablet and smartphone applications and technology. The answer to every question seems to be "Google it."

"The technology piece has just exploded. ... It's been a learning curve for me for some time," said Spigner.

She's had to take an iPad class herself. She learned how to design apps in a technology class at The Citadel.

School microscopes used to be simple optical devices; now they're computer-aided optics equipped with USB connectors. "Funding is always an issue," she said. "Our district is really working hard to keep up with technology."

One new educational endeavor looming in her future is CyberPatriot. Spigner has signed on as a coach of an open division team in the Air Force Association-sponsored student cyber defense competition. West Ashley High School has a JROTC CyberPatriot squad as well.

"You are to be commended for the above-and-beyond commitment you give so unselfishly in order to help prepare the next generation's national STEM workforce," wrote AFA Vice Chairman for Aerospace Education Jerry E. White in a letter informing Spigner of her Teacher of the Year honor. ■

Peter Grier, a Washington, D.C., editor for the Christian Science Monitor, is a longtime contributor to Air Force Magazine. *His most recent article, "Mission Accomplished," appeared in February.*