

- **IPEDS enrollment, Fall 2010:** 4,823
- **Type of community:** Rural
- **Number of campuses:** 4
- **Number of chemistry students, Fall 2011:** 100
- **Number of full-time chemistry faculty:** 1
- **Number of adjunct chemistry instructors:** 4
- **Structure:** Chemistry is within the Physical Education, Health, and Science Division
- **Focus of chemistry program:** Transfer
- **Sections of the Guidelines used:** 4.1, 5.1, 5.10, 6, 7.2, 7.3

Jack Lee Hayes, the only full-time chemistry instructor at State Fair Community College, relied on the *American Chemical Society (ACS) Guidelines for Chemistry in Two-Year College Programs* to restructure the college's chemistry program. He used the Guidelines to

- Revise the curriculum
- Shift the focus of class sessions to students doing chemistry and analyzing laboratory experiment results
- Add academic journals and scientific databases to the college library's collection for his professional development and students' research assignments
- Develop students' skills in laboratory safety and the use of chemical literature
- Influence facility decisions and set enrollment limits

When Hayes joined the faculty at State Fair Community College in 2005, it was his first full-time teaching assignment. The college's chemistry classes met for 50-minute lectures 5 days a week and one 50-minute lab per week. The schedule inhibited students' engagement in chemistry, and the curriculum did not address the philosophy of science.

Hayes turned to the Guidelines to set goals for himself and to explain his actions and requests to administrators. "In my background, my training, my culture, I like to have specific targets. I may not always go to them in the most linear fashion, but I like to know where I'm headed," he said.

Making Curriculum More Hands-On

Hayes first used the Guidelines to set parameters for himself and program goals. Then, usually with the Guidelines in his hand, he made his case to supervisors and colleagues for changes in policies and practices. He has overlapped the recommendations in the Guidelines about pedagogy, resources, and students' skills to make "appropriate and substantial laboratory work" the cornerstone of the chemistry program. The curriculum now incorporates hands-on, investigative chemistry activities, student-centered research projects, and group learning. He chose a textbook that uses an atoms-first approach to build students' knowledge beginning with familiar materials, like water. More recently, Hayes worked with local school districts and regional universities to ensure that the college's chemistry program aligns with the programs of the other sectors.

As soon as he could, Hayes changed the class schedules so that sections meet fewer times in multi-hour blocks rather than every weekday for 50 minutes. "You need more than 50 minutes, because if you only meet for 50 minutes, you barely have time to say, 'OK, yesterday we were doing this, and now we're going to do this, and ... for tomorrow you need to do this,'" he explained. Hayes finds that students show improved comprehension and information retention when they do experiments and discuss them immediately afterward during the longer-format class.

Less frequent—but longer—class sessions also help State Fair's students, who typically have long

commutes to the main campus or a campus center from their homes in the 14-county Central Missouri district. The hybrid version of the Introduction to Chemistry course is a popular option for students who are not science majors. They come to campus once a week for extended, in-person discussions and hands-on labs to supplement the course's online content.

To avoid being the “sage on the stage,” Hayes instituted a “studio” lab for all the chemistry courses. This format combines his instruction with class discussions and laboratory activities. He usually has students conduct demonstrations that he incorporates into his presentations. He also delegates activities for small groups of students to complete, analyze, and report on to the entire class.

Enforcing a Dress Code as Part of Safe Laboratory Operations

Because students must arrive at every class “prepared to handle chemistry,” Hayes used the Guidelines to set safety standards and enforce a dress code. With a large portion of students' grades based on the lab experiments and discussions, there have been only a few times when Hayes has had to send students away for inappropriate attire.

The dress code that Hayes created for chemistry at State Fair Community College was influenced by his industry experience. It requires that students' shirts have fabric within four fingers of the clavicle notch. Sleeves must cover students' armpits during normal motion, and fabric must cover their mid-ribs at all times. Pants or skirts must go all the way down students' legs to shoes, which must cover heels and toes. Hair must be pulled back, too. Hayes keeps extra shirts for students to use as lab cover-ups but has sent away students wearing sandals or pants with holes. The administration has backed Hayes' enforcement of a dress code for chemistry.

Adding a Research Component to Courses

The college's administration has also supported Hayes' requests for additional chemistry journals and databases. He explains that, “We did not have a good science database in the library, and I approached them and said ‘Both I, as an instructor, and my students need to have access to a reasonable number of journals.’ Now amazingly, for the most part they said ‘OK.’ I think it helped because most of the time when I made requests I would reference ... best practices as stated by the *American Chemical Society Two-Year [College] Chemistry Guidelines*.”

Hayes encourages students in every course to learn how to use scientific journals, evaluate information, and conduct research. To gain permission to handle reagents, students must provide their own materials safety data sheets. These summarize information about a chemical's structure, uses, and hazards and also cite where the students found the information.

To build students' critical thinking skills, Hayes requires them to find and analyze the original papers describing the research studies reported in the news. For nonscience majors, the lab final is an extrapolation or extension of a previous experiment. For science and engineering majors, Hayes requires a semester-long group project with a presentation of results.

Setting Class Size

Hayes also used the recommendations in the Guidelines to provide 50 square feet of net space per student and to meet other facility recommendations when the college renovated the chemistry labs on the main campus and started offering chemistry at off-campus centers. Following the 50-square-foot guideline is not easy. At two off-campus centers,

where chemistry courses were offered for the first time in 2011, the small size of the laboratories has meant enrollment must be limited to 12 students, rather than 24. In addition, and also based on the Guidelines, Hayes had a portable eye wash station added to one center room that did not have a water supply line.

Even in the new science building that opened on the main campus in 2009, adhering to the 50 square feet per student standard means chemistry class sizes are limited to 20 students. Hayes describes the planning of the new facility as a “good interactive process.” He said administrators did not argue for placing more students in the new lab when he pointed out the limitation suggested by the ACS Guidelines.

“A large portion of the way chemistry runs at State Fair is formed by the Guidelines. I use them ... as my boundaries, my objectives, what I'm heading for, and then I don't have a contentious relationship with my supervisors,” Hayes concluded.

The content of this case study was provided by Jack Lee Hayes. While serving in the U.S. Navy, Hayes worked as an engineering laboratory technician. He then worked for 10 years for a radioactive waste remediation company. Hayes decided midcareer that he wanted to teach chemistry, so he earned his bachelor's degree at Western Montana College. From there he went to Indiana University, where he earned a master's degree in chemistry. He also earned a master's degree in adult education and distance learning from the University of Phoenix. During graduate school, he “fell in love” with community colleges while teaching as an adjunct chemistry instructor at Ivy Tech Community College of Indiana. He has been at State Fair Community College since 2005.