

Strategic Programs For Innovations In Undergraduate Physics At Two Year Colleges

A Project of The American Association Of Physics Teachers

A Case Study

Amarillo College Amarillo, Texas

Institutional Setting

Amarillo College (AC) located in Amarillo, Texas serves a diverse population of approximately 8300 credit students and 30,000 continuing education students through its four campuses located in Amarillo and a fifth campus located in Dumas, fifty miles away. Governance for the college system is provided by a local board of trustees operating under community college guidelines set by the Texas Coordinating Board.

AC is an integral part of the community, due in part to Amarillo being the largest city in Texas without a university. Fifty percent of all high school students in the Amarillo city limits attend AC within two years of graduation and one in six Amarillo residents attends AC each year. The breakdown of gender and ethnicity of AC students is similar to that of the area high school populations, with the exception of a slightly higher female population (59% at AC vs. 49% at high schools) and higher Asian and American Indian populations (4% vs. 3%, 1% vs. 0.2%, respectively). The African-American populations are comparative at 4% at AC vs. 6% at high schools.

Approximately 50% of the students enrolled at AC are enrolled in a transfer curriculum and 50% in a career tract program. AC students who transfer to universities will typically receive GPA's higher than other transfers or native students. Technical program graduates report a placement rate of 94%. Health occupations rate consistently high (90%) for licensure and certification.

The Physical Science Department, comprising physics and chemistry, is housed within the Science and Engineering Division, the largest division on campus with a staff of 145. Atypical of most TYC physics programs that have one or two faculty, AC has five full-time physics faculty, one of whom serves as the Chair of the Science and Engineering Division. Two of these faculty teach geology and astronomy as part of their regular teaching responsibilities and one faculty teaches calculus during the summer. A retired high school physics teacher serves as a consultant for a NSF/ATE funded project addressing in service and pre service teacher training. Support staff include a full time administrative assistant and a staff assistant.

The AC physics program provides a wide range of courses including the traditional suite of algebra-based and calculus-based physics courses, a preparatory physics course for students with limited backgrounds in science and math, an integrated physics course for elementary and middle school teachers, and a physical science course for non science majors. An allied health physics course services the occupational therapy, pharmacy and physical therapy programs.

What Has Been Done

1. The enrollment in physics has been stable over the past five years and the number of STEM majors enrolled in physics has increased by about 4%.
2. The physics program aggressively recruits minority and female students.

3. Microcomputer-based activities, spreadsheet and computational activities are used extensively in physics laboratories.
4. The physics faculty, in partnership with other STEM faculty, conduct successful and highly popular outreach activities to area schools.
5. Engineering and physics majors successfully transfer to universities and applied health programs are well served by required physics courses.
6. The physics program is an active participant in and contributor to teacher training. The program has implemented an Integrated Physics course, one of four integrated science courses fulfilling education requirements set by AC's major transfer institution. A part-time staff member, a retired physics teacher from the Amarillo School district, serves as consultant for the AC Teaching Education Center and coordinates the students' experiences with in service teachers.

Indicators of Success

1. The physics courses at AC have achieved a comparative balance between males (52%) and females (48%) and minorities comprise about 21% of the physics student population.
2. From 2000 to 2002, the physics program enrolled about 12 students who indicated that they were pursuing a major in physics. For the same period, the total number of students majoring in a STEM discipline increased from 209 in 2000 to 235 in 2002. The majority of these students will transfer to universities. Most of these will go directly into the workforce as engineers after completing their baccalaureate studies and some transfer students will enter the workforce with degrees in technology.
3. Faculty are implementing physics education research based curriculum (*Just in Time Teaching* and *Physics of Inquiry*) into physics courses targeting STEM majors (among these are students who plan to teach physics/science at the secondary level)
4. The Division of Sciences & Engineering conducted a successful Pre Freshman Engineering Program (Amarillo PREP) over thirteen years for area middle and high school students. 88% of the students recruited during the lifetime of the program were minority students. Follow-up studies of its student participants reveal that all graduated from high school, 63% went on to college, and 47% entered engineering or science disciplines.
5. The Science and Engineering division hosts the annual Panhandle Science Fair. (This commitment has led to a permanent line item in the division's budget.)
6. The AC's CSEMS scholarship program funded by the NSF successfully attracted 51 computer science, engineering and math majors from the Fall, 2000 to Spring, 2003. 48% of these students are minority students.
7. The Integrated Physics Course satisfies the education requirements for future teachers at Amarillo College's transfer institutions. 90% of the students enrolled in this AC course go on to become teachers. In addition, 3-5 students enrolled in the algebra-

based and calculus-based physics courses (representing about 1% of the combined enrollment for these two courses) will pursue a major in physics as a secondary teaching area.

Keys to Making the Changes

1. *Strong Departmental and Divisional Leadership.* Decision making responsibility for implementing academic change, instructional and programmatic, is the domain of the leadership of the Physical Science Department and the Science and Engineering Division, who are themselves science teaching faculty.
2. *Collaborating STEM Faculty.* The leadership of the Science and Engineering Division and the Physical Sciences Department has forged a strong and viable collaboration among the STEM faculty, enhanced by the multi science teaching responsibilities of many of the divisional faculty. The activities of the division reflect the faculty's shared commitment to providing quality education and helping their students succeed.
3. *Supportive Administration.* The administration encourages its faculty to try new ideas and, upon recommendation from the divisional chair, cooperates with them to find the resources to implement change. The administration supports the efforts of the Science Division in seeking external funding from such sources as the NSF, NASA and Hewlett Packard. However many of the physics efforts are internally funded and some appear as college budget line items. Professional development is required for faculty promotion and tenure and appropriately then, faculty are granted semester or year sabbaticals. AC also requires that all newly hired faculty complete four courses providing a philosophical understanding of community colleges and the mission and goals of the AC system. (This provision is rarely encountered among two year colleges in our country.)
4. *Team of Diverse Physics Faculty.* The physics faculty, with many years of combined physics teaching experience, have diverse backgrounds ranging from astronomy, geographic information systems, geology, research physics, teacher education, and computer technology. The faculty are very receptive to new ideas and technology. They are active members of physics professional societies, including the national and Texas Section American Association of Physics Teachers, and regularly participate in professional development activities addressing both physics content and new teaching innovations.
5. *Student-Centered Environment.* There is a college-wide commitment to student success manifested by college policies and support programs. STEM majors are required to obtain faculty advisement from the Science Division Chair prior to registration. Institutional tutoring and mentoring programs, such as Supplemental Instruction and the Access Learning Center, provide basic skills development and peer tutoring. The college facilities include informal student lounge areas located near the science-engineering classrooms and laboratories that serve as sites for student study groups. Special college services help faculty prepare presentations using technology and a Testing Center provides assessment services facilitating instructional planning.
6. *Financially Resourceful.* With funding from the Texas A&M University System through the Houston Endowment Grant, the college was able to establish the Community College Teaching Education Center that oversees the award of scholarships and advisement of pre service teachers. With funding awards from the Texas A&M University System through the Houston Endowment grant to Amarillo College and West Texas A&M

University (WTAMU), Amarillo College provides 40 scholarships from \$300 to \$800 to specified education majors who start their college career at the community college and finish at WTAMU. A NSF/ATE grant received last year provides funding to extend the alignment, articulation and oversight of AC's science education courses. AC combined these two grants into the Teacher Education Center, housed and operated on the AC Washington campus. Currently 575 majors in education are being assisted.

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