Strategic Programs For Innovations In Undergraduate Physics
At Two Year Colleges

A Project of The American Association Of Physics Teachers

A Case Study

Mount San Antonio College
Walnut, California

The Institutional Setting

Mount San Antonio College (Mt. SAC) in Walnut, California enrolls about 42,000 students, making it one of the largest single-campus two year colleges in the United States. When the college was opened in 1946 it enrolled 625 students. The growth experienced by Mt. SAC mirrors the growth occurring within the community it serves. The college shares a boundary with California Polytechnic State University - Pomona, which receives the largest number of Mt. SAC transfers.

The community surrounding Mt. SAC is highly educated but the economic bracket is middle to low income. Currently the college, a Hispanic serving institution, has an enrollment that is 38.2% Hispanic, 22.1 % Caucasian, 24.5 % Asian and 5.8 % African American. During the last ten years, the community has experienced a substantial growth in the Asian population.

Mt. SAC has 37 academic departments grouped within six instructional divisions, each of which is headed by a dean. The Department of Physics and Engineering is in the Division of Natural Sciences along with the departments of Agricultural Science, Biological Sciences, Chemistry, Mathematics and Computer Science, Registered Veterinary Technology, Earth Sciences, Astronomy, and Photographics.

The Physics and Engineering Department has five full time physics faculty and one full time engineering faculty. Two of the physics faculty with engineering backgrounds share responsibility for teaching some of the engineering courses. Two of the five physics faculty are tenured and have taught at Mt. SAC for ten years. The Department Chair was hired as a physics faculty member three years ago and was only recently promoted to the Chair position. The remaining two faculty have completed their first year at Mt. SAC. Approximately five part time faculty teach physics, one of whom is the former Department Chair. The Department has a full time physics lab technician and shares a secretary with the other sciences in the division.

What Has Been Done

1. The enrollment in physics courses targeting STEM majors at Mt. SAC has grown significantly during the last four years.

2. The physics program successfully transfers STEM majors to four-year institutions.

3. The physics faculty have implemented research-based teaching innovations in their physics courses.

4. The physics program successfully recruits and retains students from under represented populations.

5. The physics program provides courses targeting all students enrolled at Mt. SAC, including those students who plan to become K-12 teachers.

6. The physics program provides a nurturing environment for its students beyond the classroom.

7. Physics faculty work cooperatively with each other and with other STEM faculty.

8. Physics faculty regularly participate in professional development activities.

9. The program provides research opportunities for its students.

10. The physics program has a strong outreach program with local schools.

Indicators of Success

1. The enrollment in the algebra-based physics course displays a steady growth over the last four years with a 43% increase. The three semester calculus based course has realized a 69% percent increase since 1999.

2. Students who complete all three sections of the calculus-based physics successfully transfer to the local universities. Seventy-five percent will transfer as engineer majors. Typically 3 to 5 students/year transfer as physics majors, a reputable number from a two year college.

3. The program has successfully implemented inquiry-based activities within all physics levels. The conceptual physics course is using materials adapted from *Physics by Inquiry* and *CASTLE* in an integrated lecture/lab format. The laboratory section of the algebra-based physics uses interactive materials from *RealTime Physics* and *Workshop Physics*. The third semester of calculus-based physics has introduced *Just in Time Teaching* with desktop experiments, McDermott's *Tutorials* and white boarding. Initial assessment tools show positive gain in student learning.

4. The students enrolled in physics mirror the college's student population by minority representation. Owing to the large influx of Asian families in the area, seventy percent of the students in engineering physics are Asian The physics program enrolls approximately 40% females.

5. Mt. SAC course offerings target students of all majors. The conceptual physics course and the physical science course target non science majors. The algebra-based sequence enrolls STEM majors and students pursuing studies in architecture and allied health. A special audience for this sequence is the engineering major who has not had high school physics. The calculus-based, engineering physics enrolls primarily engineer majors and students majoring in physics, chemistry and mathematics.

   One section of physical science is a linked lecture-laboratory course specifically designed for pre service teachers. Approximately 80% of the 60 students enrolled in the Teacher Prep physical science class are pursuing an elementary education major. Forty percent of the algebra-based physics students and the engineering physics students indicate that they will consider teaching as part of their career path.

Physics student tutors employed and trained by the college's Supplemental Instruction Program are inspired to pursue degrees in physics and ultimately to teach at the college level.

6. The Physics-Engineering Department has designated a room centrally located among the faculty offices as a well-used student study room with computer, Internet access, whiteboards and reference materials. Students (typically four) actively tutor and mentor other students either as student instructors in the college's Supplemental Instruction Program or as Departmental tutors/lab assistants. The Department also hires 2-4 students per semester as paper graders.

   Mt. SAC has a large and vibrant SPS chapter. Only 20 two year colleges currently have SPS chapters and of these only about 5-6 can be described as active chapters.

7. The physics-engineering faculty have bi-weekly department meetings where they share information about what works and what will not work in the laboratory exercises or share ideas on methodology. Lecture notes belonging to all faculty teaching the same course are available to all enrolled students. Two of the physics faculty will teach some engineering courses in the fall and therefore work cooperatively with the engineering faculty to successfully prepare the engineering students for transfer to Cal State Fullerton and Los Angeles and Cal Poly Pomona. Some faculty attend meetings of the math department and physics faculty incorporate topics into their courses which address the Mt. SAC Electronics and Computer Engineering Technology Program and the Airframe and Aircraft Power Plant Maintenance Technology Program.

8. Physics faculty are active members of the AAPT, the APS, the American Society for Engineering Education and the local TYC21 organizations, attending professional meetings of these organizations and incorporating activities described in *The Physics Teacher* in their classes. In addition the faculty participate in Chautauqua workshops and NSF workshops addressing physics pedagogy. Two faculty regularly participate in research programs at local universities.

9. The physics program at Mt.SAC places several students per year in summer internships at JPL, Cal Tech and other REU programs. The Special Projects, Physics 99, course allows students to perform special research projects, typically two per year, such as the design and construction of hovercrafts to the testing of new tutorial software. Student design projects are incorporated within the physical science course and engineering physics. Some additional research activities are available to students as they participate in campus SPS competitions.

10. Students enrolled in the Teacher Preparation Physical Science Course prepare activities that they present to fourth graders in nearby elementary schools. Physics and engineering faculty regularly participate in visitations to local high schools during the schools' college recruitment days. The SPS chapter also annually hosts a High School Outreach Day. One physics faculty member is active in the Speakers Bureau on the Mt. SAC campus and presents talks to local community groups.

Keys to Making the Changes

1. *A Student-Centered Environment.* The physics program at Mt. SAC maintains an environment fostering a student learning community. The accessibility of the faculty offices to the classrooms, the assignment of research projects and the active SPS chapter provide many opportunities for the students to interact with the faculty. The designation of the student study room and large hallways provide students with a place to congregate between classes. Opportunities for student employment within the physics program as tutors, lab assistants and paper graders strengthen the learning community.

2. ***Team of Committed Physics Faculty.*** The multimember physics department comprises a team of well-qualified and diverse physics faculty who are receptive to new ideas and are resourceful. A strong mentoring program is in place for the new faculty and the part time faculty. Every three years the faculty collectively examine each of the physics courses and subsequently prepare future program goals and a plan to accomplish these goals. The faculty are cognizant of funding sources for physics education initiatives and have successfully prepared proposals for external funding from NSF, NASA and Hewlett Packard.

3. ***Strong Administrative Support.*** The administration encourages the physics faculty to participate in professional development activities, providing faculty with a paid sabbatical every seven years. The Dean of Natural Sciences encourages faculty to implement teaching innovations
and will seek funding, either internally or externally, to implement and maintain these changes. In an effort to respond to the increased demand for more STEM classes and to enhance cooperation across the STEM disciplines, the administrators were successful in getting two recent bond issues passed. These bonds will fund construction and renovation of science buildings by 2005, producing a quadrangle of four buildings housing the STEM programs.

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