

Andrew Lettes, Ph. D.: Narrative

Ron Mardigian Memorial Biotechnology Explorer Award

At Pueblo High School, 96% of the students are from a minority background, and 74% are eligible for free/reduced lunch. These students are vastly underrepresented in the math and science fields. When I taught AP Biology at Pueblo High School, my largest class was six students. There had to be a better way to excite students about science, while providing a college preparatory curriculum. The answer is simple, Biotechnology, or as named by the State of Arizona, Bioscience.

In 2001, I began to include Biotechnology in my curriculum. Recalcitrant students were first to receive their electrophoresis equipment and buffer. The more relevant to the students' lives one can make science, the greater the students' academic achievements. Students observe Biotechnology everywhere from forensics themed television programs to debates on genetically modified foods. Biotechnology is relevant to the lives of us all.

Serendipitously, the University of Arizona sponsored a Biotechnology "Boot Camp" during the summers of 2001 and 2002. I then offered Biotechnology as a summer class in 2003 and 2004. All students displayed impressive gains. My disappointment was the limited enrollment of 6 students each year. During the 2005-6 school year, I offered a yearlong Biotechnology class, and twenty-two students completed the class. Since then, our Bioscience Program has grown to 5 classes with students eager to learn.

The Bioscience curriculum provides a rigorous, relevant hands-on curriculum that prepares our students with 21st Century Skills. Students become proficient in pipetting, centrifugation, DNA and protein gel electrophoresis, PCR, bioinformatics, and spectrophotometry. The units include DNA, transcription, translation, gene regulation and bioethics. Biotechnology Students have embraced summer opportunities to work in labs and enrich their understanding of Biotechnology. Pueblo students have worked in summer Biotechnology opportunities at the University of Arizona, and Pima Community College.

Bioscience students can be members of HOSA (Health Occupations Students of America). HOSA provides students a venue to participate in leadership opportunities, and various competitions. Pueblo students have participated in the HOSA National Summer Leadership competitions for the last 4 years. One student earned third in the nation in Epidemiology for the past three years. This student is currently attending the University of Pennsylvania as a Biology major.

The Biotechnology students work the Biology students. My Bioscience students travel to the Biology classes, and work in small groups to discuss and demonstrate DNA electrophoresis. This involves loading, running, and interpreting the resultant gels. Clearly the Bioscience students learn the material better since they teach it. The biology students benefit in turn from this peer education model.

Bioscience provides the framework for students to be excited about science. Society worries about the lack of college graduates in math and science. Biotechnology is a solution. The Bioscience curriculum produces students who are prepared for good paying careers in the technology sector instead of traditional service sector jobs. It has made a profound difference at Pueblo High School. This year, 130 students have chosen Bioscience. This is a great start.

Andrew Lettes, Ph. D.: Description of How the Curriculum was Modified to Meet Student Needs

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My school district, TUSD, was released from the desegregation order from 1978. Yet my high school remains highly segregated, 94% minority population. At Pueblo Magnet High School less than 10% of the student population is enrolled in at least 1 AP class compared to 20% of the district's Anglo population. My largest AP Biology class was only six students.

Most underrepresented students must work on their skills due to lack of enrichment opportunities for success in college. It is not enough to say that they should take AP classes to help them for college. AP classes such as AP Biology tend to be test driven, fast paced, and with few opportunities to motivate students who generally do not enroll in science classes. As a result, our students were not well prepared for science in college, and tended to falter when confronted with Biology 181, an introductory Biology class for majors, at the University. There had to be a better way. So I modified my curriculum to build student skills by employing a relevant curriculum that employs real work experiences in science. My Advanced Biology class became a Biotechnology class. This then evolved into a Career and Technical Education (CTE) program.

CTE training not only provides the academic skills necessary for post secondary education, but also provides students with leadership roles through student organizations, and most important for low socioeconomic students, work based learning. Parents become very supportive when they see that their student is earning internship money by doing science.

At Pueblo Magnet High School our Bioscience program provides college preparation for our students plus provides genuine work based learning. Students work in science, not simply read about it during a career search on the Internet. Bioscience not only attracts the already college bound students, but also those who are interested in work experience. Students who have mastered the content and students who have mastered the technical skills are equally valued in my classroom. This fosters a cooperative atmosphere where all students try to do well. Truly Bioscience is the rising tide that lifts all boats.

**Andrew Lettes, Ph. D.: Demonstrated Impact/Engagement of
Families/Communities**

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After four years of our CTE based Bioscience Program, I have witnessed some encouraging results. Graduated students return to the classroom to discuss their experiences in college Biology and Chemistry. Students participate in competitive summer bioscience internship programs. During their research presentations, extended families attend as well as other Pueblo students to provide support. Finally students have entered competitions that help with their career objectives, and work independently to achieve their goals.

Student achievement and community support are linked. Bioscience students are given numerous opportunities for community service at Pueblo High School, as well as at other academic sites. The Science Department offers an Annual Science Night that over 400 members of the community attend. Topics in my Biotechnology classroom include DNA extraction, dying wool with cochineal, an insect that played an important part in the Hispanic and Native American culture, and the use of spices as antibiotics. This year students will present their work on the antibiotic actions of creosote, a native plant. This is a major research project for my Advanced Bioscience class.

We also work with educational institutions outside of our school. Annually our students work with middle school students at the Mansfield CTE Parent Night. Students extract DNA, use the micropipettes, and do gel electrophoresis. During the Junior Scientists Day at the University of Arizona, Biotechnology students worked with graduate students from the Biotech Project to do DNA extractions with children throughout Southern Arizona I have opened many doors for my students, and they have walked through them.

Andrew Lettes, Ph. D.: Student Research Summary
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For the past century, bacteria were classified by three different characteristics: gram staining, bacteria shape and the effect of various nutrients, Though modern techniques brought a new method of relating bacteria through the identification of bacteria and similar genes through DNA sequencing, these techniques have yet to be fully related to prior techniques.

Problem Statement

What techniques are available for the classification and identification of bacteria, and how can they be related to previous techniques of identification?

Results

Based on the information attained through the three tradition, and comparing it through a Nucleotide BLAST, we both confirmed that our control was *Bacillus cereus*, and found that our unknown bacteria, found growing on a plate for Triclosan to be a strain of *Pseudomonas*, which is characterized as being resistant to Triclosan, gram negative and rod shaped. This is consistent with our previous methods of bacteria identification.

Conclusion

Though we discovered the genus of the bacteria growing on the Triclosan plate to be *Pseudomonas*, we're not certain of the species. This is because of the selection of our primers that isolate the 16S rRNA gene, which was not unique enough in classification to identify the specific strain of our unknown bacteria. In future experiments things we should consider are choosing a more versatile region of DNA to sequence, or a longer region of DNA to sequence in order to attain a more accurate result. In conclusion, the modern techniques of identifying bacteria were more successful in comparison to the traditional techniques.

Brian Bishop and Christina Verdugo May 2011

E. Recognition and Awards

- 2010 Arizona BioIndustry's Michael A. Cusanovich Bioscience Educator of the Year
- 2010 Arizona Innovation Heroes Award from Science Foundation Arizona
- 2010 Nominee for Arizona Teacher of the Year Program
- 2009 Arizona HOSA Outstanding Advisor Award
- 2008 Finalist Arizona BioIndustry's Michael A. Cusanovich Bioscience Educator of the Year
- 2008 Finalist Circle K Teacher of the Year Award
- 2008 Writer for state Bioscience Standards: Arizona Department of Educations
- 2008 Renewal of Arizona Innovative CTE Programs Award
- 2007 Outstanding Biology Teacher Award, Arizona: National Association of Biology Teachers.
- 2007 Recipient of Arizona Innovative CTE Programs Award
- 2005 Jordan Foundation Grant recipient
- 2003 Finalist for the Intel Math and Science "Innovator of the Year" Award.