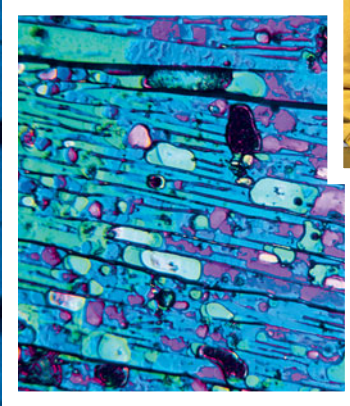


Building the Bioscience Pipeline

A snapshot of
Arizona high school bioscience education
2006-2007





Building the Bioscience Pipeline

To remain competitive in a global economy,

- Arizona's high school math and science preparation must improve;

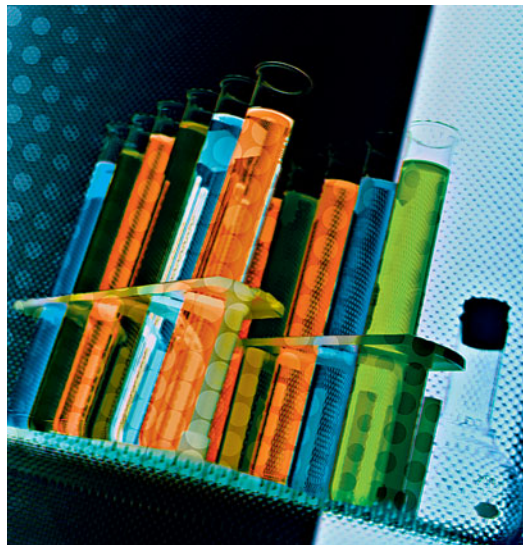


- The biosciences are an important focus of Arizona's future workforce;
- Arizona's high school science programs are a key building block in the development of that workforce.

So? What's next?

Arizona institutions and schools have already started down this path, but no coordinated statewide effort exists – to promote, develop, coordinate, or standardize existing or emerging high school bioscience programs.

Arizona's Bioscience Roadmap was launched as a comprehensive study in April 2002 by Battelle, a leading nonprofit science and technology enterprise. The study, commissioned by the Flinn Foundation, concluded that Arizona has many of the essential elements needed to become a national leader in niche areas of the biosciences, but must strengthen its medical research base and build a critical mass of bioscience firms and jobs.



The study outlined a 10-year roadmap that can “fast track” Arizona on a path to achieve national bioscience stature and a diversified economy. Check it out at www.flinn.org.

The biosciences offer an opportunity to establish a high-wage, technology-driven employment base of highly skilled workers. The Battelle definition of the biosciences includes five subsectors:

- Organic and Agricultural Chemicals
- Drugs and Pharmaceuticals
- Hospitals
- Medical Devices and Instruments
- Research, Testing, and Laboratories

One of the key strategies of **Arizona's Bioscience Roadmap** is the development of a strong workforce for the foundation of the state's bioscience enterprise.

Four major strategies

Arizona's Bioscience Roadmap is comprised of four major strategies. These include:

"Build a Research Infrastructure" and **"Build a Critical Mass of Firms"**

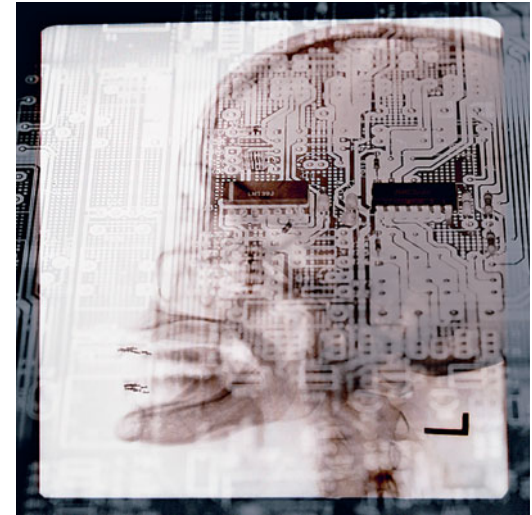
and **"Enhance the Business Environment"**

AND

"Encourage the state's citizens to become a more informed citizenry in the biosciences and encourage young people to explore and pursue scientific and technical careers."

The Roadmap recommends

- Curriculum development in K-12
- Support for science teachers





Arizona's bio workforce

In 2003, Battelle reported a "mismatch in demand and supply for bioscience workers" with key challenges in aligning supply with demand. Specifically, Battelle found that there were disconnects between Arizona's workforce needs and education programs in a number of important bioscience workforce segments.

Some shortcomings:

- Few existing Arizona education programs address the need for qualified laboratory scientists;
- A generation of biology students lack employable laboratory skills;
- The lack of education and training curricula in regulatory affairs and quality assurance for medical devices must be addressed.

Helping to piece the puzzle together are groups such as the Arizona Initiative in Math & Science Education, Arizona Department of Education, and Governor's P-20 Council.

We've got some work to do

In 2003, Battelle noted, “[There is a] limited awareness – particularly among school-age youth and those seeking new careers – of the opportunities to pursue biotech careers...especially among minority populations.”

“There is a lack of statewide coordination. A patchwork of programmatic efforts with little scale or strategic focus is emerging...making it difficult to gain resources to support the growth of needed programs.”

“Arizona will succeed in its bioscience workforce development efforts by establishing a demand-driven bioscience workforce approach that broadly emphasizes access to bioscience careers for Arizona residents.”

Where are we now?

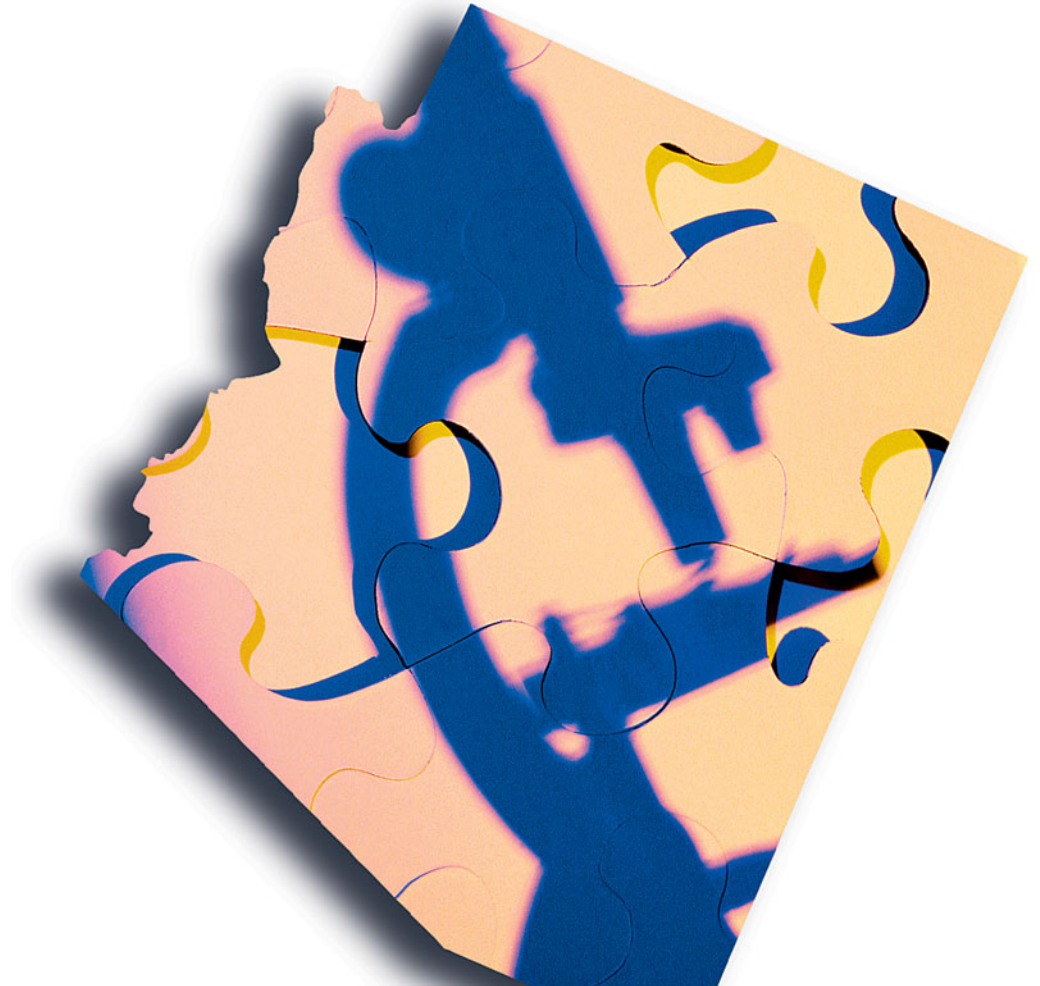
In 2006, the Flinn Foundation commissioned an online survey through **ASU's ASSET** program to canvass the state's public and private high schools on the status of Arizona high school bioscience offerings.

Of 327 high schools surveyed, 221 responded.

SRP loaned a senior community outreach representative to the Flinn Foundation for six months, beginning in June, 2006. Darrell Sheppard conducted personal, in-depth interviews with selected individuals, attempting to get a more detailed vision of bioscience education programs in our high schools.

This report is intended to be a scan of our status today. "Building the Bioscience Pipeline" is intended to give us a sense of where we are, where we hope to be, and what we need to do to get there.

The programs profiled in this report represent some of the most promising models for the advancement of high school bioscience education.



What are we talking about?

We asked educators to tell us what they were doing in "bioscience" and "biotechnology."

Here's how we defined those terms:

- **"Bioscience"** means the study and application of knowledge about genetic coding to fight disease, improve health care, improve the world's food resources, combat environmental threats, and generally improve human health and well-being.
- **"Biotechnology"** is the application of technology to any of the above problems.
- By **"bioscience education,"** we mean any combination of curricular offerings, student competencies, and community partnerships specifically understood to be preparation for continued study and/or a career in the biosciences.

We limited our scope specifically to high school and its immediate interface with higher education, based on the need to immediately address the needs of Arizona's workforce.



What's the state of our state?

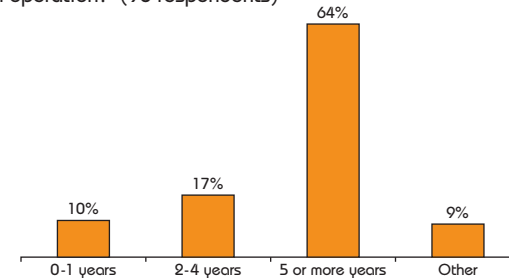
In September and October of 2006, Mighty Interactive, a Tempe-based Internet consulting firm, used ASU's ASSET program to poll every public and private high school in Arizona. ASSET – Arizona School Services through Educational Technology – is devoted to helping Arizona K-12 educators integrate technology into their classrooms. 221 schools responded, with 90 answering that some type of bioscience program was in place.

FACTS:

- Most of the 90 respondents said their program had been in place five years or more.
- Almost 80% of respondents said their program was college-preparatory.
- More than half said that no post-graduation tracking program is in place.
- Funding sources for bioscience programs came mostly from state government.

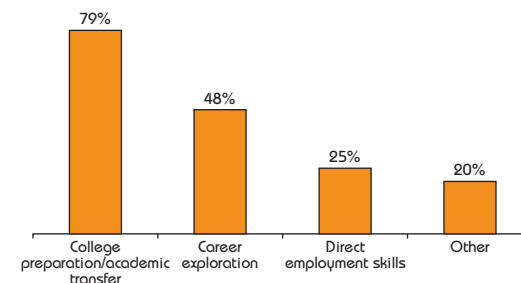
PROGRAMS ARE IN PLACE

How long has your school had a bioscience education program in operation? (90 respondents)



COLLEGE PREP IS MAIN FOCUS

What are the primary objectives of your school's bioscience education program? Please check your top two choices (87 respondents)



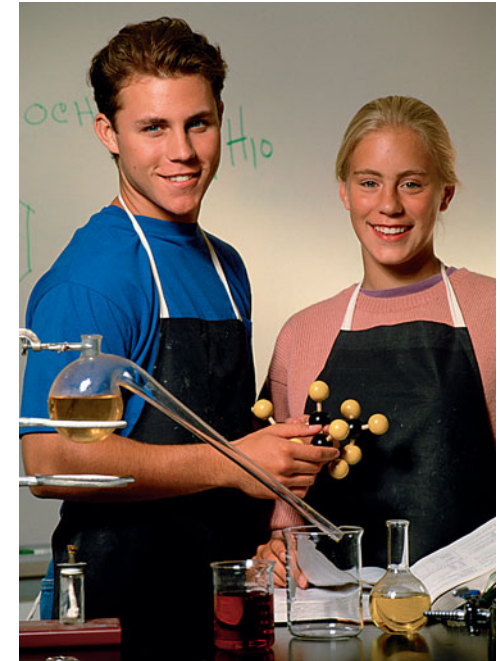
By far, the most important factors in creation or improvement of a high school bioscience program were:

- **The ability to attract and retain qualified teachers**
- **Support for program expenses and consumables**
- **Support for teacher training**

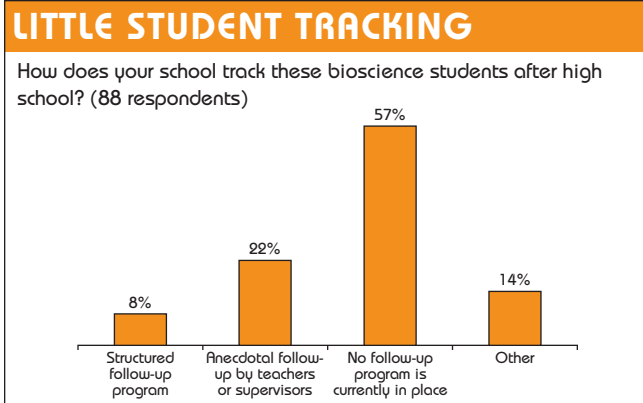
The educators' familiarity with Arizona bioscience organizations, medical facilities, education institutions, and businesses was very low.

Opportunities abound for communication and partnerships with high schools.

Nearly a third of the respondents offer a program in bioscience, but many schools indicate a strong interest in starting or growing a program.



However, today there is no coordination of these efforts in the state, and relatively little familiarity by the high schools with the state's bioscience community or initiatives.



FUNDING SOURCES UNCLAR

What percentage of funding support for your bioscience education program comes from the following sources? (85 respondents)

	None	1-25%	26-50%	51-75%	75% or more	Don't know or not sure	Total #
Municipal/county government	37%	5%	2%	0	5%	52%	62
State government	16%	9%	10%	2%	26%	37%	81
Federal government	22%	16%	3%	3%	4%	50%	67
Philanthropy	30%	17%	0	0	4%	50%	54
Business	29%	20%	0	4%	0	47%	55

The educators responded to the survey:

"Our school is in a low income, high minority ...area. I want to help [my students] realize that college isn't just for doctors and lawyers. Bioscience provides a door to that realization."

"The BIOTECH Project at the University of Arizona has been a godsend to many teachers. [Dr. Nadja] Anderson is a wonderful resource...we simply couldn't do this without her."



"Lack of funds to purchase hands-on laboratory materials is a big reason why teachers feel discouraged..."

"Why isn't there a statewide clearinghouse for science teachers?"

"The Arizona bioscience industry should make an attempt to work closer with high schools to ensure that students are aware of the opportunities that are available to them."

Who's doing what?

The following are profiles of programs that offer opportunities for duplication. They're not the only ones, but they're effective:

Arizona Science Center

Initiated by Dr. Laura Martin at the Science Center more than five years ago, the Arizona Biotechnology Program is one of the oldest continual bioscience outreach programs in the state. This curriculum and training program for middle school teachers began in 2000 with a grant from the Howard Hughes Medical Institute. It's a set of four self-contained "turn-key" supplemental curriculum manuals, available online. The program is now fee-based. The themes are DNA study, genetically-modified foods, and water. More than 250 teachers have completed the training since it began, and the program is now used in Cartwright, Mesa, and Scottsdale school districts, as well as others. Educator explorations are intensive, four-hour workshops, exploring concepts through hands-on activities and investigations. Lesson ideas, instructional techniques, and standards are addressed. Four hours of professional development are awarded for completion of the workshop, which is held at the Arizona Science Center. According to Diane McKee, who now administers the program, "The Center saw that this was more than a trend – it was a need."

Contact: Diane McKee, Arizona Science Center
(602) 716-2000, ext. 2564 or mckeed@azscience.org
or www.azscience.org



Barrow Neurological Institute at St. Joseph's Hospital and Medical Center

Barrow's High School Student Research Program is for Phoenix-area high schoolers. It's a very competitive, year-round internship in the labs of Barrow, St. Joseph's Hospital, the Mayo Clinic, ASU, and Palo Verde Labs in Chandler. Students must apply through their high schools and all Phoenix-area schools can nominate two students per year. The number accepted depends on their commitment and the number of mentors who sign up. Says Dr. Adrienne Scheck, who runs the program, "These students are excellent. It is surprising how much they can do in a research laboratory when given the chance.

When it comes to bioscience education, nothing can replace the feeling of discovery a student can get from hands-on work on a project. Each student works with a mentor to

design a research experience, which lasts from a year to more than three years for those students who return as college undergraduates. But we need more mentors to accommodate the many qualified students in the Valley." Students are expected to spend a minimum of six hours a week during the school year and four full days a week during the summer in a lab.

Contact: Natasha Dennis, Barrow Neurological Institute
(602) 406-3648 or natasha.dennis@chw.edu
or www.thebni.org

"...we need more mentors to accommodate the many qualified students in the Valley."

– Dr. Adrienne Scheck

BIO5 and the University of Arizona Department of Molecular and Cellular Biology BIOTECH Project

The University of Arizona offers the most comprehensive, coordinated, and personal outreach program for Arizona high school bioscience educators. While the scope of the offerings is statewide, most of the personal service and contact is with educators in southern Arizona.

BIO5

Dr. Stacey Forsyth offers programs in association with the Flandrau Science Center at the UA. Leveraging funds through Proposition 301, an education sales-tax approved by Arizona voters in 2000, Forsyth seeks to augment and improve a new segment in the workforce by working with science faculty at UA. This partnership has resulted in more and better offerings to the education community. Says Forsyth, "The new science center is a great opportunity for faculty to share their interests and achievements with a much broader audience."

BIO5 support to outreach programs includes support to K-12 programs, teacher internships in genomics, a Master's program in General Biology, the BIOTECH Project, and grants to university students who work with classroom teachers.

Contact: Dr. Stacey Forsyth, BIO5
(520) 626-2308 or forsyth@email.arizona.edu
or www.bio5.org

BIOTECH Project at UA

Begun in 1996, the UA Department of Molecular and Cellular Biology developed the BIOTECH Project to provide technical support for Arizona classroom teachers conducting molecular genetics (DNA

science) experiments with their students. Currently directed by Dr. Nadja Anderson, the BIOTECH Project has been successful in two major ways: the university makes equipment and expertise available to students and teachers to assist educators in engaging students in a hands-on approach to biotechnology; it also makes Anderson and the UA very popular with the teachers it serves. Noted more often than any other individual in the Mighty Interactive poll as being critical to the success of high school programs, Dr. "Nadi" Anderson serves as a model for caring, dependable outreach. Teachers served by Anderson universally insist they could not deliver high quality biotechnology experiences for their students without the BIOTECH Project.

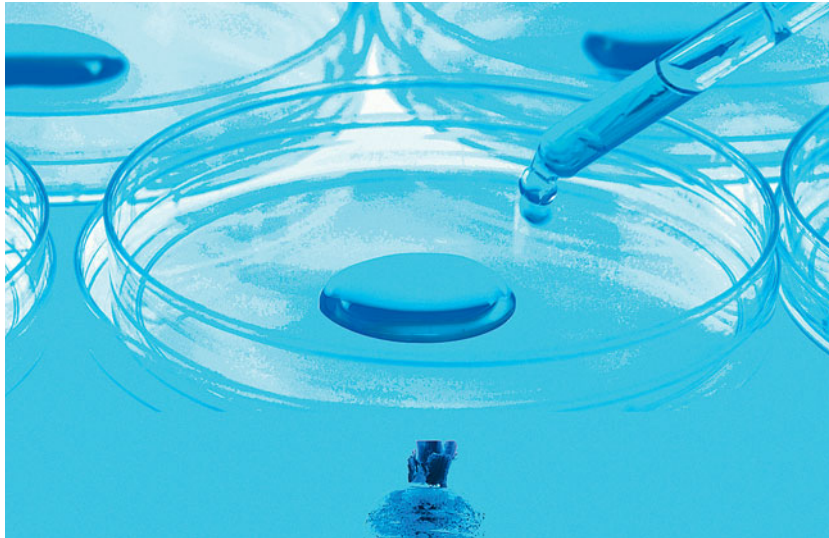
Anderson and her predecessors have worked with over 100 Arizona teachers and thousands of students each year. She supports programs all over the state. But the expanding interest in bioscience is placing too great a strain on her resources.

"The increased interest is wonderful," says Anderson. "But the funding doesn't increase at the same rate, and it's always a struggle to ensure continued funding. Most of my personal focus is on southern Arizona programs... it's a significant strain to serve emerging programs all over Arizona."

Contact: Dr. Nadja Anderson, BIOTECH Project
(520) 626-4664 or nadja@email.arizona.edu
or <http://biotech.biology.arizona.edu>

"...it's always a struggle to ensure continued funding... it's a significant strain to serve emerging programs all over Arizona."

– Dr. Nadja Anderson



Biodesign Institute at ASU

The Biodesign Institute at Arizona State University offers a paid summer internship program for high school students age 16 and older. Students are encouraged to pursue careers in science through the internship. In the summer of 2006, 18 students from metropolitan Phoenix spent eight 20-hour weeks working in the Biodesign labs on real research projects. Overseen by researchers in the labs, the students conducted benchwork, attended weekly presentations on the Institute's cutting-edge research, and toured other ASU labs and research facilities.

Biodesign plans to offer the internships again in the summer of 2007, and is in the process of developing additional outreach opportunities.

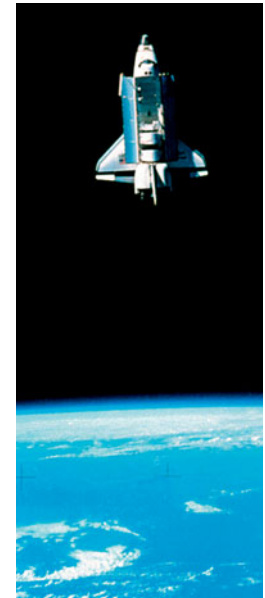
**Contact: Kimberly Ovitt, Biodesign Institute at ASU
(480) 727-8688 or kimberly.ovitt@asu.edu
or www.biodesign.asu.edu**

Challenger Space Center

The Challenger Space Center, in association with the Smithsonian Institution, offers a number of programs, including enrichment activities for children and training for teachers. In addition to their signature space missions, the Center's educators have offered a bioscience camp for children in grades 5-8 and an all-girls summer science camp. Those camps have been developed into a comprehensive science immersion workshop that can be tailored to many grade levels and disciplines. The Center also offers events sponsored by the Smithsonian Institution and plans to develop more opportunities for educator professional development, as well as partnerships with local schools. Space Center staffers have long been experts in distance learning, and are seeking innovative teachers for virtual classroom activities.

According to Acting Director Mary Lynn Kelly, "Challenger strives to inspire and educate youth to fulfill the vision for an economic future based on innovation and technical capability – a vision that certainly requires the acquisition of 21st century skills."

**Contact: Challenger Space Center
(623) 332-2001 or
www.azchallenger.org**



JobPath

The U.S. Employment and Training Administration awarded Pima Community College and JobPath, Inc. a substantial grant to conduct biotechnology training programs. JobPath is a demand-driven workforce development not-for-profit agency. One portion of the program involved a summer program for Tucson high school students. Twenty-four applicants completed a paid summer program that saw students working with major southern Arizona researchers and educators. Dr. Lisa Werner of Pima Community College says, "Many of these kids had no idea what they were getting into, but when they realized they might have a chance to help cure cancer, or contribute to something no one has ever done before, they got highly motivated. We didn't have a single absence all summer. It also didn't hurt that they got paid."

Contact: Dr. Lisa Werner, Pima Community College
(520) 206-6002 or lisa.werner@pima.edu
or www.jobpath.net

Maricopa Community Colleges

All of the ten colleges offer degrees in biology, with emphasis offered on bioscience. But only two offer certificates in biotechnology. They are Mesa Community College and Glendale Community College.

Mesa Community College

Dr. Lewis Obermiller, Professor of Life Science and Director of the Biotechnology Program at MCC, says, "We now have top-of-the-line equipment [in our labs], thanks to our generous partners. Our students have laboratory skills very competitive with, or better than, students with B.A.'s from four-year universities." The program at MCC

began in 1999, with the first cohort of graduates seeking positions in 2001.

In 2006, Obermiller teamed with Mesa High School's Xan Simonson and Dr. Steven Slater at ASU Polytechnic on a 2+2+2 grant program. "We partner with local high schools so that freshmen can 'hit the ground running'," says Obermiller. "As often as possible, we offer dual or concurrent enrollment.

"We need to increase the number of high schools offering similar coursework and programs," says Obermiller. "If the state is to realize its goals in workforce development, programs like the one at MCC need more and better-prepared students. And these high school students need options. The major universities can't be the only options for students in this arena."

Contact: Dr. Lewis Obermiller, Mesa Community College
(480) 461-7119 or obermiller@mail.mc.maricopa.edu
or www.mc.maricopa.edu

"If the state is to realize its goals in workforce development, programs like the one at MCC need more and better-prepared students."

— Dr. Lewis Obermiller

Glendale Community College

Glendale's certification program is newer than Mesa's. It began in 2004 as an official two-year degree program. Says Dr. James Tuohy, director of the program, "Our goal is to produce a graduate who is very competitive in the marketplace with a graduate of university programs. At Glendale, we offer authentic vocational preparation in state-of-the-art labs." Tuohy goes on to say, "We need to break through the impression in Human Resources departments that people who hold Associate's degrees can't compete in a laboratory with B.A.'s. Our students are very capable, and their training tends to be more practical."

Tuohy's program is new and has produced few graduates. But Tuohy worries about the other end of the pipeline. "Many of my students are adults being retrained. The high school students coming into our program are too few, and their preparation is spotty...some of them haven't even taken high school chemistry."

Tuohy is interested in the motivations of his students. "Some of them just want 'to put a brick in the wall'," he says. "They want to be on the team that cures cancer, even if their contribution is very small."

**Contact: Dr. James Tuohy, Glendale Community College
(623) 845-3845 or www.gc.maricopa.edu**

Pima Community College

Tucson's major community college also offers a biotechnology program, though its two-year certificate is intended to transfer to a university. Says director Dr. Lisa Werner, "We're working toward a goal of an integrated system here from high school to higher

education. We're not quite there." Like so many others in Arizona, Werner's program is quite new, though coursework has been offered for five years. "We've only offered a certificate for a little over a year," says Werner. "But our program can offer a student options to a university experience." Werner notes also, "Most of my students are older, more mature adults. We don't yet have a lot of high school graduates. Success in high school chemistry is our biggest predictor of success.

"Our mission is to produce a graduate qualified for immediate employment locally," says Werner. "Beyond that, we want to make the local population interested in classic science, and in the new arena of genetics and bioscience. When this thing catches fire, I'm going to need more people and more space for labs."

**Contact: Dr. Lisa Werner, Pima Community College
(520) 206-6002 or lisa.werner@pima.edu
or www.pima.edu**



NAU/TGen/Arizona Board of Regents

The Arizona State Board of Regents awarded the financial resources for a three-year professional development program to Northern Arizona University's Center for Science Teaching and Learning, and the Department of Biological Sciences. Twenty-eight high school teachers from all over the state will take online coursework, attend seminars, participate in summer and weekend workshops, and improve their grant-writing skills. At the end of three years, the teachers will have earned coursework credits as well as preparation in the biosciences, identified as a key component in building Arizona's bioscience pipeline.

Says one teacher participant, "I'm excited to learn to work with new technology and teach this new technology to my students."

According to Nena Bloom, Professional Development Associate at NAU, "Updating teacher content knowledge and skills in the biosciences is critical for increasing student achievement and preparing students for Arizona's bioscience economy."

Contact: Nena Bloom, NAU
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or www.nau.edu/cstl

TGen

The Translational Genomics Research Institute in Phoenix offers a summer internship program that concluded its second year this past summer. It's a highly competitive, eight-week summer internship program designed to provide hands-on research experience for high school, college, and graduate/medical students. Approximately 50 students are selected for the program each year. Students work in

one of the most prestigious bioscience institutions in Arizona, under the supervision of top researchers. Says the program's director, Dr. Candice Nulsen, "This program is a unique opportunity for students to experience a working laboratory setting and find out first hand what research is all about. Typically, even after one summer, students know what direction they want to take." Nulsen also says, "Right now, we need long-term commitments of funding to keep this program alive. Wonderful and generous contributors have donated in the past, but in order to sustain the program we will need to continue to seek longer term commitments."

Contact: Dr. Candice Nulsen, TGen
(602) 343-8466 or cnulsen@tgen.org
or www.tgen.org



Bioscience at the Top of the High School Curriculum

Most Arizona high schools offering more than one class in bioscience include challenging electives designed to prepare high school scholars for more intensive work in college. An important distinction is that the following programs involve sophisticated and specialized laboratory equipment, with highly qualified teachers and a significant level of technical know-how required of students. In Arizona, schools like this are few.



Palo Verde High School

Kevin Kehl chairs the Science Department at Palo Verde High School in Tucson. Forensics and Biotechnology are offered as electives to juniors and seniors. Candidates must have taken two science courses in the regular curriculum (with satisfactory grades) before they are allowed to enroll. One of the courses should be chemistry. This is the third year of the program. Approximately 150 students have completed the courses. Says Kehl, "Our classes are elective, so they represent more science than is required...if students tell their friends 'it's cool' then more sign up, and that's a large success." Kehl also says that the continued success of the program is due to the constant support of Dr. Nadja Anderson at the UA.

**Contact: Kevin Kehl, Palo Verde High School, Tucson
(520) 584-7400 or <http://edweb.tusd.k12.az.us/pvscience>**

Pueblo High School

Also in Tucson, Pueblo High offers bioscience as a standard science elective, designated "Advanced Biology." Though class sizes are smaller now than they were two years ago, Dr. Andrew Lettes has graduated just less than 50 students. Says Lettes, "Pueblo students don't tend to take higher-level science courses. This opportunity is the 'carrot' that attracts the minority students. I'm not sure they'd [take the prerequisites] if this course wasn't the reward." He also says, "We don't do 'cookbook' science anymore. The equipment we get from the UA is more sophisticated, and that makes it more meaningful and exciting for the students." But he also cautions, "This is expensive science, for a relatively few students. If you're going to help us, stay in it for the long haul – a single initial grant probably just gets us in trouble."

**Contact: Dr. Andrew Lettes, Pueblo High School, Tucson
(520) 225-4300 or www.pueblowarriors.com
or <http://edweb.tusd.k12.az.us>**

Hamilton High School

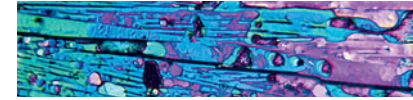
This south Chandler high school has had a successful biotechnology program in place since 2001. The Hamilton High School Biotechnology Institute currently has 34 students engaged in serious laboratory skills training and research. The instructor, Teresa Clark, says, "I don't think people understand just how much motivated high school students can achieve if they have the proper instruction and good facilities." Clark's biology students have won numerous state, national, and international honors for their research.

Composed of two year-long courses, the Institute requires students to work in teams in a research paradigm. Clark's goals for her students are that they graduate ready to enter higher education or the workplace. Her greatest joy is convincing students that her requirements are not beyond their abilities. "I don't see how anyone can really teach science without requiring students to do challenging research," she says. "They have to become involved in their own learning.

"It would be great if we could establish a network of like-minded science instructors in the state," she says. "I also need to know more about what opportunities are available to my students."

Clark adds, "It's expensive, and the amount of preparation is phenomenal. But the worst stumbling block is how few qualified teachers there are for this kind of teaching and experimentation. Our state has to do something about that."

Contact: Teresa Clark, Hamilton High School, Chandler
(480) 883-5139 or clark.teresa@chandler.k12.az.us
or www.hamiltonhuskies.com



"I don't think people understand just how much motivated high school students can achieve if they have the proper instruction and good facilities."

— Teresa Clark



Magnets and Academies

Arizona enjoys open enrollment, and certainly, any student may enroll in a charter or private school. Some districts and charter schools have elected to offer specialized programs in bioscience and biotechnology. Here are the profiles of some that offer promise:

Arizona Agribusiness & Equine Charter School

AAEC has been in the business of educating charter school students in metropolitan Phoenix for almost a decade. Students at the schools have engaged in intensive, directed investigations of plant and animal genetics. There are now three such schools in Greater Phoenix, but only one, in south Phoenix, has a focus on bioscience.

Dr. Ralph Conley is proud of the relationship his students have with the staff of nearby South Mountain Community College. "Our students graduate with about twenty-five college credits and ten credits of lab science. Most of them go on to higher education. Our kids usually come to us from areas where education is not highly prized, and their science preparation is sketchy...we introduce them to disciplines of thinking that can be highly motivating, and many of our graduates go on into science disciplines."

Like almost all Arizona biotechnology educators, Conley reports a fundamental problem. "We have a great staff, but fully-funded facilities are a challenge. As a charter school, we can do bonding, but we can still use a lot of help in making sure the kids have the equipment they need."

Contact: Dr. Ralph Conley, AZ Agribusiness & Equine Charter
(602) 323-9890 or wconley@aaechighschools.com
or www.aaechighschools.com

Mesa BioTech Academy

The BioTech Academy, on the campus of Mesa High School, is the most successful biotech training facility for high school students in metropolitan Phoenix, and perhaps the state. The director, Xan Simonson, also currently serves as the president of the Arizona Science Teachers Association. She presides over a facility that has grown from humble beginnings three years ago to a multimillion-dollar showplace for a "school-within-a-school" with excellent equipment and facilities.

Students can enroll as sophomores for a three-year program. Besides science instructors, Simonson oversees English, math, and social studies teachers. The academy's science teachers must be certified as Career and Technical Education (CTE) professionals, and the other content area teachers are receiving professional development to learn how to integrate bioscience into their curriculum. Simonson says, "The positive change in the students we've recruited makes this very rewarding...before they came to this academy, most of [the students] didn't have the dream of going to college, and now they do."

"We're trying to meet Arizona's needs – but our first question for [the bioscience] industry is, 'what's your focus?' Help us clarify that for the students."

– Xan Simonson

But Simonson voices a concern that many share about the system. The BioTech Academy is funded in part by CTE money. "Our biggest current problem is the disconnect between adequate preparation of teachers for [biotechnology] and state-mandated qualification requirements. Certification of teachers is a real problem. Our content instructors have to spend a lot of time and money getting certified in order to justify funding."

She notes, "The CTE funding is strongly tied to agriculture. Mesa was once a major agricultural community, but now our parents say, 'Why does my kid have to do a project on agriculture?' Nothing against agriculture; everybody likes to eat. But our system needs to rethink how to educate the students for success in the 21st century workforce. What worked in the past won't be adequate for the future."

Simonson also says, "We're trying to meet Arizona's needs – but our first question for [the bioscience] industry is, 'what's your focus?' Help us clarify that for the students."

**Contact: Xan Simonson, Mesa High BioTech Academy
(480) 472-5783 or nxsimons@mpsaz.org
or www.mpsaz.org/biotech**



Tucson High Magnet School

Just a few blocks from the UA, Tucson's oldest public school has been transformed into a successful magnet school for the visual and performing arts and science and technology. Margaret Wilch reports that the program has been in existence since 1995 when the UA began serious outreach to the state's high schools. "We've changed a lot from those days," says Wilch. "We're a lot more sophisticated. Our kids don't do 'cookbook' bioscience anymore; we're able to do in-depth, investigative research. Some of our students do coordinated research with UA researchers."

Graduates receive an endorsement in science and technology, with an additional endorsement if they have conducted research, but there is no specific endorsement for biotechnology. Nor is there a formal tracking mechanism. Seven staff educators deliver some portion of the program related to biology.

"The most exciting aspect of our program is our Summer BLAST Program," says Wilch. "We graduated twenty-two students."

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As the online survey suggests, many more Arizona high schools are ready to offer serious investigation in the biosciences. Three examples are [Copper Ridge Academy](#) and [Arcadia High School](#) in Scottsdale, and [Wildcat Charter School](#) in Tucson.

Career and Technical Education

Much of Arizona's response to the emerging need for a trained workforce is provided through CTE. Federal funds are routed through the CTE department at the Arizona Department of Education. As biotech instruction emerges as a high-dollar investment, many high schools have explored this route for finance. Currently, that resource requires schools to seek CTE certifications for their instructors and to adopt a strong agriculture theme. Both requirements have caused some reluctance and contention in the education community. A divide has appeared between those who view bioscience as a strongly academic pursuit and those who focus on career preparation.

Tony Maldonado, Director of the Star Tech Professional Center at Paradise Valley High School, sees this as an unfortunate misunderstanding. "The biotechnology workforce of the future isn't like many we've seen before. It'll include both medical Ph.D.'s and lab bench workers. Any kid in high school should be able to choose how far they wish to carry their education."

Paradise Valley Biotechnology Signature Program

On the campus of Paradise Valley High School in Phoenix, director Tony Maldonado is creating a biotech program that melds existing curriculum with a new vision of service to the district's students and the state's workforce. It's a magnet concept within the framework of visionary career preparation. Students from around the district can explore health and agriscience careers in a regular or honors slate of coursework. Freshmen and sophomores would transfer to Paradise Valley High from other campuses for their junior and senior years.



Says Maldonado, "We need to build the workforce capacity before employers locate or expand here. If we build it, they will come." Maldonado wants to motivate students to achieve as much as they can. "A four-year college degree isn't for everybody," he says.

"For many, community college is a very good option. But every kid deserves the tools to decide for themselves. In the meantime, the motivational factor of challenging science in high school will improve test scores in math and science." But he also cautions, "This science is expensive. I'll find the resources [for the students] somehow. But this field moves so fast, that it's easy to get behind while we talk about it."

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Peoria High School

Jim Kaltenbach has a degree in microbiology and used to run a college lab before he decided to become a high school teacher. Now he teaches biotechnology at Peoria High. "A college degree doesn't necessarily make you better qualified to perform lab work," says Kaltenbach. "If you need a large workforce of competent lab technicians, they don't all need four-year degrees."

"We've had a program for twelve years, says Kaltenbach. "In the last six years, we've moved the focus from purely agricultural to genetics and laboratory science. We've offered bioscience for three years." Approximately 50 students have completed the program since the change in focus. But enrollment has been uneven. As the Peoria district opens new schools, students are drawn off. And as the attendance demographic changes, fewer students are drawn to agriscience.

"We've headed off some potential problems, and have a really good relationship with our science department, but we still have to recruit kids, and half of our kids aren't enrolled in other agribusiness courses," says Kaltenbach. "But we can do practical, hands-on applications of sophisticated science, where other courses are theoretic."

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One school, dedicated to bioscience

Phoenix Union Bioscience High School

This high school is growing from a vacant lot in the shadows of the UA College of Medicine in collaboration with ASU, the ASU School of Nursing, and TGen in downtown Phoenix. Its first class of students is housed in the Phoenix Preparatory Academy. The unique high school will have a science and math focus, and consist of a total of 400 students in four classes. The location and focus of the school will offer high school students extraordinary opportunities for interactions with universities, private bioindustry, medical facilities, and more.

"The focus on science and math is important," says principal Dr. David Silcox. "But that's not all; we've changed the instructional model, too. We are offering physics first, then chemistry and biology, taught in a block during the sophomore year. We're also integrating math instruction with the science classes.

"It's not an elitist school," says Silcox. "Students are chosen on the strength of their interest and commitment. It's a school for any student that has

demonstrated deep interest, commitment, and success in math and science."

All the students at the school this year (2006-07) are freshmen. Many of the curricular offerings in the junior and senior years will be developed as this first cadre of students matures. Of greatest importance to this report is the commitment of the Phoenix Union High School District to a new high school, dedicated to the exploration of the biosciences.

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Where do we go from here?

If Arizona is to realize its dream of competing as a significant player in the emerging biotechnology marketplace, it will need to maximize the potential of its educational system. Policy makers cannot count on in-migration to produce our workforce because other states and nations offer attractive alternatives in this arena. **We need to build our own workforce.**



From the online survey responses and in-depth personal interviews a few important themes become clear:

- **There are a lot more high schools in Arizona that would LIKE to offer bioscience or biotechnology than currently do...**
- **More don't because**
 - ◆ They really don't know how to begin...
 - ◆ Modern laboratories for genuine, hands-on, investigative genetic experimentation are very expensive...
 - ◆ The state has a severe shortage of qualified instructors for bioscience...
 - ◆ Many faculties are divided by the CTE requirements.
- **The philosophic divide between "career education" and "college preparation" must be bridged.**

What do we need to do?

The following recommendations would make a good start:

- Form a collaboration of the major universities, community colleges, and high schools to produce streamlined 2+2+2 programs.
 - Resolve institutional barriers between so-called “academic” bioscience programs and those delivered through Career and Technical Education models.
 - Involve in policy discussions the many organizations that are working to enhance science and math education in order to position Arizona competitively in the global knowledge-based economy.
 - Propose that universities seeking educational grants should include systemic, effective, sustained outreach to high school bioscience programs.
 - Create a systematic outreach program from the state’s commercial bioscience industry.
 - Fund high school biotechnology programs as if they were just as important as interscholastic sports.
- Develop, fund, and sustain training courses for science teachers that produce confident, qualified classroom practitioners.
 - Create a central, statewide information center for any school that wishes to enter this challenging arena.
 - Start yesterday, and catch up fast.



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