

Report of the

EIGHTY-SEVENTH ARIZONA TOWN HALL

**“MAXIMIZING ARIZONA’S OPPORTUNITIES IN THE BIOSCIENCES
AND BIOTECHNOLOGY”**

Grand Canyon, Arizona
October 30 – November 2, 2005

The 21st Century has been dubbed the "Century of Biology" and in the decades ahead, breakthroughs in our understanding of nature promise both advances in human health and economic growth for regions, states and nations prepared to foster innovation. With the discovery of the structure of DNA—the human genome—bioscience is poised to be the great engine of our time. Arizona's investments in the biosciences and biotechnology offer the potential for the state to play a leading role in the worldwide effort to advance healthcare and to improve the quality of life for all Arizonans through economic development focused on human health. Maximizing Arizona's opportunities in the biosciences and biotechnology sets the stage for Arizona not just to catch up, but to sprint ahead of other states and nations that seek the mantle of leadership in innovation and knowledge-driven commerce.

As Arizona's economy begins to adapt to science-driven innovation, several questions have arisen. To what extent will Arizona benefit from the economic development of bioscience and biotechnology? How can Arizona pursue a major role in the 21st Century economy? How can Arizona best leverage and capitalize on its existing advantages and, correspondingly, address its existing weaknesses in building the state's economy? How can the benefits of bioscience and biotechnology be enjoyed by all Arizonans? And, how can any potentially adverse consequences of this new knowledge and innovation be minimized?

The 87th Arizona Town Hall convened at the Grand Canyon on October 30, 2005 and considered these issues over the ensuing three days. The conclusions and recommendations contained in this report represent the consensus reached by the Town Hall participants during this session. Although not all participants would agree with every conclusion or recommendation, this report reflects the significant degree of consensus reached during the 87th Arizona Town Hall.

EXAMINING ARIZONA’S ECONOMY

Arizona historically built its economy successfully around the “5 C’s:” cattle, cotton, copper, citrus and climate, with construction a recently added 6th. However, to be successful in the 21st Century, Arizona must diversify beyond these 6 C’s. There is an urgency for public officials and private leaders to turn their attention to building a vision for the future economy of Arizona.

Building Arizona’s Future Economy

Arizona has made significant progress in creating a positive business climate and is working toward projecting that image nationally. To attract additional businesses to our state, and to retain existing businesses, Arizona must promote and encourage collective and collaborative action among its various public programs, private industries, and public and private education systems. The collaboration must extend to and encompass various disciplines within science and technology. Arizona must gauge its progress against other competitive communities.

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Arizona must build on its current physical infrastructure. While a long-term infrastructure plan is significant, short-term planning is critical. Arizona must address transportation and communication facilities, education, tax, regulatory and water policies.

Arizona also must build on recent investments in public education to create an aligned, clearly articulated and integrated education system from early childhood through pre-kindergarten, K-12, community colleges and universities to establish a talent pool that will be necessary and to attract and keep the businesses and families that will be needed to sustain Arizona's economic future.

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A knowledge-based economy, driven by a knowledgeable workforce, goes hand-in-hand with an economy more and more dependent on Arizona's emerging "research enterprises." Already, Arizona is strong in the areas of advanced communications and information technology. In addition, the state's healthcare and bioscience research enterprises create and attract businesses with good paying jobs in the sectors of medical devices, drugs and pharmaceuticals, and diagnostics as well as provide access to quality healthcare to the state's residents. As the state's population continues to grow at a rapid pace, these enterprises will be further in demand.

Arizona should take advantage of its existing cultural diversity, its climate and its unique geographical position to capitalize on opportunities in bioscience and biotechnology. Bioscience and biotechnology have the potential to expand, diversify and strengthen Arizona's workforce, to increase the number of higher paying jobs, and to be a leading driver of the state's economy throughout the 21st Century. Arizona can benefit from a consistent, coordinated and collaborative vision of its economic potential in the biosciences and biotechnology.

The Future Impact of "Non-Healthcare" Bioscience and Biotechnology

While bioscience and biotechnology often are thought of in the context of medical science, bioscience and biotechnology advances also will integrate with and benefit many other economic sectors including agriculture and animal husbandry, forestry and environmental sciences, renewable energy, national security, mining, water resources, professional services, nanotechnology, information technology, communications, material sciences, education, software development, real estate development and construction, electronics and semiconductor manufacturing, optics, and the hospitality industry. In return, bioscience and biotechnology will benefit from advances in many of the same economic sectors including optics, nanotechnology, semiconductors, information technology, software development and communications.

There are still many opportunities in the emerging fields of bioscience and biotechnology. Arizona has several existing competitive advantages in a number of these emerging and complementary fields. Our state is known nationally and internationally for its attractive climate and lifestyle. We have a young and growing population. Arizona has an abundance of land, strong agriculture and mining industries, and a diverse and complex ecology suitable for research projects into some of the most pressing bioscience issues including arid lands studies, drought and other water issues. Various research programs and industries including semiconductor, information technology, communications and optics currently have a strong presence within Arizona. Our state has a strong and cooperative public and private university system with several top-tier programs already in place. Arizona also has a strong community college system with the flexibility to tailor its programs to the bioscience and biotechnology industry. Arizona is well-positioned to be a national leader in the use of biotechnology in security solutions. Additionally, Arizona has successfully formed and attracted several premier research and development organizations. The state has a public leadership and voter base that is demonstrating a commitment to supporting bioscience and biotechnology research and development, for example, the Technology and Research Initiative Fund (TRIF, Proposition 301) which passed in 2000, among other public initiatives.

Arizona also has several competitive disadvantages in bioscience and biotechnology that must be addressed. These disadvantages, if approached with a bold and determined vision, may be turned from hurdles into opportunities. The public in Arizona is not conversant in the potential benefits and solutions bioscience and

biotechnology offer. Arizona's education system is lacking in adequate publicly-funded pre-kindergarten and kindergarten and quality math and science instruction in pre-K-12 overall. Arizona currently does not have the number of private research and development organizations or the amount of public or private capital to invest to reach the critical mass necessary to self-sustain a large bioscience and biotechnology industry. Arizona lacks the telecommunication infra-structure, particularly within rural Arizona, to fully implement a statewide interoperable, electronic health record system that would allow exchange of health information among providers within the healthcare delivery system. Real estate development may be overtaking and converting Arizona's agricultural lands. Arizona has a transportation and communication infrastructure that needs to be improved upon to meet the more advanced needs of the biotechnology industry. Arizona has a substantial skilled bioscience and biotechnology workforce but needs to build greater capacity for the 21st Century bioscience and biotechnology economy.

The Future Impact of Bioscience and Biotechnology on Arizona Healthcare

Bioscience and biotechnology will move healthcare toward an individual and patient focused/personalized model of delivery. Personalized or individualized healthcare will result in improved patient education, improved diagnosis of existing disease, improved prevention of disease, improved long-term care, and increased longevity. Advances in bioscience and biotechnology hold the long-term potential for overall reduced healthcare costs, including the reduction of unnecessary healthcare expenditures. In addition, advances in complementary technologies will benefit communication between healthcare workers, portability of medical information and will lead to increased access to outpatient care, including community-based and home healthcare.

Arizona has several existing competitive advantages upon which to build, including world-class telemedicine and optics programs and several exceptional research institutions. Arizona is widely recognized as a pioneer and leader in the delivery of Medicaid services through the Arizona Health Care Cost Containment System (AHCCCS). Further, Arizona healthcare organizations are regularly recognized as providing cutting edge diagnostic and clinical services. The governor of the state is calling for all healthcare providers to transition to electronic medical records (EMR), as well as for the development of standards for EMR and the creation of a statewide health information exchange system. The increased usage of EMR saves time and money, allows for more time spent with the patient and decreases the likelihood of miscommunication. Better information technology and telecommunications systems will increase these existing advantages.

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Arizona has a unique, clinically diverse population, with population subsets that will benefit from increased research focus, including the Hispanic and Native American populations, a growing elderly population and a large population with high total sun exposure.

Arizona also has several existing gaps in its healthcare system that present exciting opportunities. Greater Phoenix is the largest metropolitan area in the United States without a full four-year allopathic medical school. The state has a rapidly growing population coupled with a shortage of educational opportunities and facilities for healthcare workers. Consequently, Arizona has a critical shortage of physicians, nurses, and associated healthcare providers, and a shortage of residency and other training programs. This presents opportunities for the collaborative development and construction of new facilities that are critical to Arizona's future competitiveness.

Arizona will need the educational system to educate and train the entry-level workers required by a large bioscience and biotechnology industry. Further, medical research and development depends largely on the availability of funds, and Arizona currently needs greater congressional support and a more equitable portion of federally-funded research facilities and large program funds. Arizona also suffers from low reimbursement rates for medical services coupled with high malpractice insurance rates that impact the state's ability to attract and retain physicians.

Increased availability of venture capital, especially increasing the availability of seed money for pre-commercial research and development, research and development tax credits, improved avenues for technology

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transfer, and an increase in the rate of incubator formation and expansion, would benefit technology commercialization.

Arizona's Opportunities and Priorities

Arizona's Bioscience Roadmap (first developed by Battelle in December 2002 at the request of The Flinn Foundation) contains a detailed and comprehensive proposal of short and intermediate steps addressing Arizona's bioscience and biotechnology opportunities that should function as a guide to the development of Arizona's bioscience and biotechnology leadership. Town Hall recommends that emphasis be placed on the Roadmap as a guide to the development of bioscience and biotechnology in Arizona.

Addressing Arizona's critical weaknesses in order to compete globally requires immediate emphasis on the following items: improving the education system generally and mathematics and science education specifically, capital development, technology transfer policies and regulations, and expansion of the University of Arizona medical school in Phoenix.

The further development of translational research opportunities will accommodate the realization of a "bench to bedside" approach, allowing basic research scientists and clinical research scientists to work for the advancement of patient care. This development, coupled with the efforts outlined previously, will enable Arizona to fast track its path to research excellence.

To attract and maintain top intellectual capital, emphasis should be placed on Arizona's current strengths, including its research organizations, business environment, public and private leadership, location, demographics and quality of life.

Existing strengths that should be maximized also include those areas of near-term excellence and long-term opportunities outlined in Arizona's Bioscience Roadmap—cancer research, neurological sciences, Alzheimer's research, diabetes treatment, bioengineering, agricultural biotechnology, asthma, cardiovascular and infectious diseases, and diagnostics and bioinformatics.

EDUCATING ARIZONA'S WORKFORCE FOR A BIOSCIENCE AND BIOTECHNOLOGY ECONOMY

While today's technical workforce has been adequately trained for existing jobs, Arizona's current workforce is not adequately prepared for participation in a bioscience and biotechnology economy. The focus of education has not been specific to and adequate for full participation in a bioscience and biotechnology economy. Arizona will need to educate students to fill employment positions ranging from lead scientists to laboratory directors to research technicians with specialized technical skills.

At the postsecondary education level, Arizona lacks the facilities and resources to meet the current demand for bioscience and biotechnology education as evidenced by the number of qualified applicants who are denied enrollment due to lack of capacity in university professional programs. The community colleges are doing a good job in producing students with the skills to enter the technical workforce. Professional and technical schools must become more closely aligned with the needs of the bioscience and biotechnology industry. Concurrently, the universities, community colleges and technical schools need to align their programs more efficiently to eliminate gaps and overlaps.

It is imperative that the development of math and science skills starts early. From pre-K-12th grade, Arizona must set higher academic expectations for students and strive to improve students' readiness for postsecondary education, including career and technical education. The increased need for math and science

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education can be met only by highly qualified teachers. Arizona must address the difficulties of attracting and developing enough qualified math and science teachers. Obviously, funding teacher salaries is a major part of the equation, but other challenges facing school districts must be addressed immediately such as inadequate facilities

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and equipment, lack of time and money for professional development, inadequate funding for English language learners, and lack of a system to address children who come to school not ready to learn. The universities need to examine different models for teacher training that may include integrating education courses with content courses, including more experiential in-classroom opportunities.

Beyond recruitment and retention of highly qualified teachers, Arizona should develop and implement more innovative curricula. After program implementation, Arizona must hold students, teachers, parents, policymakers and the community as a whole responsible for students' reaching identifiable and measurable standards. Special focus should be given to gifted students of all backgrounds so that they are sufficiently challenged.

Overall, the different levels of education should collaborate to develop an articulated, aligned education system, resulting in students being adequately prepared for subsequent levels of learning. Industry and the private sector must partner in efforts to identify essential knowledge and skills that must be present in the curriculum at each level. If Arizona is to compete in a global market, math and science education must meet the higher standards prevalent throughout the world. Arizona's ability to meet the increased job demands of a bioscience/biotechnology economy depends on an education system that can produce a skilled workforce.

Community partnerships play an important role in improving educational facilities and programs. However, both the public and policymakers must be educated regarding the deficiencies in math and science education and the opportunities available in bioscience and biotechnology.

Arizona's political leaders will play an important role in the success of the state's future in bioscience and biotechnology. They must emulate the visionary strategy used by President John F. Kennedy when he proclaimed that the U.S. would put a man on the moon within a decade.

Opportunities for Arizona's Current Workforce in Bioscience and Biotechnology

The growing bioscience and biotechnology industry will create many new jobs—some requiring extensive retraining and some requiring relatively little training.

One initial challenge is to communicate to the public, workforce and educational system, Arizona's commitment to, and need for, a technically competent workforce. Concurrently, agencies engaged in placement must demonstrate to the unemployed/underemployed that opportunities exist in bioscience/biotechnology. Arizona's community colleges will remain integral to any training, including the use of fast track programs designed to move workers into the bioscience/bio-technology workforce quickly.

Arizona is challenged immediately by the need for medical technicians, research technicians and other medical professionals as well as teachers with strong math and science backgrounds. Arizona will face a growing need for in-home, long-term and preventive healthcare. Increased communication and partnerships with private sector businesses will be necessary to develop innovative programs to retrain the workforce as needed. Likewise, private industry should be encouraged to participate in high school teaching and under-graduate and graduate level work study and intern programs.

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The professional schools and technical schools must communicate the threshold requirements for student participation in higher education. In turn, K-12 teachers and educators must align their curricula to meet those needs. Communication among the various public and private entities is essential to best utilize Arizona's educational resources.

Special attention must be paid to rural infrastructure needs, including the loss of trained people from rural areas to urban areas. Information technology and advanced communications will become crucial to spread knowledge and jobs to rural areas and to retrain existing workers.

Attracting and Retaining Bioscience and Biotechnology Faculty, Students and Employees

Arizona currently has several programs and resources dedicated to improving the environment for bioscience and biotechnology including public funding, school tax credits, and public support for funding of community colleges and universities as well as private research organizations.

However, in order to attract and retain bioscience and biotechnology faculty, students and employees, Arizona must increase the flow of funding to the community colleges, universities and independent research institutions. Arizona cannot simply match or maintain the status quo with respect to bioscience and biotechnology. Arizona is competing in this industry worldwide and must surpass its competitors to attract and maintain bioscience and biotechnology development. Funding is needed to build additional facilities, including laboratory and teaching facilities adequate to train the numbers of professionals needed in Arizona. Funding is needed to attract the best faculty and offer the endowed chairs, fellowships and scholarships necessary to attract and retain faculty and students. In turn, the best faculty and students will attract additional funding from grants.

Additionally, quality of life issues such as transportation, arts and culture, diversity and quality education will help attract the people who are creating a strong bioscience and biotechnology sector.

Arizona will need to significantly reform the K-12 education system. Without improved education, especially in math and science, Arizona will not have the necessary future workforce. Public awareness should be raised through the use of marketing plans to attract the best students into the math and science fields. Innovative programs should be developed to challenge students in the math and science fields, such as expanded college classes for high school students.

Policy Implications of Bioscience and Biotechnology Advances

Public policymakers, math and science faculty and students, the media and the general public, all must be informed about the benefits and potential solutions offered by bioscience and biotechnology. The education system, science community and leading bio-science organizations have a key role in disseminating information to the public, policymakers and other stakeholders.

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University officials, faculty and private sector representatives bear an obligation to meet regularly and continuously with policymakers to discuss bioscience and biotechnology advances and the implications of such advances. Once the information is available to the public and the policymakers, marketing concepts such as newsletters, information seminars, interactive website development targeted at both youth and adults, speaking engagements at universities, civic and community groups, and statewide conferences can be used to reinforce the information. Media of all types should be used to ensure dissemination of the information. A marketing slogan and/or an entire marketing campaign highlighting the potentials of bioscience and biotechnology should be explored.

Regardless of career track, all students should be exposed to bioscience and biotechnology developments to create a general excitement for math and science. Existing math and science programs through museums, zoological and botanical gardens and science centers should be supported and integrated into school curricula.

A simple, understandable and compelling case for the need to invest in bioscience and biotechnology research and development should be made to the public and reinforced at the public policy level by all interested stakeholders. This effort should emphasize the potential direct benefits of bioscience and biotechnology to everyone.

CONCERNS IN BUILDING THE BIOSCIENCE AND BIOTECHNOLOGY ECONOMY

Ethical, Legal and Societal Concerns

Bioscience and biotechnology research and development does not occur in a vacuum separate from the larger society. Many of the ethical, legal and societal concerns inherent in medical care have been identified and debated from the dawn of human civilization; now is not the time to reinvent the wheel. Bioscience and biotechnology advances will continue to revolutionize healthcare and numerous other fields. The ethical, legal and societal concerns that will be raised by this revolution will be addressed not just in Arizona but in the entire nation, and indeed the world.

Education of, and communication with, public policymakers and other stakeholders is a crucial component of bioscience and biotechnology advancement. People generally are cautious with developments that they do not understand. The public should be continuously educated about the benefits of bioscience and biotechnology research and development. The education system, science community and leading bioscience organizations must take the lead in this education process. Developments must be updated continuously, even “moment by moment” if appropriate, and accurate, thorough information must be disseminated. The science community must candidly discuss what is known and what is not known. All interested parties must be involved in the debate, and the risk/benefit analysis openly discussed. Our education system must incorporate ethical, legal and societal education into the curricula and provide ongoing training for those already working in bioscience and biotechnology.

The public should be properly informed so attempts to stifle scientific research and advancement are not made out of fear or lack of understanding. Research should be allowed to proceed freely within regulatory limits designed to protect the public.

Society must come to terms with the questions of who will receive new, and presumably expensive, treatments and who will make these decisions. Arizona should work toward universal access to health insurance in order to maximize the application of bioscience to improve individual and population health, and to minimize the risk of denial of care due to genetic profiling. Privacy of individuals must be maintained and protected.

Town Hall acknowledges that intellectual property protections are important nationally and internationally and we must continually review relevant laws to ensure that these protections are maintained.

Legislative and Other Public Policy Initiatives

The future success of bioscience and biotechnology demands leadership on a state level. The regional economic development organizations in conjunction with a restructured, strengthened and knowledgeable Department of Commerce are uniquely positioned to take this leadership role. The Department of Commerce must be restructured to be proactive, entrepreneurial and nimble and must receive adequate funding to collaboratively build the bioscience and biotechnology initiatives within the state.

Funding for bioscience and biotechnology must be addressed. Tax incentives linked to bioscience and biotechnology opportunity benefits, public/private ownership, venture capital, bonds and angel funds all should be tapped to provide necessary pre-seed and seed money. The state has taken a good step by passing the angel tax credit bill that allows for certain state credits for private investments in start-up companies, with extra emphasis on bioscience/biotechnology and rural-based companies.

Workmen's compensation dollars that are designated for workforce development by statute should be used as specified and may not be swept into the General Fund by the Legislature. In addition, lottery funds designated for the Commerce and Economic Development Commission (CEDC) grants should not be

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The education system, science community, leading bioscience organizations and private interests must take responsibility for educating policymakers on the benefits of bioscience and biotechnology, including direct benefits to the state's economy. This aggressive effort to educate the public should extend to all levels: from legislators to grass roots organizations, to municipal governmental entities, to civic groups, to schools. In turn, policymakers have a duty to assist in the education of the public, and to promote the shared vision.

The private sector and the public must demand more funding for education from pre-kindergarten through graduate school to support math and science education and bioscience and biotechnology growth. Specifically, the expansion of the University of Arizona College of Medicine Phoenix Program should be accelerated and fully funded.

Town Hall recommends ...a change to Arizona's Constitution to allow the state to acquire stock in a private company in payment for transferring an interest in technology and intellectual property created or acquired by the Board of Regents, Arizona's universities or the Biomedical Research Commission.

Intellectual property transfer policies and regulations need to be designed to encourage commercial development and application of innovations created through the state universities. Specifically, Town Hall recommends that the Arizona Legislature refer to the voters in 2006 a change to Arizona's Constitution to allow the state to acquire stock in a private company in payment for

transferring an interest in technology and intellectual property created or acquired by the Board of Regents, Arizona's universities or the Biomedical Research Commission.

Participation of All Arizonans — Benefits to Rural Arizona's Economy

Arizona's rural areas have several distinct advantages to offer bioscience and biotechnology research and development in the sectors of agriculture, forestry, mining and manufacturing. The state universities have the ability and should continue to ensure that these advantages are optimized so that rural Arizona shares directly in the economic benefits of bioscience and biotechnology research and development.

Advancements in medical science and treatment should be communicated to and leveraged into rural communities through communication technology such as online research, distance learning and telecommunications. Members of rural communities should be offered the opportunity to participate in clinical trials; public education in various parts of rural Arizona needs to be conducted to foster further bioscience and biotechnology developments.

Electronic communications technology would allow all areas of the state to participate equally in research and educational opportunities. Training programs offered through universities or community colleges should be available statewide. Communication and computer technology must be available statewide for use in classrooms, hospitals and workforce training programs. Arizona's existing distance learning programs should be actively promoted and, if appropriate, expanded.

In addition, the state should make sure that its vision for bioscience and biotechnology development reaches and includes rural areas. A statewide public awareness, marketing and education campaign should address the benefits expected for all Arizonans from bioscience and biotechnology development. The necessary emphasis on math and science education must be statewide. In turn, rural Arizona leaders must communicate their needs, interests and advantages in biotechnology development.

Infrastructure Improvements Needed to Support Bioscience and Biotechnology Development

Infrastructure improvements needed in Arizona generally include: 1) improved education infrastructure statewide from pre-kindergarten through graduate school to provide more or better utilization of facilities leading to smaller class size, to provide increased laboratory facilities, and to expand professional and technical training programs; 2) improved communication infrastructure, particularly within and between rural and urban Arizona; and

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3) improved transportation within urban areas, between urban and rural areas, and internationally. Infrastructure improvements needed specific to bioscience and biotechnology include manufacturing facilities equipped to meet biotechnology criteria and increased office and wet lab facilities wired for communication with similar facilities.

As priorities shift, reallocation of state, county, local and private resources will be required. To facilitate this reallocation of resources, an emphasis needs to be made on nurturing public/private partnerships.

High speed and reliable communications facilities need to be extended to all areas in rural Arizona. The transportation network between urban and rural areas has not kept pace with Arizona's population growth, and needs to be updated and expanded. Urban transportation facilities need to be updated to reduce congestion. Interstate and international transportation facilities, particularly air service outside the metropolitan Phoenix area and deep water ports, need to be upgraded and expanded.

To increase the numbers of students who enter technical and professional programs, we need to develop a pre-K education system and expand our science and technical facilities telecommunications capabilities, office and laboratory space and work-based learning experiences.

INVESTMENTS IN ARIZONA'S FUTURE IN BIOSCIENCE AND BIOTECHNOLOGY

Roles of Government and the Private Sector

Governments in general have a primary role in creating an infrastructure and regulatory environment that is conducive to development, yet protects the public's interest.

Many funding sources for basic bioscience and biotechnology research are required; they include significant involvement of the federal government. Our congressional delegation should help the state to move forward in bioscience and biotechnology in three ways: first, by securing a greater share of federal dollars to Arizona for economic development; second, by supporting increased funding for federal agencies' competitive grant programs; and third, by reinstating funding for basic infrastructure improvements and developing funding for innovative and translational research. Arizona's scientists are positioning themselves to compete successfully for federal grants and contracts supporting innovative bioscience and biotechnology projects ranging from basic to applied research. The federal government also plays a lead role in creating the minimal necessary safety and privacy regulations.

State government, with other stakeholders, must undertake primary responsibility for creating and marketing the vision for Arizona's bioscience and biotechnology development.

State government, with other stakeholders, must undertake primary responsibility for creating and marketing the vision for Arizona's bioscience and biotechnology development. The state is in the best position to leverage current resources and provide direct funding for infrastructure and education. The state also is in the best position to create an Arizona-specific pool of funds and to attract pre-seed and seed money and venture capital. The state ultimately is responsible for improvements to the education system including dedicated resources to math and science programs.

In order to be successful, the state must support statewide coordination, reduce redundancy and capitalize on emerging opportunities. The state should work collaboratively with area regional economic development organizations and bioscience leaders. Together, the stakeholders should be empowered to grow and support bioscience and biotechnology research, increase funding for the same and support new industries that will emerge in this catalytic environment.

Native American governments have an important role to play as a partner in the development of bioscience and biotechnology in Arizona. Native American governments are an important source of facilities, research and development funds and cooperative research programs, especially in areas of special knowledge or concern such as

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the medicinal use of plants or the treatment of diabetes. A significant opportunity exists with tribal colleges that hold land grant status to develop Native American researchers.

Local governments must work with the private sector to identify and facilitate office space and functional research and manufacturing space through appropriate development strategies and incentives. Additionally, they must communicate local community concerns to the private sector and state government.

Research and education institutions bear the primary responsibility for leveraging the funds that do exist to attract grants and contracts and for developing and implementing the necessary education programs. Research and educational institutions should have a role in increasing public awareness of the bioscience and biotechnology industry and its opportunities for Arizona. At a basic level, research and educational institutions must extend the cooperative structures necessary to advance bioscience and biotechnology and real world applications.

The public and private sectors share key roles in educating the public and policymakers about the benefits of bioscience and biotechnology research and development as well as translational research. The state has the responsibility to create certain infrastructure improvements and the regulatory environment conducive to bioscience and biotechnology development. The state and the private sector share responsibility to help fund pre-commercial business and develop business startups. The private sector ultimately is responsible for funding commercial enterprises over the long term. However, to attract private sector funding, it is likely further collaboration and partnership between and among healthcare providers, academia and state government will be required to support an adequate return on investment.

Public/Private Collaboration in Bioscience and Biotechnology

Public/private collaboration is necessary in the development of bioscience and biotechnology. Much of the basic research and funding for research and development comes from and through public entities. Arizona's past successful collaboration provides momentum upon which the state should continue to build. All entities should continue to promote our past successes in forming public/private partnerships. Key partnerships and leadership from non-profit foundations have made bioscience and biotechnology a reality in Arizona and should be applauded and encouraged.

Private sector input into developing educational programs and opportunities is appropriate. Internships, work/study opportunities and scholarship creation also should be encouraged. Joint efforts should be made to attract grant and matching funds.

Public entities should continue to create start-up funding avenues including low-interest loans. Public entities also should continue to implement regulatory and tax policies that are conducive to bioscience and biotechnology development.

Prospects for future public/private partnerships include joint faculty at universities, biomedical research institutions and private hospitals to encourage joint research projects. Joint use of some facilities will be especially cost effective and will spur increased collaboration. Collaboration between Arizona's universities and some private healthcare entities has been good, but episodic in the past. Accordingly, it is vital that we encourage a continuation of collaborative efforts. Consortia among public and private institutions and community physician practices must be developed to build research centers of excellence. These centers will be magnets to attract new companies and will stimulate entrepreneurship and growth of existing bioscience firms. Public funding is necessary to bring these centers into place.

Arizona's and other states' institutions should build on past successes in developing partnerships with research and educational institutions in other states, both to secure funding, to conduct novel research and to enhance its national and international reputation. Arizona also should continue to advertise and promote its vision for the future of bioscience and biotechnology in Arizona in an effort to attract the attention of angel and venture capital.

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The best current opportunities for partnering exist in the same areas in which Arizona already has established world-class programs and competitive advantages, such as bio-imaging, infectious diseases, neurosciences, cancer therapeutics, diabetes, asthma, bio-engineering and bio-agriculture.

Benefits of the Biomedical Campus in Downtown Phoenix

The Phoenix metropolitan area already has two osteopathic medical schools and a regional campus of the University of Arizona medical college. Building the University of Arizona's expanded campus of the medical college in downtown Phoenix promises immense opportunity for all of Arizona. The expanded campus would create additional opportunity for enhanced collaborative teaching and research efforts with area hospitals, Arizona State University, TGen and others. It is a critically important opportunity for collaboration between scientists and other clinical researchers and would become an integral part of the translational ("bench to bedside") model. The Phoenix Biomedical Campus would fill the need for a full four-year allopathic medical school in Phoenix—the largest metropolitan area in the United States without an allopathic medical school.

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Specific challenges to building the expanded medical school campus in downtown Phoenix include funding, educating the rest of Arizona as to the benefits to all of Arizona, and setting aside political, regional and interagency rivalries. Creating an academic health center, with all of the attendant requirements, is an essential undertaking.

Overall, the creation of the downtown Phoenix campus is a tremendous opportunity for all of Arizona—for healthcare, for professional training, for research, and for adding generally to the critical mass of Arizona's bioscience and biotechnology industry. A full four-year, research-intensive, allopathic medical school in Phoenix will enhance the efforts of Arizona in bioscience and biotechnology.

Opportunity for Arizona to Become a Prime Location for Bioscience and Biotechnology Enterprises

The importance of Arizona's place in the "bioscience sun" is dependent on building a critical core of both firms and researchers. By focusing the research and encouraging collaboration among researchers, clinicians and industry, the state can jump-start its way into the 21st Century through the power of partnering. This is a cost effective approach; however it requires trust, goodwill and mechanisms that encourage networking, relationship building, joint venturing and joint ownership.

The spirit of collaboration is strong in Arizona. It is one of the state's differentiations relative to other locations and regions. Arizona has placed a strong emphasis and focus on interdisciplinary and translational approaches that can lead to faster returns on investments in bioscience and biotechnology to improve the lives of individuals throughout the state.

The successful building of a focused bioscience and bio-technology enterprise whose goal is to develop into national centers of excellence will require sustained attention to improving preK-12 education, particularly in math and science; sustained efforts to attract and maintain the necessary funding for basic research; and the venture capital to translate research into commercial application. Additionally, it is necessary to continue to identify and recruit world-class scientists and projects.

The potential benefits to Arizona's economy and educational system are enormous, and there are no insurmountable obstacles to Arizona's successful building of a preeminent bioscience and biotechnology industry.

The bioscience and biotechnology industry is an exciting and logical opportunity for Arizona to capitalize on its collaborative, interactive and entrepreneurial spirit. Arizona already has demonstrated its ability to build several successful enterprises in collaboration with other public and private entities, and should continue to build on those successes.

TOWN HALL RECOMMENDATIONS

A critical step is the articulation of a vision for a strong bioscience and biotechnology industry and obtaining the leadership and commitment to implement that vision with a sense of urgency. We believe Arizona's Bioscience Roadmap (Battelle 2002) was a first step on this path and that this Town Hall report is the next step in achieving that vision.

A critical step is the articulation of a vision for a strong bioscience and biotechnology industry and obtaining the leadership and commitment to implement that vision with a sense of urgency.

Arizona should receive a tremendous return on its investment if the state is successful in building world-class bioscience and biotechnology centers of excellence.

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