



GROWING SOUTHERN ARIZONA'S  
BIOSCIENCE SECTOR:

**A REGIONAL ROADMAP**

PREPARED FOR:

Southern Arizona Leadership Council  
with financial support provided by the Flinn Foundation

PREPARED BY:

Battelle  
Technology Partnership Practice

November 2006

## Executive Summary

### INTRODUCTION

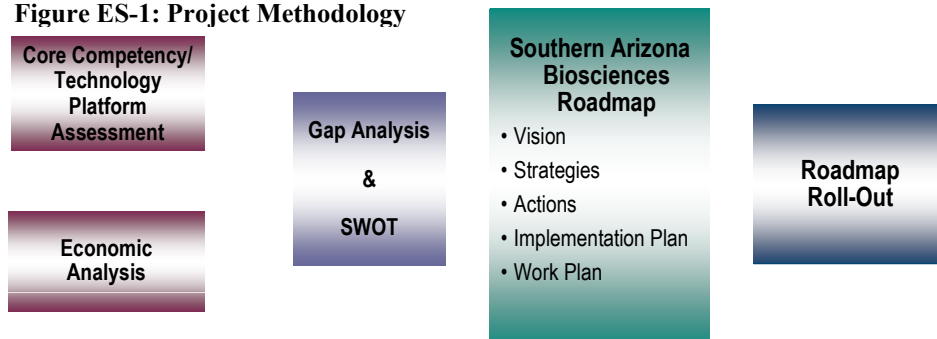
In 2002, public and private leaders in Arizona committed to making the investments necessary to position Arizona as a leading center for the biosciences. The *Arizona Bioscience Roadmap*<sup>1</sup> called for building the state’s infrastructure around selected technology platforms, growing a critical mass of bioscience firms, and offering a business climate and environment to support bioscience enterprises. Significant progress has been made in building an environment in Arizona that is supportive of bioscience enterprises.

Much of Arizona’s existing bioscience activity—both its industry base and research base—is located in Southern Arizona. The region is home to the University of Arizona (UA), which is the key driver of bioscience research in the state, and contains both well-established bioscience companies, such as MRI Medical Manufacturing and Research Inc., SEBRA, Sonora Quest Labs, and Ventana Medical Systems, and smaller, startup and emerging companies. The Southern Arizona region, under the leadership of the Southern Arizona Leadership Council, has developed this regional bioscience roadmap to complement the statewide effort and to focus on specific challenges and opportunities facing Southern Arizona. This Roadmap, developed with support provided by the Flinn Foundation and assistance provided by Battelle, lays out a pathway to accomplish the following vision:

*Southern Arizona is one of the nation’s recognized bioscience centers, driven by its strengths of a talented workforce, a cutting-edge research university, and a global center for bioscience innovation. Its civic leaders help drive the bioscience economy, mobilizing leadership committed to collaboration, results, and economic growth.*

This Regional Roadmap was developed with guidance and input from the region’s research institutions, bioscience companies, and other public and private leaders. The Battelle project team collected and analyzed data on Southern Arizona’s bioscience industry and research bases and interviewed academic, research, business, and civic leaders to develop an understanding of the region’s existing bioscience research strengths and capabilities and to gather input on the types of investments needed to enable Southern Arizona to become a well-recognized regional bioscience center. Figure ES-1 displays the project methodology.

**Figure ES-1: Project Methodology**



<sup>1</sup> *Platform for Progress: Arizona’s Bioscience Roadmap*. Prepared for the Flinn Foundation by Battelle Technology Partnership Practice. December 2002.

## SOUTHERN ARIZONA'S BIOSCIENCE INDUSTRY BASE

***Southern Arizona's bioscience sector is young, but has experienced rapid growth in total and across key subsectors.*** The bioscience sector (defined here as including agricultural feedstock and chemicals; drugs and pharmaceuticals; hospitals; medical devices and equipment; and research, testing, and medical laboratories) added nearly 1,000 jobs, an increase of 7.1 percent between 2001 and 2004 in the Tucson metropolitan area. (These data include only private sector employment, employment at the University of Arizona is not included.) Southern Arizona bioscience employment grew about 1.5 times as fast as the sector nationally (up 4.8 percent).

***The largest bioscience subsector, hospitals, has a strong and growing regional presence.*** The premier nature of bioscience research at the UA and the University Medical Center (UMC) are tremendous strengths for the Southern Arizona bioscience base. Nearly 13,000 individuals were employed in the hospitals subsector in Southern Arizona in 2004.

***Southern Arizona's nonhospital bioscience sector is modest in size, but growing rapidly.*** The nonhospital sector employs nearly 2,000 individuals across 112 business establishments. Nearly all these workers are within the medical devices and equipment and research, testing, and medical laboratories subsectors. While the nonhospital biosciences overall have a modest location quotient (LQ)—0.65 in 2004—the sector is growing at a rapid pace.<sup>2</sup> ***Since 2001, the Southern Arizona nonhospital biosciences have seen employment rise by 21.9 percent, compared with just 0.9 percent nationally.*** This strong employment growth boosted the regional LQ as the concentration of bioscience workers in Southern Arizona increased relative to the nation.

***The research, testing, and medical laboratories subsector is the fastest growing and the largest among the nonhospital subsectors.*** The subsector employed 1,100 in the Southern Arizona in 2004. The region added more than 300 jobs during the 2001 to 2004 period, a gain of 45.6 percent, much faster than the 7 percent growth of this subsector at the national level. Research, testing, and medical laboratories in Southern Arizona posted a 1.07 LQ in 2004, making it a concentrated industry subsector. ***In Battelle's 2006 national report for the Biotechnology Industry Organization (BIO), the Tucson metropolitan area ranked 28th among 72 large metropolitan areas based on its LQ in the research, testing, and medical laboratories subsector in 2004.***<sup>3</sup>

***Manufacturers of medical devices and equipment have a significant presence in Southern Arizona.*** Firms engaged in the production of medical devices, supplies, and instruments employ more than 800 in Southern Arizona, up slightly (1.5 percent) since 2001. Nationally, the subsector shed jobs during the early 2000s—employment declined by 3 percent and the number of U.S. establishments was essentially flat. Southern Arizona added to its medical device establishments; in 2004, there were 57 total.

<sup>2</sup> Location quotients are a standard measure of the concentration of a particular industry in a region relative to the nation (reference area). The LQ is the share of total regional employment in the particular industry divided by the share of total industry employment in the nation (reference area). An LQ greater than 1.0 for a particular industry indicates that the region is relatively concentrated, whereas an LQ less than 1.0 signifies a relative underrepresentation. An LQ greater than 1.20 denotes employment concentration significantly above the national average. Throughout this report, LQs are used to report regional industry concentrations relative to the U.S. as a whole. The minimum concentration threshold for declaring a regional specialization is a matter of judgment and varies somewhat in the relevant literature. In this analysis, regional specializations are defined by LQs of 1.20 or greater.

<sup>3</sup> *Growing the Nation's Bioscience Sector: State Bioscience Initiatives 2006*. Prepared for BIO by Battelle Technology Partnership Practice and SSTI, April 2006. The full report can be accessed online at <http://www.bio.org/local/battelle2006/>.

***The biosciences provide well-paying jobs for Southern Arizona’s residents.*** In 2004, the average bioscience worker in Southern Arizona earned \$40,004, which is 22 percent (or \$7,227) more than the \$32,777 for the average worker in the private sector. Average wages in the nonhospital bioscience sector tend to be higher than average hospital wages. In 2004, the average annual salary in the nonhospital sector was \$47,476, nearly \$15,000 more than the private sector average (Table ES-1).

**Table ES-1: Average Annual Wages in Southern Arizona for the Biosciences, 2004**

Major Southern Arizona Industry	2004 Avg. Wages
Drugs & Pharmaceuticals	\$61,333
Research, Testing, & Medical Laboratories	\$58,140
Total Nonhospital Biosciences	\$47,476
Total Biosciences	\$40,004
Hospitals	\$38,845
Agricultural Feedstock & Chemicals	\$37,040
Medical Devices & Equipment	\$33,532
Total Private Sector	\$32,777

Source: Battelle calculations based on Bureau of Labor Statistics, Quarterly Census of Employment and Wages program data from IMPLAN.

***Southern Arizona accounts for a large share of Arizona’s overall bioscience sector.*** The region has an influential role in driving state bioscience trends and a unique opportunity to leverage its research base to further build its bioscience industry base.

## SOUTHERN ARIZONA’S BIOSCIENCE RESEARCH BASE

***The UA is both the leading statewide bioscience research driver as well as the principal driver of bioscience research in Southern Arizona.*** At the statewide level, UA accounts for 59 percent of all university life sciences research in Arizona and 62 percent of National Institutes of Health (NIH) funding to Arizona—and is home to the only medical school, pharmacy school, and agricultural school in the state. Almost half of the university’s research enterprise is in the life sciences, with medical sciences accounting for \$100 million in R&D in 2004. In addition, the university has strong bases in the biological sciences (\$76.6 million) and the agricultural sciences (\$66.5 million).

***Life sciences have been a key generator of growth in the UA’s research base in recent years.*** From 1997 to 2004, life sciences research grew by 77 percent, compared with 68 percent overall growth in the university’s research base. In the aggregate, 50 percent of the \$193 million gain in research activity at the UA resulted from growth in the life sciences.

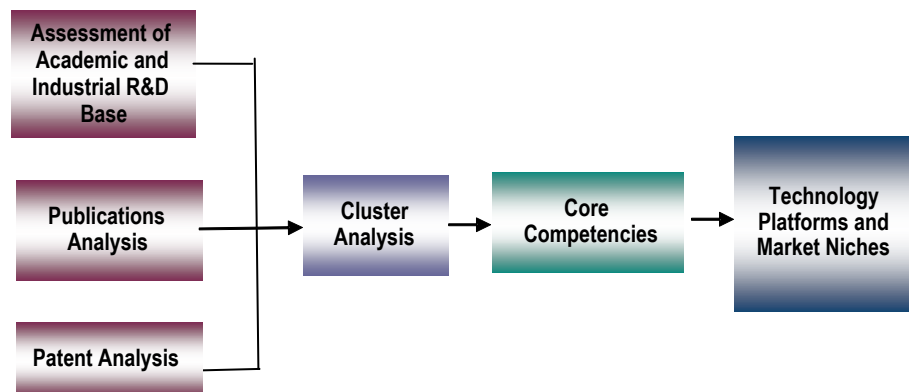
***In medical sciences and agricultural sciences, the UA outpaced overall U.S. university research growth from 1997 to 2004.*** Medical sciences research at UA rose by 108 percent, compared with growth of 103 percent nationally. In agricultural sciences, where the UA ranks 13th nationally, the relative growth has been even more impressive, with UA advancing by 60 percent compared with 37 percent growth nationally in university research from 1997 to 2004. In closely related fields of psychology and chemistry, UA also made substantial gains of 124 percent and 101 percent, respectively, which outpaced national growth in those fields.

**Overall, however, the UA is still playing catch-up in the biosciences.** While UA is growing its intensity in bioscience research as a percent of total university research—from 48 percent in 1997 to 53 percent in 2004—it is still below the national average of 60 percent. Also, despite significant gains in overall medical research funding, it is still not keeping pace in NIH research funding—the gold standard of biomedical research funding—with UA’s share of national NIH extramural funding dropping from 0.57 percent in 1997 to 0.46 percent in 2005.

### Bioscience Technology Platforms for Southern Arizona

The biosciences present so many opportunities for the future that it is extremely important for a state or region to understand where its opportunities will lie within a very broad universe of bioscience disciplines, opportunity areas, and possibilities. To identify the specialized niches for Southern Arizona, Battelle employed a methodology that uses the “marketplace” of academe, including peer-driven recognition systems, e.g., publications, citations, and federal fund awards, along with extensive number of interviews with research leaders, to identify targets of opportunity (Figure ES-2). Battelle used its proprietary software, *OmniViz*<sup>™</sup>, to examine the presence of research “clusters.” Using this unique text analysis tool, along with detailed faculty interviews and a review of publications strengths and funding levels, Battelle documented Southern Arizona’s research core competencies and recommended associated technology platforms, which can form the basis for the future growth of Southern Arizona’s bioscience sector.

**Figure ES-2: Methodology to Identify Technology Platforms and Market Niches**



The areas of greatest opportunity for developing technology platforms are those in which a region has

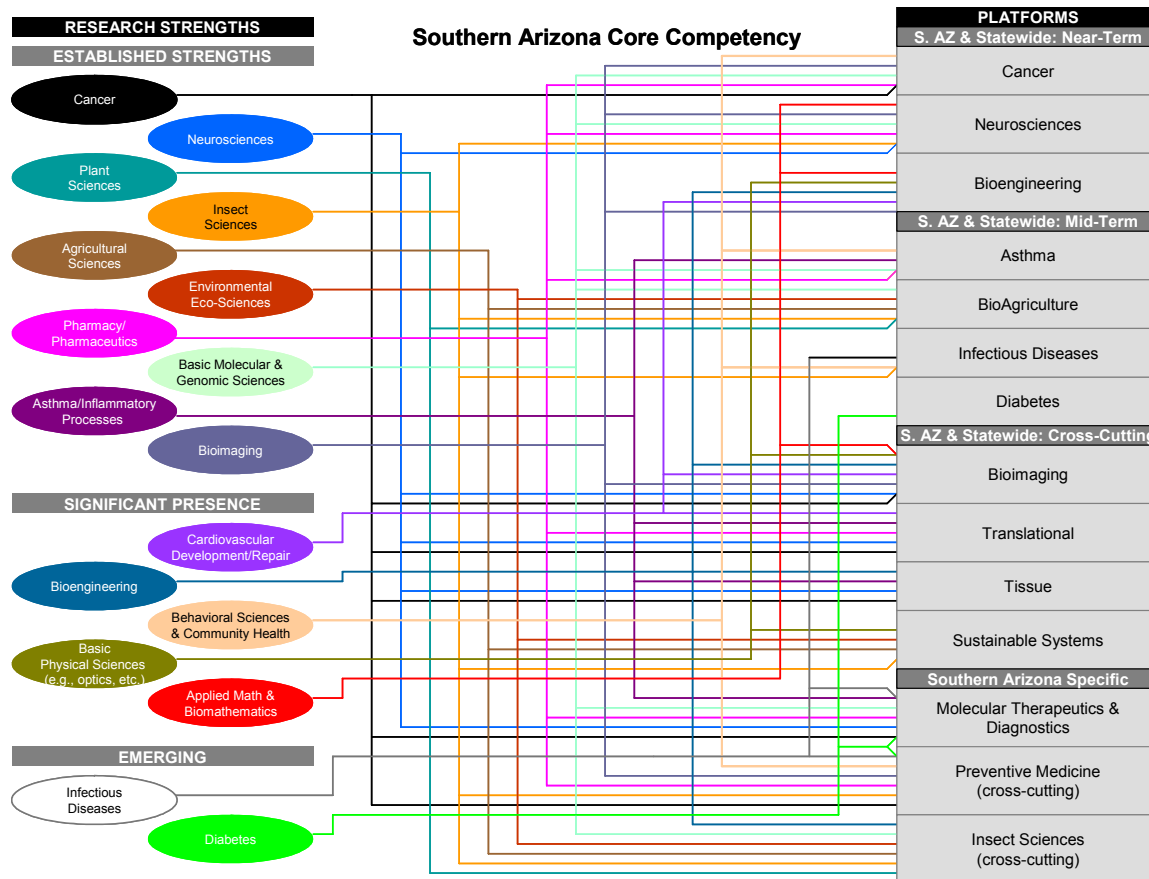
- Existing research strengths;
- Bases of commercial activity emerging or established within the region with genuine opportunity to create a base in the near future;
- Distinct opportunities to leverage the region’s comparative advantages to create competitive marketplace advantages;
- Significant product market potential; and
- Links to, or reinforcements of, other bioscience strengths and core research competencies, thereby helping to enhance other fields as a platform expands.

The Battelle team in its 2006 update of the Arizona’s core competencies and technology platforms in the biosciences validated the same near-term and mid-term platforms first identified in 2002, as well as the cross-cutting areas in which universities, teaching hospitals and medical centers, and research institutions have been working since 2002. But, Battelle also identified the following three technology platforms unique to the region that build upon Southern Arizona’s research core competencies and can be a source of innovative technologies and products for Southern Arizona’s economy:

1. Molecular Targeted Therapeutics and Diagnostics
2. Preventive Medicine
3. Insect Sciences.

Figure ES-3 shows the relationship between Southern Arizona’s research strengths and both the state’s and Southern Arizona’s technology platforms.

**Figure ES-3: Relationship Between Southern Arizona’s Research Strengths and Arizona and Southern Arizona Technology Platforms**



## SITUATIONAL ASSESSMENT

It is clear that Southern Arizona has an emerging industrial base and a strong research base on which to continue to build its bioscience economy, and strategic areas for future development have been identified. But, this region is not the only region seeking to grow its bioscience sector. States and regions across the United States are investing significant resources in the biosciences.

To succeed, Southern Arizona must build upon its competitive advantages as a location for bioscience companies and address any competitive disadvantages. The Battelle project team interviewed public and private leaders, bioscience company CEOs, entrepreneurs, venture capitalists, government officials and service providers to get their assessment of Southern Arizona as a location for bioscience development. The text box at right summarizes the region's key competitive advantages and the challenges that will need to be addressed to accelerate the growth of Southern Arizona's bioscience economy.

There was general agreement that Southern Arizona has three differentiating drivers on which to build its bioscience base:

1. **A culture of entrepreneurship.** Southern Arizona has a strong history of creating bioscience-driven firms. Some of these have been developed around technologies developed by UA faculty and researchers, particularly those associated with the Cancer Center; others were created when some of these initial firms generated additional spin-off companies. The region has identified successes such as Ventana and Sanofi-Aventis, among others, something few other regions in the country have to the extent that this region does.
2. **A deep research base.** UA's and UMC's strengths in the core competencies and technology platforms identified in this report show how critical UA is to the state's and region's research enterprise. A pioneering UA has emphasized interdisciplinary research and partnerships since the early 1970s and is ideally positioned to respond to the opportunities and challenges that face the biosciences.
3. **A strong quality of life.** The region's quality of life attracts and retains talent, researchers, and enterprises. Reasonable costs of living, relatively smooth traffic flow, cultural amenities, and other factors are all rated positively by residents of Southern Arizona.

Competitive Advantages
<ul style="list-style-type: none"> <li>➤ University of Arizona               <ul style="list-style-type: none"> <li>➤ R&amp;D Base</li> <li>➤ Students and Graduates</li> <li>➤ Highly rated Entrepreneurship Program</li> </ul> </li> <li>➤ Entrepreneurial environment</li> <li>➤ Core base of bioscience start-ups and established companies</li> <li>➤ Quality of life that appeals to many talented individuals</li> <li>➤ Base of experienced retirees</li> </ul>
Challenges
<ul style="list-style-type: none"> <li>➤ Retaining faculty and staying at the cutting edge of bioscience research</li> <li>➤ Not enough being done to commercialize technology generated by U of A</li> <li>➤ Small clinical science base, small medical school</li> <li>➤ Insufficient interaction between large and small bioscience companies and between companies and the U of A</li> <li>➤ Perception of quality of K-12 education</li> <li>➤ Insufficient sources of capital</li> </ul>

To take advantage of these drivers, several **strategic directions** are suggested, based on the strengths and opportunities found in the region:

- Ensure that UA continues to be Arizona’s strong research engine in the biosciences, particularly in those platforms of strength or emerging strength identified in this report.
- Increase the region’s ability to capture innovation from this research base and its existing bioscience enterprises and other industries in order to become a strong center of technology entrepreneurship, which can translate into new firms, increased wealth, and high-wage jobs.
- Focus the region’s economic development approach on recruiting bioscience-related firms around the region’s strengths in its technology platforms and its existing industry base.
- Employ the region’s civic leadership to recognize and engage the entire population in a technology-driven economic future, a key component of which is the biosciences. The biosciences represent a technology convergence opportunity as well, building on the region’s strengths in optics and related information technology areas.

## STRATEGIES AND ACTIONS

The strategies proposed for Southern Arizona focus on leveraging the region’s assets—its talent base, research base, and its core of established companies — to attract, create, grow, and strengthen further its critical mass of research in focused areas, while at the same time continuing to achieve a critical mass of bioscience firms. The region’s bioscience industry base is growing, but it is still small. Specific strategies include the following:

**Strategy One:** Continue to build Southern Arizona’s research strengths around bioscience technology platforms.

**Strategy Two:** Continue to build a critical mass of bioscience firms in Southern Arizona.

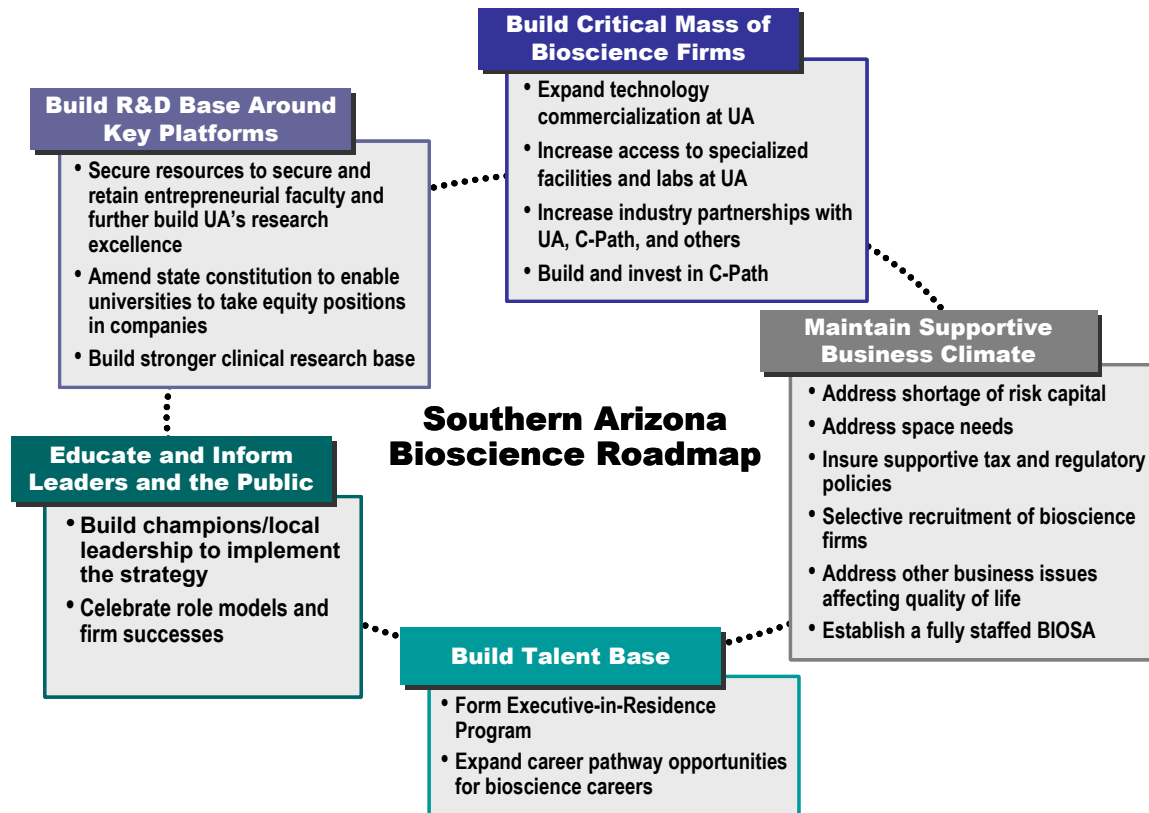
**Strategy Three:** Build a talent base that captures and retains Southern Arizona’s human resources.

**Strategy Four:** Address and maintain a business climate supportive of the biosciences and their growth in Southern Arizona.

**Strategy Five:** Educate, inform, and spur to action opinion leaders and the general public on Southern Arizona’s future in the biosciences.

These five strategies and the 17 actions proposed to achieve them are outlined in Figure ES-4. Each action is described in the full report. It is anticipated that 90 percent of these actions would be implemented over a 5-year time period. Specific metrics to monitor implementation of the Southern Arizona Bioscience Roadmap are contained in the full report.

Figure ES-4: Overview of Strategies and Actions



## IMPLEMENTATION PLAN

The actions described in this Roadmap, while requiring some public catalytic action in the initial stages, rely, for the most part, on the private and philanthropic sectors, federal funding sources, and others to achieve significant progress and impact. In many cases, the effort is focused on ensuring that the private sector market gaps are addressed and filled over the long-term by private actions and private investments, such as addressing the need for risk capital, developing a bioscience research park, and increasing technical networking among firms and universities.

### Immediate Work Plan Priorities

Immediate work plan priorities are those steps the private and public sectors in Southern Arizona should undertake in the first 12 months of implementation. Several critical priorities need to be implemented right away, while others will need to be planned and resources secured before they can move forward.

The following actions should be undertaken in the first year of Roadmap implementation:

- Identify champions and assign responsibility for Southern Arizona Bioscience Roadmap implementation
- Work with Science Foundation Arizona and state to secure their support in implementation of this Roadmap including funding for the following:

- Research excellence—universities and technology anchors
  - Technology commercialization
  - Executives in residence
  - R&D pilot voucher program
- Complete work under NIH Clinical and Translational Science Award (CTSA) planning grant to seek full funding to further build capacity regionally and statewide
  - Develop communications and education plan for the biosciences in Southern Arizona including role model success stories
  - Move forward with bioscience park and incubator/accelerator space
  - Monitor and assess C-Path progress and needs
  - Complete planning for Biosciences Academy
  - Assist in establishment of statewide BioSeed Fund
  - Determine time frame for state constitutional amendment with Bioscience Steering Committee

### Organization and Structure

This Regional Roadmap proposes a set of strategies and actions that involve many private and public sector organizations. There are four primary components to the issue of organization and structure for the Southern Arizona Bioscience Roadmap to move forward in implementation:

- Strengthen and expand the role of BIOSA by securing resources for full-time staff.
- Place responsibility for undertaking the interrelated issues of technology commercialization and business planning support services in one entity, whether it be at UA or with BIOSA.
- Complete work under NIH Clinical and Translational Science Award (CTSA) planning grant to seek full funding to further build capacity regionally and statewide
- Continue the existing Steering Committee or use the Southern Arizona Leadership Council Board as the key organization responsible for monitoring progress in implementation.

### Conclusion

Southern Arizona represents Arizona’s bioscience entrepreneurship center. It has a strong track record of start-ups succeeding start-ups in a robust genealogical tree, UA has a strong track record of bioscience spin-offs from its research, and both the university and industry are making plans to build further research excellence in their core competencies and achieve a critical mass of bioscience firms in the region. This Roadmap charts a set of strategies and actions for implementation over the next 5 years, identifies priorities and a time frame, identifies the resources required, and proposes measures of success and an organizational design and structure to oversee monitoring and implementation of this Roadmap.