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# Arizona's Bioscience Roadmap

2025 – 2030

## A Statewide Vision for Bioscience Innovation and Impact

## Acknowledgements

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**The Flinn Foundation** is a privately endowed, philanthropic grantmaking organization established in 1965 by Dr. Robert S. and Irene P. Flinn to improve the quality of life in Arizona to benefit future generations. Based in Phoenix, the Foundation supports the advancement of the biosciences in Arizona through grants, the convening of Arizona's Bioscience Roadmap Steering Committee, and the commissioning and coordination of the Bioscience Roadmap and its metrics. The Foundation also supports a merit-based college scholarship program, arts and culture, and the Arizona Center for Civic Leadership.

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# Welcome

Arizona's Bioscience Roadmap

Dear Arizonans,

Since 2002, Arizona's Bioscience Roadmap has supplied a long-term plan for our state's bioscience enterprise: build on strengths, work across institutions, translate discoveries, and foster industry growth to improve health and prosperity.

In the years following the Roadmap's 2014 update, Arizona's bioscience sector—already world-class in key domains—has begun to mature broadly, with growth across universities and health systems and new shared venues for innovation, applied research, and technology translation. Our talent pool has increased, and we have exceeded the nation's growth rate in research funding and job creation.

Today, Arizona is in an especially dynamic period. Federal support, capital for new ventures, and the broader economy's health are uncertain, even as astonishing breakthroughs are reshaping what is possible scientifically and clinically, and the state's historic high-tech manufacturing boom is transforming our industry landscape.

The new Roadmap sets out strategies to amplify collaboration, accelerate research impact, support entrepreneurs more effectively, match talent development with industry needs, and tell Arizona's bioscience story with one voice. It is a practical plan for this moment.

The Flinn Foundation reaffirms its commitment to convene leaders, catalyze partnerships, and measure progress. We invite you—researchers, clinicians, entrepreneurs, educators, investors, public servants, and community leaders—to join us in this work.

**Eric Reiman, M.D.**
Chair, Board of Directors
Flinn Foundation

**Tammy McLeod, Ph.D.**
President & CEO
Flinn Foundation

# Executive Summary

Arizona's Bioscience Roadmap—a long-term strategic plan commissioned by the Flinn Foundation—has served as a catalyst for developing Arizona's bioscience ecosystem since 2002. Members of Arizona's Bioscience Roadmap Steering Committee, joined by hundreds of private- and public-sector leaders, have used the Roadmap for more than two decades to support expansion of the state's research infrastructure, commercialization capabilities, and bioscience companies and health systems.

Arizona's bioscience journey reflects both rapid growth and resilience in uncertain times. Over two decades, the state has evolved from a modest bioscience presence into a rising bioscience ecosystem, driven by strong anchor institutions, deepening bioscience specializations, adjacent tech industry expansion, and a growing talent base. The next five years will be pivotal as Arizona seeks to translate momentum into national leadership while navigating funding volatility, global competition, and talent retention—turning progress into lasting, transformative impact.

## A Shifting Context

The bioscience sector in Arizona and beyond is in a period of profound disruption and uncertainty—yet also opportunity. Federal research budgets are unstable, early-stage capital is shifting heavily toward artificial intelligence, and public trust in science has weakened. At the same time, bioscience discovery is entering a new golden era: CRISPR is reshaping medicine and agriculture, mRNA platforms are redefining vaccine development, immunology is unlocking new cancer therapies, and AI is supercharging drug discovery and diagnostics. For Arizona, the moment is clear: adapt to disruption, harness convergence with adjacent industries, and translate discovery into impact.

### Progress and Momentum

Despite challenges, Arizona has achieved nationally competitive growth across the biosciences. Its progress is evident on multiple fronts:

- **Talent expansion**: There were more than 25,000 bioscience-related program completions in 2023, with completions growing rapidly in Arizona as the nation as a whole saw a decline. Yet retention remains inadequate, with too many graduates leaving for coastal markets or staying in Arizona but working in tech-based sectors beyond bioscience.
- **Research momentum**: NIH funding in Arizona reached a record $368 million in FY24, growing nearly four times faster than the national average. Flagship institutions are producing notable breakthroughs while carving distinct strengths—U of A in biomedicine, ASU in bioengineering and computing, and NAU in pathogen genomics.

- **Commercialization signals**: Patent activity is accelerating, trademarks are growing, and tech transfer reforms are underway. However, startup formation and licensing still lag, limiting translation of intellectual property into companies and jobs.
- **Capital inflows**: Arizona raised $1.1 billion in bioscience venture capital from 2019 to 2023. But this represents less than 1% of the U.S. total and is concentrated in a handful of firms, underscoring the fragility of the funding base.
- **Ecosystem maturity**: Innovation hubs like the Phoenix Bioscience Core and Tech Parks Arizona have become convergence zones. Yet infrastructure remains fragmented, with labs and testbeds underutilized, angel networks weakening, and industry associations underpowered compared to peers.

The result is an ecosystem that has outpaced the U.S. in job growth and research funding growth, though it still operates at a smaller scale than benchmarks like Colorado, North Carolina, and San Diego. Even so, Arizona's trajectory demonstrates high potential: The pace of progress shows that with continued investment and coordinated action, the state can build on its growth, achieve greater success, and begin transitioning from momentum to long-term leadership. While challenges remain, the foundation sets the stage for the next set of strategies to sustain and accelerate Arizona's rise.

## The Imperative Ahead

As described below, the 2025–2030 Roadmap lays out five goals and 15 strategies – each with an accompanying set of actions – that are designed to help Arizona navigate an unstable period of threatened resources and technological revolution to emerge as a rising bioscience leader.

Arizona's bioscience sector has momentum, but momentum alone will not suffice. Without deeper commercialization infrastructure, broader capital access, stronger workforce alignment, and unified communications, the state risks falling short of its potential. The Roadmap challenges Arizona to bet boldly on collaboration, talent, and discovery translated into impact.

### Bioscience Roadmap Vision: 2025–2030

***Arizona is a nationally recognized, rising bioscience leader with a skilled talent base, world-class research, and dynamic industry growth. It exemplifies collaboration, agility, and the courage to bet on discoveries that strengthen the economy and Arizonans' health and quality of life.***

By executing on the Roadmap, Arizona can achieve four defining outcomes:

- National competitiveness in select bioscience domains such as neuroscience, oncology, precision medicine, and medical devices.
- A robust startup pipeline fueled by stronger capital markets and commercialization capacity.
- A resilient talent base and unified brand that attracts and retains top researchers, entrepreneurs, and investors.

- Effective translation of innovation into impact through manufacturing and care delivery.

## Roadmap Goals and Strategies

### GOAL 1: Amplify the Collaborative Gene

Arizona's bioscience ecosystem will exemplify a culture of collaboration where organizations and participants ensure success of one another and the ecosystem. This will be facilitated through institutionalized collaboration that aligns stakeholders, leverages complementary sectors, forges new opportunities across regions, and builds connectivity to global markets.

**Strategy 1.1**: Update Arizona's Bioscience Roadmap Steering Committee to ensure strategic coordination of efforts and activate a new generation of bioscience leaders.

**Strategy 1.2**: Enhance the impact of the Arizona Bioindustry Association.

**Strategy 1.3**: Build connectivity with other technology-intensive industries in Arizona to create a more integrated innovation ecosystem.

**Strategy 1.4**: Engage with complementary bioscience ecosystems beyond Arizona to leverage partnership opportunities for investment, innovation, and talent development.

### GOAL 2: Accelerate Research into Impact

Arizona's bioscience ecosystem will increase the scale, speed, and success of commercialization of bioscience discoveries and innovations that address critical needs. This will be accomplished through new partnerships and resources that create an approachable and opportunity-rich environment for researchers to translate findings into solutions that address real-world challenges.

**Strategy 2.1**: Strengthen partnerships between research institutions, health systems, and industry to accelerate bioscience commercialization and tech transfer.

**Strategy 2.2**: Create a statewide bioscience commercialization network to support researchers and entrepreneurs across the state.

**Strategy 2.3**: Develop statewide research initiatives focused on major diseases and public-health priorities.

### GOAL 3: Elevate Arizona's Startup Ecosystem

Arizona's bioscience ecosystem will nurture and empower bioscience entrepreneurs and startups, providing the resources and support needed to launch, scale, and retain more bioscience ventures. Even in a time of decreased federal support, traditional research institutions will continue to play a critical role in bioscience innovation. However, startups are increasingly taking on more of the bioscience developmental risk that in the past was born by large corporations. Thus, a strong entrepreneurial community will benefit individual startups and be a flywheel to catalyze reinvestment and growth of the ecosystem. The end goal of this ecosystem development work will be demonstrated if new bioscience startups are increasingly created, sustained, and retained in Arizona, and ultimately attract the attention and investment in Arizona of more global-scale bioscience firms.

**Strategy 3.1**: Diversify the investment base for Arizona's entrepreneurial ecosystem to increase access to capital for emerging bioscience companies.

**Strategy 3.2**: Scale innovation and commercialization programs that offer tailored programming and mentorship in specific bioscience fields or technologies.

**Strategy 3.3**: Build a statewide bioscience incubator network aligned to regional specializations and needs.

**GOAL 4: Strengthen Talent and Career Pathways**

Arizona's bioscience ecosystem will be a premier bioscience workforce hub that attracts, develops, and retains top-tier professionals and skilled workers. This will be demonstrated by Arizona becoming a residence of choice for workers and destination of choice for companies requiring a large, skilled, and sustained talent pool.

**Strategy 4.1:** Unite education institutions and employers to align Arizona's bioscience talent pools with evolving labor needs.

**Strategy 4.2**: Implement and scale effective workforce development programs.

**Strategy 4.3**: Establish a bioscience talent concierge to recruit and retain transformative research, clinical, entrepreneurial, and business talent.

**GOAL 5: Tell Arizona's Bioscience Story**

Arizona's bioscience ecosystem will be recognized in-state and out as a national leader by policymakers, investors, potential collaborators and other key constituencies for its contributions to health outcomes and economic growth, together benefiting all Arizonans. This will be demonstrated through an increased media presence and the emergence of a more competitive policy environment that strengthens the ecosystem's long-term competitiveness.

**Strategy 5.1**: Promote and position Arizona as a bioscience hub with a coordinated communications plan.

**Strategy 5.2**: Advocate for policy to enhance Arizona's competitiveness.

## The Roadmap in Action

The infographic below summarizes the Roadmap goals with example actions that illustrate how Arizona can strengthen its foundation and advance toward national leadership in the biosciences.

Some of the proposed actions are intended to fortify and protect assets through difficult times. Some actions would extend exciting progress that Arizona has already made. And some would enable true leaps forward. In certain instances, Arizona's current environment may not today be ripe for the most audacious actions, and there the charge to bioscience leaders and supporters is to prepare, to ensure that Arizona is ready for an opening when it arrives.

# Roadmap Goals & Example Actions

## Amplify the Collaborative Gene

Arizona's bioscience ecosystem will exemplify a culture of collaboration where organizations and participants ensure success of one another and the ecosystem.

| | |
|---|---|
| **Fortify Assets** | **Update Arizona's Bioscience Roadmap Steering Committee** membership and areas of focus. |
| **Extend Progress** | Build **cross-industry connectivity** within Arizona and relationships with bio ecosystems nationally. |
| **Leap Forward** | Enhance organizational **impact and statewide reach of Arizona Bioindustry Association.** |

## Accelerate Research into Impact

Arizona's bioscience ecosystem will increase the scale, speed, and success of commercialization of discoveries and innovations that address critical needs.

| | |
|---|---|
| **Fortify Assets** | Improve processes facilitating research **partnerships with health systems and industry.** |
| **Extend Progress** | Create statewide **commercialization mechanism** with regional coordinators. |
| **Leap Forward** | Develop **statewide research initiatives** focused on major diseases and public health priorities. |

## Elevate Arizona's Startup Ecosystem

Arizona's bioscience ecosystem will nurture and empower entrepreneurs and startups, providing resources and support to launch, scale, and retain bio ventures.

| | |
|---|---|
| **Fortify Assets** | Create **bioscience-specific cohorts** of existing commercialization & entrepreneurship programs. |
| **Extend Progress** | Build statewide **bioscience incubator network** aligned to regional specializations and needs. |
| **Leap Forward** | **Attract global bioscience companies to Arizona** via acquisition of promising homegrown companies. |

## Strengthen Talent & Career Pathways

Arizona's bioscience ecosystem will be a premier bioscience workforce hub that attracts, develops, and retains top-tier professionals and skilled workers.

| | |
|---|---|
| **Fortify Assets** | Conduct **workforce needs assessments** and translate findings into curricula revision recommendations. |
| **Extend Progress** | Expand flexible modular learning pathways, including **AI literacy programs for mid-career workers.** |
| **Leap Forward** | Launch **bioscience talent concierge** to support the recruitment and retention of high-level bioscience professionals. |

## Tell Arizona's Bioscience Story

Arizona's bioscience ecosystem will be recognized nationally for its contributions to health outcomes and economic growth and a competitive policy environment.

| | |
|---|---|
| **Fortify Assets** | Identify existing **government initiatives that can support bioscience** ecosystem development. |
| **Extend Progress** | Develop coordinated **communications plan to promote and position Arizona** as a bioscience hub. |
| **Leap Forward** | Build consensus among priorities and mobilize champions to **advocate for targeted policy changes.** |

# Introduction

### A Roadmap for a Time of Disruption and Opportunity

Arizona's Bioscience Roadmap—a long-term strategic plan commissioned by the Flinn Foundation—has served as a catalyst for developing Arizona's bioscience ecosystem since 2002. Members of Arizona's Bioscience Roadmap Steering Committee, joined by hundreds of private- and public-sector leaders, have used the Roadmap for more than two decades to support expansion of the state's research infrastructure, commercialization capabilities, and bioscience companies and health systems.

A new iteration of Arizona's Bioscience Roadmap is now available to help the state accelerate this progress. Its arrival is timely. At the moment of the Roadmap's public release in 2025, the bioscience sector in Arizona and beyond is in a period of disruption and uncertainty—yet also opportunity.

In the United States, the biosciences are contending with losses of federal research grants and the possibility of curtailed federal research for years to come, while international competition, especially from China, grows stronger. Risk-capital funding for bioscience ventures has become more uncertain since its 2021 peak, with a surge in investment toward artificial intelligence (AI). Healthcare spending in the United States is expected to continue steady growth, while safety-net programs like Medicaid are threatened. In the wake of the COVID-19 pandemic, trust in public health and scientific expertise has declined. Confidence in the value and values of higher education institutions has likewise eroded, while new challenges have emerged as immigration policy shifts toward constraining enrollment of foreign students and employment of foreign workers in research, industry, and healthcare settings.

Simultaneously, the biosciences are achieving scientific progress as astonishing as when Arizona's Bioscience Roadmap debuted alongside the completion of the Human Genome Project. CRISPR technology is transforming genome editing, with vast implications for agriculture and medicine. Developments in immunology are rewriting approaches to cancer treatment. mRNA platforms are enabling faster, cheaper development of vaccines and therapeutics. Blood-based diagnostic tests are improving rapidly, providing the basis for new ways to diagnose, treat, and prevent many diseases, including Alzheimer's and numerous types of cancer.

And now AI is here. While the general public's first experiences of AI may be casual interaction with chatbots, AI applications in drug discovery, biomanufacturing, regulatory compliance and quality control, imaging and microscopy, diagnostics, public health bioinformatics, and clinical decision support have been proliferating for several years and are growing exponentially in power and efficiency. Accelerated by AI, the bioscience sector may—right now—be entering a unique period of advancement.

How can Arizona respond to the challenges and change facing its bioscience sector? What factors differentiate the state from competitors? How ready is it to seize the opportunities this period presents?

The new Bioscience Roadmap engages these questions. It proposes a set of goals building on those of the 2002 Roadmap and its 2014 update, but recognizes the altered and unstable landscape of 2025. The Roadmap's recommended strategies and actions aim to increase Arizona's health outcomes and economic prosperity by driving forward three domains in the biosciences:

- Research and discovery
- Commercialization and entrepreneurship
- Translation of innovation into real-world impact through manufacturing and care delivery

Some of the proposed actions are intended to fortify and protect assets through difficult times. Some actions would extend exciting progress that Arizona has already made. And some would enable true leaps forward. In certain instances, Arizona's current environment may not today be ripe for the most audacious actions, and there the charge to bioscience leaders and supporters is to prepare, to ensure that Arizona is ready for an opening when it arrives.

**Arizona's Position**

Since the Roadmap's creation, Arizona's bioscience sector has been characterized less by its size—being in the middle among states by several measures—than by the pace of its expansion. Bioscience job growth in Arizona consistently outpaces that of the sector nationally, as well as the overall growth rate of Arizona's private sector. This rapid growth has multiple sources, including the state's leading research universities, significant industry presence, large talent base, and emerging innovation ecosystem.

Arizona has several core research strengths to build on under the new Roadmap: biomedical informatics, diagnostics, genomics, medical devices, neurosciences, oncology, and precision medicine—fields central to advancing human health. Arizona is also primed to be a national hub for translational research; it is a leading state in clinical trials, supported by strong infrastructure and access to diverse populations, enabling clinical partners to accelerate development of new treatments. It has several comprehensive, nationally recognized hospital systems. And since the Roadmap first launched, Arizona has grown from one to four allopathic medical schools—often the discovery engines for the biosciences—with a fifth opening in 2026 and a sixth possible in the future.

Arizona's commercialization capacity has expanded substantially since 2002, with its colleges and universities increasingly focused on applied research and technology translation and new entrepreneurship programs sponsored by a range of entities. The state has a reputation for collaboration, with important partnerships among health systems, universities, companies, risk-capital funders, nonprofits, and economic development groups. And numerous innovation hubs have emerged across the state to enable comingling of research groups, education and training programs, startups, and investors.

Also important to the biosciences is Arizona's maturation in complementary high-technology industries, including defense and aerospace, and most notably the explosive growth in semiconductor manufacturing—including the largest foreign direct investment in U.S. history. The expansion and increasing impact of these industries is introducing new opportunities for cross-sector partnerships on research and development (R&D) and workforce, increasing the state's entrepreneurial breadth and density as talent flows in, and helping to magnify the state's reputation as a center of innovation.

Finally, public support at the local, state, and federal levels has been vital throughout the history of Arizona's Bioscience Roadmap. Arizona policymakers have ensured a favorable tax and regulatory climate for development of the biosciences, and at key junctures lawmakers and voters have approved essential investments that strengthen the sector and benefit Arizonans' health and prosperity. Looking forward, some of the Roadmap's most ambitious proposals will again require public backing.

**The New Roadmap**

Arizona's Bioscience Roadmap is informed by rigorous data analysis, ecosystem benchmarking, and deep statewide engagement. It reflects lessons learned since the Roadmap first launched, as well as the current economic and innovation landscape. The updated strategy is designed for Arizonans ready to confront headwinds, adapt, and lead in a rapidly evolving, globally interconnected environment.

### Bioscience Roadmap Vision: 2025–2030

***Arizona is a nationally recognized, rising bioscience leader with a skilled talent base, world-class research, and dynamic industry growth. It exemplifies collaboration, agility, and the courage to bet on discoveries that strengthen the economy and Arizonans' health and quality of life.***

Arizona can preserve progress and build on two decades of growth by deepening focus on its strengths while pursuing opportunities in high-potential, emerging areas. With respect to research, the state's longstanding competencies in bioengineering, cancer, and neurosciences remain foundational. At the same time, opportunities and expertise are growing in cross-cutting domains like precision medicine, precision health, and healthy aging, where research assets and health-system capacity align with Arizona's needs and global demand.

The Roadmap proposes strategies and actions to address challenges in early-stage funding, access to commercialization expertise, regional connectivity, and workforce attraction and retention. It recommends ways to accelerate translation of research into clinical and commercial impact, improve the environment for startups, deepen collaboration with high-tech sectors beyond the biosciences, and ensure that the bioscience workforce is prepared to adapt in the sector's uncertain future.

Proposed actions include several modest steps with potential for an outsize impact. Other actions would extend progress with enhancement of existing assets, like updating Arizona's Bioscience Roadmap Steering Committee and aligning tech-transfer policies at the state's public research institutions. The most ambitious recommended actions could take several years to implement, given their complexity, the need for major commitments from across the ecosystem, and the challenging current landscape. But their capacity to unlock potential in Arizona's bioscience ecosystem makes initiatives such as the following exciting to pursue:


- Demonstrate Arizona's collective research strengths through statewide, multi-institution research initiatives, especially by addressing prominent diseases and public health challenges distinctive to Arizona
- Create a statewide investment fund to support bioscience and health innovation
- Form a new bioscience commercialization effort and a network of bioscience incubators tailored to regional needs
- Expand the capacity and impact of the Arizona Bioindustry Association
- Broaden Arizona's industry base by attracting major Arizona expansions of global bioscience companies

Together, efforts such as these provide a framework for action for the next five years—positioning Arizona to compete and lead in key bioscience domains that will shape the state's health, economy, and future. Achieving the Roadmap's vision will require sustained leadership, fresh investment, and a strong commitment to cross-sector collaboration.

Metrics and progress tracking under the new Roadmap will continue to be commissioned and reported by the Flinn Foundation and shared by community partners throughout the state.

# Defining Arizona's Bioscience Sector

## What Bioscience Is and Why It Matters

Bioscience focuses on the research, development, and commercialization of therapies and products to prevent, diagnose, and treat disease, improve health outcomes, enhance crops, and generate biological solutions for environmental and industrial challenges. It employs scientific methods to understand normal and abnormal biological processes and answer profound questions about what life is, how it works, and how it changes. Bioscience plays a central role in addressing many global challenges and improving quality of life for future generations.

Arizona's bioscience sector is made up of six subsectors, each with an important role in the ecosystem and in improving outcomes for Arizonans and beyond:

- **Agricultural Feedstock and Industrial Biosciences:** Firms engaged in agricultural research and development, processing, organic chemical manufacturing, and fertilizer manufacturing. The subsector includes industry activity in the production of ethanol and other biofuels.
- **Bioscience-Related Distribution:** Firms that coordinate the delivery of bioscience-related products spanning pharmaceuticals, medical devices, and agricultural biotech. Distribution in the biosciences is unique in its deployment of specialized technologies, including cold storage, highly regulated monitoring and tracking, and automated drug distribution systems.
- **Medical Devices and Equipment:** Firms that develop and manufacture surgical and medical instruments and supplies; laboratory equipment; electromedical apparatus, including MRI and ultrasound equipment; and dental equipment and supplies.
- **Pharmaceuticals:** Firms that develop and produce biological and medicinal products and manufacture pharmaceuticals and diagnostic substances.
- **Research, Testing, and Medical Laboratories:** Firms engaged in R&D in biotechnology and other life sciences, life-science testing laboratories, and medical laboratories. This subsector includes contract and clinical R&D organizations.
- **Hospitals:** Hospitals are vital for delivery of clinical care as well as for discovery, with many collaborations between health systems, universities, and private companies on research, experiential learning opportunities, and commercialization. Rural hospitals and clinics, in particular, are often early adopters of cost-effective healthcare technologies.

The scope of Arizona's bioscience sector described above aligns with the previous definition used by Arizona's Bioscience Roadmap and uses subsector definitions—with one exception—developed by the Biotechnology Innovation Organization (BIO), the industry's national trade association. BIO does not include hospitals in its definition, but SRI and the Flinn Foundation decided to retain Arizona's hospitals in Arizona's definition because they help lead the translation of bioscience research to patient populations.

## Bioscience in Arizona by the Numbers

Arizona's bioscience industry, inclusive of hospitals, represents over 144,000 jobs (Table 1). In line with the state's population, most bioscience jobs are in Greater Phoenix, a top-employing MSA across multiple bioscience subsectors. Tucson and Flagstaff have nationally competitive employment concentrations of Medical Devices and Equipment jobs, while Yuma and Sierra Vista-Douglas have competitive employment concentrations of Agricultural Feedstock and Industrial Biosciences jobs among small MSAs.

*Table 1: Profile of Arizona's Bioscience Sector*

| Industry Subsector | | Arizona | | United States |
|---|---|---|---|---|
| | | 2023 | 2019-2023 Change | 2019-2023 Change |
| Agricultural Feedstock and Industrial Biosciences | Establishments | 18 | -1.4% | 14.4% |
| | Employment | 690 | 13.1% | 4.2% |
| | Location Quotient | 0.46 | | |
| | Average Annual Wage | $58,466 | 1.7% | 21.8% |
| Bioscience-Related Distribution | Establishments | 2,129 | 28.1% | 17.6% |
| | Employment | 13,307 | 23.9% | 12.8% |
| | Location Quotient | 0.98 | | |
| | Average Annual Wage | $133,440 | 16.3% | 21.8% |
| Medical Devices and Equipment | Establishments | 208 | 39.5% | 32.1% |
| | Employment | 10,061 | 14.5% | 6.1% |
| | Location Quotient | 1.16 | | |
| | Average Annual Wage | $92,982 | 7.3% | 8.3% |
| Pharmaceuticals | Establishments | 110 | 26.7% | 52.7% |
| | Employment | 5,023 | 43.5% | 12.7% |
| | Location Quotient | 0.67 | | |
| | Average Annual Wage | $72,899 | 17.7% | 11.1% |
| Research, Testing, and Medical Laboratories | Establishments | 1,186 | 93.7% | 61.4% |
| | Employment | 11,318 | 29.1% | 23.8% |
| | Location Quotient | 0.68 | | |
| | Average Annual Wage | $89,200 | 24.6% | 20.4% |
| Total Non-Hospital Bioscience | Establishments | 3,652 | 44.4% | 35.0% |
| | Employment | 40,399 | 24.6% | 14.7% |
| | Location Quotient | 0.84 | | |
| | Average Annual Wage | $102,161 | 15.2% | 18.2% |
| Hospitals | Establishments | 324 | 38.2% | 34.5% |
| | Employment | 103,717 | 4.1% | 2.7% |
| | Location Quotient | 0.96 | | |
| | Average Annual Wage | $81,311 | 21.3% | 19.% |
| Total Bioscience | Establishments | 3,975 | 43.9% | 35.0% |
| | Employment | 144,116 | 9.2% | 6.0% |
| | Location Quotient | 0.93 | | |
| | Average Annual Wage | $87,156 | 20.5% | 21.7% |

**Source**: TEConomy Partners, Arizona's Bioscience Roadmap 2025 Progress Report data.

Research-related positions (including the job categories of biological scientists, clinical lab techs, physicians, and surgeons) make up 13% of Arizona's hospital workforce, with 13,066 jobs in total, and grew 2.59% from 2019 to 2023.

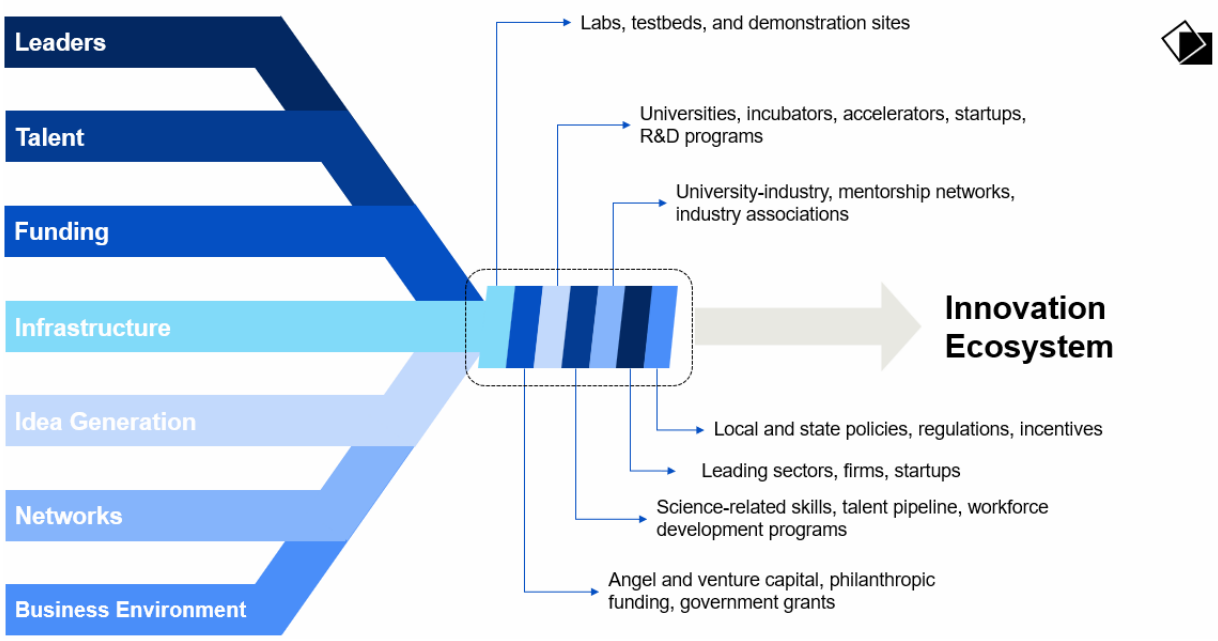
Some bioscience leaders are surprised by the modest employment for Agricultural Feedstock and Industrial Biosciences. Note that some activity one may think of as agricultural biotech is included in other subsectors. For instance, medicinal and botanical manufacturing is part of Pharmaceuticals, and development of genetically modified crops is generally captured in Research, Testing, and Medical Laboratories.

Complementing hundreds of startup ventures and small companies, several national and global bioscience companies have R&D, manufacturing, sales, and/or administrative operations in Arizona. These companies include Abbott Laboratories, Align Technology, AstraZeneca, Becton Dickinson, Bristol Myers Squibb, Caris Life Sciences, Central Admixture Pharmacy Services (CAPS), Covetrus, Dexcom, Exact Sciences, GE HealthCare, Medtronic, Procter & Gamble, Roche Tissue Diagnostics, Stryker, Thermo Fisher Scientific, and W. L. Gore. More information about Arizona's bioscience industry leaders can be found in Table 8 in the Appendix.

## Characteristics of a Thriving Bioscience Ecosystem

A thriving bioscience ecosystem is defined not just by breakthroughs in discovery, but by the integration of strong research institutions, commercialization capacity, capital and infrastructure, skilled talent, and health systems that together translate innovation into economic and health impact. These elements function within a resilient innovation ecosystem—a dynamic network of individuals, institutions, resources, and policies that enables the creation, development, and scaling of new ideas, technologies, and enterprises (see Figure 1). It is not merely the presence of these assets but their strategic alignment that defines success. High-performing ecosystems direct institutional capacity toward collaboration and effective interaction, creating synergies that drive sustained bioscience innovation and growth.

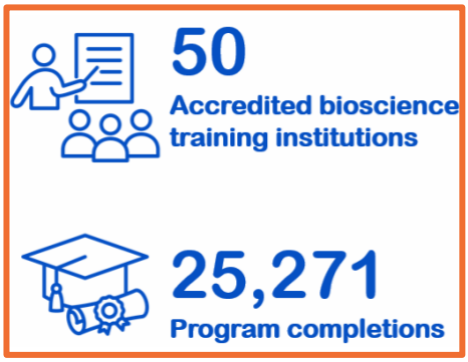
*Figure 1: Innovation Ecosystem Framework*




An Ecosystem Assessment is a critical tool to parse assets and gaps within the ecosystem, assess its "connective tissue," and understand the contributions of different regions and systems across the state. Over a yearlong period, SRI conducted research and engaged with hundreds of Arizonans—and representatives of comparator regions—through focus groups, interviews, presentations, and surveys to understand Arizona's progress since the Roadmap first launched in 2002 and the state's current status. That work revealed a bioscience sector in Arizona that has grown faster than the sector nationally and faster than the state's overall private sector. This performance can be attributed to rapidly expanding talent pools, strong clinical and research infrastructure, and a favorable business environment.

These essential assets—and the other factors contributing to the state's innovation ecosystem—must develop further for Arizona to become a leading bioscience region in the United States. Arizona's Ecosystem Assessment begins below.

### Talent: A Diverse and Growing Bioscience Talent Pool




Bioscience-related education pathways are available at 50 Arizona universities, community colleges, and other accredited training institutions, which together supplied 25,271 bioscience-related program "completions" (degree, certificate, and award completions) in 2023. Of those completions, half were produced by the state's three public universities (in order of number of completions): Arizona State University (ASU), the University of Arizona (U of A), and Northern Arizona University (NAU). Grand Canyon University followed closely behind. Arizona's bioscience program completions in 2023 were 12th-most in the country, an outsize contribution to the bioscience workforce, as Arizona is 15th among states in working-age population.[1] And the state's relative position is improving, with a 9% increase in completions from 2019 to 2023, a period that saw a nationwide decline in completions.[2]

As Arizona students finish high school, they have opportunities to enroll in in-demand associate degree and certificate programs enabling quick entry into bioscience careers, as well as in bachelor's and then graduate degree programs. Students matriculate at four allopathic medical schools (Creighton University School of Medicine, Mayo Clinic Alix School of Medicine, and the University of Arizona's College of Medicine – Phoenix and College of Medicine – Tucson) and two osteopathic medical schools; nursing, pharmacy and veterinary colleges; and colleges and programs in allied health. Students have access to major academic research centers at public universities, including the Biodesign Institute at ASU, the BIO5 Institute at U of A, and the Center for Community Health and Engaged Research (CHER) and Pathogen and Microbiome Institute (PMI) at NAU. Arizona's community colleges, tribal colleges, and private technical schools are also essential contributors to the bioscience workforce, serving as hubs for early-stage lab training, gateways for underserved communities, and apprenticeship opportunities, from the Maricopa Community Colleges system in the state's population center to Arizona Western College in Yuma and Diné College in Tsaile.

*Survey Snapshot: Emerging Education Program Priorities from Arizona's Bioscience Community*

- **Emerging technologies:** Need to embed AI, machine learning, data analytics, and programming into bioscience curricula.
- **Frontiers in bioscience:** High-interest areas for expanded training include bioinformatics, biomanufacturing, and the "Omics" fields (e.g., genomics, proteomics, metabolomics)
- **Laboratory training:** Continued importance of foundational lab safety and experience with advanced techniques like CRISPR and next-generation sequencing (NGS)
- **Regulatory science:** Need for stronger training in compliance, quality management, and regulatory standards, especially in pharmaceuticals and medical devices
- **Stronger academic-industry alignment:** Deeper partnerships between education institutions and bioscience workforce organizations from high school through graduate education to proactively and flexibly align programs with bioscience industry needs

### *The Labor Market for Bioscience Roles*

The U.S. biosciences sector added nearly 300,000 non-hospital jobs from 2019 to 2023, outpacing overall private sector growth by 3.8 times.[3] Globally, the biosciences are experiencing rising demand, especially for talent with cross-disciplinary skills in areas such as data science, manufacturing, and regulatory affairs, driven by rapid innovation in personalized medicine, synthetic biology, and AI-enabled drug discovery.[4] Arizona ranks 21st among states in bioscience jobs, somewhat lower than its working-age population rank, but it ranks higher for several specific bioscience occupations. Wages for Arizona's non-hospital bioscience industry grew by 15% from 2019 to 2023. Although this wage growth was lower than the sector nationally by 3%, it outperformed national trends in two subsectors: Research, Testing, and Medical Laboratories; and Pharmaceuticals. (More information about occupational employment and wage competitiveness can be found in Table 21 and Table 22 in the Appendix.)

Despite the growth of Arizona's bioscience talent pool and competitive wages for many bioscience occupations, examination of job postings revealed shortages or unfilled positions in several vital bioscience roles, with unique job postings far exceeding hires. These shortages appear in career fields that require varying levels of education, from technicians, to physicians, to engineers in bioscience companies.[5] Arizona's bioscience labor shortage in certain areas is partly the product of the sector's rapid expansion, as well as competition from other high-technology sectors where training and skills are transferrable. The state also experiences some difficulty retaining bioscience talent: Arizona trails most western and southwestern states in the retention of engineering, biological sciences, and medical-residency graduates.[6] Several factors may contribute to individuals leaving Arizona after completing training. For one, everywhere in the country, out-of-state students are retained at much lower rates than in-state students after graduation; Arizona ranks 13th among all states in the share of out-of-state first-year college students.[7] Job opportunities in larger and higher-paying markets draw some graduates away, and for some, lifestyle factors motivate departures—suggesting the importance of marketing strategies targeting not only out-of-state bioscience workers but also students trained at Arizona institutions.

### *Alignment Between Industry and the Education System*

Analysis of job postings provides insights about the desires and behaviors of Arizona employers as they seek talent matching their business needs, which can surface opportunities for alignment with workers seeking pathways into good jobs. Toward this end, SRI assessed several thousand job postings in a pair of bioscience job categories that cut across all six bioscience subsectors and are thus relevant to a large share of the bioscience community: Bioscience Manufacturing and Core Laboratory and Discovery. While distinct, these two categories include a number of overlapping skills demands (see Figure 5 in the Appendix). In terms of educational requirements, Bioscience Manufacturing jobs are relatively accessible, though they may demand a range of soft and technical skills and may require prior work experience or on-the-job training. Core Laboratory and Discovery jobs often require more education. (See Table 11 and Table 12 in the Appendix for more information on top occupations under each category.)

Even where roles in these categories do not require education beyond high school, math, computer, and data skills are increasingly expected, underscoring the importance of dialogue between K-12 districts, career and technical education districts (CTEDs), and state agencies that set curricular requirements—and the employers that will be hiring their graduates. Many of these entities are already working well together, and Arizona has notable innovators in the K-12 realm, including some of its CTE programs, specialized curricula in schools like Paradise Valley High School and Bioscience High School, and the SciTech Institute—the last of which also works beyond K-12 (Table 13). But education leaders must redouble their efforts to ensure that, as advanced robotics and applications of AI further transform what it means to work in domains like manufacturing, students complete high school ready for jobs of the present and able to adapt to what will be a wholly different future.

Current indicators suggest that while Arizona is home to school-choice innovation and a handful of the highest-performing charter schools in the nation, most of the state's K-12 schools need to prepare most of their students much better. The most recent administrations of the National Assessment of Educational Progress found Arizona 8th graders scoring slightly below the national average in mathematics and reading (exam administered in 2024) and more significantly below the national average in science (2015).[8] The Education Recovery Scorecard, a measure of post-pandemic recovery from learning loss, ranked Arizona 41st among states in terms of the 2019–2024 change in achievement in math and 35th in reading.[9] Many education leaders and observers have pointed to historic underfunding of Arizona's schools as a contributor to weak outcomes; in 2023, the state's total per-pupil funding was 43rd nationally.[10]

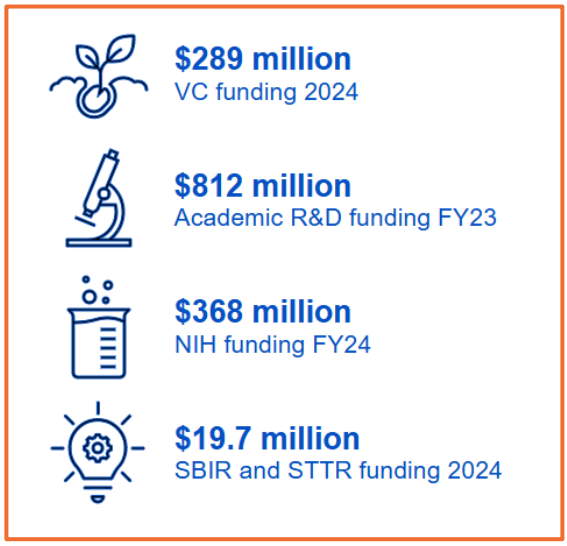
Although K-12 education outcomes and alignment with bioscience-sector skill requirements need attention, Arizona's postsecondary educational alignment with current roles in the biosciences appears quite strong. Complementary to the job postings analysis, a curriculum mapping of 22 postsecondary bioscience programs throughout the state was performed. (More information about the programs mapped can be found in Table 15 of the Appendix.) This exercise revealed strong overall alignment with industry's top in-demand skills. However, most of Arizona's mapped bioscience programs are missing two key skills common to assessed job categories: regulatory compliance and quality assurance/quality control (QA/QC). Bioscience employers, industry organizations, and education institutions should seek opportunities to improve education for regulatory compliance and QA/QC, as these skills are critical to supporting the commercialization of bioscience innovations.

Finally, it must be noted again that the bioscience roles of today will radically change in the coming decade. Postsecondary institutions must approach curricular review with a bias for flexibility and responsiveness to the injection of AI into the bioscience sector.

### Funding: The Bioscience Funding Landscape

Funding for bioscience research and commercialization in Arizona looks much different in mid-2025 than it did at the beginning of the year, and confident predictions for the next several years are plainly impossible. Whether or not cancelled and frozen federal grants and contracts will be restored, permanent losses that may reach hundreds of millions of dollars have already occurred for individual projects and programs across Arizona research-performing institutions. Consequent cuts to scientific trainees and staff may mean that restarting programs will require years-long processes, even if federal funding entities do not see long-term budget decreases. Meanwhile, risk-capital funding for the biosciences, always influenced by conditions across the broader economy, is in an uncertain position, affected by difficult-to-forecast interest rates, shifts in industrial and trade policy, and the enormous shift of capital resources into startups and technologies leveraging AI. In 2022, for example, 14% of all venture capital (VC) activity went to AI companies; in the first quarter of 2025, the share was 71%.[11] With that said, overall investment rose to $69.9 billion and 4,001 deals in the second quarter of 2025, up from $49.9 billion and 3,819 deals in the second quarter of the prior year.

Setting the current turmoil to one side, Arizona's bioscience ecosystem in recent years has demonstrated encouraging growth in federal funding and private capital, suggesting the potential for Arizona to align its research capabilities with a stronger investment footprint.




Arizona's overall federal funding streams are relatively diverse, with about 30% of the state's federal investments being made by the U.S. Department of Health and Human Services.[12] Arizona received $368 million in National Institutes of Health (NIH) funding in Fiscal Year 2024 (FY24), and produced $812 million in bioscience-related academic R&D expenditures in FY23.[13,14] These are both new records for the state, and on both measures, Arizona's recent growth has outpaced funding growth nationally—in the case of NIH funding, by 3.9 times over the 2020–2024 period. (NIH grants awarded within Arizona typically align with core areas of research strength, such as cancer and genetics at the Translational Genomics Research Institute (TGen), an affiliate of City of Hope, and neurodegenerative diseases at several institutions.) Nevertheless, the state has a long way to go to become a top-tier state among recipients of federal research funding. It ranked 25th in FY24, and to break into the top 10, Arizona would need to nearly triple its current NIH funding; Ohio ranked 10th in FY24 with over $1 billion in NIH funding.[15]

Data reported by the National Science Foundation (NSF) reveals that Arizona's share of academic R&D expenditures for biosciences is dominated by U of A, with most funding going toward the fields of biological and biomedical sciences, health sciences, and agricultural sciences. One obvious driver of U of A's excellence is the longstanding integration of its core academic research centers with research at its medical and pharmacy colleges. Since Arizona's Bioscience Roadmap launched, the addition of newer medical schools in the state—including the soon-to-open ASU School of Medicine and Advanced Medical Engineering and the future possibility of an NAU College of Medicine—offers avenues to secure far more federal research grant funding in Arizona. It is also important to note that while ASU's bioscience R&D expenditures are today much smaller than those of U of A, it saw growth from 2020 to 2023 of 61%, nearly triple the growth at U of A (21%) and NAU (20%).[16]

Federal funding data indicates the distinct research profiles of Arizona institutions. In terms of the universities' disciplinary concentrations, U of A is the state's leading research engine for biomedicine, ASU's top strengths are in areas like bioengineering and computing, and NAU has exceptional competitiveness in pathogen genomics and community health. Similar clustering occurs in the research programs of health systems, such as neurodegenerative diseases and brain injury at St. Joseph's Hospital and Medical Center and its Barrow Neurological Institute, and Alzheimer's disease at Banner Health. Through the first two decades of the Roadmap, Arizona leaders have generally sought to double down on these clusters of excellence rather than seek institutional parity or build intrastate competing research programs from scratch, a strategically sound approach that will be critical to sustain. Organizations have also found grant-funding success pursuing cross-institutional collaborations like the Partnership for Native American Cancer Prevention, which involves scientists at NAU and U of A, and the seven-member Arizona Alzheimer's Consortium. Potential for additional collaborations is high in such interdisciplinary areas as biomedical engineering, health data science, and regenerative medicine, where translational impact is high and funding opportunities are increasingly cross-agency.

Another important mechanism for translating research into commercial outcomes is through Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants. (The former program supports internal R&D at small businesses; the latter funds partnerships between small businesses and research institutions.) In Arizona, the focus of projects funded under these grants aligns with academic research strengths. In 2024, Arizona bioscience companies earned nearly $20 million from SBIR/STTR programs, ranking 18th among U.S. states. They earned $9 million in 2023 (29th) and $34 million in 2022 (14th). Unlike a number of other states, Arizona does not have a program of matching funds provided to SBIR/STTR recipients.

As technologies move from the laboratory into commercialization, angel investors have historically played a crucial role in bridging the early-stage funding gap. Networks like Desert Angels in Tucson and Arizona Tech Investors in Phoenix have supported numerous bioscience startups, providing not just capital but also mentorship, validation, and access to broader investment networks. However, Desert Angels has seen a marked decline in the number of investments and size of investments made in recent years, and this decline has created a gap in seed-stage capital in southern Arizona. Without a vibrant angel network, promising startups may struggle to gain traction, regardless of the quality of their science.

Arizona would benefit from revitalizing its angel ecosystem through new syndicates, particularly in northern and southern Arizona; alumni-driven investment groups; or state-supported co-investment models, particularly those aligned with university innovation hubs.

On the VC front, Arizona raised $290 million in bioscience VC in 2024, and over $1.1 billion from 2019 to 2023.[17] While these figures may be impressive at first glance, just four companies accounted for nearly half of the $290 million, and the 2024 total was 0.58% of all U.S. bioscience VC.[18] A look over a longer span shows Arizona struggling to increase its share of the national total. Since tracking under the Roadmap began in 2002, the state's most competitive year was 2014, when it secured 0.76% of bioscience VC nationally. In the years since 2014, it has reached 0.50% only four times. In terms of the stage of funding, trends over the last five years indicate that Arizona's bioscience ecosystem needs a refresh in early-stage funding to continue building its investment pipeline. A fully developed innovation market would include a broader base of seed, Series A, and Series B deals spread across multiple subsectors. Strengthening the bioscience startup environment will also require nurturing more in-state capital, as Arizona-based investors have contributed to deals that accounted for approximately 20% of total VC in 2024 and 31% of bioscience VC from 2019 to 2023.[19] And as Arizona's bioscience ecosystem continues to grow, attention must increasingly focus on supporting entrepreneurs and startups not only with early-stage capital, but also with the resources and guidance needed to become investment-ready.

Some recent activity in the ecosystem has been encouraging. For example, Xcellerant Venture's Fund I for Arizona-based health technology startups received an investment of $5 million from AZ Venture Capital (AZ-VC), established in 2022 to deploy federal funds to Arizona startups through the Arizona Commerce Authority, and that commitment spurred an additional $2 million in private capital.[20] Much more in-state investment is certainly possible, as private equity (PE) and family-office capital remain largely untapped for bioscience, especially in wealth centers like Scottsdale, but also in in metro Tucson, Flagstaff, and elsewhere. While PE has historically favored sectors like real estate and healthcare services, it could become a crucial source of growth-stage funding for bioscience companies that are too advanced for seed funding but are not yet IPO-ready. Engaging PE firms more deliberately, particularly those focused on diagnostics, digital health, and outpatient services, could create a new tier of capital for scaling companies.

To fully capitalize on its progress, Arizona must intentionally bridge the gap between research excellence and commercialization readiness. This will require not only more capital at all stages, but also greater coordination among investors, institutions, and policymakers to build a truly integrated bioscience innovation ecosystem.

### Infrastructure: Bioscience Research Infrastructure That Supports Innovation

Figure 2 highlights some of the key entities in Arizona's bioscience research environment, anchored by major universities, nationally recognized health systems, and nonprofit research organizations, increasingly linked through shared research centers, co-located facilities, and collaborative translational projects that form a growing innovation network across the state.

*Figure 2: Arizona Bioscience Research Environment*


This ecosystem is reinforced by infrastructure that integrates scientific discovery with commercialization, training, and entrepreneurship. Innovation hubs, including the Phoenix Bioscience Core (PBC), Phoenix Medical Quarter / Midtown, ASU Research Park, and Tech Parks Arizona, are physical spaces designed as convergence zones where startups, academic researchers, and clinical partners co-develop new therapies, diagnostic tools, and device technologies, enabling streamlined access to wet labs, clinical trial networks, specialized equipment, and mentorship, which create conditions where translational science can accelerate toward commercial impact. Academic research centers, including the U of A's BIO5 Institute, the Biodesign Institute at ASU, and NAU's Pathogen and Microbiome Institute, drive interdisciplinary research in areas such as neuroscience, medical devices and diagnostics, genomics, agriculture biotechnology, and biodefense. Such academic centers, as well as the state's medical schools, have increasingly established joint ventures and translational studies with research centers within Arizona's health systems, including Banner Alzheimer's Institute, Banner MD Anderson Cancer Center, Barrow Neurological Institute, HonorHealth Research Institute, Mayo Clinic Arizona, and Phoenix Children's Research Institute, that extend the research continuum into clinical and commercial applications.

Beyond centers of bioscience research, several other labs, testbeds, and demonstration sites throughout Arizona in the advanced manufacturing, optics, and electronics fields offer cross-cutting capabilities that can be applied to bioscience challenges, such as miniaturized diagnostics and wearable sensors.

Examples include ASU's Manufacturing Innovation Center and Polytechnic School Innovation Hub, and U of A's Imaging Technology Laboratory and Precision Freeform Optics Design, Fabrication, and Testing Facility. However, potential partners like these appear significantly underutilized. Stakeholder engagement surfaced visibility gaps, fragmented access, and unclear engagement pathways. Many high-potential labs and testbeds are—or at least are perceived to be—siloed within host institutions, missing centralized directories or outreach mechanisms, and researchers and startups report difficulties navigating intellectual property (IP) processes, locating prototyping support, or accessing scale-up expertise. These barriers inhibit innovation flow and limit Arizona's ability to convert scientific excellence into bioscience enterprise growth. To address these gaps, Arizona should pursue targeted strategies to enhance connectivity, transparency, and shared use of its research and commercialization assets. Doing so will strengthen the link between discovery and deployment—and position Arizona to lead in bioscience innovation domains aligned with its institutional strengths and health priorities.

*Supply Chain Snapshot: How Localized Is Arizona's Bioscience Supply Chain?*[21]

- Arizona has a localized bioscience supply chain, with approximately 73% of all bioscience industry purchases coming from Arizona-based suppliers.
- Subsectors in Arizona with 70% or more of purchases made in-state include hospitals, bioscience-related distribution, and research, testing, and medical laboratories.
- Looking economy-wide, specific industries (by 4-digit NAICS code) with highly localized supply chains include satellite telecommunications (99%), general medical and surgical hospitals (98%), medical and diagnostic laboratories (94%), architecture and engineering services (93%), and commercial and industrial machinery and equipment (91%).
- Supply chain gaps in key subsectors threaten Arizona's resilience during public health or natural disasters. Sixty percent of agricultural and industrial bioscience purchases and 50% of medical devices and equipment purchases are imported from out-of-state.
- Material-producing industries (by 6-digit NAICS code) that represent significant gaps in Arizona's bioscience component supply chain include irradiation apparatus manufacturing (14%), electromedical and electrotherapeutic apparatus manufacturing (19%), pharmaceutical preparation manufacturing (28%), and surgical and medical instrument manufacturing (35%).

## Idea Generation: A Growing Track Record of Bioscience Innovation

An analysis of scientific publications, patents, trademarks, licenses, and startup formation indicates Arizona's technology-transfer strengths and challenges and the impact of the tech-transfer offices at its universities and independent research institutions like TGen.

Arizona ranked 23rd nationally in bioscience publications in 2023, with over 2,800 papers, just ahead of Utah and Oregon, and just behind Colorado and Wisconsin. U of A produced 37% of the state's bioscience publications between 2019 and 2023, followed by ASU, Mayo Clinic Arizona, and St. Joseph's Hospital and Medical Center (including Barrow Neurological Institute). Over this same period, HonorHealth, Phoenix Children's Hospital, Mayo Clinic Scottsdale, and Midwestern University Glendale showed the fastest growth in the number of publications. Grand Canyon University, Caris Life Sciences, TGen, NAU, and HonorHealth stand out as institutions with the highest average citation impact per publication.

Fast-growing and high-impact areas include imaging technologies (e.g., MRI in cognitive function), climate and agricultural biosciences, immunotherapy, and randomized clinical trials—fields that reflect both Arizona's institutional strengths and its alignment with national health priorities.[22]

Patent activity is a key indicator of knowledge generation and translational potential, and Arizona's bioscience patent output is growing and increasingly globally competitive in biological sampling, medical devices, microbiology, genetics, and bioinformatics. This high rate of patenting signals not only an active R&D base but also growing potential for IP-driven startups and industry-university technology partnerships. ASU, through Skysong Innovations, has emerged as a national leader in biological sampling and analysis patents, ranking 13th in the United States in that domain and 9th among all universities in U.S. Patent and Trademark Office (USPTO) patents in 2023. Arizona's corporate contributors, including Roche Tissue Diagnostics and PhycoTerra (previously Heliae Development, LLC) demonstrate the state's innovation footprint in diagnostics and agricultural biosciences.[23]

Trademark activity offers a window into branding, market differentiation, and product deployment. Between 2018 and 2022, Arizona bioscience entities filed 3,573 bioscience-related trademarks, a 21% increase from the previous five-year period, exceeding a 13% increase nationally. This indicates a market-facing innovation ecosystem with a growing number of bioscience products and services entering commercialization stages. Arizona's trademark portfolio shows global specialization in chemicals, pharmaceuticals, medical and aesthetic products, and agricultural biosciences, consistent with both the state's academic focus areas and emerging bioscience industry segments.[24]

Despite these indicators of strength, other aspects of technology-transfer performance have been uneven. While bioscience patent applications from Arizona's public universities rose 29% from 2023 to 2024, the number of licenses and options executed dropped 31%, indicating a gap between idea generation and commercial deployment. And the number of bioscience startups spun out of Arizona universities declined from 17 in 2022 to 12 in 2023, before rebounding slightly to 14 in 2024.[25] These mixed results suggest that while Arizona's academic institutions are producing valuable bioscience IP, they face persistent barriers in converting discoveries into market-ready ventures. Partly in recognition of these barriers, in 2024 the Arizona Board of Regents (ABOR) launched a technology transfer roadmap and committed $1.5 million to strengthen life sciences commercialization capacity system-wide.[26] Improving startup formation support, licensing efficiency, and access to early-stage capital will be essential to fully capitalize on Arizona's growing patent pipeline.

## Networks: Institutions and Programs That Promote Collaboration

*Figure 3: Arizona's Bioscience Industry-Supporting Organizations*


Arizona has several industry and economic development organizations, technical support resources, and collaborative networks that support bioscience ecosystem growth through business recruitment, market analytics, education and advocacy, funding, and technical assistance, including:

- **Arizona Bioindustry Association (AZBio)** is a statewide, industry-focused membership organization dedicated to supporting the needs of Arizona's life science ecosystem. AZBio is the state affiliate of BIO, Arizona's representative on the Council of State Bioscience Associations (CSBA), and the state affiliate of the Advanced Medical Technology Association (AdvaMed) and the State Medtech Alliance, which focuses on medical devices, diagnostics, and health IT. AZBio advocates for the sector and provides members throughout Arizona with access to information, contacts, resources, cost-saving programs, and connections to the global bioscience and medtech community. AZBio partners with the nonprofit Opportunity Through Entrepreneurship Foundation (OTEF), which provides entrepreneurial education, mentorship, and workforce development through its AZAdvances programs and is the designated organization to deploy future distributions from the Arizona Health Innovation Trust Fund (AHIT).
- **Arizona Technology Council (Tech Council)** is a membership organization for technology companies across the state that hosts events, advocates for pro-technology public policy, and offers exclusive resources for member companies. The Tech Council's MedTech Committee brings together executive leaders from medical device, medical software, and telehealth companies to help one another accelerate growth.

- **Arizona's Bioscience Roadmap Steering Committee**, organized by the Flinn Foundation, comprises about 125 leaders from the public and private sectors in science, health care, business, academia, and policy, and is the leadership group responsible for overseeing Arizona's Bioscience Roadmap. The group helped to devise the Roadmap in 2002 and contributed to its update in 2014.
- **Arizona Farm Bureau** is a statewide membership organization representing production agriculture and farm and ranch interests related to educational improvement, economic opportunity, and social advancement.
- **Bioindustry Organization of Southern Arizona (BIOSA)** is a membership organization that builds community within the region's bioscience sector and supports the commercialization of university-based technologies and creation, operation, and expansion of life science enterprises.
- **Healthcare Innovation Council (HIC)**, organized by the Greater Phoenix Economic Council (GPEC), is a diverse group of leaders committed to advancing the healthcare and bioscience ecosystem in an effort to attract and retain companies and talent in the region. HIC serves as a convener, connector, and supporter of cross-sector collaboration.
- **Medical Device Manufacturing Multiplier (MDM2)**, a pilot program with coordinating leadership provided by GPEC, is a recipient of an Economic Development Administration (EDA) Tech Hub Strategy Development Grant. It is building a consortium of companies, institutions, and statewide organizations collaborating to position Greater Phoenix as a globally competitive and sustainable medical-device manufacturing hub, facilitating research alignment and partnerships between medical-device researchers and manufacturers. The success of its consortium model can serve as a blueprint for pursuing large, multi-stakeholder grants.
- **Venture Café Phoenix**, by the Center for Entrepreneurial Innovation (CEI), hosts a weekly "Thursday Gathering" that brings together entrepreneurs, investors, mentors, and experts to network, learn, and share ideas—frequently focusing on bioscience. These events are held in CEI LabForce, which bridges the talent gap in the bioscience sector by providing on-demand training and skills development for professionals in the bioscience economy.
- **WearTech Applied Research Center**, created by Partnership for Economic Innovation in 2019, connects entrepreneurs and companies seeking to commercialize emerging healthcare technology with research teams conducting biomedical innovation employing wearable devices.

### Business Environment: Policies and Programs That Foster Innovation

Arizona's bioscience landscape benefits from a generally pro-business environment marked by restraint with respect to regulation, a flat income-tax rate, no corporate franchise tax, and constitutional recognition as a right-to-work state. These features help position the state as an attractive base for technology-driven enterprises.

Yet, while the state's general business advantages are frequently cited, Arizona's bioscience sector is missing some valuable targeted support mechanisms, including bioscience-specific incentives and robust investment channels tailored to the needs of startups and scaling firms. Important state-level initiatives that do support research and commercialization include:

- **Arizona's Angel Investment Program**, authorized through 2031, offers up to 35% in nonrefundable tax credits for investments in bioscience or rural companies and may allocate up to $2.5 million in tax credits annually. In FY24, 29 small businesses (16 bioscience-related) were qualified to receive angel investments; 34 unique investors received over $1 million in tax credits by investing nearly $3.4 million into 17 companies.[27]
- **Arizona Biomedical Research Centre** was established in 1984 by the state of Arizona and distributes several million dollars each year in competitive direct grants to biomedical researchers, funded by tobacco taxes and lottery revenue. It disburses several million dollars more to the Arizona Alzheimer's Consortium and TGen from the general fund of the Arizona Department of Health Services and administers special research projects authorized by the Arizona Legislature.[28]
- **Arizona Health Innovation Trust Fund (AHIT)** was established in 2022 by the state legislature as a lasting endowment fund supported by public and private contributions. As designed, once AHIT reaches a size of $200 million and then matures for five years to $250 million, the fund will allocate approximately $10 million annually to provide entrepreneurial education services, workforce development programs, and R&D and commercialization funding. To date, the state has contributed just $100,000 to the fund.
- **Partnership for Economic Innovation** (PEI) is a nonprofit economic development organization founded in 2016 by stakeholders across metro Phoenix, with an emphasis on workforce development, smart infrastructure, and technology commercialization. Its applied research centers, including the WearTech Center, have secured at least $8.3 million in matching funds, and it operates a cohort-based grant program supporting applied research.
- **Technology and Research Initiative Fund (TRIF)**, fueled by a portion of state sales tax under Proposition 301, has since 2001 provided support to Arizona's public universities for research, workforce development, and access to higher education. (In 2024, the university system received $136 million in TRIF revenue.) One of TRIF's mechanisms, "Base Allocation Funds," provides allocations to each university for projects in five strategic research areas. From FY22 to FY24, $70 million, or 30% of base allocation funds, went to projects in the Improving Health area. Other TRIF initiatives include support for the Phoenix Bioscience Core and "Opportunity Initiative Funds" to support ABOR priorities that advance TRIF goals.

Other initiatives and tax incentives in Arizona are industry-agnostic, including sales tax exemptions for manufacturing, R&D tax credits, qualified facility tax credits, no inventory tax, and special allowances for Navajo entities.

## Learning from Leaders and Peers

States that lead in the bioscience sector nationally exhibit a set of defining characteristics that support vibrant, innovation-driven economic ecosystems. They produce a critical mass in talent at a range of training levels (often exceeding 15,000 bioscience-related graduates annually) and champion reskilling and upskilling of existing talent pools. They typically lead in academic R&D expenditures (often exceeding $1.5 billion annually) and NIH funding (often exceeding $750 million annually), with strong collaboration across the university-industry-health system continuum. This collaboration often includes well-integrated tech-transfer operations, research-intensive medical schools, and health systems with innovation arms that help translate discoveries into clinical and commercial applications. These states generate high volumes of bioscience-related patents, especially in fields like medical devices, genetic engineering, and bioinformatics, showing active IP development. They also support healthy capital ecosystems, with active cycles of angel, early-stage, and later-stage funding that enable startups to progress across the business development pipeline. (More information about VC funding by deal type can be found in Table 19 and Table 20 in the Appendix.) National bioscience leaders often house vibrant regional innovation hubs like the North Carolina Biotechnology Center (NCBiotech) and Massachusetts Life Sciences Center (MLSC), supported by collaborative public-private partnerships. The result: These states typically have high levels of employment and establishment growth across most of the bioscience subsectors, with specialized employment concentrations (location quotients above 1.2).

To identify lessons and examples for Arizona, SRI conducted a national scan of bioscience ecosystems to identify benchmark regions. This involved a data-driven screening of workforce trends, research activity, and funding levels across all 50 states.[29] From this review, Colorado, Utah, and Washington were selected as comparable peers with regional profiles similar to Arizona and steadily advancing bioscience development. Two others—San Diego and North Carolina—were identified as aspirational leaders, offering examples of what is possible with long-term coordination, investment, and innovation. SRI examined each benchmark's bioscience innovation ecosystem, and this section presents a synthesis of the key programs and insights from those benchmarks.

Table 2 highlights BIO's 2024 data comparing the selected bioscience ecosystems. Arizona performs close to Colorado and Utah on several measures, but lags North Carolina, San Diego, and Washington more significantly.

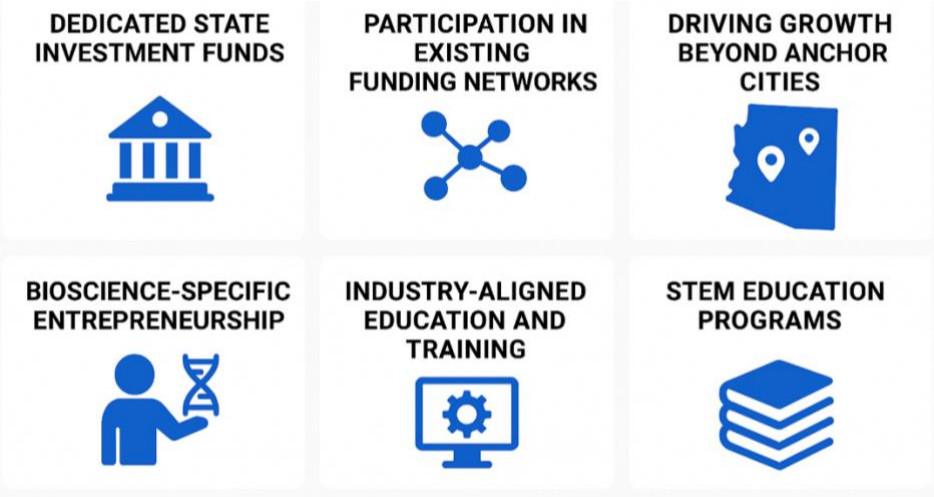
*Table 2: BIO Data Benchmarking Rankings*

| Region | Economic Impact | Jobs | Firms | R&D Expenditures | VC Funding | NIH Funding |
|---|---|---|---|---|---|---|
| Arizona | 20 | 21 | 14 | 24 | 23 | 25 |
| Colorado | 17 | 22 | 10 | 19 | 8 | 20 |
| North Carolina | 9 | 7 | 5 | 5 | 10 | 5 |
| San Diego* | N/A | 10 | 26 | 18 | 3 | 10 |
| Utah | 23 | 20 | 27 | 29 | 17 | 26 |
| Washington | 13 | 15 | 15 | 15 | 7 | 8 |

**Source**: Biotechnology Innovation Organization's (BIO's) State Comparison Dataset, 2024.
* SRI approximated San Diego's rankings as if it were a state from publicly available data, as BIO's state comparison dataset included only state-level data.

Desk research and interviews with leaders in these five benchmark regions revealed six recurring strategies that contribute to their success. As illustrated in Figure 4, these themes range from targeted funding efforts to workforce and entrepreneurship initiatives.

*Figure 4: Benchmark Themes*




## Colorado

Colorado's bioscience sector is similar to Arizona in employment, is somewhat stronger in research funding, produces 43% more bioscience patents, and is far ahead in VC—raising $6.5 billion from 2019 to 2023.[30]

- Colorado's later-stage funding ($4B) more than doubled its early-stage funding ($1.8B), highlighting a mature ecosystem that helps startups scale and attract follow-on capital.
- Boulder and Denver combined for 204 accelerator/incubator, angel, and seed investments, suggesting strong grassroots innovation and local investor communities.
- Colorado stood out for its diverse mix of investable companies in healthcare services, pharmaceuticals and biotechnology, and medical devices and technology verticals like AgTech, Digital Health, HealthTech, and AI/ML.

*Bioscience-Related VC Snapshot: Colorado's Scaling Strength and Sector Diversity, 2019–2023*

Colorado's large base of bioscience firms has also had significant success securing SBIR/STTR funding, attracting over $29 million in SBIR/STTR funding in 2023 (9th nationally), demonstrating the state's proficiency in translating bioscience discoveries into new companies and technologies (Arizona ranked 29th).[31] Contributing to these outcomes is strong organizational leadership and support for bioscience education.

The Colorado BioScience Association's (CBSA's) 501(c)(3) nonprofit arm, the Colorado BioScience Institute (CBSI), strengthens the workforce through K-12 STEM teacher training and programs like the STEM Research Experience for Teachers. CBSA and CBSI are also sponsors for Pathways in Technology Early College High Schools (P-TECH) programs in rural Colorado high schools, which, like dual-enrollment programs in Arizona, allow students to earn a high school diploma and an associate degree in as few as four years, preparing them for bioscience careers. These initiatives highlight the important role bioscience industry organizations play in supporting workforce development initiatives.

In addition to K-12 education, CBSI supports bioscience entrepreneurial education. CBSI is a participating organization in the Innosphere Ventures Regional Life Sciences Incubator, a multistate program backed by $2 million in EDA funding and a $2.8 million local match. (The capacity to assemble that match is strong evidence of Colorado's engaged leadership in its bioscience community.) The initiative's 2024 cohort of 34 companies raised $18.2 million and created more than 60 jobs during the nine-month program. Colorado leaders plan to expand the program to other states, presenting an opportunity for Arizona to participate and boost bioscience commercialization. Arizona bioscience leaders should examine the benefits and drawbacks from joining multistate efforts like the Innosphere Ventures Regional Life Sciences Incubator, including funding and administrative capacity and potential program impact or duplication.

Like Arizona, Colorado is a highly urbanized state, with its population concentrated in its cities and vast rural regions dotted with small towns; 90% of the state's bioscience firms are clustered along the Front Range region of the Rocky Mountains.[32] To promote growth beyond Denver, Boulder, Colorado Springs, and Fort Collins, 22 partners across cities and counties launched the Colorado Hub for Health Impact, a national campaign to attract talent and investment statewide.

### North Carolina

North Carolina is a leading bioscience ecosystem in the United States, backed by a combination of strategic public investment and competitive research infrastructure anchored by Research Triangle Park. This foundation has led to strong outcomes across funding and innovation metrics: The state attracted over $4.4 billion in VC from 2019 to 2023, over $985 million in academic bioscience R&D in 2022, and $556 million in NIH funding in 2023.[33] From 2019 to 2023, North Carolina ranked 12th nationally in bioscience patents (3,117), with strengths in medical and surgical devices, pharmaceuticals, and microbiology and genetics, and the state accounted for 8.2% of the U.S. share of agricultural bioscience chemicals patents.[34] North Carolina also ranked 8th in bioscience publications (42,218).[35]

North Carolina's bioscience ecosystem is uniquely supported by a state-funded initiative, NCBiotech, which serves as a one-stop shop for bioscience entrepreneurs and companies that need support with funding, workforce and training development, and product R&D. Since 1984, NCBiotech, the nation's first state-funded bioscience initiative, has distributed state matching grants to support R&D, providing stable funding for sector growth. Matching grants range from $25,000 to $1 million. NCBiotech also provides entrepreneurial education and support through its Landing Pad program and developed BioWork, an industry-backed certificate program that trains entry-level technicians and is easily adopted by community colleges.

North Carolina bioscience leaders shared an example of what programs like these enable: Despite initial concerns about workforce readiness among potential employees, in 2022 Eli Lilly and Company started to build a manufacturing plant in Concord, near Charlotte, because of regional community colleges' nimble implementation of the BioWork program. Emulating this model could be a way for Arizona to foster bioscience activity beyond Greater Phoenix. NCBiotech also collaborates with historically black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), and military programs like SkillBridge to connect diverse talent to bioscience jobs.

### San Diego

San Diego is one of the premier regional bioscience ecosystems in the country, drawing nearly $18.5 billion in venture capital from 2019 to 2023, with biotechnology and diagnostics companies attracting over 58% of the region's total. San Diego also attracted over $1 billion in NIH funding and over $1 billion in academic R&D expenditures in 2023.[36] This funding has stimulated entrepreneurship, allowed companies to develop and grow, and supported a significant workforce. If it were a state, San Diego would rank 10th in non-hospital bioscience workforce. The University of California, San Diego's (UCSD's) six decades of leadership in research and medical and bioscience education provides the region a strategic advantage by fueling discovery, innovation, and a steady supply of top-tier talent. UCSD is home to a top-tier medical school and several nationally ranked bioscience programs.[37] MiraCosta College complements UCSD's education and training efforts by offering a low-cost biomanufacturing bachelor's degree, recently placing 122 graduates across six bioscience companies. Although Arizona's community colleges lack such a program, it is plausible that they could adopt MiraCosta's model now that the Arizona Legislature has enabled community colleges to award bachelor's degrees. In addition to postsecondary bioscience education, programs like the Amgen Biotech Experience support K-12 bioscience workforce development, with 28 San Diego high schools offering hands-on biotech education and training resources. Other organizations in San Diego, like LaunchBio, offer education and networking opportunities to bioscience entrepreneurs. LaunchBio's Investor Connect links companies with investors, and 51% of participants receive follow-up interest. Arizona companies are eligible to participate in LaunchBio and could benefit from a concerted effort to facilitate access to such proven platforms—which would help Arizona close its VC gap.

### Utah

Utah's bioscience ecosystem is growing rapidly, with a 47% increase in firms and 21% rise in employment from 2019 to 2023, outperforming Arizona's growth in both firms (44%) and employment (9%) over the same period.[38] This growth is in part a product of a well-developed university-to-spinout pathway in Utah, supported by collaboration among universities, industry, government, and the statewide trade association, BioUtah, as well as the Utah Innovation Fund, which provides $15 million annually in state funding to commercialize technologies through public academic institutions. BioHive, a nonprofit public-private partnership chartered by BioUtah, was established in 2021 to "brand, build, and bring together" Utah's life science and healthcare innovation ecosystems; the state of Utah supported BioHive's creation with a $600,000 investment. Taking an approach that differs from Arizona's TRIF, Utah channels investment funding of $250,000 to $1 million to startups that partner with higher education institutions on R&D.

Researchers and startups also benefit from the University of Utah Therapeutic Accelerator Hub (U2TAH), which, in its first year, engaged over 200 researchers and reviewed more than 70 discoveries. Pharmaceuticals and therapeutics are among Utah's fastest-growing bioscience subsectors, driven by focused commercialization through U2TAH. Between 2019 and 2023, nearly 38% of Utah's bioscience VC flowed into these areas, reflecting the subsector's growing prominence within the state's innovation economy.

The University of Utah also partnered with Recursion in 2020 to start Altitude Lab, which has successfully incubated 29 bioscience startups to-date. Utah has been able to support its growing bioscience ecosystem through strategic workforce initiatives like Talent Ready Utah, which aligns academic programs with industry needs and helps develop bioscience-focused credentials, while the STEM Action Center broadens outreach through camps, competitions, and student resources. Additionally, though concentrated in Salt Lake City, the bioscience industry has expanded statewide through competitive incentives like EDTIF and REDTIF, which offer tax credits based on new state revenue rather than capital investment.

### Washington

Although Washington and Arizona are comparable in population and the number of non-hospital bioscience establishments, state outcomes in bioscience investment and employment diverge significantly. Washington supports approximately 7,500 more non-hospital bioscience jobs than Arizona and attracts far greater levels of investment across multiple funding streams, with $7.8 billion in VC between 2019 and 2023 and $1.30 billion in academic R&D spending in 2022. (That figure for R&D expenditures will certainly rise when 2023 totals are released; the state secured $1.29 billion in NIH funding alone in 2023.)[39]

*Bioscience-Related VC Snapshot: Washington's Concentrated VC Landscape, 2019–2023*

- Washington maintained a strong early-stage funding environment, securing $3.5 billion in early-stage VC, positioning it as a leading hub for startup formation and innovation.
- Seattle was an extremely active VC destination, attracting $5.7 billion in 567 bioscience deals. It accounted for 73% of Washington's total VC activity—a larger share than any other single city in a benchmark state.
- 81% of Washington's VC activity went to 140 pharmaceutical and 94 medical device companies, underscoring the state's strong concentration in core bioscience subsectors.

Washington's bioscience ecosystem benefits from a history of public and private investment in research infrastructure. Major institutions such as the University of Washington (UW), Fred Hutchinson Cancer Center, and Pacific Northwest National Laboratory anchor the ecosystem; some UW labs, like the Baker Lab, combine research and commercialization. The Washington Research Foundation has invested over $615 million to support bioscience innovation in Washington, and before it closed in 2014, Washington's Life Sciences Discovery Fund generated $450 million in bioscience research funding.[40,41]

These sustained investments have translated into strong research outputs and innovation activity that reinforce Washington's position as a bioscience leader. For example, from 2019 to 2023, Washington ranked 13th in the nation for bioscience patents (3,004), with concentrations in medical and surgical devices (1,536 patents), pharmaceuticals (501), microbiology and genetics (326), and biochemistry (306).[42] During his time, Washington ranked 14th in the United States for bioscience publications (25,862) and notably held the 5th highest percentage of highly cited bioscience publications, reflecting the impact and quality of its scientific research.[43]

The Life Science Washington Institute (LSWI) coordinates the ecosystem, connects adjacent sectors, and operates the Washington Innovation Network (WIN), a mentorship program for life science startups, through which bioscience entrepreneurs can learn how to leverage commercialization resources at Washington's bioscience research institutions. While Washington's bioscience research infrastructure is heavily concentrated in Seattle, LSWI is expanding efforts in eastern Washington, including support for Spokane's Evergreen Bioscience Innovation Cluster.

## Strengths, Weaknesses, Opportunities, and Threats Analysis

An evaluation of strengths, weaknesses, opportunities, and threats (SWOT) provides a structured way to consider Arizona relative to external bioscience competition and other political, social, or economic dynamics. The SWOT analysis captures a comprehensive view of the state's strategic position and helps identify where action is most needed to sustain and enhance the state's bioscience ecosystem (Table 3). Addressing challenges strategically will be essential to positioning Arizona as a national leader in select bioscience domains.

The rise of AI offers Arizona's bioscience ecosystem powerful new tools for discovery, care delivery, and product development. While AI's momentum has attracted significant investment and talent, potentially drawing focus from traditional bioscience domains, it also creates opportunities for integration and value creation in the biosciences. Meanwhile, reductions in federal research funding pose risks to commercialization, workforce pipelines, and public engagement, underscoring the need for strategic action to sustain and grow Arizona's bioscience leadership.

To inform the SWOT analysis, SRI drew on a range of quantitative sources, including proprietary datasets such as Pitchbook, GlobalData, and Lightcast; national datasets from NSF, NIH, Bureau of Labor Statistics, and National Center for Education Statistics; and analyses from BIO, TEConomy, and other industry organizations. These sources were complemented by extensive stakeholder engagement through interviews, focus groups, and surveys with bioscience leaders in Arizona and selected peer regions. Based on this comprehensive evidence base, SRI finds that Arizona's bioscience ecosystem is experiencing nationally competitive growth—fueled in part by two decades of aligned strategic efforts under Arizona's Bioscience Roadmap. The state benefits from world-class universities, research institutions, and health systems; a large, skilled workforce; an active network of conveners and support organizations; and expanding entrepreneurship resources. However, persistent challenges limit Arizona's ability to fully translate its strengths into long-term competitive advantage.

Gaps remain in commercialization infrastructure, bioscience-specific funding, talent attraction and retention, and coordination across institutions and regions. Workforce development activities are strong in volume but are fragmented and not always responsive, lacking a systematic mechanism to align employer needs with training programs. A growing base of fundable ventures is emerging, yet the capital infrastructure—particularly at the earliest and riskiest stages of innovation—is insufficient. Without this support, promising technologies risk stagnation or relocation.

Regional, specialized concentrations of bioscience activity are emerging as a collective strength for Arizona, with Tucson, Flagstaff, and Yuma making distinct contributions that complement activity in Greater Phoenix. This characteristic of the state presents a new opportunity for targeted regional investment and collaboration.

*Table 3: SWOT Analysis of Arizona's Bioscience Ecosystem*

| Strengths | Weaknesses | Opportunities | Threats |
|---|---|---|---|
| World-class research institutions and leadership at health systems, universities, and ecosystem facilitators.<br><br>Presence of global companies in medical device and biotechnology research, development, and manufacturing.<br><br>Strong collaborative potential and flexibility, with desire for cross-sector partnerships, networks, and emerging clusters.<br><br>Strategic location and business advantages, including proximity to Southwest and West Coast markets, semiconductor and bioscience overlap, competitive tax and regulatory environment, and strong in-state supply chain.<br><br>Large talent pool with partnerships to expand graduate medical education and competitive wages for several bioscience occupations.<br><br>Top-10 U.S. state for active, industry-sponsored clinical trials.<br><br>Competitive growth across economic indicators with new entrepreneurship, applied research, and technology translation programs. | Coordination challenges, including fragmentation and competition among health systems, academic institutions, and regions.<br><br>Insufficient affordable bioscience laboratory infrastructure for young companies and commercialization resources.<br><br>Lack of a statewide investment fund and state matching funds for SBIR/STTR grants.<br><br>Uncertainty regarding bioscience-enabling policy, including unprotected status of TRIF and limited authorization of the Angel Investment Program, while competitive tax environment limits available funding for new state investments.<br><br>Insufficient talent pool in key bioscience occupations, including scientists, some engineering roles, managers, and technicians.<br><br>Comparatively low public spending per K-20 student and poor K-12 education outcomes.<br><br>Recent and prospective leadership turnover at leading institutions.<br><br>Low in-state and out-of-state awareness of Arizona bioscience activity. | Further distinguish Arizona as a leader in neuroscience, oncology, precision medicine, and medical devices.<br><br>Launch targeted initiatives, fully fund an endowment for bioscience investment, engage investors in life sciences, and support J-1 visa waivers to retain talent.<br><br>Address Arizona's health-outcomes challenges through collective action that includes underserved communities, boosting awareness of bioscience's community impact.<br><br>Leverage overlap with semiconductor, defense, and AI sectors to drive bioscience innovation, investment, and talent development.<br><br>Strengthen research-industry collaboration across sectors and regions to accelerate commercialization and workforce development.<br><br>Improve coordination among entrepreneurship funding programs to specialize by stage or project type. | Declining federal funding and shifts in public funding priorities.<br><br>Potential policy-driven reduction in research investments.<br><br>Rising skepticism about the value of science and research among policymakers and the public.<br><br>Competition from states with dedicated bioscience funding, stronger federal grant positioning, and overlapping workforce demands from semiconductor and manufacturing industries.<br><br>Difficulty attracting investors due to long investment horizon compared with other sectors.<br><br>Supply chain gaps in agricultural and industrial bioscience and medical devices that may weaken resilience during public health or natural disasters.<br><br>Vulnerabilities across Arizona related to cost of living, interstate water allocation agreements, electricity needs, wildfire risk, and extreme heat. |

# The Path Forward

The goals and strategies of Arizona's Bioscience Roadmap are designed to help the state navigate a deeply unstable period of threatened and reduced resources and technological revolution to emerge as a rising bioscience leader. Executing on the Roadmap's strategies over the next five years would help Arizona align strengths and unlock new pathways for collaboration, discovery and innovation, talent development, economic growth, and better health outcomes for all Arizonans.

## Bioscience Roadmap Vision: 2025–2030

***Arizona is a nationally recognized, rising bioscience leader, with a skilled talent base, world-class research, and dynamic industry growth. It exemplifies collaboration, agility, and the courage to bet on discoveries that strengthen the economy and Arizonans' health and quality of life.***

The Roadmap features five overarching goals and 15 strategies that guide the next five years. Each strategy recommends the type of lead and support organizations best positioned to drive action; priority actions; a timeline for implementation organized into near-term (0–2 years), mid-term (3–5 years), and long-term (5–10 years); and estimated costs. Estimated costs are notated as follows: $ = $100,000 or less, $$ = $100,000 to $1 million, $$$ = $1 million to $10 million, and $$$$ = $10 million or more.

Released at a time when many institutions face existential challenges, the five-year Roadmap necessarily includes some recommended actions aimed at safeguarding existing capacities. Most strategies emphasize the need for Arizonans to collaborate more intentionally and efficiently. Some of the more complex proposals may have a low likelihood of implementation in today's environment, and ongoing instability means that conditions could shift dramatically—rendering certain strategies obsolete while creating opportunities for new ones. Despite these uncertainties, it is essential to look ahead and include bold recommendations that can significantly enhance Arizona's long-term competitiveness. Work should begin now.

## Overview of Goals and Strategies

*Table 4: Overview of Goals and Strategies*

| Goal | Strategies |
|---|---|
| 1. Amplify the Collaborative Gene | 1.1 Update Arizona's Bioscience Roadmap Steering Committee |
| | 1.2 Enhance the impact of the Arizona Bioindustry Association |
| | 1.3 Build connectivity with other technology-intensive industries |
| | 1.4 Engage with complementary bioscience ecosystems |
| 2. Accelerate Research into Impact | 2.1 Strengthen partnerships between research institutions, health systems, and industry |
| | 2.2 Create a statewide bioscience commercialization network |
| | 2.3 Develop statewide research initiatives focused on major diseases and public health priorities |
| 3. Elevate Arizona's Startup Ecosystem | 3.1 Diversify the investment base |
| | 3.2 Scale innovation and commercialization programs |
| | 3.3 Build a statewide bioscience incubator network |
| 4. Strengthen Talent and Career Pathways | 4.1 Unite education institutions and employers to align with labor needs |
| | 4.2 Implement and scale effective workforce development programs |
| | 4.3 Establish a bioscience talent concierge |
| 5. Tell Arizona's Bioscience Story | 5.1 Promote and position Arizona as a bioscience hub |
| | 5.2 Advocate for policy to enhance Arizona's competitiveness |

# GOAL 1: Amplify the Collaborative Gene

Arizona's bioscience ecosystem will exemplify a culture of collaboration in which organizations and participants ensure the success of one another and the ecosystem. This will be facilitated through institutionalized collaboration that aligns stakeholders, leverages complementary sectors, forges new opportunities across regions, and builds connectivity to global markets.

**Strategy 1.1**: Update Arizona's Bioscience Roadmap Steering Committee to ensure strategic coordination of efforts and activate a new generation of bioscience leaders

- **Lead:** Flinn Foundation
- **Support:** Public officials, education leaders, industry groups, health systems, economic development and community organizations, entrepreneurship programs, nonprofits
- **Timeline:** 0–2 years
- **Estimated Costs:** $
- **Priority Actions:**
  - Review and refresh Steering Committee membership
  - Activate Bioscience Workforce Alignment project team
  - Activate Communications and Marketing project team
  - Assess creation of regional chapters
  - Define programming

Arizona leaders have long recognized the importance of collaboration to accelerate bioscience innovation. This is evidenced by the sustained work of Arizona's Bioscience Roadmap Steering Committee over more than two decades, but the Steering Committee has hardly been alone in this approach. At the behest of local leaders, in the years soon after the statewide Roadmap was released in 2002, both northern and southern Arizona regional Roadmaps were created; these plans were activated by groups like the Southern Arizona Leadership Council and Bioscience Leadership Council of Southern Arizona and the Northern Arizona Leadership Alliance. More recently, groups like the Greater Phoenix Economic Council's Healthcare Innovation Council and a new effort of Flagstaff-area bioscience leaders have worked to implement Roadmap recommendations and seize emergent opportunities.

During the second decade of the Roadmap, one tactic to increase the impact of the Steering Committee was the creation of project teams with specific charges, such as a Legislative Relations project team to monitor public-policy issues, an Entrepreneurship project team to support and represent startups, and a Risk Capital project team to draw attention of private funders to Arizona's bioscience sector. The latter two have in recent years taken on a narrow, concrete responsibility: planning and presenting the Flinn Foundation Bio Capital Conference. Under the new Roadmap, this approach should be repeated by activating project teams focused on Bioscience Workforce Alignment and Communications and Marketing. Both of these are described below, under Goals 4 and 5.

It is also time to refresh the Steering Committee's membership. In the first years after the Roadmap was established, the Steering Committee included only C-level leaders from a relatively small number of institutions. Naturally, as the bioscience ecosystem has matured, the Steering Committee's membership has expanded substantially, and equally as naturally, not all

members are routinely active. In the first year under the new Roadmap, the Steering Committee can assume responsibility for the cultivation of a new generation of leaders, its own long-term health, and its impact by reviewing its membership and, where appropriate, identifying bioscience leaders across the state ready to contribute. With a refreshed membership, the Steering Committee will have new mechanisms for members to advocate for and champion new project teams based on emerging ecosystem needs.

To ensure regional relevance, the Steering Committee may launch regional chapters that advance localized bioscience strategies. In metro Tucson, the Southern Arizona Leadership Council continues to serve as a vital bioscience advocate, working alongside the University of Arizona, the Bioindustry Organization of Southern Arizona, and others; in Flagstaff, a self-organizing group has emerged in 2025 to respond to a range of local bioscience and healthcare concerns. Rather than the Steering Committee facilitating these various regional chapters in a top-down fashion, the Flinn Foundation and Steering Committee leadership could take the lead in supporting the local leaders who will initiate and sustain regional efforts.

Finally, platforms for the Steering Committee's work have understandably evolved since the Roadmap launched, most fundamentally through the disruptions of the COVID-19 pandemic, when its meetings moved almost exclusively to videoconference. A more predictable mix of virtual and in-person meetings is warranted to ensure cohesion, especially as the Steering Committee's membership changes.

### **Strategy 1.2**: Enhance the impact of the Arizona Bioindustry Association

- **Lead:** AZBio
- **Support:** AZBio board and members, major bioscience employers, health systems
- **Timeline:** 2–5 years
- **Estimated Costs:** $
- **Priority Actions:**
  - Expand AZBio leadership and core support infrastructure to meet the increasing needs of Arizona's bioscience ecosystem
  - Broaden membership of AZBio throughout the state, targeting especially large industry members, health systems, and regionally unique life science companies
  - Scale bioscience policy advocacy
  - Provide coordinating support for collaborative activities with other technology sectors and bio ecosystems beyond Arizona
  - Provide representation – via AZBio staff or staff or member organizations – on new project teams of Arizona's Bioscience Roadmap Steering Committee focusing on Bioscience Workforce Alignment and Communication and Marketing

One of the necessary developments in Arizona's bioscience ecosystem since the release of Arizona's Bioscience Roadmap in 2002 has been the growth of the Arizona Bioindustry Association, the statewide membership organization serving industry and other participants in the sector. As the Roadmap moves into its next phase, a stronger, more broadly representative AZBio will be a more potent asset to drive forward the recommendations in this document.

Compared to other states, AZBio is currently a modest organization in scale and reach, which limits its ability to effect its goal of Arizona becoming a top-10 bioscience region nationally. It has approximately 270 members, similar to benchmark state Utah, but fewer than Colorado (350) and North Carolina (800), and far fewer than a national leader like Massachusetts (1,700). AZBio has a staff of 1 full-time equivalent (FTE), supported by some contract staffing, that accomplishes an admirable amount of work but clearly has limited capacity in comparison to other states' bioscience associations with larger staffs. Like some of its peers, AZBio affiliates with a nonprofit organization that addresses sector needs beyond AZBio's core industry-focused activities. That organization, Opportunity Through Entrepreneurship Foundation (OTEF), provides entrepreneurial education, mentorship, and workforce development through its AZAdvances programs, which in the future will be supported by distributions from AHIT.

Strategically increasing AZBio's membership would provide the organization with additional revenue to build its staff capacity, but, as importantly, doing so would enhance AZBio's ability to serve as the recognized statewide voice of the biosciences. For instance, while the organization's large-company members include global firms like Roche Tissue Diagnostics and W. L. Gore, a number of other major bioscience companies with a presence in the state are missing; the same dynamic exists for health systems. Building the organization's membership—the number of members, the inclusion of more major employers, more members in southern and northern Arizona—should be seen not merely as a goal for its staff and board to pursue, but as an ecosystem-wide priority that can strengthen members throughout the state via AZBio's services and programming and elevate the sector's visibility through its advocacy. AZBio should also pursue opportunities for alliance with other business associations and advocacy groups with common interests, such as the Arizona Chamber of Commerce and Industry.

The Roadmap envisions AZBio as an important contributor to the new Bioscience Workforce Alignment and Communications and Marketing project teams recommended as action steps for Arizona's Bioscience Roadmap Steering Committee; representation could come from AZBio staff, its board members, and/or its members. Where a stronger AZBio would likely have the greatest impact, though, is through more robust local and state policy advocacy regarding priority issues for the biosciences (and for broader concerns of high-tech sectors, alongside organizations like the Tech Council). AZBio would scale up existing activities like legislative briefings, innovation showcase days at the Capitol, tours that spotlight local assets, and invitations to elected officials to participate in conferences, lab visits, industry networking events, and facility openings. Achieving important objectives in an individual legislative session or gradually building a constituency for major investments over the longer term requires an entity that is the representative, recognized voice of the bioscience industry.

**Strategy 1.3**: Build connectivity with other technology-intensive industries in Arizona to create a more integrated innovation ecosystem

- **Lead:** Industry groups
- **Support:** Public officials, nonprofits, economic development organizations, education leaders
- **Timeline:** 0–2 years
- **Estimated Costs:** $
- **Priority Actions:**
  - Identify contacts at leading companies in the semiconductor, aerospace and defense, and AI industries in Arizona
  - Create cross-industry working groups
  - Host and participate in industry roundtables and networking events

Arizona's bioscience sector stands to gain significantly by building stronger connections with other technology-intensive industries in the state. Historically, the biosciences have at times stood alone, in part because of the highly regulated environments in which bioscience innovations are developed into products and models of care delivery, and the long timeframes for such development. But bioscience and other high-tech sectors are increasingly intertwined, and there are important reasons to remove barriers. By strategically linking with adjacent sectors—particularly semiconductors, aerospace and defense, and AI—bioscience leaders and organizations can tap shared resources, accelerate innovation, and enhance the state's overall competitiveness. This effort will begin by identifying adjacent industries with clear opportunities for synergy and mapping leading organizations in those spaces.

Once identified, bioscience leaders and supporting partners will convene working groups composed of representatives from bioscience, adjacent industries, academia, and economic development organizations. These working groups will meet regularly to identify overlapping R&D interests, workforce development needs, shared infrastructure opportunities, and market opportunities. Organizations like AZBio and the Tech Council, with its established leadership in convening technology companies across sectors, may be well positioned to help facilitate such engagement.

Working groups should be supported by industry roundtables and networking events tailored to specific thematic areas (e.g., "AI for Drug Discovery and Precision Medicine," "Dual-Use Chips: Semiconductors in Medical Devices and Aerospace Systems"). Events of this kind are not intended just as one-time meetups but as springboards for deeper collaboration, such as co-hosted innovation challenges or joint grant applications. Roundtables will include facilitated discussions, matchmaking components, and presentations of cross-industry case studies to spark new ideas and shared ventures.

The semiconductor industry presents particularly strong alignment with the bioscience sector, as both rely heavily on advanced manufacturing and share applications in diagnostics, medical devices, and imaging. Arizona's $165 billion investment from Taiwan Semiconductor Manufacturing Company (TSMC) is the most visible exemplar of this sector's presence in Arizona, and multi-industry initiatives like the MDM2 , U of A's new Center for Health and Technology, and SEMI's Smart MedTech already demonstrate momentum.[44,45] SEMI's Arizona Chapter should remain a central partner in expanding these efforts.

Emphasizing especially R&D collaboration between the bioscience and semiconductor sectors could help Arizona position itself as a flexible, scalable biomanufacturing, medical-device, and digital-health hub ready for high growth. Arizona's state leadership was central to attracting and supporting the semiconductor industry, and a similar commitment could help accelerate bioscience growth and strengthen its ties to the semiconductor and other advanced technology sectors.

Aerospace and defense is another high-potential partner. Companies like Honeywell and Raytheon Missile Systems have long histories in Arizona and remain committed to the state, as evidenced by Honeywell International's 2025 decision to keep Honeywell Aerospace headquartered in Phoenix after spinning off its aerospace division as a separate company.[46] Areas of crossover include health monitoring systems, dual-use imaging, space biotechnology, and biodefense—all areas in which Arizona bioscience researchers have worked, from a U of A initiative applying Raytheon remote-sensing algorithms to skin-cancer detection, to the many biosecurity projects led by NAU's Pathogen and Microbiome Institute. Drawing inspiration from North Carolina's Medical, Biomedical & Biodefense: Support to the Warfighter Symposium research partnership, Arizona can leverage Aerospace Arizona as a strategic ally in exploring bioscience-defense synergies as well as DARPA-funded researchers and cybersecurity departments at all three Arizona public universities and potentially at Embry-Riddle Aeronautical University, which houses labs focused on ergonomics, industrial hygiene, and biological forensics.[47] There may also be opportunities for translational-research engagement between bioscience innovators and Arizona's significant military bases.

Finally, AI offers transformative potential across all sectors. Arizona's universities, health systems, and companies are already making advances—such as through ASU's NIH-funded training program in AI-powered medical imaging and U of A's Artificial Intelligence Division in Simulation, Education, and Training.[48,49] Caris Life Sciences, which recently completed its initial public offering, is analyzing molecular and clinical outcomes with AI to classify cancer at the molecular level and predict patient responses to treatment.[50] These efforts demonstrate the integration of AI into the biosciences and provide a strong foundation for scaling cross-industry innovation.

By forging these connections, Arizona can foster a more integrated innovation ecosystem that amplifies the strengths of its industries and accelerates shared economic growth.

**Strategy 1.4**: Engage with complementary bioscience ecosystems beyond Arizona to leverage partnership opportunities for investment, innovation, and talent development

- **Lead:** Economic development organizations and industry groups
- **Support:** Economic development organizations
- **Timeline:** 0–2 years
- **Estimated Costs:** $
- **Priority Actions:**
  - Advocate for Arizona's inclusion in national and regional bioscience programs
  - Assess international ecosystems for partnership opportunities
  - Establish cooperative agreements with other states' bioscience ecosystems

Arizona has a significant opportunity to grow its bioscience ecosystem by forming strategic partnerships with regional hubs across the United States and internationally. Close to home, potential collaborators include Colorado, Oregon, Southern California, Utah, and Washington—states with complementary strengths and growing bioscience activity. Arizona could join multistate initiatives such as the collaboration enabling the Innosphere Ventures Regional Life Sciences Incubator in Colorado, as described above.[51] Similarly, AZBio and other industry groups could partner with other state trade associations, following the model of the Southeast Biotech Collaborative (SEBC) and the Heartland Civic Collaborative, both of which align bioscience strategies across state lines to strengthen priorities like biomanufacturing, commercialization, and workforce development.

Internationally, Arizona can leverage its approach to attracting foreign direct investment from global semiconductor companies to strengthen ties with bioscience companies abroad. The Arizona Commerce Authority (ACA), cities like Phoenix, Tucson, and Flagstaff, and groups like GPEC, which already routinely host foreign delegations, can work together to spotlight the state's research infrastructure, high-wage job creation, and renowned health-system anchors like Barrow Neurological Institute and Mayo Clinic—the former among the nation's largest centers for neurology and neurosurgery and the latter annually performing more solid-organ transplants than any hospital in the country.[52] Bioscience companies and research institutions in neighboring countries like Canada and Mexico are natural targets; the United Kingdom offers synergies in neuroscience, genomics, and AI-driven biotech, while Singapore has emerged as a leading hub for biomanufacturing and clinical trials in Asia.[53,54]

Arizona could also pursue international exchange programs between incubators or research centers, helping foreign bioscience companies enter the U.S. market while offering Arizona-based institutions new global collaboration and commercialization opportunities. Despite current geopolitical and trade challenges, a focused international strategy would position Arizona as a globally connected bioscience hub and forge new pathways for investment, innovation, and talent development.

# GOAL 2: Accelerate Research into Impact

Arizona's bioscience ecosystem will increase the scale, speed, and success of commercialization of bioscience discoveries and innovations that address critical needs. This will be accomplished through new partnerships and resources that create an approachable and opportunity-rich environment for researchers to translate findings into solutions that address real-world challenges.

**Strategy 2.1**: Strengthen partnerships between research institutions, health systems, and industry to accelerate bioscience commercialization and tech transfer

- **Lead:** Universities
- **Support:** Industry groups, health systems, public officials
- **Timeline:** 5–10 years
- **Estimated Costs:** $$$$
- **Priority Actions:**
  - Improve processes facilitating research partnerships with health systems and industry
  - Update existing partnership incentives and implement new models to address federal funding losses
  - Assess and fill gaps in university bioscience tech transfer

Arizona has destination hospitals and clinical providers, including City of Hope, Barrow Neurological Institute, and Mayo Clinic Arizona; world-class research centers embedded in its universities and health systems; core facilities with available capacity across the state; and significant physical and virtual collaborative hubs and platforms that place in proximity researchers, healthcare practitioners, startups, and established life-science companies.[55] But the presence of such assets alone is missing the level of efficiency necessary to stimulate bioscience commercialization at the scale of a national leader. A strategic focus on organizational infrastructure and formal partnerships between research institutions, health systems, and industry is critical to more quickly developing and scaling technologies and aligning research activity with real-world needs and markets.

Valuable actions that can be taken, coordinated through ABOR, include developing centralized directories and marketing activities, streamlining engagement processes (e.g., expediting the master agreement process), and codifying plans to drive accountability and outcomes. In parallel, it is essential to revisit and realign existing partnership incentives to better reflect the shared value and risk in translational research. Despite partnership incentives offered by the state, like university R&D tax credits, surveyed bioscience business and ecosystem leaders indicated a lack of alignment between universities' bioscience R&D activity, the most urgent needs of health systems, and the commercial interests of the state's bioscience industry. A statewide review of current partnership terms and practices would help identify where friction exists and inform the design of incentive structures that are transparent, equitable, and conducive to long-term, mission-aligned collaboration. Without such process improvements, Arizona risks letting its assets languish.

Creating programs to help offset losses in funding from federal agencies like NIH and NSF is also necessary. Companies and health systems—and the state of Arizona—should be partners in these programs, as they have vested interests in preserving both research programs with commercial potential and universities' capacity to prepare the graduate students, postdoctoral scholars, and research professors who constitute the next generation of bioscientists. New programs might include:

- A mechanism for health systems to pre-competitively coordinate clinical trial patient selection, enrollment, and management to ensure that targets are met and that researchers understand health systems' capacity.
- Targeted translational-research grant opportunities in the vein of the Washington Research Foundation's technology commercialization grants, which fund commercialization projects across three phases for researchers and students from nonprofit research institutions.
- Structured industry membership programs—the Wisconsin Electric Machines and Power Electronics Consortium provides one model—that generate funding for R&D and tech-transfer capacity while providing companies access to discoveries and talent.
- Direct funding or matching programs for startups to commercialize technologies at public research institutions, as in the Utah Innovation Fund. MDM2 is planning to pilot a comparable program.

**Strategy 2.2**: Create a statewide bioscience commercialization network to support researchers and entrepreneurs across the state

- **Lead:** Arizona Board of Regents (ABOR)
- **Support:** Arizona Commerce Authority (ACA), economic development organizations, health systems, industry representatives, and entrepreneurship programs
- **Timeline:** 3–5 years
- **Estimated Costs:** $$$
- **Priority Actions:**
  - Evaluate opportunities to align and strengthen tech-transfer policies and infrastructure at public research institutions
  - Establish a statewide portal to access university IP and research to simplify access for stakeholders
  - Establish regional commercialization coordinators for Flagstaff, Phoenix, Tucson, and Yuma
  - Develop bioscience-specific commercialization resources

Arizona should build on ABOR's $1.5 million initiative to study technology transfer at the state's public universities by launching a coordinated, statewide bioscience commercialization mechanism. Insights from the ABOR project should serve as a catalyst for system-wide improvements, aligning the commercialization functions of Arizona's research universities and providing a more seamless experience for funders, businesses, and entrepreneurs engaging with academic innovations.

By improving coordination and reducing inefficiencies, Arizona can more effectively support the translation of university-based discoveries into market-ready solutions.

This new mechanism—a centralized but distributed Arizona Bioscience Commercialization Network (ABCN)—would include a cross-institutional commercialization team dedicated to supporting bioscience researchers and entrepreneurs across the state. Activated by ABOR and integrated with university tech-transfer offices, the team would not replace existing efforts but instead serve as a shared resource for specialized services such as grant writing, regulatory guidance, IP strategy, market analysis, and prototyping.[56] By focusing specifically on the complex and regulated bioscience sector, the team would fill current gaps and improve the quality and accessibility of commercialization support for academic innovators. The team's statewide perspective should help connect commercialization efforts to the broader financing community.

To ensure regional engagement and localized impact, ABCN should establish a distributed network that brings statewide resources and connections to region-specific challenges, with coordinators based in Flagstaff, Phoenix, Tucson, and Yuma. ABCN should also establish coordinators to engage with tribal and smaller rural communities that can support unique research partnerships related to agricultural and environmental biosciences and represent potential adopters of pilot healthcare innovations due to cost constraints. There are university representatives who already work closely with tribal and small rural communities that ABCN coordinators can leverage to facilitate connections and build trust. These coordinators would work closely with tech-transfer offices, faculty, and would-be entrepreneurs at their local universities while remaining accessible statewide, offering place-based insights and facilitating connections to region-specific assets. The team would also coordinate with key ecosystem partners—such as ACA, AZBio, local economic development organizations, and rural and tribal community leaders—to integrate researchers into the broader innovation ecosystem.

ABCN would also catalyze cross-institutional projects. Collectively, by virtue of its cross-institutional perspective, the team would be positioned to identify interdisciplinary synergies and catalyze high-impact projects that draw from the combined strengths of Arizona's research universities. Its work should be supported by establishment of a statewide portal enabling access to a catalogue of IP and research across Arizona's universities to simplify access for stakeholders.

Arizona's approach would stand out nationally for its bioscience focus, regional delivery model, and statewide coordination across multiple universities and economic development institutions. While other states have established components of such strategies—such as Ohio's Entrepreneurial Services Provider Program and North Carolina's life science commercialization efforts—Arizona has the opportunity to lead with a unified model that leverages its existing institutional strengths, delivers targeted support, and advances bioscience innovation at scale.

**Strategy 2.3**: Develop statewide research initiatives focused on major diseases and public health priorities

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Public officials, universities, health systems, research institutions, nonprofits
- **Timeline**: 1–5 years
- **Estimated Costs:** $$$
- **Priority Actions:**
  - Identify critically important diseases and public health priorities for Arizonans
  - Coordinate scientific and funding resources across institutions to pursue pre-competitive demonstration projects
  - Establish multi-funder collaborations for broader implementation

As described in the introduction to this Roadmap, Arizona is facing the most challenging environment for bioscience research in generations, with federal grants canceled, future scientific priorities and budget allocations uncertain at NIH and NSF, research universities under a range of pressures, and health systems contending with the prospect of not only escalating costs but also devastating revenue losses from reduced Medicaid enrollment and lower federal cost-sharing. In this unprecedented research environment, preserving progress requires a strategic narrowing of scope—recognizing the fields where Arizona's research enterprise is most mature and competitive, and concentrating resources there rather than seeking to initiate new programs without a critical mass of basic science expertise and record of translational activity. By making strategic, focused bets in areas of high local and global need where Arizona already has a density of assets, the state can amplify its strengths, build an innovation flywheel, and position Arizona as a leader in critical domains. State government also has an important role to propel strategic bets, whether by providing dedicated funding or issuing a call to action that unites institutions, industry, and communities around shared bioscience priorities.

Despite sharply reduced—or, at best, unreliable—federal funding in the near term, Arizona does have options for developing significant, forward-looking bioscience research initiatives, but they may look different than the cornerstone projects of recent years. Arizona's Bioscience Roadmap Steering Committee could provide a forum for exploring possible collaborative statewide projects, following principles such as the following:

- **Pursue broad collaborations across institutions and technology sectors.** The paradigmatic examples in Arizona are partnerships like those noted earlier in this document, such as NAU and U of A's work together on the Partnership for Native American Cancer Prevention and the Arizona Alzheimer's Consortium, as well as the Precision Aging Network, led by U of A with involvement from ASU, TGen, and several institutions beyond Arizona. Some opportunities have been explored where the biosciences meet a sector like defense, from sensor and chemical-signature technology to optics applications in medical devices.

- **Leverage distinct Arizona assets.** In some cases, these assets are globally unique institutions and programs, such as the Critical Path Institute (the trusted partner of both pharmaceutical companies and regulators like the Food and Drug Administration and European Medicines Agency that is accelerating the development of therapeutics), ASU's new Health Observatory, and Creighton University's Knowledge Donor Program. In other cases, the assets are Arizona's population subgroups, from its 22 federally recognized tribes, to the binational farmworker communities of southwestern Arizona, to the Greater Phoenix residents who have donated to Banner Health's Brain and Body Donation Program—all of which should be recognized as sources of knowledge and potential research partners.
- **Identify nontraditional co-funders with interests in research outcomes.** Especially in an era of precarious finances for research institutions, health systems, and county and state governments, partnerships with the potential to reduce costs can enable institutional leaders to commit resources to research initiatives. Examples include a recent partnership between NAU's Pathogen and Microbiome Institute and Northern Arizona Healthcare that employs genomic surveillance to identify the origins of infections among hospital patients, and U of A's development of a Clinical Decision Support System tested by prescribers in Banner Health clinical settings. Government health agencies within Arizona may also have strong incentives to support projects offering clinicians predictive, preventive, and early diagnostic support.
- **Concentrate on public health concerns and diseases of local significance.** In a time of declining public trust in scientific authority, highlighting the relevance of Arizona's bioscience ecosystem to residents' lives is ever more important. Arizona has a disproportionately high burden of certain chronic diseases; the state also faces exceptionally high burdens for niche diseases like valley fever—for which several institutions and startups are working to develop therapeutics and faster diagnostics. Meanwhile, the state has concentrations of research excellence in more prevalent conditions with devastating impact, like neurodegenerative diseases.

What would a statewide project aligned with these principles look like? Imagine, as one example, a precompetitive partnership across Arizona health systems to design an implementation model for a new blood test to detect pre-symptomatic Alzheimer's disease. Still in the neuroscience space, imagine applying AI data analysis that does not exist today but may in two years, to identify healthy-aging protective behaviors among the hundreds of thousands of participants in TGen and U of A's MindCrowd project, and then testing the incorporation of those findings into a major health insurance plan's wellness incentive program for members. Imagine an initiative uniting wastewater surveillance expertise at Arizona's universities and TGen North, county health departments, and Arizona's Health Information Exchange, to monitor not just seasonal surges in influenza and SARS-CoV-2, but also emerging regional trends in synthetic opioid use. These are the sort of research programs with direct health and economic impacts for Arizonans, and in many cases significant commercial potential, that no single institution can accomplish.

# GOAL 3: Elevate Arizona's Startup Ecosystem

Arizona's bioscience ecosystem will nurture and empower bioscience entrepreneurs and startups, providing the resources and support needed to launch, scale, and retain more bioscience ventures. Even in a time of decreased federal support, traditional research institutions will continue to play a critical role in bioscience innovation. However, startups are increasingly taking on more of the bioscience developmental risk that in the past was born by large corporations. Thus, a strong entrepreneurial community will benefit individual startups and be a flywheel to catalyze reinvestment and growth of the ecosystem. The end goal of this ecosystem development work will be demonstrated if new bioscience startups are increasingly created, sustained, and retained in Arizona, and ultimately attract the attention and investment in Arizona of more global-scale bioscience firms.

**Strategy 3.1**: Diversify the investment base for Arizona's entrepreneurial ecosystem to increase access to capital for emerging bioscience companies

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Public officials, nonprofits, entrepreneurship programs, economic development organizations, industry groups
- **Timeline:** 5–10 years
- **Estimated Costs:** $$$$
- **Priority Actions:**
  - Engage high-wealth angel investment groups and family offices
  - Solicit funding for private funding pools
  - Evaluate avenues for state bioscience funding
  - Assess national and international funding networks
  - Draw global bioscience companies to Arizona via acquisition of promising Arizona companies.

Bioscience startups and early-stage companies require significant upfront funding—often more than startups in other sectors—for the high-risk developmental phases of research, clinical trials, regulatory approvals, and product development that precede the generation of meaningful revenue. Without a strong, diversified investment base, including VC, angel investors, state-backed funds, and corporate partnerships, these startups generally cannot progress to commercialization. And a well-funded bioscience ecosystem not only benefits entrepreneurs already in a region, but also makes that region a more attractive place to relocate or expand for out-of-state talent, innovators, and companies.

Arizona has some components of a strong investment base in place, but there are several ways to improve the funding environment. Currently, the state has one strong angel investment network, Arizona Tech Investors, which has recently expanded from its base in Phoenix to conduct more activity in southern Arizona. Another, Desert Angels, has historically been a significant funder of bioscience startups but has recently stepped back from robust bioscience funding.

The Flinn Foundation's Bioscience Entrepreneurship Program supports bioscience startups under an administrative and funding partnership with AZBio, and several other competitive programs, like Venture Madness, the Arizona Innovation Challenge, and IdeaFunding (hosted by Startup Tucson and the U of A Center for Innovation), regularly include bioscience companies among their winners. Xcellerant Ventures is one recent entrant with a focus on healthtech and medtech companies, but it is essentially alone as a VC funder targeting the biosciences in Arizona.

Coordinated by Arizona's Bioscience Roadmap Steering Committee, the state's bioscience leaders can take several actions to diversify the state's investment base:

- Bring more high net-worth individuals into existing angel networks, leveraging Arizona's increasing attraction of wealthy part- and full-time residents.[57]
- Revitalize angel investment networks in regions where they have faltered, and develop new angel investment networks where they are currently absent, such as in northern Arizona—a region with growing bioscience research and entrepreneurial activity and numerous high-wealth residents with expertise and interest in high-tech sectors.
- Establish a new bioscience and healthcare innovation sidecar fund—a pooled investment vehicle designed to co-invest alongside investors, family offices, and other high-net-worth individuals. Sidecar funds reduce risk for contributors by following lead investors with sector expertise and clear, transparent investment criteria to build trust among stakeholders, and attract a broader pool of capital.
- Increase participation in existing bioscience investment networks—including programs like LaunchBio's Investor Connect, which matches researchers and startups with potential investors based on focus area and funding stage. (LaunchBio operates in hubs like Boston, New York, San Diego, and San Francisco; Arizona companies are eligible to participate, but only one has done so to date.)
- Join multistate partnerships, like the Innosphere Life Sciences Incubator, with established records of forging new investment opportunities for participating startups.

As the last several years have shown, with a flood of VC investment in 2021 followed by a sharp pullback, the private, financially incentivized investment market for bioscience can be volatile and cyclic. This makes the case for state-backed funds that can hold a long time-horizon investment perspective less affected by short-term market fluctuations and that can be synergistic with and multiplied by private capital. Dedicated state bioscience funding entities in other ecosystems, like the North Carolina Biotechnology Center (a recipient of continuous appropriations since 1984 that has distributed over $160 million in grants since its founding), Massachusetts Life Sciences Center ($1.6 billion commitment to life sciences since 2008), and Cancer Prevention and Research Institute of Texas ($6 billion commitment to cancer-focused funding since 2007), have provided transformative direct investment in bioscience research and entrepreneurship initiatives and represent models that Arizona could follow.[58,59,60] Gubernatorial leadership in championing biosciences and working with the legislature could play an important role in helping Arizona secure similar long-term commitments when the environment is right.

Arizona has had success leveraging state-backed venture funds to catapult additional private and government investments. For example, AZ Venture Capital (AZ-VC) was established through $87 million in ARPA funding in 2022 and has since catalyzed more than $230 million in statewide investments to support capital access for underrepresented entrepreneurs. The Arizona Health Innovation Trust Fund (AHIT) is one approach for a bioscience-dedicated state-backed fund. As described earlier in this Roadmap, AHIT is structured as a perpetual resource for the biosciences, including through support of startup companies, with a projected annual distribution of around $10 million once fully funded. It should be noted that creating a tool like AHIT was recommended in the original Roadmap in 2002 and again when the Roadmap was updated in 2014—signaling that, even if it seems a long shot, its value for the sector persists.

A combination of strategies have been proposed to raise the $200 million to fund AHIT:

- Advocate with state, regional, and local government to secure additional allocations for AHIT.
- Deploy a fundraising strategy focused on Arizona-based high-net-worth individuals and family investment offices.

If an evaluation of progress toward funding AHIT suggests that modifications to the model would make its success more likely, such adjustment should be pursued.

Arizona's bioscience ecosystem could also take a more active role in connecting Arizona-based startups to the broader national bioscience investment ecosystem. One way to achieve this would be sending a delegation to JPMorgan's Annual Healthcare Conference. This conference serves as a significant healthcare investment symposium that connects global healthcare industry leaders, emerging companies, inventors, and investors. These types of conferences and events can serve as a catalyst for organizing roadshows for promising Arizona-based bioscience startups to non-Arizona-based investors.

The number and range of approaches described above—from cultivating an angel investment network in northern Arizona to building the corpus of AHIT—suggest the complexity and importance of diversifying and deepening the sources of risk capital available to Arizona startups. Helping them survive early-stage development is vital not only for the individual companies and the patients and customers they serve, but for Arizona's bioscience ecosystem as a whole. The transformative arrival of a global company in a state like Arizona almost never happens because of a CEO's whim. Sometimes it occurs because a startup community is strikingly active, with scientists and entrepreneurs generating new firms continuously. More often, great innovations are nurtured by a funding community until they can grow on their own—sometimes for two years, sometimes for two decades—to the point that they are impossible to ignore. Among others, Caris Life Sciences, Medtronic, and Roche Tissue Diagnostics all arrived in Arizona in this fashion. It will happen again.

**Strategy 3.2**: Scale innovation and commercialization programs that offer tailored programming and mentorship in specific bioscience fields or technologies

- **Lead:** Public officials and entrepreneurship program leaders
- **Support:** Universities, nonprofits, economic development organizations, industry groups
- **Timeline:** 0–2 years
- **Estimated Costs:** $$
- **Priority Actions:**
  - Assess existing commercialization and entrepreneurship programs for opportunities to specialize
  - Create bioscience-specific cohorts
  - Recruit highly skilled mentors for bioscience entrepreneurs
  - Develop catalog of realigned and tailored bioscience programs

Bioscience entrepreneurs and startups face innovation and commercialization challenges that are fundamentally different from those encountered in other technology sectors, evidenced by the high level of patent applications but low levels of licensure and commercialization. These include complex regulatory pathways, longer development timelines, higher capital requirements, and the need for highly specialized scientific expertise. These challenges also differ among bioscience domains, further arguing for tailored support. For example, regenerative medicine companies often struggle with the scalability of living cell therapies and stringent manufacturing requirements, while diagnostic startups must navigate intricate regulatory approvals and payer reimbursement pathways. Arizona currently has several entrepreneurship and commercialization programs intended to address such complexity as they support bioscience and high-tech startups (Table 5). Despite positive momentum, some of these programs are small and/or nascent, with unclear track records for participating bioscience entrepreneurs and startups.

*Table 5: Focus Areas and Stages Supported by Existing Entrepreneurship Programs*

| Name | Focus Area | Stages Supported |
|---|---|---|
| ACA's Venture Start | High tech | Early stage |
| ACA's Venture Raise | | Ready to generate commercial or licensing revenue for the company within 12 months after the company receives funding |
| ACA's Venture Scale | | |
| AZ TechCelerator | High tech | Incorporated in the last two years, aiming for self-sufficiency in under five years |
| C-Path's Translational Therapeutics Accelerator | Drug discovery and development | Early lead optimization through IND-enabling studies (~seed to Series B) |
| Flinn Foundation Bioscience Entrepreneurship Program | Bioscience | Pre- or early-revenue stage |
| MAC[6] Growth Academy | Sector agnostic | Early stage and growth stage |
| Mayo Clinic and ASU MedTech Accelerator | Medical devices and healthcare technology | Early, growth, or late stage with at least $500,000 raised |

| Name | Focus Area | Stages Supported |
|---|---|---|
| | | or generating recurring revenue |
| PBC XLR8 | Healthcare technology | Scale-ready (Series A/B) |
| SEED SPOT | Sector agnostic | Idea stage and early stage |
| PHX FWD Founders Collective | Sector agnostic | Early stage, approaching $500,000 annual recurring revenue |

To continue to improve bioscience startup outcomes in Arizona, the state's bioscience leaders should pursue three priorities:

1. **Expand and deepen bioscience subdomain-specific programming.** Arizona needs more-specialized innovation and commercialization resources tailored to the scientific and market realities of different bioscience fields. Programs focused on specific subdomains (e.g., medical devices, drug discovery) can better connect entrepreneurs to aligned mentors, partners, and capital sources, thereby increasing the likelihood of successful market translation. Existing high-tech innovation programs could establish bioscience-specific cohorts, offering participants more-tailored guidance and technical resources that reflect the unique demands of the sector. Any of the programs supporting bioscience companies would see strong developmental returns from recruiting accomplished bioscience entrepreneurs and executives to provide critical insights on regulatory pathways, clinical development, and partnering models and ultimately improve outcomes for emerging startups.
2. **Strengthen coordination across existing mentorship and commercialization programs.** Arizona's current programs span stages and focus areas, but they are not sufficiently connected to one another to support companies through the full bioscience commercialization continuum. A more intentional coordination framework—where programs align offerings without undue duplication based on startup maturity, bioscience field, and specific commercialization milestones—would ensure that entrepreneurs are directed to the right resources at the right time. A specific step to strengthen coordination of mentorship programs and resources would be to develop a roster of industry mentors (e.g., former executives, regulatory specialists) who are able to provide startups with sustained guidance.
3. **Ensure geographic inclusivity.** Most bioscience commercialization resources are concentrated in Greater Phoenix. Expanding these offerings to Flagstaff, Tucson, and Yuma will help spark greater entrepreneurial activity and investment beyond the Valley and will allow for community-specific specialization, such as an initiative to support Native entrepreneurs in traditional medicine commercialization and culturally appropriate healthcare technologies, or a program in agricultural bioscience innovation leveraging ABOR's strategic roadmap for sustainable agriculture in arid environments.[61]

To support this growth, Arizona's industry groups and regional economic development organizations can take a more active role in entrepreneurial education across the state. LSWI's Washington Innovation Network (WIN), which identifies university spinouts and other early-stage bioscience companies that require targeted guidance, offers a useful blueprint for creating a dedicated bioscience mentoring program that Arizona could adapt.

Arizona could also explore a partnership with LaunchBio to establish an Arizona version of HiveBio—an accelerator piloted in Philadelphia in 2025 to support pre-seed bioscience companies, with a focus on advancing underrepresented entrepreneurs.[62] Other actions to support bioscience commercialization in Arizona include offering milestone-based microgrants that supplement SBIR/STTR awards for activities like proof-of-concept testing, prototype development, and small-scale clinical validation, similarly to MLSC's Massachusetts Ramp-Up Program.[63]

**Strategy 3.3**: Build a statewide bioscience incubator network aligned to regional specializations and needs

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Universities, nonprofits, entrepreneurship programs, economic development organizations, industry groups
- **Timeline:** 3–5 years
- **Estimated Costs:** $$$$
- **Priority Actions:**
  - Validate knowledge of regions' bioscience specializations and health needs
  - Identify potential sites for incubator networks
  - Raise capital for site development, equipment, supplies, and programs
  - Determine revenue model

Relative to other high-tech startups, bioscience ventures tend to have unique facility (e.g., wet lab, hoods, chemical and biosafety) and technical (specialized lab capital equipment) needs that are prohibitively expensive for a young startup to fund and that represent significant barriers to venture growth. Proper biosafety labs require significant investment in specialized infrastructure and systems, like HVAC, containment, cold storage, and waste management systems, as well as specialized analytical equipment that costs millions to acquire and maintain. To overcome these challenges, Arizona's leaders should work to establish a statewide network of bioscience-specific incubators, complementing but not competing with existing incubators, aligned with regional specializations and needs.

While incubators can support early-stage startups during ideation, prototyping, and initial development, they also play the distinct role of serving slightly more established ventures that are not yet ready to secure their own facilities (see Table 6). Incubator programs typically offer relatively long-term support (often 1–2 years), including access to coworking space, shared lab facilities, and ongoing technical or business mentorship, while serving as magnets for interested scientists and entrepreneurs to connect, further strengthening the ecosystem.

The proposed incubator network is intended to complement and strengthen Arizona's existing bioscience incubation resources, not replace or compete with them. Rather than duplicating capabilities, the network would enhance existing offerings and fill identified gaps in specialization, geographic coverage, and commercialization support. By aligning closely with existing incubators to leverage expertise, facilities, and community networks, the proposed incubator network will help boost visibility, attract additional resources, and create more opportunities and support for bioscience innovators across Arizona. This network should be distributed statewide in cities with bioscience startup activity—likely Flagstaff, Greater Phoenix, Tucson, and Yuma.

These incubators can partner or co-locate with existing research institutions and entrepreneurship centers, helping to minimize costs while leveraging current infrastructure. A surge in funding to support bioscience-specific programming and specialized equipment would better align these spaces with the unique needs of bioscience commercialization. For example, participating incubators could retrofit existing space with sinks, fume hoods, bench equipment, and cold-storage space to add capacity for startups to conduct wet-lab work, filling a significant need that bioscience companies routinely cite. These incubators can also house the regional coordinators of the proposed statewide commercialization team, creating a hub-and-spoke model that connects innovators, expertise, and resources across the state.

*Table 6: Potential Locations and Specializations for a Network of Bioscience-Specific Incubators*

| Name | Location | Potential Specialization |
|---|---|---|
| NAU Center for Community Health and Engaged Research | Flagstaff | Health equity and aging |
| Moonshot | Flagstaff | Medical devices |
| Mayo Clinic Arizona | Phoenix | Transplant surgical technology |
| Pathogen and Microbiome Institute | Flagstaff | Genomics, infectious disease, and precision medicine |
| 850 PBC | Phoenix | Precision oncology |
| Center for Entrepreneurial Innovation* | Phoenix | Medical devices |
| ASU Nanofabrication Center | Phoenix | Semiconductors and microelectronics |
| SkySong | Scottsdale | Biomedical informatics |
| U of A Center for Innovation* | Tucson and Oro Valley | Diagnostics and therapeutics |
| Yuma Center of Excellence for Desert Agriculture | Yuma | Agricultural biotechnology |
| Arizona Western College and Onvida Health's Health Career Center | Yuma | Health delivery |

* Existing physical sites of bioscience incubators. Moonshot also has wet-lab space compatible with a bioscience-specific incubator.

Arizona can look to successful models in other states that have built sustainable incubator networks, like the Illinois University Incubator Network (IUIN) and the New York State Certified Business Incubators and Innovation Hot Spots program. Started in 2018, IUIN supports incubation and entrepreneurship by linking 12 university incubators to resources, technical assistance, and best practices. New York State maintains a statewide incubator network (started in 2013) with 10 Innovation Hot Spots and 20 Certified Business Incubators, which receive funding to coordinate regional entrepreneurial ecosystems and improve the quality and quantity of incubator services provided to startups.[64]

Operating a network of bioscience incubators requires investment to support programming, staffing, and shared use of existing facilities and equipment. To fund this network, bioscience leaders can identify partners who share an interest in advancing targeted bioscience innovations or addressing region-specific health challenges such as valley fever, heat-related illness, or rural and indigenous health disparities, which could be among the focus areas of participant startups. The proposed incubator network can also pursue revenue-generating to support ongoing operations and services. Under a fee-for-service model, startups could pay for specific offerings, such as technical consulting or access to shared lab equipment on an as-needed basis; this structure is particularly useful for companies with existing funding that may only require targeted support. A membership model could complement this by offering companies broader, ongoing access to facilities, mentorship, and programming across the statewide network in exchange for a recurring fee, creating a more predictable revenue stream. As incubator locations offer distinct areas of specialization and commercialization infrastructure, network-wide access could create a compelling value proposition for startups, allowing them to engage with multiple sites based on their evolving needs, foster cross-regional collaboration, and optimize the use of specialized infrastructure throughout Arizona.

# GOAL 4: Strengthen Talent and Career Pathways

Arizona's bioscience ecosystem will be a premier bioscience workforce hub that attracts, develops, and retains top-tier professionals and skilled workers. This will be demonstrated by Arizona becoming a residence of choice for workers and destination of choice for companies requiring a large, skilled, and sustained talent pool.

**Strategy 4.1**: Unite education institutions and employers to align Arizona's bioscience talent pools with evolving labor needs

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Industry groups, workforce boards, education institutions, public officials, nonprofits
- **Timeline:** 0–2 years
- **Estimated Costs:** $$
- **Priority Actions:**
  - Establish a Bioscience Workforce Alignment Project Team
  - Coordinate regular bioscience workforce needs assessments
  - Identify shared talent gaps and competency requirements
  - Translate findings into aligned curricula (existing or new), standards, and training investments
  - Raise and coordinate public, corporate, and nonprofit funding for implementation
  - Recommend policy updates to accelerate workforce alignment

As discussed above (see Arizona's Strategic Positioning), Arizona's bioscience workforce is rapidly expanding, bolstered by strong postsecondary education programs. However, persistent challenges remain, including weak funding and outcomes in the K-12 system, insufficient retention of postsecondary graduates, and resultant workforce shortages—shortages that differ between and among cities and rural regions. Additionally, the education sector is a dynamic ecosystem, including K-12 schools, out-of-school players, postsecondary institutions, state and local governments, workforce and industry partners, work-based learning programs, and wraparound support subsectors. The environment's complexity contributes to fragmented talent pathways that may not align with the current and emerging needs of a dynamic, fast-evolving industry.

To address these challenges and facilitate long-term sector growth, Arizona's attention should be on building stronger, sustained connections among the major stakeholders in bioscience education pathways. This strategy focuses on establishing the collaborative infrastructure, common language, and shared discovery plus the deployment processes needed to assess workforce needs in real time, align training pathways with industry demand, and identify policy and funding mechanisms to implement change. By doing so, Arizona can proactively shape a bioscience workforce system that is responsive and future-ready.

This strategy assigns responsibility to launch this work to a Bioscience Workforce Alignment Project Team, which can become a standing initiative of Arizona's Bioscience Roadmap Steering Committee, to coordinate workforce-talent efforts statewide.

The project team should include representatives from bioindustry firms and associations (e.g., AZBio, medical device manufacturers, health systems); workforce development boards and training providers; universities, community colleges, and high-school CTE programs; state and city workforce and economic development offices; and philanthropic foundations and community-based organizations such as the SciTech Institute. This project team, leveraging the credibility of Arizona's Bioscience Roadmap Steering Committee, will serve as Arizona's central platform to share bioscience workforce data, co-design strategic talent initiatives, and align funding and policies that enable rapid training deployment and long-term system improvements.

The working group could initiate a range of high-impact actions to strengthen Arizona's bioscience talent pathways and ensure alignment with industry needs, including:

- Develop a "Portrait of a Bioscience Graduate" to define clear, outcomes-based learning goals across high-school and postsecondary levels, as well as reskilling programs.
- Map existing career and education pathways statewide, including regionally distinct pathways, identifying barriers to access and opportunities for equity-driven improvements.
- Create a shared skills framework to support curriculum development and training alignment, emphasizing critical cross-sector competencies such as quality assurance, lab safety, and data literacy.
- Convene regional Workforce Futures Forums in Flagstaff, Tucson, Phoenix, Yuma, and across Arizona to facilitate dialogue between employers and educators.
- In parallel, convene employers and university career-services leaders to explore strategies to retain high-achieving graduates in Arizona and recruit back top young professionals who have left the state.
- Recommend policy changes, explore realignment of existing funding streams, and coordinate joint grant proposals to secure new public and philanthropic funding streams to scale apprenticeships, externships, and teacher-immersion programs statewide.

**Strategy 4.2**: Implement and scale effective workforce development programs.

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Industry groups, postsecondary institutions, workforce boards, public officials, economic development organizations
- **Timeline:** 0–5 years
- **Estimated Costs:** $$$
- **Priority Actions:**
  - Adapt and scale proven training programs and credentials
  - Expand flexible, modular learning pathways
  - Leverage reskilling and upskilling programs for veterans and other groups

As bioscience careers increasingly require hybrid skill sets—spanning data analytics, integration of AI tools, automation, regulatory science, and advanced manufacturing—Arizona must transform its training ecosystem to be more agile, interdisciplinary, and responsive both to employer and worker needs. This strategy aims to empower Arizona's employers and educators to co-create a dynamic, future-ready talent development system. It focuses on sourcing and adapting high-impact training programs and filling critical workforce gaps through co-developed, industry-vetted curricula and modular, stackable credentials.

By anchoring this strategy in collaborative governance and data-informed decision-making, Arizona can cultivate a resilient and inclusive bioscience labor force that keeps pace with the sector's rapid evolution and supports sustained economic growth, especially as increasingly powerful AI agents and other applications upend skill requirements, productivity expectations, and role definitions. Implementation will be coordinated by the Bioscience Workforce Alignment Project Team, a standing initiative of Arizona's Bioscience Roadmap Steering Committee (see Strategy 4.1). This group will lead ongoing employer/educator engagement, interpret labor-market signals to inform curriculum and credential priorities, and guide the development of responsive, scalable training models that organizations can apply flexibly as appropriate to their needs. It will also play a critical role in aligning public and philanthropic funding and recommending policy changes to institutionalize successful practices.

This strategy recommends tailored approaches for distinct talent segments. For the current workforce, the focus is on upskilling mid-career professionals—who are likely to face particular threats in a period of high technological change—offering flexible, modular training programs that emphasize skills in digital tools and AI literacy, QA/QC, regulatory compliance, and improved preparation for success in cross-disciplinary fields like advanced manufacturing and health data analytics.[65] These upskilling opportunities should be embedded in career-advancement pathways, supported by employer partnerships and delivered through regional training hubs to ensure accessibility and long-term impact.

Arizona's community colleges and universities play a critical role in co-developing stackable, industry-aligned credentials in high-demand domains such as biomanufacturing, biotech data science, and regulatory affairs. For example, all of Maricopa Community Colleges' institutions offer an associate degree in science with a biological sciences emphasis, and students who complete these programs can have the credits for their associate degree count toward degrees at Arizona's public universities. Community colleges are hubs for early-stage lab training, offer accessible simulation centers, and are engaged industry partners.

Still, with much of the public now doubting the value of higher education—and historically high unemployment for graduates of bachelor's degree and higher programs[66]—institutions at all levels must do more to ensure their relevance and attractiveness, such as by incorporating more work-based learning experiences—including internships, co-ops, apprenticeships, coursework involving employer-based projects,[67] and faculty-industry fellowships—and these enhancements should be designed for rapid deployment and statewide scalability. One example of this approach is Oregon Bioscience Association's Access Bio Manufacturing Apprenticeship Program, which connects employers to talent via structured, grant-funded apprenticeship pathways. A similar apprenticeship system in Arizona could diversify access points into bioscience careers, especially for workers taking nontraditional educational paths.

For accelerated training opportunities, Arizona can take lessons learned from efforts in other sectors and create bioscience-focused quick-start programs, improving on initiatives like the Semiconductor Technician Quick Start program and the Future48 Workforce Accelerators to quickly equip students with core competencies needed to succeed in entry-level bioscience roles. While bioscience firms may not require new workers in the same immediate volume as semiconductor firms, labor-market analysis has identified an unmet demand in certain fields, and Arizona's growing research and startup activity suggests that demand is likely to remain strong. Developing responsive programming now can help Arizona proactively build workforce capacity in line with its long-term bioscience industry goals.

Finally, this strategy emphasizes the importance of early exposure—as early as elementary school—and educator engagement to build strong bioscience talent pathways. In some instances, Arizona has national leadership in this area, such as through the SciTech Institute's Chief Science Officers program, which has been implemented in many states, and its national Rural STEM Learning Summit. The state also has robust CTE programs. Arizona has a few specialty high school programs, like the Bioscience High School and Paradise Valley High School's Center For Research in Engineering, Science and Technology (CREST), as well as summer enrichment programs that include the Banner-ASU Neuroscience Scholars Program, NAU's Cultural and Academic Research Experience (CARE), the Helios Scholars at TGen program, and the Keep Engaging Youth in Science (KEYS) Research Internship at U of A's BIO5 Institute. These efforts are exemplars to scale and build on through new initiatives that will help cultivate early interest in bioscience careers while equipping educators to deliver more industry-relevant instruction.

Priorities include:

- Launching bioscience externships for K-12 teachers (one model is the Colorado BioScience Institute's Research Experience for Teachers [RET] program)
- Expanding student-facing bootcamps and summer institutes in underserved regions
- Embedding bioscience career awareness modules into STEM curricula through partnerships with employers and community-based organizations
- Building a bioscience-aligned behavioral health workforce, including peer specialists, addiction counselors, and mental health technicians, with focused efforts in rural, tribal, and border communities

Arizona's strategy can also adapt successful practices from leading bioscience states. For example, North Carolina's BioWork certificate set a national standard for short-term, job-ready training delivered through community colleges in collaboration with the biomanufacturing industry. Targeted fellowships, like the Mountain Area Health Education Center (MAHEC) Rural Fellowship, represent successful models for improving recruitment and retention of rural healthcare providers and researchers, with the added benefit of improving health outcomes in places where services are more difficult to access. MAHEC's Rural Fellowship offers mentorship, educational opportunities, research support, and community-building experiences to health science students and researchers in western North Carolina. Since 2017, MAHEC's Rural Fellowship has graduated 30 fellows, 83% of whom are still in based in western North Carolina.[68] MiraCosta College's applied bachelor's degree in biomanufacturing exemplifies workforce-relevant, affordable postsecondary education.

To ensure access across Arizona's diverse regions and populations, this strategy prioritizes expanded experiential learning opportunities and wraparound support services. Arizona already has promising models to build on. The previously mentioned CARE program engages students from underserved and tribal communities in STEM and health-related research projects, providing a platform that could be expanded to introduce more bioscience workforce pathways to participants. Similarly, the Indian Health Service (IHS) supports externships and residency rotations in rural and tribal health systems across Arizona, offering practical experience that links education to patient care. These initiatives demonstrate how experiential learning, rooted in Arizona's cultural and community contexts, can broaden access and strengthen retention in the state's workforce pipeline. Building on these efforts, Arizona can adapt additional models—such as BioSTL's internship and wraparound services framework and the California Indian Museum and Cultural Center's Tribal Community Health Representatives program, which trains students as certified community health workers focused on tribal health challenges. Complementary initiatives like Workforce Futures Forums (see Strategy 4.1) and the U.S. Department of Defense's SkillBridge program can further extend access for veterans and underserved communities, ensuring that bioscience training pathways are industry-aligned, inclusive, and geographically tailored.

**Strategy 4.3**: Establish a bioscience talent concierge to recruit and retain transformative research, clinical, entrepreneurial, and business talent

- **Lead:** State-level agency
- **Support:** Regional economic development and community organizations, industry groups, universities, health systems
- **Timeline:** 0–2 years
- **Estimated Costs:** $$
- **Priority Actions:**
  - Assess existing "concierge" infrastructure and capacity for bioscience-specific support
  - Launch bioscience talent concierge to support the recruitment of high-level bioscience professionals

Along with a strong workforce supply at all levels of skill and experience, a thriving innovation ecosystem requires dynamic executive talent that can launch groundbreaking ventures, transform industries, catalyze new activity, and help define the culture of the region. But recruiting top-tier bioscience talent often requires coordination of multiple organizations—academic institutions, employers, economic development organizations, and community partners—to meet the personal and professional needs of highly sought-after individuals. The creation of a one-stop support hub dedicated to recruiting and relocating high-level bioscience professionals to Arizona could streamline this process.

A bioscience talent concierge would provide personalized services including relocation assistance, lab or office space identification, spousal job-seeking support, housing and school navigation, community onboarding, and direct access to Arizona's bioscience networks. The concierge should also be equipped to showcase Arizona's business climate, quality of life, and bioscience-specific assets to help prospective talent see the full value of building their future in the state. In cases where recruitment is led by a specific institution or employer, the concierge can serve as an extension of that effort, offering wraparound support tailored to the candidate's needs.

The talent concierge should consult and collaborate with Arizona universities and companies to anticipate needs and support recruitment of strategic hires in bioscience subfields deemed critical to the state's long-term growth—such as biomanufacturing, genomics, and biotech-AI integration.

ACA's existing concierge program—which supports company recruitment and relocation efforts—is one foundation to learn from, though this initiative should be driven by the experience and needs of companies, health systems, and universities that recruit talent globally. Sector-specific services would enhance Arizona's ability to attract high-level bioscience talent and align with ACA's mission to grow quality jobs across the state. Alternatively, the concierge function could be housed within another bioscience support organization with deep connections across government, economic development, industry, education, and regional partners throughout the state.

Talent-centric cluster development can establish a self-reinforcing cycle where top-tier hires attract funding and generate industry activity, which in turn enhances Arizona's national competitiveness and helps attract even more talent. By positioning talent as a cornerstone of its bioscience growth strategy, Arizona can strengthen its innovation ecosystem and deliver long-term, inclusive economic value across the state.

# GOAL 5: Tell Arizona's Bioscience Story

Arizona's bioscience ecosystem will be recognized in-state and out-of-state as a national leader by policymakers, investors, potential collaborators and other key constituencies for its contributions to health outcomes and economic growth, together benefiting all Arizonans. This will be demonstrated through an increased media presence and the emergence of a more competitive policy environment that strengthens the ecosystem's long-term competitiveness.

**Strategy 5.1**: Promote and position Arizona as a bioscience hub with a coordinated communications plan

- **Lead:** Arizona's Bioscience Roadmap Steering Committee
- **Support:** Communications leaders across core private- and public-sector bioscience and economic development organizations; SciTech Institute's Chief Science Officers program
- **Timeline:** 0–2 years
- **Estimated Costs:** $$
- **Priority Actions:**
  - Develop bioscience awareness campaigns for in- and out-of-state that include paid marketing, earned media, and live events
  - Build a network of media contacts at both general-interest and field-specific outlets; and journalism associations
  - Build an Arizona bioscience news network to create and share content across organizations
  - Attract more bioscience conferences to the state; participate in existing conferences

A unified narrative is essential to showcasing the full scope of innovation happening across Arizona and elevating the visibility of the state's bioscience ecosystem. This can be created with a three-pronged communications strategy that includes marketing campaigns, earned media coverage, and live events (including professional conferences).

Researchers, entrepreneurs, companies, investors, economic development leaders, and policymakers—both within Arizona and beyond—need a clear, compelling story about the state's bioscience strengths to drive interest and engagement. By aligning messaging and amplifying success stories through communication planning and materials, Arizona can strengthen its reputation as a national bioscience hub. The unified communications strategy should include several elements:

- **Collaborate with ecosystem partners.** Arizona has lacked a unified communications campaign to increase bioscience media mentions and awareness. The existing group of communications leaders across core bioscience organizations should expand and refine its mission to collaborate on a shared narrative and communications plan. The group should become a Communications and Marketing project team of Arizona's Bioscience Roadmap Steering Committee.

- **Clearly define value propositions.** The communications strategy should highlight the state's bioscience assets and articulate their value. This strategy should highlight unique features as an innovation frontier, a business-friendly environment, density of clinical trial activity, research specializations, and capacity to tackle important health topics facing Arizonans. Messaging should be tailored to tiered audiences, including the general public, the business research community, policymakers and lawmakers, investors, and entrepreneurs.
- **Align key message and brand.** A key message and brand should be considered together to help answer the overarching question "For what does Arizona's bioscience ecosystem want to be known?" The marketing strategy could highlight Arizona's commitment to collaboratively developing and advancing novel bioscience to improve health outcomes.
- **Utilize success stories and testimonials.** Success stories can be a compelling way to convey the real-life impact of Arizona's bioscience activity, from creating economic value to improving health outcomes. Health systems can showcase patient outcomes, university tech-transfer offices can highlight successful startups, and funding programs can feature grantees' progress and follow-on investments.
- **Develop marketing campaigns and events.** Showcase the state's regional bioscience assets to educate Arizona's public leaders and draw visitors from outside the ecosystem to learn about statewide bioscience advances. In Colorado, for example, CBSA hosts the Drive to Five: Life Sciences Innovation Tour, a personalized two-day tour across five diverse regions within the state's bioscience sector for invited legislators, investors, site selectors, and community leaders. Bioscience leaders should also fully leverage broader technology conferences, such as the recently announced Arizona Tech Week.[69]
- **Cultivate a media network.** National media outlets should have access to a list of bioscience experts from Arizona to tap as sources for national trend or other coverage. Similarly, local newsrooms should have easy access to bioscience experts. The Communications and Marketing project team can be a liaison for local and national media outlets.
- **Conduct continuous evaluation and improvement.** The strategy should be regularly evaluated and refined by the project team based on feedback and performance metrics to ensure effectiveness and responsiveness to changing needs, market dynamics, and emerging bioscience assets.

**Strategy 5.2**: Advocate for policy to enhance Arizona's competitiveness

- **Lead:** Industry groups and public officials
- **Support:** Economic development and community organizations
- **Timeline:** 3–5 years
- **Estimated Costs:** $$
- **Priority Actions:**
  - Identify existing government initiatives that can support bioscience ecosystem development
  - Build consensus among shared bioscience funding priorities
  - Mobilize champions to advocate for targeted policy changes

For Arizona to achieve a position as a true national bioscience leader, the state must advance targeted policy strategies that address critical funding gaps, enhance competitiveness, and support talent attraction and retention. Leading bioscience hubs nationally, such as Massachusetts, North Carolina, and Texas, have deployed billion-dollar funding mechanisms and bioscience-specific incentives, with spectacular outcomes for their communities. Arizona lacks comparable statewide tools to advance its position.

Closing this policy gap will require both pragmatic legislative efforts and a strategic shift in how bioscience is prioritized within state economic development frameworks. Specific policy actions, among a number of others, may include:

- Providing incremental funding to build the corpus of a bioscience endowment such as AHIT.
- Creating an SBIR/STTR federal grant matching program.
- Strengthening the Angel Investment Tax Credit. Modifications could include raising the annual tax credit cap, increasing per-investor limits, allowing transferability of unused credits, and authorizing the tax credit past 2031.
- Streamlining data-sharing agreements for health research while ensuring patient privacy, which would accelerate collaboration and discovery.
- Enabling a "Regulatory Innovation Hub" or pilot "sandbox" for digital health tools, mobile diagnostics, and AI-enabled therapeutics.
- Referring to the ballot a long-term continuation of Proposition 301, including TRIF, to ensure protection of an essential tool to foster discovery in Arizona's innovation ecosystem.

Further, Arizona faces strong competition from other regions to attract and retain top talent in the biosciences and other high-skill sectors. While the state offers lifestyle advantages and a business-friendly climate, these alone are not enough. Enhancing financial incentives and investing in supportive infrastructure—affordable housing, childcare, green spaces, and a vibrant arts and culture sector—will strengthen Arizona's appeal.

Just as critical are long-term investments in talent development, including stronger K-12 education with expanded access to STEM, CTE, and early-college programs. These efforts are essential to securing Arizona's competitiveness in the biosciences and beyond.

Policy change and innovation benefiting the biosciences in Arizona faces known headwinds, including tight budgets at the state level, frequent turnover among policymakers, limited public appetite for large-scale appropriations, and an insufficiently unified bioscience policy agenda across agencies and stakeholders. As noted earlier in this Roadmap, organizations such as AZBio and the Tech Council play critical advocacy roles, but the current scale and reach of these efforts are not yet sufficient to match the sector's needs or potential, indicating in particular the need for significantly enhancing the capacity of AZBio. A more coordinated, coalition-driven strategy that actively engages allied organizations across the state, shares advocacy tools widely, and mobilizes consistent participation from industry, academia, research institutions, and other bioscience advocates is vital to effectively communicate the economic and social returns of bioscience investment. Building support for policy successes that have already occurred has taken years, and the most ambitious policy actions discussed in this document will likely take years more of sustained effort.

# Conclusion

Arizona's bioscience ecosystem is experiencing a period of dynamic growth, with two decades of momentum positioning the state as an emerging hub. However, achieving national leadership requires more than steady progress—it demands creative, coordinated action to realize the potential of the state's talent, research assets, and entrepreneurial energy. This iteration of the Roadmap charts a path toward this future, grounded in five strategic goals that together aim to elevate Arizona's bioscience ecosystem into a recognized national leader.

To scale from emerging promise to national competitiveness, the ecosystem must transition from what is sometimes informal cooperation to institutionalized collaboration to align regional priorities, reduce duplication, and catalyze cross-sector partnerships. At the same time, the state must address a persistent gap in commercialization capacity. Despite world-class research output from universities and health systems, too few discoveries made in Arizona reach the market or create value. Targeted efforts to scale regional commercialization infrastructure, deepen research-industry partnerships, and concentrate investment in strategic domains—such areas of existing strength like bioengineering, cancer, and neurodegenerative diseases, and cross-cutting areas like healthy aging and precision medicine—will be key to driving impact.

Unlocking the full potential of Arizona's bioscience economy requires strengthening two foundational enablers: entrepreneurship and talent. Entrepreneurs and early-stage companies face friction accessing capital, facilities, and mentorship. Tailored support programs and expanded investment pipelines will be critical to fostering a high-performing startup environment. Simultaneously, Arizona must accelerate bioscience workforce development through aligned training pathways, sector-specific credentials, and proactive recruitment. A unified narrative and supportive policy environment will enhance the state's capacity to attract resources and solidify its national relevance.

As the state navigates uncertainty around federal funding for bioscience research, Arizona's bioscience community must remain both strategic and adaptable. National science and health agencies are likely to experience flat or reduced budgets in the coming years. This changed landscape presents real risks to Arizona's research institutions, emerging companies, and partnerships that depend on predictable federal support. At the same time, private investment is becoming more risk-averse and concentrated in sectors with faster commercialization cycles. In this environment, Arizona must lean into its existing advantages—such as foundational research capabilities, clinical trial infrastructure, and access to diverse geographies and patient populations—while sustaining the nimbleness and creativity that made it a rising bioscience state. This approach will help the state position itself to compete for resources and seize new opportunities.

Executing this Roadmap will require focus and collaboration among key partners. Doing so will strengthen Arizona's economy, improve health outcomes, and cement the state's place as a vital contributor to bioscience in the United States and beyond.

# Appendix: Methodology and Sources

## Subsector Definitions

*Table 7: Subsector Definitions by NAICS Code*

| SUBSECTOR | NAICS CODE | DESCRIPTION |
|---|---|---|
| Agricultural Feedstock and Industrial Biosciences | 311221 | Wet Corn Milling |
| | 311224 | Soybean and Other Oilseed Processing |
| | 325193 | Ethyl Alcohol Manufacturing |
| | 325311 | Nitrogenous Fertilizer Manufacturing |
| | 325312 | Phosphatic Fertilizer Manufacturing |
| | 325314 | Fertilizer (Mixing Only) Manufacturing |
| | 325320 | Pesticide and Other Agricultural Chemical Manufacturing |
| Pharmaceuticals | 325411 | Medicinal and Botanical Manufacturing |
| | 325412 | Pharmaceutical Preparation Manufacturing |
| | 325413 | In-Vitro Diagnostic Substance Manufacturing |
| | 325414 | Biological Product (except Diagnostic) Manufacturing |
| Medical Devices and Equipment | 334510 | Electromedical and Electrotherapeutic Apparatus Manufacturing |
| | 334516 | Analytical Laboratory Instrument Manufacturing |
| | 334517 | Irradiation Apparatus Manufacturing |
| | 339112 | Surgical and Medical Instrument Manufacturing |
| | 339113 | Surgical Appliance and Supplies Manufacturing |
| | 339114 | Dental Equipment and Supplies Manufacturing |
| Research, Testing, and Medical Laboratories | 541380 | Testing Laboratories |
| | 541713 | Research and Development in Nanotechnology |
| | 541714 | Research and Development in Biotechnology (except Nanobiotechnology) |
| | 541715 | Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology) |
| | 621511 | Medical Laboratories |
| Bioscience-Related Distribution | 423450 | Medical, Dental, and Hospital Equipment and Supplies Merchant Wholesalers |
| | 424210 | Drugs and Druggists' Sundries Merchant Wholesalers |
| | 424910 | Farm Supplies Merchant Wholesalers |
| Hospitals | 622110 | General Medical and Surgical Hospitals |
| | 622210 | Psychiatric and Substance Abuse hospitals |
| | 622310 | Specialty (except Psychiatric and Substance Abuse) Hospitals |

**Note**: Includes only the portion of these industries engaged in relevant life science activities.

*Table 8: Arizona Bioscience Company Leaders by Subsector and Approximate Employee Count*

| Name | Subsector | Approx. Employee Count in AZ | Location(s) | Facility Type |
|---|---|---|---|---|
| Nutrien Ag Solutions | Agricultural Feedstock and Industrial Biosciences | 145 | Tucson, Chandler, Yuma | Corporate, Warehouse |
| Gowan Company | Agricultural Feedstock and Industrial Biosciences | 112 | Yuma | HQ, Manufacturing |
| OnePointOne | Agricultural Feedstock and Industrial Biosciences | 98 | Avondale | HQ, R&D |
| PhycoTerra (Heliae) | Agricultural Feedstock and Industrial Biosciences | 85 | Gilbert | HQ, Manufacturing, R&D |
| MyLand | Agricultural Feedstock and Industrial Biosciences | 84 | Phoenix | HQ |
| Isagenix International | Bioscience-Related Distribution | 3,796 | Gilbert | HQ, Manufacturing |
| Confluent Medical Technologies | Bioscience-Related Distribution | 2,000 | Scottsdale | HQ, Manufacturing, R&D |
| Medassure | Bioscience-Related Distribution | 140 | Tucson, Phoenix | HQ, Warehouse |
| Langham Logistics | Bioscience-Related Distribution | 135 | Phoenix | Warehouse |
| BioCareSD | Bioscience-Related Distribution | 115 | Tempe | HQ |
| W. L. Gore | Medical Devices and Equipment | 4,300 | Flagstaff, Phoenix | Corporate, Manufacturing, R&D |
| Dexcom | Medical Devices and Equipment | 2,000 | Mesa | Manufacturing |
| Medtronic | Medical Devices and Equipment | 820 | Chandler | Manufacturing, R&D |
| Stryker | Medical Devices and Equipment | 700 | Tempe, Chandler | Corporate, Manufacturing, R&D |
| Becton, Dickinson and Company | Medical Devices and Equipment | 650 | Tempe, Tucson | Manufacturing, R&D, Corporate |
| West Pharmaceutical Services | Pharmaceuticals | 1,386 | Scottsdale, Tempe | Corporate, Manufacturing |
| Abbott Laboratories | Pharmaceuticals | 605 | Scottsdale, Casa Grande | Corporate, Manufacturing |
| Bristol-Myers Squibb | Pharmaceuticals | 350 | Phoenix | Manufacturing |
| CND Life Sciences | Pharmaceuticals | 91 | Scottsdale | HQ, Testing |
| Precision Science | Pharmaceuticals | 55 | Phoenix | HQ, Manufacturing |
| Journey Medical | Pharmaceuticals | 41 | Scottsdale | HQ |
| Sonora Quest Laboratories | Research, Testing, and Medical Laboratories | 3,500 | Statewide | Testing |
| Roche Tissue Diagnostics | Research, Testing, and Medical Laboratories | 1,800 | Oro Valley | HQ, Manufacturing, R&D |
| Labcorp | Research, Testing, and Medical Laboratories | 917 | Statewide | Testing |
| Caris Life Sciences | Research, Testing, and Medical Laboratories | 790 | Phoenix | Corporate, R&D, Testing |

| Name | Subsector | Approx. Employee Count in AZ | Location(s) | Facility Type |
|---|---|---|---|---|
| Exact Sciences | Research, Testing, and Medical Laboratories | 80 | Phoenix | Testing |
| Banner Health | Hospitals | 45,185 | Statewide | Hospital, Testing, Specialists |
| HonorHealth | Hospitals | 16,000 | Maricopa and Yavapai County | Hospital, Testing, Specialists |
| Dignity Health | Hospitals | 14,000 | Maricopa and Yavapai County | Hospital, Specialists, Testing |
| Mayo Clinic | Hospitals | 11,072 | Maricopa County | Hospital, Specialists, Testing |
| Phoenix Children's | Hospitals | 7,310 | Statewide | Hospital, Specialists, Testing |

# Quantitative Methods and Sources

## Investment and Funding

### *Venture Capital*

To define bioscience-related venture capital, SRI started with BIO's methodology, which includes companies in Healthcare Devices and Supplies, Healthcare Technology Systems, Pharmaceuticals and Biotechnology, and Other Healthcare as well as all additional companies included in PitchBook's Digital Health, HealthTech, and Life Sciences industry verticals. Only Healthcare Distributors and Laboratory Services companies are included from PitchBook's Healthcare Services industry group, excluding hospitals, clinics, elder care facilities, and other healthcare service companies. Investments in Agricultural Chemicals were also included.

### *SBIR/STTR*

The Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs offer funding to small businesses to research, develop, and commercialize new technologies. SRI retrieved data on SBIR and STTR awards from SBIR.gov and only analyzed awards containing bioscience-related keywords in the proposal abstracts. A total of 543 keywords were used in combination to identify related awards. Of these, 356 keywords were used as indications that an award had a higher probability of relating to bioscience (such as "biotech," "disease," "pharma," or "pathogen"), and 187 were used to indicate a higher probability that an award was *not* related to bioscience (such as "ballistic," "aviation," "surveillance," or "railcar"). No award was included or excluded based on a single keyword, but rather through assessment of the total related and unrelated keywords identified with each award. After filtering to bioscience-related awards, SRI categorized the award research areas by topic code.

### *NIH*

SRI collected funding data from the National Institutes of Health (NIH) by searching NIH's Research Portfolio Online Reporting Tools (RePORT) database using the RePORT Expenditures and Results (RePORTER) tool. To classify the research areas of each award, SRI used the NIH spending categorizations.

## Educational Completions

SRI collected educational program completions data from Lightcast, and Lightcast sourced this data from the National Center for Education Statistics (NCES) Integrated Postsecondary Education Data System (IPEDS) dataset. This data represents program completions (total degree, certificate, and award completions); however, successful completion of one of these programs does not mean an individual will fill a bioscience-related job. It is possible that individuals will go on to support other industries following program completions.

*Table 9: 2023 Arizona College Bioscience Course Completions*

| Institution | All Completions | Doctoral Degrees | Master's Degrees | Bachelor's Degrees | Associate Degrees | Certificates |
|---|---|---|---|---|---|---|
| Arizona State University | 7,791 | 265 | 2,213 | 5,142 | Not Offered | 171 |
| University of Arizona | 3,369 | 535 | 513 | 2,274 | Not Offered | 47 |
| Pima Medical Institute | 1,539 | Not Offered | Not Offered | 152 | 398 | 989 |
| Northern Arizona University | 1,527 | 15 | 153 | 1,215 | Not Offered | 144 |
| Grand Canyon University | 1,297 | Not Offered | 1 | 1,296 | Not Offered | Not Offered |
| Mesa Community College | 816 | Not Offered | Not Offered | Not Offered | 208 | 608 |
| Midwestern University-Glendale | 752 | 565 | 181 | Not Offered | Not Offered | 6 |
| Pima Community College | 739 | Not Offered | Not Offered | Not Offered | 185 | 554 |
| Carrington College | 577 | Not Offered | Not Offered | Not Offered | 83 | 494 |
| Refrigeration School, Inc. | 557 | Not Offered | Not Offered | Not Offered | Not Offered | 557 |
| GateWay Community College | 554 | Not Offered | Not Offered | Not Offered | 184 | 370 |
| UEI College | 550 | Not Offered | Not Offered | Not Offered | Not Offered | 550 |
| Glendale Community College | 521 | Not Offered | Not Offered | Not Offered | 119 | 402 |
| Phoenix College | 440 | Not Offered | Not Offered | Not Offered | 144 | 296 |
| Arizona College | 355 | Not Offered | Not Offered | Not Offered | Not Offered | 355 |
| Chandler-Gilbert Community College | 303 | Not Offered | Not Offered | Not Offered | 124 | 179 |
| Yavapai College | 299 | Not Offered | Not Offered | Not Offered | 45 | 254 |

| Institution | All Completions | Doctoral Degrees | Master's Degrees | Bachelor's Degrees | Associate Degrees | Certificates |
|---|---|---|---|---|---|---|
| Estrella Mountain Community College | 268 | Not Offered | Not Offered | Not Offered | 137 | 131 |
| Brookline College | 264 | Not Offered | Not Offered | 2 | 140 | 122 |
| Northland Pioneer College | 242 | Not Offered | Not Offered | Not Offered | 28 | 214 |
| Central Arizona College | 237 | Not Offered | Not Offered | Not Offered | 82 | 155 |
| Paradise Valley Community College | 219 | Not Offered | Not Offered | Not Offered | 40 | 179 |
| Arizona Western College | 184 | Not Offered | Not Offered | Not Offered | 133 | 51 |
| Universal Technical Institute of Arizona, Inc. | 174 | Not Offered | Not Offered | Not Offered | Not Offered | 174 |
| Eastern Arizona College | 164 | Not Offered | Not Offered | Not Offered | 23 | 141 |
| Bryan University | 145 | Not Offered | Not Offered | Not Offered | Not Offered | 145 |
| Mohave Community College | 141 | Not Offered | Not Offered | Not Offered | 38 | 103 |
| Cochise County Community College District | 133 | Not Offered | Not Offered | Not Offered | 49 | 84 |
| East Valley Institute of Technology | 119 | Not Offered | Not Offered | Not Offered | Not Offered | 119 |
| Embry-Riddle Aeronautical University-Prescott | 112 | Not Offered | Not Offered | 112 | Not Offered | Not Offered |
| Miller-Motte College-Arizona Automotive Institute | 101 | Not Offered | Not Offered | Not Offered | Not Offered | 101 |
| Sonoran University of Health Sciences | 99 | Not Offered | 99 | Not Offered | Not Offered | Not Offered |
| Coconino Community College | 95 | Not Offered | Not Offered | Not Offered | 15 | 80 |
| Sonoran Desert Institute | 87 | Not Offered | Not Offered | Not Offered | Not Offered | 87 |

| Institution | All Completions | Doctoral Degrees | Master's Degrees | Bachelor's Degrees | Associate Degrees | Certificates |
|---|---|---|---|---|---|---|
| Scottsdale Community College | 77 | Not Offered | Not Offered | Not Offered | 36 | 41 |
| Rio Salado College | 69 | Not Offered | Not Offered | Not Offered | 33 | 36 |
| Western Maricopa Education Center | 67 | Not Offered | Not Offered | Not Offered | Not Offered | 67 |
| Allen School-Phoenix | 57 | Not Offered | Not Offered | Not Offered | Not Offered | 57 |
| Ottawa University-Surprise | 45 | Not Offered | Not Offered | 45 | Not Offered | Not Offered |
| South Mountain Community College | 38 | Not Offered | Not Offered | Not Offered | 20 | 18 |
| University of Advancing Technology | 34 | Not Offered | 8 | 14 | 12 | 0 |
| Arizona Christian University | 24 | Not Offered | Not Offered | 24 | Not Offered | Not Offered |
| Prescott College | 21 | Not Offered | 9 | 12 | Not Offered | Not Offered |
| Regional Center for Border Health | 18 | Not Offered | Not Offered | Not Offered | Not Offered | 18 |
| Southwest Institute of Healing Arts | 15 | Not Offered | Not Offered | Not Offered | Not Offered | 15 |
| Dine College | 14 | Not Offered | 0 | 2 | 12 | 0 |
| Kino College | 10 | Not Offered | Not Offered | Not Offered | Not Offered | 10 |
| Tohono O'odham Community College | 6 | Not Offered | Not Offered | Not Offered | 6 | Not Offered |
| University of Phoenix-Arizona | 5 | 4 | Not Offered | 1 | Not Offered | Not Offered |
| DeVry University-Arizona | 1 | Not Offered | Not Offered | 1 | 0 | Not Offered |
| **Total** | **25,271** | **1,384** | **3,177** | **10,292** | **2,294** | **8,124** |

## Job Postings

SRI conducted the skills analysis of bioscience manufacturing and core laboratory and discovery occupations using job postings data between August 2019 and June 2024 from the National Labor Exchange (NLx). To extract the skills required in job postings, SRI employed supervised machine learning with a natural language processing (NLP) model from the transformers family. SRI inputted the sentences identified as skills-related into a transformer-

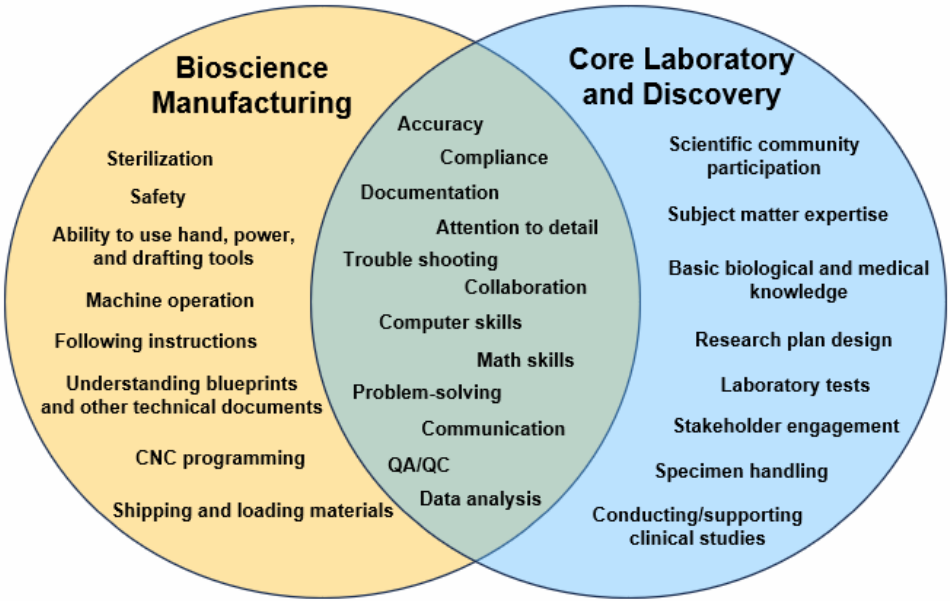
type topic model to form skill requirements into clusters, which were further grouped, categorized, and analyzed in conjunction with extracted educational requirements data.

## Alignment Between Industry and the Education System

Analysis of job postings provides insights into the actual desires and behaviors of Arizona employers as they seek talent matching their business needs. This analysis can surface opportunities for both improving industry's access to well-trained talent and helping workers find pathways into good jobs in Arizona's bioscience ecosystem. With these complementary goals in mind, two bioscience job categories were selected for evaluation: Bioscience Manufacturing and Core Laboratory and Discovery. These categories were chosen for the analysis because they cut across all six bioscience subsectors and are thus relevant to a large share of the bioscience community.

Several thousand Bioscience Manufacturing and Laboratory and Discovery job postings from Arizona were assessed. As Figure 5 illustrates, the categories include a number of overlapping skill demands, including problem-solving, compliance, data analysis, and attention to detail. Specialized technical skills such as machine operation, sterilization, and understanding blueprints are emphasized in Bioscience Manufacturing, while research plan design, specimen handling, and scientific community participation are important for Core Laboratory and Discovery jobs. See Table 11 and Table 12 for more information on the top 10 occupations under each category in the job-posting analysis.

*Figure 5: Top In-Demand Skills by Job Category*




Job postings revealed that for entry-level positions, Bioscience Manufacturing roles and Core Laboratory and Discovery roles have distinct educational requirements (Table 10). While more accessible, roles in the Bioscience Manufacturing category (e.g., production workers, electrical and electronic equipment assemblers, machinists) still demand a range of soft and technical skills (see Figure 5) and may require prior work experience or on-the-job training.

Core Laboratory and Discovery jobs (e.g., natural science managers, medical scientists, medical and clinical laboratory technicians) tend to require more education, but a substantial share of roles are open to those with less than a bachelor's degree.

*Table 10: Degree Requirements for Key Focus Areas, from Job Postings*

| Category | No Degree Required | High School Diploma | Associate Degree | Bachelor's Degree |
|---|---|---|---|---|
| Bioscience Manufacturing | 34% | 61% | 2% | 2% |
| Core Laboratory and Discovery | 5% | 17% | 10% | 47% |

Job postings confirm that math, computer, and data skills have become increasingly expected for Bioscience Manufacturing roles, even where those roles do not require education beyond high school, underscoring the importance of dialogue between K-12 districts, career and technical education districts (CTEDs), and state agencies that set curricular requirements—and the employers that will be hiring their graduates. While many of these entities are already working well together, they must redouble their efforts to ensure that, as advanced robotics and applications of AI further transform what it means to work in domains like manufacturing, students complete high school ready for jobs of the present and able to adapt for what will be a wholly different future.

Although K-12 education outcomes and alignment with bioscience-sector skill requirements need to improve, Arizona's postsecondary educational alignment with current roles in the biosciences appears quite strong. Complementary to the job postings analysis, a curriculum mapping of 22 postsecondary bioscience programs throughout the state was performed. (More information about the programs mapped can be found in Table 15.) This exercise revealed strong overall alignment with industry's top in-demand skills, such as documentation laboratory testing, specimen handling, and computer skills. However, two key skills across both the Bioscience Manufacturing and Core Laboratory and Discovery job categories—regulatory compliance and quality assurance/quality control (QA/QC)—are missing from most of Arizona's mapped bioscience programs. Bioscience employers, industry organizations, and education institutions should seek opportunities to improve education for regulatory compliance and QA/QC, as these skills are critical to supporting the commercialization of bioscience innovations. And it must be noted, as above, that the bioscience roles of today will radically change in the coming decade. Postsecondary institutions must approach curricular review with a bias for flexibility and responsiveness to the injection of AI into the bioscience sector.

*Table 11: Top 10 Occupations for Core Laboratory and Discovery Job Postings from NLx Analysis*

| O*Net Categories | Count |
|---|---|
| Natural Science Managers | 2,920 |
| Medical Scientists, except Epidemiologists | 2,536 |
| Medical and Clinical Laboratory Technicians | 1,899 |
| Medical and Clinical Laboratory Technologists | 894 |
| Health Specialties Teachers, Postsecondary | 639 |
| Biological Technicians | 501 |
| Medical and Health Services Managers | 416 |

| O*Net Categories | Count |
|---|---|
| Clinical Data Managers | 223 |
| Statisticians | 179 |
| Cardiovascular Technologists and Technicians | 178 |

*Table 12: Top 10 Occupations for Bioscience Manufacturing Job Postings from NLx Analysis*

| O*Net Categories | Count |
|---|---|
| Production Workers, All Other | 459 |
| Production Laborers | 321 |
| Electrical and Electronic Equipment Assemblers | 265 |
| Production Inspectors, Testers, Graders, Sorters, Samplers, Weighers | 242 |
| Assemblers and Fabricators, All Other | 189 |
| Packaging and Filling Machine Operators and Tenders | 168 |
| Machinists | 126 |
| Team Assemblers | 116 |
| Welders, Cutters, Solderers, and Brazers | 87 |
| Numerical Control Machine Tool Operators and Tenders, Metal and Plastic | 72 |

*Table 13: Arizona Workforce Development Programs*

| Program Name | Program Type | Participant Type | Subject/ Field | Lead Organization | Geography |
|---|---|---|---|---|---|
| Future48 Workforce Accelerators | Academic Programs | Community college | Advanced Manufacturing | ACA | Statewide |
| Talent Ready AZ | Coordination | Workforce agencies | Various | Governor's Office | Statewide |
| Flinn Scholars | Scholarship | High school | Agnostic | Flinn Foundation | Statewide |
| TGen Bioscience Leadership Academy | Experiential Learning | High school | Bioscience | TGen | Statewide |
| CommunityShare | Educational Outreach, Experiential Learning | K-12 | STEM | Flagstaff STEM City | Northern Arizona |
| Working Groups | Networking, Information Sharing | Various, STEM-engaged individuals | STEM | SciTech Institute | Statewide |
| Science for All | Educational Outreach | K-12 | STEM | SciTech Institute | Statewide |
| Chief Science Officers | Ambassadorship Program | Grades 6-12 | STEM | SciTech Institute | Statewide |
| Cultural And Academic Research Experience (CARE) | Experiential Learning | High school | Science, technology, engineering, math, and medical | NAU | Southwest Arizona |
| BIO5 Institute's KEYS Internship | Experiential Learning | High school | Bioscience | U of A | Statewide |
| Student Industry Networking Event | Industry Engagement | University | Bioscience | U of A BIO5 Institute/BIOSA | U of A students |

| Program Name | Program Type | Participant Type | Subject/ Field | Lead Organization | Geography |
|---|---|---|---|---|---|
| Devils Invent | Experiential Learning | University | Agnostic | ASU | ASU Students |
| Hack Arizona | Experiential Learning | University | Agnostic | U of A | U of A students |
| Mayo Clinic Hack for Health Innovation | Experiential Learning | University | Bioscience | Mayo Clinic | Statewide |
| Careers in STEAM Camp | STEM Exposure | K-12 | Agnostic | Center for Entrepreneurial Innovation | Statewide |
| Talent Internship Program | Experiential Learning | High school and university | Bioscience | AZAdvances/AZBio | Statewide |
| Bioscience Summer Camp | STEM Exposure | High school | Bioscience | Center for Entrepreneurial Innovation | Statewide |
| AZBioPEERS/ AZBio PEERS Mentoring Program | Professional Mentorship | Early-stage life science ventures | Bioscience | AZBio | Statewide |
| Career Center | Job Board Platform | Life science job seekers | Bioscience | AZBio | Statewide |
| Student Discovery Zone | Industry Engagement | High school and university | Bioscience | AZBio | Statewide |
| Bioscience High School | High School Curriculum | High school | Bioscience | Bioscience High School | Phoenix |
| Center for Research in Engineering Science and Technology (CREST) | High School Curriculum | High school | Bioscience, engineering, and computer science | Paradise Valley High School, CREST of NSF | Phoenix |
| Women in Science and Engineering (WISE) | Internships, Educational Outreach, Scholarship, Research | K-12 and university | Science and engineering | WISE | Tucson/Phoenix focus, statewide |
| Arizona Technology Council | Professional Networking, Engagement Events | Technology companies | Technology | Arizona Technology Council | Statewide |
| Biomedical Research & Education Foundation of Southern Arizona | Veteran Healthcare Research, Talent Development | Veterans, healthcare professionals | Bioscience | Biomedical Research & Education Foundation of Southern Arizona | Southern Arizona |
| Promising Student Teacher Program, Rodel Exemplary Teacher/Principal Initiatives | Teacher Placement Program and Award System | K-12 teachers/education staff | Math | Rodel Foundation of Arizona | Statewide, low-income districts |
| GCU Learning Lounge | No-Cost Tutoring | K-12 | Various | Grand Canyon University | Phoenix |
| The Weil Foundation | Grant Awards for Educational and WFD Programs | Nonprofits | Integrative medicine | The Weil Foundation | National |
| Arizona College Access Network (AzCAN) | College Attainment Network | Nonprofits, parents, high school educators | Various | Education Forward Arizona | Statewide |
| Phoenix and Flinn Foundation Summer Research Internship | Internship, Experiential Learning | Undergraduate students | Bioscience | University of Arizona College of Medicine, Phoenix and Flinn Foundation | Phoenix |
| Saturday Scrubs/ Summer Scrubs | Lectures, Career Exploration | High school | Medicine | University of Arizona College of Medicine | Phoenix |

| Program Name | Program Type | Participant Type | Subject/ Field | Lead Organization | Geography |
|---|---|---|---|---|---|
| Connect 2 Mentors | Mentorship, Career Exploration | High school | Medicine | University of Arizona College of Medicine | Phoenix |
| The Irene H. Bailey Cardiology Academy | Mentorship, Career Exploration | High school | Medicine | University of Arizona College of Medicine | Phoenix |
| Pre-Medical Academy/ Pre-Med Summer School | Career Preparation and Medical School Application Support | Undergraduate and graduate students | Medicine | University of Arizona College of Medicine | Phoenix |
| Medtronic Internships | Early Career Programs, Internships | Undergraduate and graduate students | Bioscience, engineering | Medtronic | Tempe |
| Helios Scholars at TGen | Summer Internship, Mentorship | Undergraduate and graduate students | Biomedical research | TGen | Statewide |
| Academic Year Internships with TGen | Internships, Laboratory Experience | University students | Biomedical research | TGen | Statewide |
| Connect2STEAM | Educational Outreach | K-12 | STEAM | University of Arizona Health Sciences, Cox Communications | Statewide |
| Arizona Bioscience Week | Educational Outreach | K-12 | Bioscience | Maricopa County School Superintendent Office, Flinn Foundation | Statewide |
| The Ivy Neurological Sciences Internship Program | Laboratory Experience, Mentorship | High school and university | Bioscience, Neurological Sciences | TGen | Statewide |
| Phoenix Youth Rise Program | Career Placement | Youth | Various | City of Phoenix, Arizona@Work | Statewide |
| BIOTECH Project | Educational Outreach | High school | Biotechnology, molecular genetics | U of A Department of Molecular and Cellular Biology | Statewide |
| Venture Cafe | Networking, Community, Business Development Programming | Various businesses | Various | Center for Entrepreneurial Innovation | Statewide |
| ElevateEdAZ | Experiential Learning, Career Preparation, Mentorship | High school | Various | Greater Phoenix Chamber Foundation | Phoenix |
| Career Connected Pathways | Educational Outreach | High school | STEM | Center for the Future of Arizona | Statewide |
| Pima Joint Technical Education District | High School Curriculum | High school | Career and technical education | Pima Joint Technical Education District | Pima County |

## R&D Expenditures Data

SRI obtained data on research and development expenditures from the National Science Foundation's (NSF's) National Center for Science and Engineering Statistics (NCSES). Data on R&D expenditures within U.S. institutions of higher education comes from NCSES's Higher Education Research and Development (HERD) survey. Similarly, SRI acquired data on R&D activity performed and funded by departments and agencies of state governments from NCSES's Survey of State Government Research and Development.

Notably, direct appropriations for R&D from state legislatures to higher education institutions are captured in HERD data but not by the Survey of State Government Research and Development.

## Emerging Innovation

### *Patents*

The patent indicators for the U.S. market in this report were produced using Elsevier's implementation of the PatentsView database, a platform derived from the U.S. Patent and Trademark Office (USPTO) bulk data files. The database provides details on patents such as full titles and abstracts, the country and state (when available) of the inventors and applicants, and the names of the inventors and applicants. Patents have been matched to bioscience and subcategories based on a mapping designed by TEConomy in a 2022 report.[70] The main objective of using this classification is to align with existing findings and ensure continuity in the definition of bioscience within the U.S. patent ecosystem. The subcategories and the corresponding Cooperative Patent Classification (CPC) classes are listed in Table 14.

*Table 14: Bioscience-Related CPC Patent Codes*

| Bioscience Patent Group | CPC Patent Classes |
|---|---|
| Agriculture Bioscience | A01H, A01N, CO5B, CO5C, C05D:C05F, C05G |
| Agriculture Bioscience – Plants | A01H, A01N |
| Agriculture Bioscience – Chemicals | A01N, C05B, C05C, C05D:C05F, C05G |
| Biochemistry | C07D, CO7H, C07J, CO7K |
| Bioinformatics and Health IT | G16B, G16H |
| Biological Sampling and Analysis | GO1N24/00, GO1N25/00, GO1N/26, GO1N28/00, GO1N33/00 |
| Pharmaceuticals | A61K, A61P |
| Medical & Surgical Devices | A61B, A61C, A61D, A61F, A61G, A61H, A61J, A61L, A61M, A61N, G0617/0012 |
| Microbiology and Genetics | C12M, C12N, C12P, C12Q |
| Microbiology and Genetics – Microbiology and Enzymes | C12M, C12P, C12Q, C12N1/00, C12N3/00, C12N5/00, C12N5/00, C12N7/00, C12N9/00, C12N11/00, C12N13/00, C12N3/00 |
| Microbiology and Genetics – Genetics | C12N15/00 |

### *Publications*

The publications data are limited to Scopus-indexed articles, reviews, and conference papers. These publication types are integral to the research cycle: Conference papers often represent the initial presentation of research ideas, which may then evolve into original research articles and, ultimately, comprehensive reviews that summarize and collate findings.

Scopus, produced by Elsevier, indexes approximately 55 million peer-reviewed publications published since 2009 (based on more than 100 million records going back to the mid-1800s) in thousands of journals and conference proceedings. Science-Metrix categorizes all journals and conference proceedings indexed in Scopus into five broad domains, 20 fields, and 174 subfields of science.

Each article published in broad-scope journals (e.g., *Science*, *Nature*, *PLOS One*) is reclassified by using a machine learning algorithm designed by Science-Metrix that assigns the article to the appropriate domain, field, and subfield using metadata such as keywords, abstract, references, and authors' affiliations. The classification is mutually exclusive, meaning that all articles are categorized in a single domain, field, and subfield. Scopus lists all the publications' authors and their affiliations, as well as their references used to measure the scientific impact of publications based on citation counts.

In producing bibliometric data, only documents that were peer-reviewed prior to being accepted for publication are retained. The peer-review process ensures that research is of good quality and constitutes an original contribution to scientific knowledge. Moreover, bibliometric studies are based on a selection of document types that include references to and citations by other academic documents.

Citation metrics referenced in the text include the average of relative citations (ARC), which is the average of the relative citation scores of all the articles published by an entity. The ARC is normalized to 1, meaning that an ARC above 1 indicates that the entity's articles have higher-than-average impact, an ARC below 1 indicates that the entity's articles have lower-than-average impact, and an ARC near 1 indicates that the publications have near-average impact. Another publication-quality indicator is the high-ranked citations percentage (HCP), which is the percentage of publications that fall within the top 10% of most cited papers in a field, offering a metric for an entity's rate of producing influential research publications.

### *Trademarks*

Elsevier mapped trademarks from the USPTO trademark database related to bioscience using the international classification of goods and services, also known as the Nice classification. Nice classification is a system used to register trademarks across categories of goods and services. It was adopted in 1957 following the Nice Agreement and comprises 45 classes. Classes 1 to 34 cover goods and 35 to 45 cover services. The system operates in almost 90 countries as of 2023, with an additional 65 non-member countries using the classification.

## Curriculum Mapping

To assess how well Arizona's postsecondary programs prepare students for bioscience roles, SRI conducted a curriculum-mapping exercise using a sample of associate, bachelor's, master's, and certificate programs. The analysis mapped these programs to the top skills identified in the NLx job postings analysis. The exercise intentionally excluded doctoral programs because the NLx job postings analysis showed that jobs requiring doctorates had fewer specific skill requirements, relying instead on the attainment of the advanced degree itself.

Both groups shared a core set of skills including documentation, compliance, computer skills, problem-solving, communication, QA/QC, and data analysis. Core Laboratory and Discovery roles emphasized additional skills such as scientific community participation, collaboration, laboratory testing, specimen handling, and conducting or supporting clinical studies, while Bioscience Manufacturing roles uniquely emphasized assembly, reading blueprints, safety, use of hand and power tools, and computer numerical control (CNC) programming. Overall, Arizona's programs cover many of the industry-demanded skills, particularly laboratory testing, problem-solving, and communication.

However, compliance, scientific community/clinical trial participation, and QA/QC emerged as gaps where skills were much less frequently required or comprehensively taught in sampled programs. Each program was assessed on whether it required, offered, or did not cover each skill, using a standardized 3-point scale (2 = required, 1 = offered but not required, 0 = not offered).

*Table 15: Sample of Arizona Programs Included in Curriculum-Mapping Exercise*

| Category | Institution | Program Type | Program Name |
|---|---|---|---|
| Core Laboratory and Discovery | U of A | Master's | Graduate Program in Applied Biosciences |
| Core Laboratory and Discovery | U of A | Bachelor's | Applied Biotechnology |
| Core Laboratory and Discovery | Pima CC | Associate | Medical Lab Technician |
| Core Laboratory and Discovery | Maricopa CC | Associate | Biotechnology and Molecular Biosciences |
| Core Laboratory and Discovery | U of A | Bachelor's | Pharmaceutical Sciences (BSPS) |
| Core Laboratory and Discovery | ASU | Bachelor's | Applied Science (Medical Laboratory Science) |
| Core Laboratory and Discovery | ASU | Bachelor's | Biotechnology and Bioenterprise |
| Core Laboratory and Discovery | Maricopa CC | Associate | Medical Laboratory Science |
| Core Laboratory and Discovery | Maricopa CC | Certificate | Certificate of Completion (CCL) in Medical Laboratory Science |
| Core Laboratory and Discovery | Pima CC | Certificate | Bioscience Lab Technician Certificate |
| Core Laboratory and Discovery | U of A | Graduate Certificate | Biomedical Sciences Graduate Certificate |
| Core Laboratory and Discovery | NAU | Bachelor's | Biomedical Science |
| Core Laboratory and Discovery | NAU | Bachelor's | Microbiology |
| Bioscience Manufacturing | ASU | Bachelor's | Manufacturing Engineering |
| Bioscience Manufacturing | Western Arizona | Associate | Manufacturing |
| Bioscience Manufacturing | U of A | Bachelor's | Biosystems Engineering |
| Bioscience Manufacturing | ASU | Bachelor's | Biomedical Engineering |
| Bioscience Manufacturing | U of A | Bachelor's | Biomedical Engineering |
| Bioscience Manufacturing | Maricopa CC | Associate | Manufacturing Production Technology |
| Bioscience Manufacturing | Maricopa CC | Associate | Industrial Design Technology |
| Bioscience Manufacturing | GCU | Bachelor's | Biomedical Engineering |
| Bioscience Manufacturing | NAU | Bachelor's | Mechanical Engineering |

## Benchmark Analysis

To identify benchmarks, SRI conducted an initial analysis of all 50 states and three metropolitan statistical areas (MSAs) in California: Los Angeles, San Diego, and San Francisco. The metrics SRI used in the initial screening and the sources of those metrics are listed in Table 16.

*Table 16: Benchmarking Initial Screening Criteria*

| Metric | Screening Criteria | Years | Source |
|---|---|---|---|
| Population | A region was included if it ranked in the top 25 states by population[71] | 2023 | Census Bureau |
| Large urban area | Presence of an anchor MSA with at least 1 million residents | 2023 | Census Bureau |
| Existence of state-affiliated bioscience industry group | A region was included if there was a state-affiliated bioscience industry group | 2024 | Biotechnology Innovation Organization Member Directory |
| Existence of an anchor research hospital | Y/N | 2024 | SCImago Institutions Rankings |
| Existence of an R1 academic institution | Y/N | 2024 | Carnegie Classification of Institutions of Higher Education |
| Prominence of multiple demographic population segments | A region was included if there was a high concentration of rural, tribal, or Latinx population segments | 2023 | Census Bureau |
| Bioscience GRP | A region was included if the region's bioscience GRP was $15 billion or greater | 2023 | Bureau of Economic Analysis; Bureau of Labor Statistics |
| Bioscience jobs | A region was included if the region had 10,000 bioscience jobs | 2023 | Bureau of Economic Analysis; Bureau of Labor Statistics |
| Bioscience job growth rate | Comparability to Arizona | 2019–2023 | Bureau of Economic Analysis; Bureau of Labor Statistics |
| Number of bioscience graduates | Comparability to Arizona | 2023 | National Center for Education Statistics |
| Number of bioscience firms | Comparability to Arizona | 2024 | Biotechnology Innovation Organization; Bureau of Labor Statistics |

These criteria narrowed the list of potential benchmark states and regions down to the following 11 states and regions:

- Colorado
- Florida
- Georgia
- Massachusetts
- New Jersey
- North Carolina
- San Diego MSA
- Texas
- Utah
- Washington
- Wisconsin

SRI collaborated with the Flinn Foundation to narrow the list of benchmarks to five benchmark states and regions, three comparable and two aspirational:

- Comparable
  - Colorado
  - Utah
  - Washington
- Aspirational
  - North Carolina
  - San Diego

For these five benchmark states and regions, SRI collected data on the following measures to conduct a deeper analysis.

*Table 17: Benchmarking Secondary Metrics*

| Metric | Years | Source |
|---|---|---|
| Percent of population with a bachelor's degree or higher | 2023 | National Center for Education Statistics |
| Bioscience industry concentration | 2023 | Lightcast's proprietary employment data |
| Annual bioscience job openings | 2023 | Bureau of Labor Statistics |
| Annual bioscience hires | 2023 | Bureau of Labor Statistics |
| Number of patents granted | 2019–2023 | Elsevier |
| Number of bioscience startups | 2019–2023 | Pitchbook |
| Venture capital invested | 2019–2023 | PitchBook, Biotechnology Innovation Organization |
| State Business Tax Climate Index | 2024 | Tax Foundation |
| Cost of living index | 2023 | C2ER: The Council for Community and Economic Research |
| Number of academic institutions with bioscience program completions | 2023 | National Center for Education Statistics |
| National Institutes of Health funding | FY23 | Biotechnology Innovation Organization |
| Academic R&D funding | FY22 | Biotechnology Innovation Organization |

SRI also analyzed the BIO State Data Dataset provided by AZBio.

*Table 18: BIO Data Benchmarking Summary Table Values*

| Region | Econ. Impact $B | Jobs | Firms | R&D Funding $K (FY22) | VC Funding $M (2019–2023) | NIH Funding $K (FY23) |
|---|---|---|---|---|---|---|
| Arizona | $43.64 | 40,399 | 3,652 | $683,298 | $1,299.28 | $366,496 |
| Colorado | $52.39 | 40,088 | 4,062 | $985,182 | $6,526.09 | $556,769 |
| North Carolina | $132.58 | 103,107 | 6,687 | $2,890,149 | $5,666.72 | $2,301,707 |
| San Diego* | N/A | 76,541 | 2,295 | $1,022,092 | $18,456.96 | $1,124,915 |
| Utah | $38.50 | 40,725 | 2,067 | $462,367 | $2,872.50 | $294,499 |
| Washington | $73.57 | 47,898 | 3,533 | $1,296,626 | $7,785.08 | $1,291,506 |

**Source**: Biotechnology Innovation Organization State Comparison Dataset, 2024. Venture capital (VC) funding totals were updated in July 2025 from PitchBook using BIO's methodology.
* SRI estimated values for San Diego using BIO's methodology.

*Table 19: Bioscience-Related Venture Capital Funding by Deal Type in Millions, 2019–2023*

| Region | Accelerator & Incubator | Angel | Early-Stage | Later-Stage | Seed | Other* |
|---|---|---|---|---|---|---|
| Arizona | $6.21 | $14.89 | $244.76 | $735.81 | $135.46 | $162.15 |
| Colorado | $7.60 | $22.52 | $1,827.34 | $4,044.41 | $337.13 | $287.09 |
| North Carolina | $10.78 | $37.72 | $1,517.23 | $3,108.69 | $376.80 | $615.50 |
| San Diego | $8.60 | $30.52 | $7,182.72 | $8,658.33 | $812.42 | $1,764.37 |
| Utah | $3.09 | $9.39 | $661.83 | $1,851.09 | $210.04 | $137.06 |
| Washington | $6.41 | $18.46 | $3,491.23 | $2,920.97 | $455.74 | $892.27 |

**Source**: Pitchbook, 2025.
* Other includes Capitalization, Equity Crowdfunding, Grant, and Product Crowdfunding Deals.

*Table 20: Bioscience-Related Venture Capital Funding by Deal Type, Percentage of Total, 2019–2023*

| Region | Accelerator & Incubator | Angel | Early-Stage | Later-Stage | Seed | Other* |
|---|---|---|---|---|---|---|
| Arizona | 0.48% | 1.15% | 18.84% | 56.63% | 10.43% | 12.48% |
| Colorado | 0.12% | 0.35% | 28.00% | 61.97% | 5.17% | 4.40% |
| North Carolina | 0.19% | 0.67% | 26.77% | 54.86% | 6.65% | 10.86% |
| San Diego | 0.05% | 0.17% | 38.92% | 46.91% | 4.40% | 9.56% |
| Utah | 0.11% | 0.33% | 23.04% | 64.44% | 7.31% | 4.77% |
| Washington | 0.08% | 0.24% | 44.85% | 37.52% | 5.85% | 11.46% |

**Source**: Pitchbook, 2025.
* Other includes Capitalization, Equity Crowdfunding, Grant, and Product Crowdfunding Deals.

SRI conducted desk research and engaged bioscience leaders from identified benchmarks to gain insights on the top programs, initiatives, collaborative models, and other regional advantages that have enabled bioscience development in those places. Bioscience occupational make-up in Arizona versus other benchmark regions was also compared.

*Table 21: Number of Jobs for Key Bioscience Occupations, 2024*

| Occupation | Arizona | Colorado | North Carolina | San Diego | Utah | Washington |
|---|---|---|---|---|---|---|
| Medical and Health Services Managers | 11,792 | 9,237 | 16,604 | 5,792 | 5,215 | 8,913 |
| Natural Sciences Managers | 946 | 1,551 | 6,259 | 2,783 | 1,240 | 2,765 |
| Software Quality Assurance Analysts and Testers | 3,475 | 6,327 | 8,288 | 2,194 | 3,032 | 10,643 |
| Bioengineers and Biomedical Engineers | 418 | 698 | 826 | 475 | 744 | 633 |
| Computer Hardware Engineers | 2,140 | 2,950 | 1,681 | 4,144 | 927 | 1,002 |
| Biochemists and Biophysicists | 182 | 728 | 1,041 | 1,399 | 360 | 475 |
| Microbiologists | 211 | 460 | 953 | 582 | 174 | 470 |
| Biological Scientists, All Other | 725 | 1,028 | 3,964 | 3,455 | 564 | 1,877 |
| Epidemiologists | 358 | 583 | 305 | 132 | 216 | 1,028 |

| Occupation | Arizona | Colorado | North Carolina | San Diego | Utah | Washington |
|---|---|---|---|---|---|---|
| Medical Scientists, except Epidemiologists | 1,764 | 2,809 | 3,952 | 4,051 | 1,809 | 7,277 |
| Life Scientists, All Other | 189 | 119 | 781 | 169 | 77 | 264 |
| Chemists | 945 | 1,988 | 5,039 | 1,556 | 888 | 1,790 |
| Biological Technicians | 1,668 | 2,884 | 3,126 | 2,646 | 733 | 3,704 |
| Clinical Laboratory Technologists and Technicians | 8,796 | 5,628 | 13,718 | 2,975 | 6,271 | 8,336 |
| Medical Dosimetrists | 92 | 83 | 159 | 100 | 27 | 78 |
| Health Technologists and Technicians, All Other | 2,908 | 2,623 | 7,074 | 1,675 | 1,407 | 4,713 |
| Health Information Technologists and Medical Registrars | 684 | 441 | 1,159 | 428 | 405 | 1,363 |
| Healthcare Practitioners and Technical Workers, All Other | 863 | 438 | 900 | 501 | 318 | 859 |
| Surgical Technologists | 2,219 | 2,361 | 3,730 | 964 | 1,044 | 2,378 |

*Table 22: COL-Adjusted Median Annual Earnings for Key Bioscience Occupations, 2024*

| Occupation | Arizona | Colorado | North Carolina | San Diego | Utah | Washington |
|---|---|---|---|---|---|---|
| Medical and Health Services Managers | $105,963.77 | $111,953.70 | $110,067.49 | $95,402.19 | $97,273.11 | $116,843.62 |
| Natural Sciences Managers | $120,351.56 | $127,549.64 | $172,168.07 | $139,387.77 | $103,036.29 | $149,597.22 |
| Software Quality Assurance Analysts and Testers | $95,271.97 | $104,219.43 | $104,275.17 | $77,811.87 | $78,378.34 | $106,448.37 |
| Bioengineers and Biomedical Engineers | $112,693.75 | $96,480.58 | $105,551.26 | $76,666.20 | $82,176.06 | $91,339.13 |
| Computer Hardware Engineers | $129,163.75 | $122,721.73 | $136,906.60 | $118,406.79 | $93,991.82 | $134,884.84 |
| Biochemists and Biophysicists | $65,994.48 | $93,424.79 | $103,435.59 | $84,258.59 | $64,245.52 | $80,905.88 |
| Microbiologists | $85,497.82 | $60,677.39 | $90,091.46 | $71,315.31 | $48,881.05 | $58,103.16 |
| Biological Scientists, All Other | $84,596.98 | $82,282.39 | $99,761.45 | $75,005.74 | $85,194.96 | $80,165.06 |
| Epidemiologists | $64,444.54 | $60,211.54 | $80,982.87 | $57,928.66 | $63,284.40 | $83,011.79 |

| Occupation | Arizona | Colorado | North Carolina | San Diego | Utah | Washington |
|---|---|---|---|---|---|---|
| Medical Scientists, except Epidemiologists | $95,772.97 | $81,559.26 | $105,551.88 | $86,334.52 | $73,891.06 | $89,476.56 |
| Life Scientists, All Other | $97,965.22 | $56,625.56 | $107,868.52 | $78,963.58 | $97,014.73 | $79,110.08 |
| Chemists | $68,971.46 | $83,674.03 | $83,468.76 | $73,933.81 | $73,801.50 | $73,041.68 |
| Biological Technicians | $45,357.81 | $47,510.79 | $51,082.35 | $41,585.38 | $45,073.36 | $44,692.87 |
| Clinical Laboratory Technologists and Technicians | $58,564.62 | $58,586.19 | $56,908.20 | $44,993.38 | $43,993.96 | $57,450.00 |
| Medical Dosimetrists | $134,618.82 | $140,934.44 | $142,717.26 | $121,786.67 | $119,284.36 | $141,832.40 |
| Health Technologists and Technicians, All Other | $50,556.69 | $45,833.25 | $44,358.88 | $37,630.01 | $42,683.20 | $45,717.84 |
| Health Information Technologists and Medical Registrars | $46,087.48 | $57,097.74 | $46,078.69 | $65,234.80 | $46,174.95 | $44,179.40 |
| Healthcare Practitioners and Technical Workers, All Other | $59,470.18 | $60,926.04 | $60,856.30 | $48,609.48 | $54,934.45 | $58,131.19 |
| Surgical Technologists | $65,955 | $58,818 | $61,679 | $57,927 | $61,175 | $63,883 |

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[6] Graduate retention data comes from AAMC (medical residency graduates) and Lightcast Job Profiles (engineering and biological sciences graduates). According to AAMC, Arizona has retained 56.8% of

physicians who completed residency training in Arizona between 2014 and 2023, which trails all southwestern and western U.S. states except New Mexico and Utah, and is within 5% of Nevada, Washington, Colorado, and Oregon. According to Lightcast's Job Profiles, Arizona has retained 51% of engineering graduates between 2015 and 2024, which trails all southwestern and western U.S. states, but is within 5% of New Mexico and Utah. Arizona retained 55% of biological science graduates between 2015 and 2024, which trails all southwestern and western U.S. states except Oregon and New Mexico, and is within 5% of Utah.

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