



ARIZONA'S
BIOSCIENCE
ROADMAP

2016 PROGRESS OF THE Biosciences in Arizona



ADVANCING THE BIOSCIENCES AND IMPROVING HEALTH OUTCOMES



An Economic Engine Continues to Shape Arizona's Future

A dynamic hub of bioscience enterprises and innovation is within sight. Sustained investment is essential.

During the Great Recession, as Arizona's unemployment rate hit 11 percent, one economic sector showed the path to the future by steadily adding high-paying jobs: health care and the biosciences. Fast-forward, and 2016 found Arizona in better shape. The biosciences saw good news

at several junctures during the year, including an IPO in Flagstaff, national attention for startups, and big progress by cornerstone institutions.

The achievements Arizona enjoyed in 2016 can't happen without cultivating our talent base. Such achievements can't

A special funding stream for university research is approaching its sunset date. **Renewing the Technology Research Initiative Fund, or TRIF, is vitally important to Arizona.**

happen without private-sector leaders investing for the long term. And such achievements can't happen without public-sector leaders making parallel commitments.

Arizona has a public-investment track record. In 2000, the Arizona Legislature referred to the ballot Proposition 301, a 20-year commitment of sales-tax funds to K-12 education and university research. The segment for universities, the Technology Research Initiative Fund, or TRIF, will provide, by its expiration, \$1.25 billion for life-saving discoveries, recruitment of premier researchers, and creation of new companies.

Discussion about renewing Prop. 301 to support K-12 has begun. TRIF—rocket fuel for our economic engine—must be part of the conversation, too.

ON THE AGENDA

PRIORITIES FOR THE NEXT 12 MONTHS

1

Spotlight the impact of the Technology Research Initiative Fund (TRIF), a key part of Proposition 301.

2

Expand mechanisms and programs to stimulate risk-capital investment in entrepreneurs and their bioscience startups.

3

Secure commitment to fund research-and-development facilities at Arizona's public universities.

» Making an Impact

JOB

+49%

From 2002 to 2014, Arizona bioscience jobs grew at a breakneck pace.

WAGES

33% higher

In 2014, bioscience workers' annual wages were \$15,000 above Arizona's private-sector average.

FIRMS

1,411

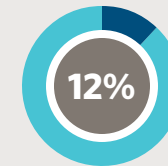
The 2014 count of Arizona bioscience firms includes hundreds of small businesses.

NIH GRANTS

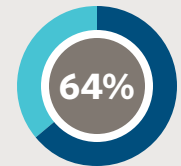
\$163 million

The gold-standard measure of Arizona research funding rose in 2016 by 8%.

→ HEALTH AND BIO AT WORK



of U.S. jobs are in health care, the **fastest-growing job sector—and soon the largest.**



of bioscience jobs nationally in 2015 required a **bachelor's degree or more.**

R&D

\$451 million

Data from 2014 shows the economic clout of Arizona universities' research-and-development activity.

VENTURE CAPITAL

\$82 million

VC funds for Arizona bioscience firms grew for a third straight year in 2015.

TECH TRANSFER

+24%

Data from 2014-15 shows a rise in Arizona university spinouts of bioscience research.

ARIZONA'S BIOSCIENCE ROADMAP

Arizona's Bioscience Roadmap is a plan through 2025 to make Arizona a leader in select bioscience fields.

A Steering Committee of state leaders in science, business, academia, and government guides the Roadmap.

Roadmap metrics are tracked and reported by TEconomy Partners, commissioned by the Flinn Foundation.

Cited data are most recent available, based on reporting from TEconomy Partners and U.S. Department of Labor.

→ 2016 HIGHLIGHTS

» PROMINENT LONG-TERM INVESTMENTS

University of Arizona wins \$43M grant for precision-medicine research: The University of Arizona receives a \$43.3 million, five-year award from the National Institutes of Health as part of the Precision Medicine Initiative. UA Health Sciences-Banner Health is one of four academic medical centers selected to recruit more than 1 million participants for the All of Us Research Program to identify new ways to treat and prevent disease.

TGen becomes affiliate of California-based City of Hope, will expand in Phoenix: Translational Genomics Research Institute will remain in Arizona and continue its genomics-based research on cancer, Alzheimer's, and more, while planning to increase its workforce, after agreeing on a partnership with the City of Hope cancer research and treatment center.

Mayo Clinic, Arizona State University announce opening of new medical school: The Mayo Clinic School of Medicine will welcome its first class of 50 students in summer 2017 to its Scottsdale campus. The partnership between Arizona State University and Mayo will enable students to earn medical degrees and a certificate in the science of health-care delivery, and the option to complete a master's degree.

Tempe unveils major biotech campus plans along Tempe Town Lake: A five-building, one million-square-foot biotechnology campus is planned along 18 city-owned acres on the west end of Tempe Town Lake. A developer is selected by the city of Tempe to create a campus for established and startup firms, with incubator and accelerator space, that would employ about 4,000 people.

» ENHANCE HOSPITAL RESEARCH, CLINICAL CARE

Banner building new hospital towers: Banner Health continues construction of patient towers on the campuses of Banner-University Medical Center Phoenix and Banner-University Medical Center Tucson, projects together totaling 1.37 million square feet at a cost of \$820 million.

Phoenix Children's Hospital joins cancer-research pediatric consortium, breaks ground on cancer center: The hospital is one of 10 organizations participating in billionaire entrepreneur Patrick Soon-Shiong's Cancer Breakthroughs 2020 Pediatrics Consortium, which will test and rapidly use experimental therapy combinations on hard-to-treat pediatric cancers. Phoenix Children's Hospital also starts construction on a \$15 million cancer center.

HonorHealth implants first fully dissolving heart stent in U.S.: The stent, a small polymer tube that opens clogged arteries and helps restore blood flow to the heart—and dissolves in two to three years—was implanted at HonorHealth Scottsdale Shea Medical Center.

Mayo Clinic opens proton-beam therapy program: Arizona's first proton-beam therapy program—which uses precision targeting to kill tumor cells with positively charged hydrogen atoms—opens on Mayo Clinic's Phoenix campus.

Barrow Neurological Institute uses supercomputer to study ALS: Barrow researchers use the IBM Watson supercomputer to identify genes with previously unknown links to ALS, also known as Lou Gehrig's disease, with hopes of finding new areas of study for the fatal disease.

Flagstaff Medical Center performs successful microbiome transplants: Working in concert with Northern Arizona University researchers, Flagstaff Medical Center's infectious-disease team successfully performs its first fecal-matter transplants to beat *Clostridium difficile* infection.

» PROMOTE ENTREPRENEURIAL CLIMATE

Bioscience company wins \$100,000 from Steve Case pitch competition: Scottsdale-based medical-device firm NeoLight wins a \$100,000 prize during AOL co-founder Steve Case's stop in Phoenix to promote entrepreneurship with his Rise of the Rest bus tour. NeoLight is one of three bioscience firms among eight pitch-contest finalists.

Arizona Bioscience Week welcomes global investors to Phoenix: Cavendish Global, a community that provides access and capital to health and life-science innovators, hosts a conference in Phoenix during Arizona Bioscience Week. The week also includes the White Hat Investors conference and annual AZBio Awards, featuring remarks from Gov. Doug Ducey.

BioAccel wins federal grant to benefit startups: BioAccel is the only Arizona organization to win a \$250,000 federal Seed Fund Support grant to provide early-stage funding for bioscience entrepreneurs.

Pitch competitions flourish around the state: The Arizona Commerce Authority's Innovation Challenge, Invest Southwest's Venture Madness, Arizona Collegiate Venture Competition, Startup Tucson's Idea Funding, and BioAccel's Solutions Challenge are among the live-pitch contests held in 2016 offering cash prizes and investment funds to early-stage bioscience firms.

PHX Startup Week attracts more than 4,000

entrepreneurs: The second annual PHX Startup Week features more than 120 seminars, chats, and speakers, including university presidents, for thousands of attending entrepreneurs.

Incubators, accelerators attract startups around the state: Avnet and ASU welcome the first bioscience company at their new accelerator, Avnet Innovation Lab. Meanwhile, the Northern Arizona Center for Entrepreneurship and Technology in Flagstaff welcomes its first tenants to the Flagstaff Business Accelerator, and Mesa's Launchpoint opens its new downtown location.

Five Roadmap Goals:

-  **1: Form a hub of bioscience entrepreneurs** and enterprises across Arizona
-  **2: Increase the ability of research-performing institutions to turn results into products, treatments**
-  **3: Make Arizona a bio-talent powerhouse**
-  **4: Promote Arizona's convergence of research, health care, and commercialization to economic partners** in neighboring states, Canada, and Mexico
-  **5: Sustain and enhance the state's "collaborative gene" reputation**

» BUILD CRITICAL MASS OF COMPANIES

Flagstaff's SenesTech receives EPA approval, goes public: Flagstaff-based SenesTech, developer of technology for managing animal populations by fertility control, has its initial public offering after receiving Environmental Protection Agency approval for its formula to limit rat populations.

HealthTell announces funding for new lab, test: Chandler's HealthTell, a diagnostics developer and spinout from ASU's Biodesign Institute, announces \$26 million in funding that will allow for a buildout of its planned lab and the ability to launch its first test to target autoimmune diseases.

Icagen buys Sanofi unit: Sanofi US's drug-discovery research center in Oro Valley is bought out by North Carolina-based Icagen, with plans for further growth.

Paradigm raises funds for study-supported cancer

sequencing test: Paradigm Diagnostics of Phoenix, a spinoff of International Genomics Consortium, has its PCDx cancer sequencing test supported in an independent study by Indiana University. The firm also secures financing to support the commercial expansion of the test that offers a more personalized approach to cancer treatment.

California manufacturer to open large Mesa plant:

Dexcom, a San Diego-based company that manufactures continuous glucose monitoring devices, will occupy a 216,000-square-foot facility in Mesa that could create up to 500 jobs.

McKesson breaks ground on regional headquarters:

McKesson Corp. begins building a new Arizona regional-

headquarters facility on Salt River Pima-Maricopa Indian Community land that will support 2,200 employees, up from the current 1,400 workers.

HSRx Biopharmaceutical attacks Zika virus, ASU develops test: The Tucson-based startup HSRx Biopharmaceutical has plans for human trials after reporting successful studies of its botanical-based drug candidate HSRx 431, which targets the Zika virus. Meanwhile, ASU researchers unveil a paper-based test that costs as little as \$1 per application to diagnose Zika infection.

» ADVANCE RESEARCH BASE

Construction taking place on university bioscience buildings: ASU breaks ground on its third Biodesign Institute building, a \$120 million, 188,000-square-foot facility that will house multiple research programs and the world's first compact X-ray laser, a drug-discovery and bioenergy research tool. Meanwhile, construction moves toward completion for UA's 10-story, \$136 million Biomedical Sciences Partnership Building on the Phoenix Biomedical Campus.

C-Path earns FDA support: The U.S. Food and Drug Administration awards Tucson-based Critical Path Institute three grants to develop data standards and a contract for further research on drug-induced kidney injury, sustaining FDA support for C-Path's efforts to advance translational research toward accelerating drug development and regulatory review.

UA researcher to lead \$27 million asthma-prevention study: The Tucson-based study funded by NIH seeks to assess a naturopathic medicine for asthma prevention in young children. In a separate \$11.4 million NIH study, UA is working to help predict which critically ill patients will develop lung disorders and how to remedy them.

TGen, HonorHealth team up for pancreatic cancer study: The organizations are leading two clinical trials at HonorHealth in Scottsdale to pair new drug combinations targeting pancreatic tumors, building on previous TGen-led studies that have led to the current treatments for patients with advanced pancreatic cancer.

TGen North, NAU develop test for MRSA infections, valley fever: TGen North and NAU Pathogen & Microbiome Institute researchers are designing a test to diagnose and trace antibiotic-resistant bacterial infection. The two teams also announce a new valley fever test that takes just one hour, and TGen North progresses on a Lyme disease diagnostic.

ASU to develop radiation-exposure test: ASU's Biodesign Institute enters a \$7 million phase of a project to produce a diagnostic test to measure individuals' absorbed radiation in the event of a radiological or nuclear event. ASU, partnering with Thermo Fisher Scientific and funded by the U.S. Biomedical Advanced Research and Development Authority, is seeking FDA clearance.

» EXPAND STEM EDUCATION, DEVELOP TALENT

Dignity Health, MIHS, District Medical Group expand partnership with Creighton University: The partnership between Phoenix providers and the Nebraska-based university will develop new academic and clinical-education programs in medicine, nursing, pharmacy, and allied health, and add vital residency and fellowship slots in Arizona.


SciTech Festival continues to grow: More than 50 communities and 800 organizations host events attracting nearly 400,000 people during the 2016 Arizona SciTech Festival, now the third-largest in the nation.


UA College of Medicine creates scholarship for Navajo students: The UA colleges of medicine in Tucson and Phoenix agree on a six-year partnership with the Navajo Nation to provide funds for Navajo medical students.


Summer STEM programs draw students: Yuma students fill a Science Foundation Arizona-funded science camp at Arizona Western College. Elsewhere, longstanding STEM internship and education programs continue, including the 10th-anniversary class of Helios Scholars at TGen.

What Are the Biosciences?


 Agricultural Feedstock and Chemicals

 Bioscience-Related Distribution

 Drugs, Pharmaceuticals, and Diagnostics

 Hospitals

 Medical Devices and Equipment

 Research, Testing, and Medical Labs

2000-04

- Prop. 301 passage secures estimated \$1.25 billion over 20 years for university research
- Flinn Foundation commits to 10 years of major funding of Arizona biosciences
- BIO5 Institute, then known as IBSB, debuts at UA
- Bioindustry Organization of Southern Arizona forms in Tucson
- IGC locates in Arizona; TGen formed
- Arizona's Bioscience Roadmap launched
- ASU's Bidesign Institute established
- Legislature approves \$440 million to build university research facilities
- State's bio cluster group reorganizes as Arizona BioIndustry Association
- Phoenix Biomedical Campus established

2005-08

- Critical Path Institute founded in Tucson
- Legislature passes angel tax credit
- Science Foundation Arizona forms
- Virginia G. Piper Charitable Trust commits \$50 million to personalized medicine
- Classes begin at UA College of Medicine-Phoenix
- Caris Diagnostics (now Caris Life Sciences) purchases MPI, created by IGC with TGen as its initial business collaborator
- Roche buys Ventana Medical Systems for \$3.4 billion
- UA BIO5 wins \$50 million grant for iPlant Collaborative
- Legislature passes expanded R&D tax credit
- NACET high-tech incubator opens in Flagstaff

2009-2012

- BioAccel launches to boost bio startups
- Abraxis BioScience (since acquired by Celgene) opens \$70 million Phoenix site

- ASU, Chandler, GateWay Community College, Surprise, and UA devote millions to new high-tech incubators, accelerators, and research parks
- W. L. Gore begins \$130 million expansion in Phoenix
- IGC secures \$59 million for key role in Cancer Genome Atlas project
- Roche announces major expansion of Oro Valley's Ventana Medical Systems; neighboring Sanofi US opens new, larger facility
- Arizona Competitiveness Package creates Arizona Commerce Authority
- Inaugural Arizona SciTech Festival attracts 200,000 participants
- Banner Alzheimer's Institute wins \$15 million NIH grant, launches \$100 million drug study
- New state laws boost university commercial research, STEM education, algae research and production
- UA opens Health Sciences Education Building on Phoenix Biomedical Campus, includes NAU allied-health programs
- BioInspire incubator opens in Peoria

2013-14

- Tech Launch Arizona opens at UA
- FDA, European counterpart endorse C-Path's new Alzheimer's disease trial-simulation tool
- FDA approves pancreatic-cancer drug combo tested by TGen, Scottsdale Healthcare (now HonorHealth)
- UA BIO5 receives NSF renewal of \$50 million iPlant Collaborative grant
- C-Path receives three Gates Foundation grants to advance TB treatments
- Arizona's Bioscience Roadmap receives update through 2025
- NAU debuts two centers for research, including bioengineering
- Banner Alzheimer's Institute, Novartis announce study of two experimental drugs
- ASU Bidesign research instrumental in fighting Ebola virus

- KUD International announces plan to develop \$1 billion north Phoenix biomedical campus
- AZBio hosts White Hat Investors, state's first bioscience capital conference
- Construction begins on Biomedical Sciences Partnership Building on Phoenix Biomedical Campus

2015

- Banner Health acquires UA Health Network in merger
- Flagstaff Business Accelerator opens doors to startups
- UA, Dignity Health St. Joseph's open new cancer center
- ASU, Banner Health partner on Alzheimer's, Parkinson's research
- C-Path launches four new scientific consortia
- TGen earns third Stand Up to Cancer Dream Team grant
- Flinn Foundation gives \$1 million for cardiology fellowship at St. Joseph's Hospital

2016

- UA wins major federal \$43 million precision-medicine research grant
- TGen plans Phoenix expansion after joining City of Hope of California
- Mayo Clinic, ASU announce 2017 opening of new medical school
- Tempe unveils plans for major biotech campus
- FDA awards C-Path three grants to develop data standards
- NeoLight wins Steve Case's Rise of the Rest pitch competition
- Arizona SciTech Festival nears 400,000 attendees in fifth year
- TGen North, NAU develop MRSA, valley fever tests
- Phoenix Children's Hospital joins Patrick Soon-Shiong's Cancer Breakthroughs 2020 Pediatrics Consortium