



ARIZONA'S
BIOSCIENCE
ROADMAP

2015 PROGRESS OF THE Biosciences in Arizona



ADVANCING THE BIOSCIENCES AND IMPROVING HEALTH OUTCOMES



A GROWING INDUSTRY—WITH A CHALLENGE

THE SECOND DECADE of Arizona's Bioscience Roadmap is well underway. In 2014 and 2015, our state saw sustained progress in its bioscience industry base, as the most visible measures of the sector's strength—jobs and wages—continued to make the case that bio is a bright spot for Arizona's economy that could become a major driver of prosperity.

But there are warning signs. While risk-capital investment in Arizona in the biosciences has accelerated during this period, mirroring national trends, two other measures of vitality have recently waned: National Institutes of Health research funding (the gold standard in the biosciences), and bio-related academic R&D expenditures. Research is the progenitor of commercial innovation in the biosciences. Without a strong research base, it will be far more difficult for Arizona to continue the good-news story of bioscience employment.

How does Arizona get back on track in research, and achieve the Roadmap's goal for the state to become globally competitive and a national leader in select fields of the biosciences? During the Roadmap's first decade, Arizona's research engine accelerated because of visionary, highly collaborative leadership throughout the state, including in the public sector. At key junctures, policy-makers made strategic investments in research-performing institutions, including Arizona's public universities, in order to build a more diverse, resilient economy. Such leadership is vital again.

» THE LATEST FIGURES

A Roadmap progress update by TEconomy Partners (formerly Battelle Technology Partnership Practice) in early 2016 revealed the following data—the most recent available—on key metrics.

JOBS: During the economic recovery of 2009-2014, bioscience jobs in Arizona **increased 14.8%**, nearly double the rate of Arizona as a whole. From 2002 to 2014, Arizona bioscience jobs increased by 49%, adding more than 36,700 jobs for a total of 110,410. The U.S. posted a 13.7% gain in bio jobs during this span.

WAGES: Bioscience workers in Arizona earn an average annual salary of \$61,823, compared to \$46,514 for the state's private sector as a whole. From 2002 to 2014, bio salaries **increased 50%**.

FIRMS: From 2002 to 2014, the number of Arizona bioscience establishments **rose 4.2%**, to 1,411. The cited growth rate was much higher before the biosciences were reclassified in 2014 to include bio-distribution firms.

NIH GRANTS: In 2015, while total NIH funding rose, Arizona's **funding fell to \$151 million** from \$158 million in 2014. From 2002 to 2015, Arizona's NIH funding grew 11.8%, far behind the top-10 funded states' growth of 40.1%. Through most of the Roadmap's history, Arizona had kept pace with these states.

R&D EXPENDITURES: The value of bioscience-related academic research-and-development expenditures at Arizona's universities reached \$451 million in 2014, **a slight drop from 2013**. Since 2002, Arizona's R&D expenditures are up 55.1%, versus the overall U.S. growth of 77.5%.

VENTURE CAPITAL: In 2015, bioscience firms in Arizona attracted **\$82 million** in venture-capital investments, the highest level since 2011, and the third straight year of growth. This was, though, just 0.56% of bioscience VC investments nationwide.

UNIVERSITY TECH TRANSFER: From 2002 to 2015, Arizona's universities have shown steady gains in developing bioscience intellectual property: invention disclosures, patent applications, patents issued, and licenses and options executed. The 2014-15 period compared favorably to the previous two years on all measures, including a **24% increase in bio-related university startups.**

2015 HIGHLIGHTS

» PROMINENT LONG-TERM INVESTMENTS

ASU, Nantworks partner on Phoenix Biomedical Campus:

The agreement between Arizona State University and Nantworks, led by billionaire physician and entrepreneur Patrick Soon-Shiong, will allow for a 7-acre expansion to build a technology-based health-research hub. Nantworks will invest at least \$75 million in the project's first phase, which includes 200,000 square feet of development.

Banner Heath, UA Health Network merger complete: Under terms of the \$1 billion-plus merger between Banner Health and the University of Arizona Health Network, Banner acquires UA Health Network's two Tucson hospitals and begins an academic partnership with UA's medical schools in Tucson and Phoenix.

UA, Dignity Health open Phoenix cancer center: The UA Cancer Center at Dignity Health St. Joseph's Hospital and Medical Center opens its new facility on the downtown Phoenix Biomedical Campus. The 220,000-square-foot outpatient center is one of only two Arizona centers designated a comprehensive cancer center by the National Cancer Institute.

» ENHANCE HOSPITAL RESEARCH, CLINICAL CARE

Banner unveils plans for expanded Tucson hospital campus: Among \$1.2 billion in current construction projects, Banner Health prepares to rebuild and expand Banner-University Medical Center Tucson, a three-year project to cost at least \$500 million. In Phoenix, UA and Banner Health will build an outpatient primary-care clinic on the Phoenix Biomedical Campus.

Phoenix Children's Hospital expansion begins: Phoenix Children's Hospital breaks ground on a \$60 million project scheduled to open in late 2017 that will include a new emergency department and a Level 1 pediatric trauma center.

Arizona's Bioscience Roadmap:

Arizona's long-term strategic plan to become globally competitive and a national leader in select fields of the biosciences

Launched in 2002; updated in 2014 to extend through 2025

Guided by state leaders in science, business, academia, and government

Metrics to be released publicly every other year

Commissioned and coordinated by the Flinn Foundation

Research and facilitation by TEconomy Partners

Mayo Clinic, TGen launch national melanoma trial: Mayo Clinic and the Translational Genomics Research Institute launch a national clinical trial to treat advanced melanoma using advances in genomics, informatics, and health-information technology.

Flinn Foundation makes \$1M cardiology grant to St. Joseph's: To recognize its 50th anniversary, the Flinn Foundation awards a \$1 million grant to St. Joseph's Hospital and Medical Center to establish and endow the Dr. Robert S. Flinn Cardiology Fellowship Program. Robert Flinn, a leading cardiologist at St. Joseph's for decades, created the Foundation with his wife, Irene, in 1965.

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**

Barrow Neurological Institute teams with Phoenix

Children's, TGen: This research collaboration will study traumatic brain injury following a stroke in order to develop better treatments and find ways to indicate the severity of hemorrhagic stroke and risk of subsequent injury.

Merger yields HonorHealth brand: HonorHealth is the new name of Scottsdale Lincoln Health Network, created in 2013 with the merger of Scottsdale Healthcare and John C. Lincoln Health Network. The combined organization has five hospitals in Phoenix and Scottsdale, including a cancer center, and significant research activities.



PROMOTE ENTREPRENEURIAL CLIMATE

BioAccel, GPEC receive federal grants to support

entrepreneurs: BioAccel and Greater Phoenix Economic Council are among 26 grantees in the U.S. Department of Commerce's Regional Innovation Strategies Program, designed to advance innovation and capacity-building activities. BioAccel will use its nearly \$500,000 grant to educate and train entrepreneurs.

Flagstaff Business Accelerator opens doors: The Flagstaff Business Accelerator debuts with a new 28,000-square-foot building featuring offices, wet and dry labs, and light-manufacturing spaces for startup companies. The nearby Northern Arizona Center for Entrepreneurship and Technology manages the accelerator.

Bio companies excel in startup competitions: Bioscience companies perform well in competitions including Venture Madness, presented by the Arizona Commerce Authority and Invest Southwest; the ACA-sponsored Arizona Innovation Challenge, where companies earn up to \$250,000 each; and several university contests. \$150,000 was awarded in BioAccel's second Solutions Challenge.

New venture-capital groups active in state: A number of venture-capital and angel-investment firms open in metro Phoenix to fund startups, including Angel Capital Group, which will provide between \$1 million and \$5 million. California-based Wasabi Ventures opens a Scottsdale office

with cohorts in Tucson and Flagstaff and plans to start 20 companies. VA Angels, a Canadian angel-investment firm, opens at Gateway Community College's Center for Entrepreneurial Innovation in Phoenix.

Arizona, Mexico groups reach partnership: The Arizona Technology Council and Arizona Business Incubation Association sign an agreement with Startup Mexico to share best practices. Meanwhile, the Tech Council and Arizona Collaboratory Inc. begin helping startups secure capital through equity crowdfunding.

» BUILD CRITICAL MASS OF COMPANIES

HTG Molecular Diagnostics raises funding, launches new test: The Tucson-based company completes its initial public offering, receiving net proceeds of \$44.2 million. HTG also announces it has raised \$15 million to fund ongoing HIV/AIDS drug trials and launches a new test for non-Hodgkin's lymphoma.

Phoenix Forward seeks to grow bio businesses: Bioscience is identified as one of four focus industries to be promoted via the \$1.5 million Phoenix Forward initiative, led by the Greater Phoenix Chamber of Commerce to strengthen existing businesses.

VisionGate anticipates strong test results will lead to clinical trials, expansion: The Phoenix-based developer of a three-dimensional specialty cell microscope achieves a 92 percent chance of finding lung cancer at an early stage, according to a newly published study, and makes plans to increase hiring in the Phoenix area.

California firm opens Oro Valley lab: LCMS Solutions, a La Jolla-based medical-laboratory company that specializes in urine diagnostics and other tests, opens a lab in Oro Valley to serve the local bioscience industry.

Northern Arizona Leadership Alliance succeeds Flagstaff Forty: The group of business, educational, and nonprofit leaders now known as Northern Arizona Leadership Alliance expands its reach to encompass all of northern Arizona. One focus of the group is developing the state's bioscience sector.

Arizona firms raise money for expansion: Arizona companies such as EpiFinder of Scottsdale, Accelerate Diagnostics Inc. of Tucson, and Picmonic of Tempe, raise millions in risk capital to expand operations and hire new staff.

California firm expands to Chandler: DaVita Rx, the nation's largest specialty kidney-care pharmacy, selects Chandler over four other markets to establish a new 500-job facility.

Global Cancer Diagnostics Inc. acquired: The Tempe-based company is acquired in a reverse merger with Oregon-based QuantRx Biomedical Corp., enabling Global Cancer Diagnostics to be publicly traded. The firm also announces a deal to distribute its early-stage lung-cancer test in India.



TGen researcher leads pancreatic-cancer dream team: Daniel Von Hoff of TGen spearheads a “Dream Team” of researchers awarded a \$12 million grant from Stand Up To Cancer to study new pancreatic-cancer therapies at three clinical sites, including HonorHealth in Scottsdale. This is TGen’s third Stand Up to Cancer Dream Team, and the second focusing on pancreatic cancer.

ASU, Banner Health partner to fight Alzheimer’s, Parkinson’s: ASU and Banner Health form the ASU-Banner Neurodegenerative Disease Research Center. The partnership will also lead to clinical and research programs at Banner Alzheimer’s Institute and other members of the Arizona Alzheimer’s Consortium.

NAU leads international anthrax research: Led by Northern Arizona University pathogen-genomics expert Paul Keim, an international anthrax-research team publishes findings demonstrating the capacity of whole-genome sequencing to identify and track disease events.

Banner Alzheimer’s receives \$10 million for trial: Banner Alzheimer’s Institute secures funding from the Alzheimer’s Association, GHR Foundation, and Fidelity Biosciences Research Initiative for a two-year Alzheimer’s Prevention Initiative trial.

AZBio Expo spotlights clinical trials: The Arizona BioIndustry Association’s 2015 Expo emphasizes how clinical trials advance the biosciences through development of drugs and therapies as well as expanded business opportunities.

UA BIO5 researchers study treatment of asthma: UA BIO5 researchers, in collaboration with Johnson & Johnson Consumer & Personal Products and Janssen immunology scientists, plan studies to identify compounds that may protect against asthma or allergies.

Critical Path Institute marks decade with banner year: Marking its 10th year, Tucson-based C-Path launches a Data Collaboration Center, and scientific consortia focusing on Parkinson’s disease, Duchenne muscular dystrophy, neonatal health, and pediatric therapies—bringing its total to 12 global consortia with 1,300 participating scientists. Also, the World Health Organization selects C-Path to host a tuberculosis clinical-trial data-sharing platform.

Tucson-based foundation targets fatal disease: The Ara Parseghian Medical Research Foundation of Tucson reports that it has raised \$40 million to study the childhood disease Niemann-Pick disease type C, and announces an agreement for a Maryland-based biotech company to develop treatments for the disease.

Guayule tires from Arizona used in track test: Arizona-grown rubber made from the guayule plant, supplied by the Casa Grande-based bio-agricultural company PanAridus, is used on a Texas test track as part of a \$7 million federal grant to test the rubber.

UA creates bio repository to share tissue samples: The Arizona Health Sciences Center Biorepository is established to share tissue samples with researchers at universities nationwide, providing opportunity for researchers to study populations unique to the Southwest.

UA develops vaccine that could prevent valley fever: A live vaccine invented by a UA fungal geneticist shows capacity to protect mice from valley fever, with potential to protect humans and dogs.

Paradigm to provide cancer molecular profiling: Paradigm, a spinoff of International Genomics Consortium of Phoenix, expands its Next Generation Paradigm Cancer Diagnostic service with the addition of key protein biomarkers. The company also forms an agreement for next-generation molecular profiling for cancer patients.

» EXPAND STEM EDUCATION, DEVELOP TALENT

Arizona SciTech Festival keeps expanding: The Arizona SciTech Festival continues to grow, with more than 380,000 people attending more than 800 science, technology, engineering and math events. The fourth annual festival's first event, Connect2STEM, is hosted by the UA College of Medicine-Phoenix, near Super Bowl Central in downtown Phoenix.

Flagstaff STEM Celebration expands in second year: The second annual Flagstaff STEM Celebration attracts some 5,000 adults, students, and children to NAU's Walkup Skydome.

UA to open veterinary school in Oro Valley: UA's planned doctor of veterinary medicine program announces that students will begin studying on a new Oro Valley campus in 2017, following curriculum preparing them for positions in medical research and clinical practice.

Pima Community College earns STEM grant to target first generation students: The U.S. Department of Education awards Pima Community College's Desert Vista Campus a 5-year, \$1.1 million grant to help support low-income and first generation college students interested in STEM careers.

ASU professor leads White House effort to attract minority women: The White House Council on Women and Girls taps ASU professor Kimberly A. Scott to lead the National Academic STEM Collaborative, which aims to attract minority women to science-and-technology careers.

NAU opens new building, expands programs: NAU opens a new Science and Health Building in Flagstaff and announces a new athletic-training cohort on the Phoenix Biomedical Campus, joining its Phoenix-based physician-assistant, physical-therapy, and occupational-therapy programs.

Mayo Medical School receives approval for Arizona campus: Mayo Medical School receives licensure for its \$150 million Arizona branch campus, allowing medical students to train at Mayo beginning in 2017.

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

2000-02

- Prop. 301 passage secures estimated \$1 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

2003-04

- ASU's Biodesign Institute established
- Legislature approves \$440 million to build university research facilities
- State's bio cluster group reorganizes as Arizona BioIndustry Association
- \$100 million for bioscience/health-care training approved for Maricopa Community Colleges
- Phoenix Biomedical Campus established

2005-06

- Critical Path Institute founded in Tucson
- Legislature passes angel tax credit
- Science Foundation Arizona forms
- Phoenix Bioscience High School opens
- Virginia G. Piper Charitable Trust commits \$50 million to personalized medicine

2007-08

- Classes begin at UA College of Medicine-Phoenix
- Caris Diagnostics 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

2009-2010

- 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

2011-2012

- Arizona Competitiveness Package creates Arizona Commerce Authority
- Banner MD Anderson Cancer Center opens in Gilbert
- Mayo Clinic, ASU announce medical-school partnership
- 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, job growth
- UA opens Health Sciences Education Building on Phoenix Biomedical Campus, includes NAU allied-health programs
- BioInspire incubator opens in Peoria; Arizona Furnace statewide accelerator debuts

2013

- Accelerate Diagnostics moves to Tucson from Denver
- 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
- SynDaver Labs announces expansion to Phoenix

2014

- 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 Biodesign research instrumental in fighting Ebola virus
- KUD International announces \$1 billion investment to develop north Phoenix biomedical campus
- AZBio hosts White Hat Investors, state's first bioscience capital conference
- Phoenix Children's Hospital and billionaire Patrick Soon-Shiong partner on genomics-based institute for seriously ill children
- Construction begins on Biosciences Partnership Building on Phoenix Biomedical Campus

2015

- ASU, Patrick Soon-Shiong's Nantworks partner on new health-research lab
- 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
- Arizona's SciTech Festival sets record with 380,000 attendees
- Flinn Foundation gives \$1 million for cardiology fellowship at St. Joseph's Hospital