

Distance Traveled

THE BIOSCIENCE ROADMAP

TURNS 10

The Path Ahead

The first decade of implementing Arizona's Bioscience Roadmap is nearly complete. Developments during the plan's ninth year confirm the impact of earlier investments and suggest opportunities ahead as Arizona pursues global stature in select niches of the biosciences, such as personalized medicine. In 2011, an ambitious health-information endeavor landed in Arizona, major new medical-education and clinical partnerships were formed, and prevention and treatment choices multiplied for Arizona patients facing the 21st century's most vexing diseases.

The Roadmap is propelled by a statewide Steering Committee of science, policy, and business experts, including leaders of regional bioscience strategies in northern and southern Arizona. One of the Steering Committee's major activities in 2011 involved compiling a "Policy Principles" document that frames key policy steps needed to continue advancing Arizona biosciences in years to come. In 2012 and beyond, Roadmap priorities will include...

Reaching critical mass in research: Arizona's investments in biosciences infrastructure have set a foundation for excellence, and in certain fields, such as molecular diagnostics, world-class scientists are already in place. That core of talent needs to be multiplied. As they achieve a larger share of NIH funding, Arizona universities and research institutions will spin out more new bio companies, and the state will attract greater attention from venture-capital funders and major firms considering expansion or relocation.

Supporting and expanding partnerships: The not-so-secret key to Arizona's success thus far has been collaboration among institutions, including colleges and universities, clinical providers, research institutes, government, and industry. Expanding these partnerships will help move discoveries rapidly from the laboratory into patient care, accelerate the translation of new discoveries into commercial products and services, and strengthen the partners' financial viability through times of continuing economic instability.

Preparing the workforce of the future: The mature bioscience sector that Arizona is building will require doctors and engineers, nurses and technicians, statisticians and laboratory scientists, all adaptive to rapidly changing technology and global economic pressures. The growth of bioscience employment in Arizona throughout and beyond the Great Recession demonstrates how good these jobs are. Arizona's capacity to keep the workforce pipeline flowing depends on the quality of its investments in K-12, community-college, and university STEM education, including medical education.

Arizona's Bioscience Roadmap

- Arizona's long-term plan to bring its bioscience sector to national competitiveness
- Driven by an extensive collaboration among statewide leaders in science, business, and policy
- Translational research component in partnership with Arizona Biomedical Research Commission
- Research and facilitation provided by Battelle
- Commissioned and coordinated by the Flinn Foundation
- Details available at www.flinn.org

Road Test

An update of Roadmap progress in early 2012 revealed the following data on key measures. Data listed represent the most recent available.

Jobs: Arizona bioscience employment saw vigorous growth of 7.4% during the post-recession period of 2009-10, even as the state's overall private sector lost 1.8%. From 2002 to 2010, bioscience jobs **increased by 41%** in Arizona, adding nearly 28,000 jobs for a total of 96,223. The U.S. posted an 11% gain in bio jobs during this span.

Firms: The number of bioscience establishments in Arizona **rose 27%** from 2002 to 2010, increasing from 682 to 867. This compares to 20% growth for the U.S. The research, testing, and medical-labs subsector remains the largest in Arizona, with 436 establishments, and since 2002 has expanded fastest, growing 49%.

Wages: Bioscience workers in Arizona earn an average annual salary of \$55,353, compared to \$42,858 for all private-sector industries. From 2002 to 2010, salaries **increased 27%**. The 3.3% drop in wages in 2010 appears to be caused by downward wage pressures at hospitals.

NIH Grants: In 2011, Arizona received \$184.1 million in funding from the National Institutes of Health, the industry gold standard. That total is smaller than 2009 and 2010, which were boosted by NIH federal-stimulus awards, but 14% higher than 2008. From 2002 to 2011, NIH funding in Arizona **grew faster (25%)** than the top-10 funded states (20%) and the overall U.S. (17%).

R&D Expenditures: Bioscience-related academic research and development expenditures at Arizona's universities reached **\$437.1 million** in 2009 (the most recently available data). This represents a 56% gain since 2002, slightly higher than the overall U.S. growth (55%).

Venture Capital: Arizona rebounded from a difficult 2010 with a 2011 total of \$69 million in bioscience venture capital. This represents the **second-most productive year** since 2002, though it is still short of the Roadmap goal of \$100 million.

Entrepreneurialism: From 2002 to 2010, Arizona's universities have shown cumulative **steady gains** in bioscience intellectual property – invention disclosures, patent applications, patents issued, licenses and options executed, gross license income, and bioscience startup companies.

Implementation: Of the 19 action items recommended by Battelle in 2002 to achieve over 10 years, **progress has been made on 18, or 95%**, including substantial progress on 10.

2000-02

- Prop. 301 passage secures \$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
- TGen created following \$90 million fundraising effort
- IGC locates in Arizona
- 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/healthcare training approved for Maricopa Community Colleges

2005-06

- Critical Path Institute founded in Tucson
- Legislature passes angel tax credit
- NAU introduces SABRE research consortium
- Science Foundation Arizona forms
- Phoenix Bioscience High School opens

2007-08

- Classes begin at UA College of Medicine-Phoenix
- TGen, ASU Biodesign Institute join Nobel laureate Lee Hartwell to launch Partnership for Personalized Medicine
- Caris Diagnostics purchases MPI, created by IGC with TGen as its initial business collaborator
- Roche buys Ventana Medical Systems for \$3.4 billion
- BIO5 wins \$50 million grant for iPlant Collaborative
- Investors form TRAC, a \$20 million fund for Arizona bio companies

- Legislature passes expanded R&D tax credit
- NACET, high-tech incubator, opens in Flagstaff

2009

- BioAccel launches to boost bio startups
- TGen forms strategic alliance with Van Andel Research Institute
- Covance opens Chandler drug-development facility
- 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

2010

- W. L. Gore begins \$130 million expansion in Phoenix
- UA breaks ground on Health Sciences Education Building on Phoenix Biomedical Campus
- Governor creates Arizona Commerce Authority to steer economic development
- 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

- Chan Soon-Shiong Institute for Advanced Health announces plan for Phoenix headquarters and \$200 million investment in health-data infrastructure
- UA, St. Joseph's Hospital and Medical Center form partnership to expand UA Cancer Center to Phoenix Biomedical Campus
- Maricopa Integrated Health System becomes primary teaching hospital for UA College of Medicine-Phoenix
- \$109 million Banner MD Anderson Cancer Center opens in Gilbert
- Mayo Clinic and ASU announce partnership to establish medical-school campus in Scottsdale



2011 PROGRESS // Build Research Infrastructure

Health-data institute chooses Phoenix: The City of Phoenix approves a plan for the Chan Soon-Shiong Institute for Advanced Health to establish its headquarters and a massive supercomputer and data center in Phoenix, with a projected investment of \$200 million by the CSS Institute. The Institute commits another \$100 million to assume responsibility for National LambdaRail, a national fiber-optic network enabling exceptionally rapid transmission of health data.

University of Arizona Cancer Center comes to Phoenix: The University of Arizona and Phoenix-based St. Joseph's Hospital and Medical Center reach agreement on an affiliation bringing the UA Cancer Center to St. Joseph's and a planned outpatient clinic on the Phoenix Biomedical Campus.

IGC establishes key partnerships for cancer study: The Phoenix-based International Genomics Consortium formalizes agreements with the Virginia G. Piper Cancer Center at Scottsdale Healthcare and the UA Cancer Center – plus other hospitals and medical centers around the country – to collect and store tumor samples for the Cancer Genome Atlas project, a massive initiative to apply genome-analysis techniques to improve understanding of cancer's molecular basis.

Alzheimer's brain scan gets go-ahead: An FDA advisory committee recommends approval of a brain scan – developed in significant part by Banner Alzheimer's Institute researchers – that can identify plaques characteristic of Alzheimer's disease. Meanwhile, the NIH gives \$8 million to Banner Sun Health Research Institute and Mayo Clinic Arizona for a brain and tissue bank for research on Parkinson's disease and related disorders, and \$7.7 million to the Arizona Alzheimer's Consortium, a multi-institution partnership, for research on Alzheimer's and other age-related disorders.

St. Joseph's receives largest-ever gift: Barrow Neurological Institute at St. Joseph's Hospital and Medical Center receives a \$10.1 million donation to create the Barrow Center for Neuromodulation. A cornerstone of the Center will be studying the use of deep-brain stimulation to treat psychiatric and motor disorders.

Arizonans lead prominent melanoma study: Stand Up to Cancer and the Melanoma Research Alliance award \$6 million to a nationwide "Dream Team" of researchers led by Jeffrey Trent of the Translational Genomics Research Institute, with key contributions from Joshua LaBaer of the Biodesign Institute at Arizona State University, Aleksandar Sekulic of Mayo Clinic Arizona, and Waibhav Tembe of TGen.

Scorpion antivenom reaches the marketplace: The FDA approves Anascorp, an antivenom for scorpion stings shepherded through the clinical-trial process by a team at UA and tested in medical facilities throughout Arizona.

Pathogen hunters solve Haitian mystery: A team led by Paul Keim of Northern Arizona University and TGen North successfully uses whole-genome sequencing to trace a cholera outbreak in Haiti to Nepalese UN peacekeepers.

2011 PROGRESS // Build Critical Mass of Firms

Banner MD Anderson opens doors: The \$109 million Banner MD Anderson Cancer Center begins serving patients in Gilbert on the Banner Gateway Medical Center campus. The new center joins the University of Arizona Cancer Center and Mayo Clinic as the third National Cancer Institute-supported comprehensive cancer center in Arizona, giving patients additional access to top expertise and clinical trials.

Phoenix Children's opens massive new facility: Phoenix Children's Hospital opens its new 11-story, \$588 million facility, giving PCH the capacity to become one of the largest children's hospitals in the world. Along with space for additional patients, the facility offers PCH the opportunity to recruit numerous new subspecialist researcher-physicians.

Ventana reaches product-development, leadership milestones: The Food and Drug Administration approves a genetic test made by Oro Valley-based Ventana Medical Systems Inc. that helps determine if breast-cancer patients are good candidates for treatment with the drug Herceptin. Weeks later, Ventana hires veteran cancer-diagnostics executive Mara Aspinall as its new president.

TGen partnership yields drug-development progress: Scottsdale-based TGen Drug Development signs a partnership agreement with Syracuse-based Oncoholdings Inc. to become the exclusive developer of Oncoholdings's oncology drug-candidate portfolio. Separately, TGen announces that it has licensed its first drug, a compound that may prove effective against ovarian and endometrial cancer, to Oncoholdings Inc.

Heliae signs deals to develop algae biofuel: Gilbert-based Heliae Development LLC, which focuses on the commercialization of fuel and other products derived from algae, signs agreements with the Dutch company SkyNRG and Gilbert-based Azmark Aero Systems to develop algae-based aviation fuel. Born from a Science Foundation Arizona-funded project at ASU, Heliae now has more than 60 employees, and has raised some \$25 million in investment since 2008.

Syncardia receives broad acclaim: Tucson-based Syncardia Systems Inc., manufacturer of the FDA-approved Total Artificial Heart, is ranked 20th on *Fast Company's* annual list of the "World's 50 Most Innovative Companies." *Forbes* ranks Syncardia 77th on its list of "America's Most Promising Companies," a list of up-and-coming private-sector firms. And the Arizona BioIndustry Association names Syncardia the Arizona Bioscience Company of the Year.

Mayo breaks ground on proton-beam facility: Mayo Clinic begins building a \$182 million facility on its Phoenix campus for its new pencil-beam proton therapy program, which will offer cancer patients a treatment option currently found at only a few sites in the U.S.

2011 PROGRESS // Enhance Business Environment

Venture-capital funding ticks up: Several Arizona-based bioscience firms secure new funding, led by Tucson-based HTC Molecular Diagnostics Inc., which closes a \$16.2 million round of financing to expand adoption of its multi-plex gene expression testing platform, and Maricopa-based Yulex Corp., which closes a \$15 million round of financing to expand its production of guayule-based natural rubber and feedstocks for bioenergy. Other firms finding new backers include Mesa-based Ulthera Inc., with \$10.5 million, Scottsdale-based Regenesys Biomedical Inc., with \$5.3 million, and Phoenix-based VisionGate Inc., with \$2 million.

BioAccel guides Peoria medical-devices initiative: The Peoria City Council approves a three-year plan to partner with BioAccel and the Plaza Companies to develop and host the Peoria Incucelator, which will offer reduced-rate leases for laboratory space, as well as business-development mentoring, to startup firms focusing on biomedical devices. Separately, BioAccel creates the Philanthro-Capitalist Network to help startups attract funding.

Governor signs economic package: Gov. Jan Brewer signs into law the Arizona Competitiveness Package, which includes provisions to replace the Arizona Department of Commerce with the Arizona Commerce Authority, to create a \$25 million deal-closing fund, and to establish a tax credit aimed at incentivizing hiring.

Chandler incubator embraced by startup companies: Chandler's Innovations Technology Incubator, open just a year, reaches full capacity. Tenants include startup firms in the fields of biotechnology, bioinformatics, software design, nanotechnology, and medical devices.

Development continues on Phoenix Biomedical Campus: While construction progresses on UA's massive Health Sciences Education Building, the City of Phoenix pledges to contribute \$14 million toward development of the UA Cancer Center's new outpatient clinic on the Phoenix Biomedical Campus. The potential to attract additional campus tenants grows with the city's selection of Utah-based Boyer Co. to build a privately-financed, \$50 million facility, which would supply an additional 150,000 square feet of laboratory-equipped space on the campus adjacent to the UA College of Medicine-Phoenix, IGC, TGen, and others.

America COMPETES Act renewed: President Barack Obama signs a renewal of the America COMPETES Act into law. Championed by Rep. Gabrielle Giffords, it includes funds for the National Science Foundation to support graduate students in STEM fields bound for non-academic careers, plus a \$7.5 million fund to develop tech parks.

New C-Path partnership to speed drug development: The Tucson-based Critical Path Institute establishes a formal partnership with the Clinical Data Interchange Standards Consortium to set new clinical-data standards, helping bioscience firms develop new therapies more efficiently.

2011 PROGRESS // Prepare Workforce, Educate Citizens

Mayo to establish med-school campus with ASU: Mayo Clinic announces that it will establish a medical-school campus in Scottsdale, partnering with ASU on an embedded master's-degree program in the science of health-care delivery. Mayo and ASU also announce enhanced collaboration in other bioscience and health-related fields, and ASU's Department of Biomedical Informatics moves to Mayo's Scottsdale's campus.

UA College of Medicine-Phoenix affiliates with MIHS: UA and Maricopa Integrated Health System sign an agreement to make MIHS the primary teaching hospital for the UA College of Medicine-Phoenix. District Medical Group, the physician group at MIHS, also part of the collaboration, will provide staff to teach medical students and perform clinical research.

Inaugural SciTech Festival lines up support: Gov. Jan Brewer establishes February 2012 as Arizona Science and Technology Month in conjunction with an announcement of the first annual Arizona SciTech Festival, to be held over a six-week period from January to March 2012. The SciTech Festival's founding partners are ASU, the Arizona Technology Council, and the Arizona Science Center.

Infrastructure grows to support STEM education: Several institutions complement the work of the statewide STEM Network and Science Foundation Arizona's STEM Initiative to strengthen science, technology, engineering, and mathematics education. ASU launches STEMnet to introduce teachers to cutting-edge research in STEM fields and to innovative teaching approaches. The Arizona Technology Council launches getSTEM-az, a web portal to help Arizona teachers and businesses match STEM education needs with STEM business resources. And UA establishes the STEM Learning Center to coordinate UA's efforts in STEM education, outreach, and research.

UA College of Medicine-Phoenix sends forth first class: The UA College of Medicine-Phoenix graduates its first class of 24 students. More than half will pursue residency training in Arizona, and 16 of 24 will pursue primary-care programs. With completion next year of its Health Sciences Education Building, the College will soon have capacity for a class size of 120 students.

ASU tops nation in Goldwater winners: Four ASU undergraduate researchers win the Barry M. Goldwater Scholarship, awarded to students pursuing careers in mathematics, the natural sciences, or engineering. ASU is the nation's only university with four Goldwater Scholars in both 2010 and 2011.

SFAz continues support for budding research stars: Science Foundation Arizona announces that it is extending its Bisgrove Scholar Program to support a second round of awards. Previously open to first-time post-doctoral researchers, the program is now expanding to accept nominations from Arizona's universities of first-time tenure-track faculty.