

**Arizona University System
Technology and Research Initiative Fund (TRIF)**



**Arizona State University
Proposition 301
Arizona Biodesign Institute
Integrated Business Plan**

Executive Summary

Nature is the penultimate architect of complexity and systems design. From but a tiny seed or a fertilized single cell, exquisite and seemingly infinitely intricate living nanosystems are formed. These bionanosystems are being increasingly recognized as potentially replicable models upon which an entirely new class of bioscience industries can be developed.

Yet, for all of its promise, the recent labeling of the transition into the 21st Century as an “Age of Biology”, we find ourselves only at the doorstep to realizing this vision and its economic and quality-of-life benefits. While our knowledge is indeed growing exponentially, we possibly know as much about how to harness and mimic all of the potentially beneficial nanosystems that nature can offer to us as the Wright Brothers knew about building a B-2 Stealth Bomber.

It is for this reason that Arizona State University has elected to reshape its entire TRIF funding portfolio to develop the Arizona Biodesign Institute. The goal of this new Institute is to coalesce and focus an extraordinary investment of existing and new talent that will accelerate the pace of discovery across a spectrum ranging from pure basic research, to use-inspired basic research, to applied research within a linked suite of highly promising life science, physical science, and engineering fields. It will supercede the previously approved Arizona Biomedical Institute, and shall incorporate key aspects of materials, information technology and manufacturing research within it. It will also engage substantial portions of faculty in the social and behavioral sciences as there is an equally important need to understand the human-technology interface, the societal impacts and the ethical considerations of the rapid advances we are making and those that sit upon the horizon.

Additionally, the Arizona Biodesign Institute will effectively leverage new research collaborations with complementary research thrusts at the University of Arizona, Northern Arizona University, the newly created Translational Genomics Research Institute (TGen) and The International Genomics Consortium (IGC), and the emerging biosciences industry in Arizona.

The Arizona Biodesign Institute will be the major focus for training a new leadership class workforce in the State. While heavily focused on graduate education, significant resources will also be dedicated to upgrading life sciences undergraduate education and Science-Math-Engineering-Technology (SMET) education generally.

The Arizona Biodesign Institute will serve as a leading focus of a newly structured and more aggressively led technology transfer program that will feature strategic linkages both within the State and nationally to better transition our discoveries into the marketplace.

Finally, ASU will make selected short term project investment of TRIF funds to advance strategic faculty groups not otherwise aligned with the Arizona Biodesign Institute, but whose research demonstrates promise for high economic development impact.

The Arizona Biodesign Institute

Knowledge for Tomorrow's Industries:
Discovery at an Accelerated Pace and with Increasing Complexity



Pure Basic Research---Use-Inspired Basic Research---Applied Research

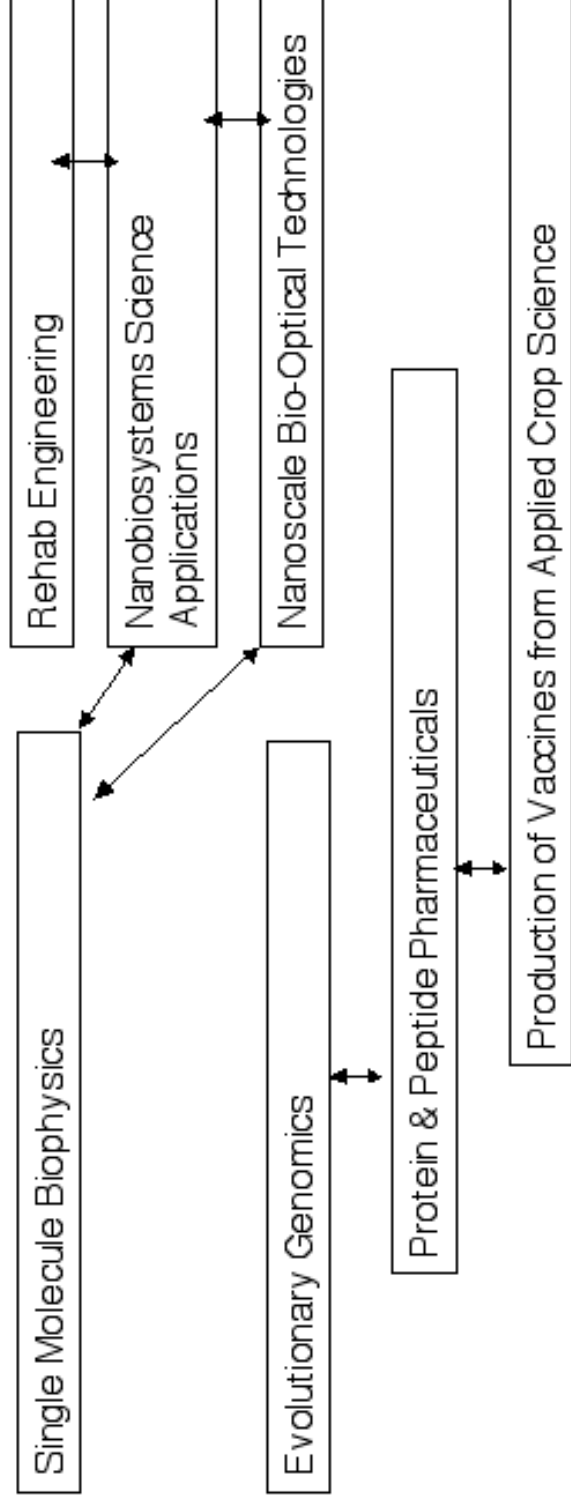


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1. Core Vision/Project Description

1.1. Brief overview of the industry or area being addressed by the initiative

The Biomedical/Biotechnology industry sector is one of the fastest growing in the United States economy, and one of the most lucrative. Market capitalization, the amount of money in the U.S. biotechnology industry, increased 156 percent in one year, soaring from 137.9 billion in 1999 to 353.5 billion in 2000.¹ Investments fell somewhat in 2001 to 330.8 billion as a result of widespread economic downturn, but many advise that the biomedical/biotechnology industry is poised for long-term success.² Biotechnology companies are expected to continue to be a major driving force behind the new economy of the 21st century.

Beyond basic economic trends, the biomedical/biotechnology industry is continuing to see an increasing convergence of technologies in a wide range of areas from materials science to computer science and information technology. Biotechnology research and development (R&D) and information technology R&D each provide tools and models useful for the other. Interdependencies also exist among chemistry, physics, microbiology, physiology, and structural biology, and among mathematics, computer engineering, bioinformatics, and genomics. Engineering research plays an important role in new research tools, device development, and diagnostic technologies for a variety of medical areas.³

1.2. Mission, goals, values and vision

The Arizona Biodesign Institute will accelerate ASU's participation in the biomedical/biotechnology research enterprise. The outcome of this effort will be to contribute to the ascendance of a globally competitive biosciences cluster in metropolitan Phoenix.

The Arizona Biodesign Institute articulates a collaborative research agenda conducted by ASU researchers in conjunction with allied faculty from Member Institutions, such as the Carl Hayden Veteran's Administration Medical Center, industrial partners in the greater Phoenix area, the International Genomics Consortium, and the Translational Genomics Research Institute and partnerships with governmental agencies such as GPEC and the Arizona Department of Commerce.

1.3. Products or services provided by the project

The Arizona Biodesign Institute will provide researchers from ASU and the surrounding biomedical/biotechnology and healthcare communities with the necessary critical mass of life science research, technology transfer, and advanced talent required to spawn the development of a nascent biosciences cluster in the Phoenix metroplex. As such, the Arizona Biodesign Institute's product can be best defined as its role as a strategic partner in leveraging university and industry related research and development in the

¹ Source: Biotechnology Industry Organization (www.bio.org).

² Source: Focus on Fundamentals: The Biotechnology Report, October 2001, Ernst & Young.

³ Capitalizing on New Needs and New Opportunities: Government-Industry Partnerships in Biotechnology and Information Technologies, 2001, National Research Council.

biosciences. The Arizona Biodesign Institute will also offer students greater industry exposure through innovative university-industry partnerships.

1.4. Positioning

The Arizona Biodesign Institute is positioned to become a major force for attracting greater research dollars (both federal and private) to the Greater Phoenix metropolitan area, for helping the area move into the biomedical devices and the protein pharmaceuticals industries, and for helping the local Health Care Industry to become an increasingly dynamic economic driver such as it has become for other metroplexes like Houston, San Diego and San Francisco. By the year 2010, the Arizona Biodesign Institute should directly attract, or leverage a 5-fold increase in federal funding to the Phoenix metro area as compared to current funding levels.

The Arizona Biodesign Institute will create a national model for the linkage of private clinical research centers and associated bioindustries with the basic and applied sciences and knowledge creation capacities of a non-medical school research university. The development of internationally recognized and innovative biomedical/biotechnology research programs will occur through ASU's joint recruitment of new faculty with Member Institutions. Key goals for ensuring continued growth and research prominence are:

- To enable ASU's capacity as a core resource for metro Phoenix clinical research facilities, specifically involving the biomedical needs of underserved populations;
- To strengthen and amplify ASU's statewide and regional linkages in novel, information-intensive biomedical therapies, new pharmaceutical products and instrumentation development;
- To utilize emerging information technologies, in conjunction with private and public industries, for biomedical education to promote citizen health awareness and successful health strategies;
- To expand current external funding in the areas of bioengineering, biotechnology, cognitive diagnostics and basic biological processes;
- To extend Arizona's economic opportunities through innovative knowledge and technology transfer opportunities with industry; and
- To leverage research innovation, through the recruitment and training of superior masters, doctoral and postdoctoral students, to have a positive impact on the high end of the bioindustry and healthcare system workforce.

1.5. How the initiative will be accomplished

ASU is already nationally known for its interdisciplinary approach to teaching and research, an approach that is critical for nurturing innovation.⁴ Leveraging ASU's existing strengths in the basic biological sciences, engineering and physical sciences as well as in information and computer technologies will provide strategic collaborative opportunities for both local and regional clinical research communities while creating a competitive advantage vis-à-vis other regions and/or states. Key technologies for the

⁴ ASU's leading role in the development of interdisciplinary science education is highlighted in the June 14, 2002 issue of the *Chronicle of Higher Education*

future of biosciences already being developed at ASU include a range of activities focusing on the convergence of Information Technology, Biotechnology, and Materials Science research. Notable examples include ASU's support of research in such areas as Bioinformatics, Computational Biology, Functional Imaging, Transformation & Transient Expression, Biological Computers, and Nanotechnology. As a focal point for drawing together existing and new researchers from both within and beyond the University, the Arizona Biodesign Institute will focus on the following key strategies.

- Focusing strategic research thrusts that will foster long-term collaborative projects in current and emerging areas of funding priority as identified for various federal agencies and industrial sources.
- Catalyzing integrative, multidisciplinary "bench-to-bedside" research efforts between departments and colleges at ASU and the outside medical community through seed grants and matching funds opportunities.
- Establishing and strengthening partnerships with institutions in the Phoenix area involved in clinical medicine and the bio-industry through shared use facilities and joint faculty appointments.
- Establishing and strengthening cooperative bioscience related research initiatives with both the University of Arizona and Northern Arizona University in areas of targeted mutual interest.
- Developing state-of-the-art laboratory facilities through the acquisition of new equipment and multidisciplinary core facilities.
- Hiring new high caliber faculty and promising young faculty in strategic areas of targeted opportunity.

2. The Market

2.1 Choices available to potential customers

Delineating the Arizona Biodesign Institute's service portfolio first necessitates delineating its "customers".

The Arizona Biodesign Institute's internal customers are comprised of the faculty. The perceived needs and wants of the faculty customer base are: (1) access to instrumentation and research facilities, (2) a platform from which to forge collaborations and partnerships that will lead to successfully funded research proposals, (3) a resource for providing postdocs and graduate students that are required for new research techniques and new research concepts, and (4) a venue for intellectual stimulation and recognition.

Faculty are responsive to value added capabilities in leveraging their research. Thus the Arizona Biodesign Institute is empowered through 301 funding to be a primary provider of new facilities and technology that will attract this internal customer base. Faculty are entrepreneurial and will naturally seek the best deal they can find in submitting proposals. If they can achieve what they need in bargaining directly with department chairs and other existing centers on the campus, they will behave as any other set of rational consumers would, and in the end pursue the path of least

resistance. However, as appealing as the Arizona Biomedical Institute may sound, it is largely intended for that subset of the faculty population who are among the University's highest performers, or who have the potential of becoming very high performers and otherwise express highly ambitious traits. Therefore the service set that the Institute offers must meet or exceed what individual departments can provide and do so in a way that connotes "special access."

The Institute's external customer set is much more diverse:

- Nationally it includes federal agencies that are shopping not only for high quality research work, but more importantly for new ideas and new initiatives that will enable them to make their cases for larger shares of the federal research budget;
- Nationally distributed biomedical and biotechnology firms are also customers seeking access to talent/future workers as well as near term technology development and validation;
- Local firms, economic partnership organizations, and increasingly state and local political jurisdictions are customers looking for talent and intellectual property necessary to fuel growth; and
- Local clinicians and medically affiliated research enterprises are seeking straightforward access to university based basic bioscience and bioengineering capabilities to leverage their own agendas.

The identified common need among this rather heterogeneous external customer set would appear to be that of a broker or gateway relationship into a pool of excellence and to consummate deals.

For the Arizona Biodesign Institute to replicate the stimulus role that other universities have achieved in providing the critical mass of basic and applied research, technology transfer, and advanced talent required to spawn the development of nascent bioscience clusters, it must compete with other better-endowed universities for the best faculty, staff, and students.

2.2 Market size and trends

Existing nationally recognized centers of excellence in biomedical/biotechnology commercialization tend to be located along either the east or the west coast and have emerged around academic giants in the field; examples include, Maryland/DC's bioscience cluster which has formed around Johns Hopkins and the University of Maryland, the Bay Area's roaring biosciences industry which has formed around Stanford and the University of California at San Francisco, San Diego's biotechnology cluster supported by both the University of California at San Diego and San Diego State University, Pennsylvania's biotechnology boom from the University of Pennsylvania, Seattle's prominent biosciences industry centering around the University of Washington, and finally Research Triangle Park in North Carolina which has developed with input from Duke University, the University of North Carolina – Chapel Hill, and North Carolina State University.

Within the state of Arizona, Maricopa County accounts for a little over three-fifths of the biomedical/biotechnology industry. Pima County and the remainder of the State, including Flagstaff, each have about one-fifth of the biomedical/biotechnology industry employment. Biomedical/biotechnology industry employment grew by approximately 18% between 1995 and 1999, with the fastest growth (~29%) taking place in non-metropolitan areas outside either Maricopa or Pima Counties. As a whole the Biomedical/Biotechnology Industry in Arizona remains largely unspecialized with some industry segments experiencing greater levels of growth than others. At present, Arizona's biomedical/biotechnology industry lacks the requisite concentration and networks of suppliers and buyers to be called a cluster.

A summary of pertinent industry trends both locally and nationally indicate the following:

Arizona & Phoenix Metro Area

- Greater Phoenix is rich in clinical resources -- hospitals, physicians and nurses -- but impoverished in research facilities related to medical research.
- Greater Phoenix does not attract health care research funding in proportion to its population or clinical investments.
- Greater Phoenix has an industrial base in microelectronics that is positioned to move into medical device technologies (which will develop a corporate "research home").
- The Health Care Industry in the Phoenix Metroplex is a series of unconnected "silo industries".
- In Arizona, at least 53 companies and branches with 25 or more employees are operating in the bioindustry sector. Of these, 38 are company headquarters, subsidiary headquarters, or single locations. The other 15 Arizona firms are branches of companies with headquarters outside of the state. 34, or 64%, of the 53 companies are located in Maricopa County. The strongest sectors in Arizona in terms of the total number of firms and total employment include commercial medical research and surgical and medical instruments (together with 50% of the total number of firms and 60% of the total employment).

Bioindustry Growth Analysis

- Arizona is one of seven states where a majority of the existing biomedical/biotechnology firms have experienced employment or sales growth above 25% over the past year.
- Nationally, the highest number of growing firms falls into these sectors: commercial physical research; surgical and medical instruments; and pharmaceutical preparations.
- However, the highest growth on a percentage basis has been in the following sectors: medicinals and botanicals; biological products, except diagnostic; and diagnostic substances (nationally).

Employment

Nationally, the largest employment gains have been in these sectors: pharmaceutical preparations, diagnostic substances, and biological products. Each sector had more than 58% employment growth from 1990 -1997. In Arizona, 5 sectors had employment gains higher than 58% between 1990 -1997. They include: electromedical equipment;

surgical and medical instruments; commercial physical research; pharmaceutical preparations; and surgical appliances and supplies.

2.3 Competition

Nationally recognized biotechnology industrial clusters tend to be located either along the East or the West Coast, with California figuring prominently in the mix. In fact, in a 2000 survey of biotechnology executives in the Los Angeles area, four of the five top ranking biotechnology areas were in California (see Table 1). Other areas with a prominent national reputation for biotechnology include: Boston’s Route 128, Montgomery County, MD, Research Triangle, NC, Philadelphia, and Seattle. States like Utah and Georgia have recently undertaken efforts to grow their biomedical/biotechnology industry.

Table 1: Ratings of the Nation’s Biotechnology Centers by Los Angeles Executives⁵

| Region | Overall Ranking |
|----------------------------|------------------------|
| Boston, MA | 1 |
| San Francisco | 2 |
| San Francisco Bay Area | 3 |
| San Diego, CA | 4 |
| Los Angeles/Orange County | 5 |
| Research Triangle Park, NC | 6 |
| Princeton, NJ | 7 |
| Austin, Texas | 8 |

A recent report completed for the Biotechnology Industry Organization details the current efforts of 41 states to either grow or more effectively leverage their participation in the expanding biotechnology industry.⁶ Several neighboring states reported state level biotechnology initiatives, these states include: California, Colorado, New Mexico, Texas and Utah. Neither Arizona nor Nevada was included in the report. According to authors of the report, no data was available for Arizona and Nevada was one of seven states reporting that their states had not initiated any activities focused exclusively on bioscience companies.

2.4 Nature of suppliers to the program

In contrast to the traditional supply chain view of industry as commonly associated with manufacturing and defined by the acquisition and movement of material assets, the Arizona Biodesign Institute’s raw materials are in fact its intellectual capital as embodied in the talent of the researchers, faculty, students and staff it can attract. By strengthening ties between ASU and the surrounding industry and healthcare

⁵ Source: San Francisco Partnership and Bay Area Council, 2000.

⁶ State Government Initiatives in Biotechnology 2001, September 2001, Battelle Memorial Institute (the report is available at www.bio.org).

communities, the Arizona Biodesign Institute should be able to attract top-notch researchers in emerging areas of synergistic research in the realms of biomedicine, biotechnology, bioengineering, bioinformatics and materials research (including cellular electronics and bionanotechnology).

The Arizona Biodesign Institute has already undertaken efforts to identify and recruit appropriate faculty and researchers to augment its overall research capacity in its five priority research focus areas. At a more general level, ASU is in the process of identifying promising young talent for recruitment in a variety of areas of potential impact to Arizona Biodesign Institute, including the life sciences.

ASU has several highly successful graduate programs aimed at synergistic research such as its NSF Research Training Group (RTG) in Optical Biomolecular Devices, now in its fourth year, and its recently NSF funded Interdisciplinary Graduate Education and Research Training (IGERT) program in Biomolecular Photonics. Both programs have been highly successful in recruiting top caliber graduate students and post docs and can serve as models for the Arizona Biodesign Institute's student recruitment efforts.

3.0 Operational Strategies

3.1 Development and production

3.1.1 Development status

The Arizona Biodesign Institute is a new concept. It does however leverage TRIF investments that have been made to date. The Institute draws upon strong core competencies among the ASU faculty, however the first priority shall be to supplement these core groups and implement and solidify ASU's partnership with the newly established International Genomics Consortium (IGC) and Translational Genomics Research Institute (TGEN). Anticipated hires in each of the three original areas of Prop 301 funding either directly or indirectly supporting the new Arizona Biodesign Institute are summarized below.

Functional Genomics

Partnership with (IGC) and (TGEN)

Through a state-wide initiative, Dr. Jeffery Trent and the IGC is relocating to Arizona. Additionally, TGEN is being established in Arizona as a world-class genomics, biosciences and biotechnology research institute that can efficiently translate information from the human genome into medical applications to improve human health. TGEN is envisioned to stimulate commercialization of biomedical advances in order to benefit the public and to promote economic development. ASU is committed to helping IGC and TGEN succeed in its ambitious mission and through AzBio will partner with TGEN in the following ways:

Faculty Hires: Four faculty members will be hired jointly between ASU and TGEN using TRIF funds. One such joint hire has already been accomplished through the hiring of Dr. J. Touchman to become Executive Director of the DNA Sequencing Core of TGEN.

ASU is also in the process of investing in a high-end computing facility to facilitate the research of IGC and TGEN. The identification of the appropriate software and hardware and the hiring of staffing for the facility have already begun. Additionally ASU will augment its already established evolutionary functional genomics program in cooperation with the TGEN. (see below)

Evolutionary Functional Genomics

Experimental Bioinformatics: The focus of this research is the creation of a unique partnership between genome informatics (information gained by probing large data bases including genome and protein sequences from many organisms including humans) and experimental research. Such analyses using large data bases and computer simulation and modeling can lead to novel experimental hypothesis testing for problems spanning human disease to the origin of species and life.

POTENTIAL FACULTY HIRES

- (i) Target Hire. (Name Withheld)

Research area: **Genetics and molecular biology of color vision.**

His current work involves designing visual proteins by site-directed mutagenesis and DNA-chip analysis in animals with and without vision. He will also be interested in testing hypotheses about functionally important mutations generated in our computational analyses. Note that this candidate was a top-5 finalist for the Del Webb endowed chair search in Biology, a few years ago. Therefore, the excellence of his research program is already well recognized. His work is routinely featured in general media as it relates to color vision in humans and other model organisms.

- (ii) Assistant Professor (Tenure-track). Open search.

Research Area: **Developmental genetics**

Expected research involves large-scale high-throughput in situ studies in understanding animal development. This person will extensively employ information gained in our computational analysis in designing his/her experiments.

Origin and diversification of life on earth and elsewhere.

- (iii) Target Hire. (Name Withheld)

Research Area: **Patterns and processes responsible for the origin of major life forms.**

This candidate's current work involves studies in early evolution of life, vertebrate evolution, historical biogeography, and primate evolution. His laboratory is part of NASA's Astrobiology Institute. This candidate's research is continually featured in top scientific journals and in the media.

Population Genomic analysis of human polymorphism data

- (iv) Assistant Professor (Tenure-track). Open search.

Research Area: **High throughput Population Genomics.**

This investigator will likely conduct large-scale studies to understand variation among humans in different genomic regions and their potential disease association. In designing experiments, he/she will have the opportunity to extensively employ our computer-generated information on the propensity of different mutations found in disease-causing genes.

P-3 Center: Protein and Peptide Pharmaceuticals

POTENTIAL FACULTY HIRES

(i) Anticipated Hire. Open search.

Research Area: **Bioinformatics.**

Bioinformatics expert to design computational algorithms to characterize motif structures of existing proteins, which will assist in the virtual design of peptide based pharmaceuticals.

(ii) Anticipated Hire. Open search.

Research Area: **Analytical Chemistry.**

Analytical chemist devoted full time to mass spectroscopic analysis of engineered and synthesized molecules.

(iii) Anticipated Hire. Open search.

Research Area: **Physiology**

Physiologist to develop bioassays to analyze the engineered P-3's which will provide the platform data necessary to support patent claims.

POTENTIAL POST DOCS, AND STAFF

Three (3) post-doctoral fellows and two (2) technicians will be hired to facilitate the actual experimental work.

An administrative assistant will coordinate the overall effort of the group.

Recruitment Strategy/Process (applies to all applicable research positions above)

The descriptions for these positions will be clearly established and a wide based advertising approach taken to optimize the applicant pool. Specific targets will also be identified using the NIH CRISP data base, medical publications, and advice from experts in the respective fields. The goal is to identify individuals with entrepreneurial attitudes who are willing to work in a multidisciplinary team approach to accomplish the overall goals of the Institute. Ideally, individuals who are funded, but are relatively early in their career (late Assistant early Associate Professor levels) will be targeted. This field is relatively young but rapidly evolving, thus, the goal would be to implement these hires as rapidly as it is possible to identify the best individual for each position.

ProVacs Center: Production of Vaccines from Applied Crop Science

POTENTIAL FACULTY HIRES

(i) Target Hire. (Name Withheld)

Research area: **Plant biotechnology with expertise in Intellectual Property.**

An expert on plant biotechnology with expertise in Intellectual Property management to fill a void in our proVacs management team. One such candidate has visited ASU, is interested in leaving his/her current industrial research position, and could be joining ASU within 2-4 months. This candidate would be an excellent addition to teaching programs in ASU's life sciences. He/she is strong in molecular biology, but also has a broad background that relate to bioethics/public perception/intellectual property.

(ii) Faculty Promotion. (to Tenure-track professor)

Research area:

Make permanent one position (conversion from research assistant professor to tenure-track assistant professor) for an existing ASU non-tenured faculty member who has established an excellent track record for attracting grant funds. Startup costs would be very minimal, since this candidate is already in place. Advantage for ASU of conversion will be that the candidate can begin to focus additional energies on long-term, basic research programs to complement his current targeted funding that covers his own salary plus all of his laboratory activities.

(iii) Research Team Development. (pending success of a previously submitted Proposal)

Research area: **Biotechnology, Health Economics and Policy, and Clinical Trial Management (multiple individuals)**

Upon successful funding of proVacs by a major pending proposal to a national foundation, recruit eight (8) Research Faculty in areas ranging from biotechnology, health economics and policy, and clinical trial management. Two of these would be in the plant biotechnology/wet laboratory arena. Funding would come from the foundation grant, supplemented by other funding sources.

(iv) Long Term Recruitments.

Research area: **Microbiology, and Clinical Immunology**

Longer term, after establishing momentum, recruit a microbiologist and a clinical immunologist to establish a broader center of excellence in bio-design of vaccines.

Center of Neural Rehabilitation Engineering

The new hires of Drs. James Abbas and Ranu Jung in partnership with Banner Health will greatly enhance our spinal cord related research. We need to take targeted immediate action on four additional fronts.

POTENTIAL FACULTY HIRES

(i) Target Hire. (Name Withheld)

Research area: **Motor Control**

This individual was trained at USC as a bioengineer and MIT as a motor control scientist and a respected rising young star in motor control research community. He is working on motor learning and control research. He has had several high impact publications and continued NIH and NSF support over the last few years, and is a potential leader in the field.

(ii) Target Hire. (Name Withheld)

Research area: **Primate Research/Motor Control**

This individual has been critical in the successful operation of primate research at ASU. He is trained as a system neurophysiologist from U Minnesota and worked as a post-doc with the director of motor control research program at U Pittsburgh. He is now indispensable for our operation of primate research because of his connection and training background.

(iii) Target Hire. (Name Withheld)

Research area: **Neural Prosthetics**

This individual is a first class neural prosthetics researcher with national visibility and would nurture our relatively young faculty group. This candidate is a recent electee to the National Academy of Engineering.

(iv) Anticipated Hire. Open search

Research area: **Bio-MEMS (Micro-Electro-Mechanical Systems) for Neural Implants**

Bio-MEMS faculty for neural implants and stimulation system design and fabrication using NANO and Micro-technology is desirable.

Nanoscale Bio-Optical Technologies (NANOBOT)

POTENTIAL FACULTY HIRES

(i) Anticipated Hires. Open searches

Research area: **Interfacial Chemistry, and Combinatorial Immunology**

The two highest priority needs of expertise within the context of this center are in the areas of interfacial chemistry (the interface between surfaces and molecules) and in combinatorial immunology (the use of large protein libraries, usually based on antibody structures, to generate molecular recognition). The search for the interfacial chemistry position has been ongoing since late last spring.

NanoBiosystems Center

Recruitment Strategy/Process

With the downsizing of Motorola ASU has a one-time opportunity to immediately assemble an applied research team of high quality individuals who are experts in nano-biosystem applications. We have identified 3 individuals who we consider critical to a successful grant-funded independent research operation: Frederic Zenhausern, Piotr

Grodzinski, and Chia-Fu Chou. The first two are current leaders of the two Motorola groups and the third is a research scientist with research experience as a postdoc at Princeton University. We are in final negotiations with to join ASU as Research Faculty. Eventually a group of about 12 people will be assembled with the necessary skills to complete this Center. Many of these may be coming from Motorola.

Zenhausern, who has a unique combination of skills, would lead the team. He receives high marks from his references as a manager for assembling a strong team at Motorola over the past two years, and as a concept innovator and scientist in nanoscale phenomena. He has both a Ph.D. in Physics and an MBA in Finance. He has experience in university and industrial research and has demonstrated the ability to develop relationships with outstanding national and international centers of excellence in the academic and private sectors. He has a significant record of research advances through publications and technical advances through patents, as well as experience in research grant writing and acquisition, research management and business development. He has initiated cutting edge projects at large, medium and start-up companies. Such skills will be required for the new Center to provide a unique and competitive environment for taking basic knowledge available from the universities and transforming it into products and processes with relevance for our society.

Center for Single Molecule Biophysics

Recruitment Strategy/Process

A nationally known scholar who has demonstrated strong entrepreneurial abilities is currently leading this center. He will lead a multi-department search group charged with recruiting candidates from across the physical sciences for six positions. Positions will be widely advertised as part of an interdisciplinary pool, leaving open the possibility of group hiring and serving to broadcast the University's ambitions.

While this strategy will bring us some advantage over conventional single-department hiring, it is also critical to address our weakness in recruiting the best graduate students. To this end, a campaign to attract top students with competitive stipends is under development. Coordinated with the IGERT in biomolecular nanotechnology, (and any future NIH training grant) this program should attract a talented cohort of graduate students. Access to this pool will be a key recruiting tool for new faculty.

The proposed areas of expertise for hiring are:

- Single Molecule Optical Methods
- Self-assembly and Design of Supramolecular Structures
- Theoretical Modeling of Molecular Processes
- Bio-inspired New Materials, Directed Evolution Methods in Materials Science
- Biomolecular/electronic Materials Interfaces, and Interfacial Organic Chemistry
- Bio-Molecular Motor Applications in Nanoscience
- Novel Probes of Molecular Structure and Function

Evaluation criteria will be:

- Will the research area integrate well into the team and will it help develop new collaborations with existing faculty, the Biodesign Institute/Genomics Consortium and Bioengineering/the Nanobiosystems group?
- Does the candidate have, or will the (junior) candidate shortly have, NIH funding?
- Does the candidate represent a substantial improvement on current faculty quality?

3.1.2 Production process

The Arizona Biodesign Institute's "production process" can most simply be defined as (1) the harnessing and leveraging of talent, and (2) strategic partnering with our sister universities, the IGC, and other related institutions/industry.

This key activity breaks down into several elements:

- Faculty Recruiting - Attract nationally competitive research faculty as well as very promising junior faculty to bridge disciplines, supplement existing teams, and forge entirely new areas of inquiry.
- Faculty Coalescing - Catalyze new interdisciplinary work by creatively linking teams of researchers to exploit emerging federal research opportunities.
- Student Development - Significantly ramp up the underwriting of high quality graduate students, establish opportunities for these students to interact with regional employers, and engage them in leading research and leadership development activities.
- Institutional Partnering - Create umbrella relationships among institutional partners, both corporate and non-profit, such that faculty can pursue new and novel collaborative work in barrier free environments. This could include Memorandums of Understanding that set forth automatic and predetermined sharing of resources, rights to intellectual property, and other items. Link closely with the strategic biosciences efforts launched by NAU and the U of A.

3.1.3 Cost of development

Costs associated with recruiting and retaining quality researchers are likely to continue to rise, as the industry becomes increasingly competitive. The marketplace for high-end research talent is small. Bidding for talent is razor keen. Almost anyone can be attracted for the right price, but at this level of competition the price is often very high.

Junior level, but very promising, researchers and high quality graduate students are, by comparison, easier to attract. But there is still a high demand for such people.

3.1.4 Labor requirements

See section 3.1.1 above

3.1.5 Expenses and capital requirements

Arizona State University is carefully considering several different funding models for the proposed Arizona Biodesign Institute facility. One promising model, a "Partial

Entrepreneurial” approach may give the University greater autonomy and flexibility. Traditional bonding would pay for the shell and core of the building, while Indirect Cost Recovery (ICR) gradually pays for tenant improvements - either directly or through issuance of additional bonds. This approach would allow for more rapid construction of the facility.

Preliminarily we are assuming a 170,000 sq ft building costing \$67M. The University would cover \$38.9M and the researchers would be responsible for \$28.1M. Using this calculation, Arizona Biodesign Institute researchers would need to generate \$114 per square foot of research expenditures, if 45% of the available ICR were diverted to financing the new space. The annual cost to service the University’s bonds would then be \$3.546M, while ICR would need to cover annual financing, operations, and maintenance costs of \$2.9M.

| | |
|---|---------------|
| Additional Research Generated per Sq.Ft. Research Space | \$ 114 |
| Additional Research Space (Sq.Ft.) | 170,000 |
| Total Research Revenue Derived from Space Allocated | \$19,380,000 |
| ICR Derived | \$ 6,395,400 |
| ICR Recovery Factor (assuming 50% ICR rate) | 33% |
| ICR Flexibility Factor (% of ICR stream deflected) | 45% |
| Availability for Debt Service OR Other Investments | \$ 2, 877,930 |
| Facilities Cost per Sq.Ft. | \$ 394 |
| Total Project Cost | \$66,980,000 |
| Annual Debt Service and O&M | \$ 6,414,400 |
| Shell Space Contribution Annually from ASU | \$ 3,546,311 |

Under this model, some of ASU’s costs could be defrayed if part of the space is provided to researchers from the Carl Hayden Veterans Administration research group, the Phoenix based NIH National Institute of Diabetes & Digestive & Kidney Diseases research group, and/or the Translational Genomics Research Institute through long-term lease agreements.

Architectural plans have been drawn for core facilities and greenhouses at ASU East for the development of protein pharmaceuticals are currently under construction. Additionally ASU is in the process of upgrading and increasing the square footage for animal care facilities on the Main campus so that these research facilities will maintain appropriate accreditation while serving an increasing number of biomedical researchers who utilize animal models for human diseases.

3.2 Marketing and Promotion

3.2.1 Strategy

Attracting the right mix of a critical mass of human capital to ensure the Arizona Biodesign Institute's long-term success will depend on a number of factors:

- Compensation – The Arizona Biodesign Institute must be prepared to offer generous salaries.
- Facilities - High quality and "desirable" lab space is an essential element of recruiting.
- Collaborative Environment – The Arizona Biodesign Institute will attempt to identify and leverage any collegial ties existing between prospects and current ASU faculty. Other mechanisms such as brokering key relationships as part of the recruiting process may be a vital component of acquiring new talent.
- Quality Perception – The Arizona Biodesign Institute will appeal to those looking for a 1st class undertaking. Perhaps where they may be distinctive in ways they cannot currently attain, or be associative with others of similar research pedigree. New facilities help convey the commitment to high quality as does the continuation of 301 funding. Early targets of recruitment must bring with them the aura required to build the perception of excitement, cutting edge work, and high potential payoff for the 2nd wave of recruits to be successfully attracted.
- Cultivation - Attracting talent is often a process of relationship building and can best be viewed as a developmental process taking several months up to a few years. Persistent and structured contacts will be undertaken with a significant pool of qualified prospects with the realization that the successful closure rate may be in the range of 1 recruitment for every 4 prospects.
- IGC – It is anticipated that the Arizona Biodesign Institute's partnership with the International Genomics Consortium (IGC) and Translational Genomics Research Institute (TGEN) will add a further competitive edge to the Institute's ability to attract prominent senior level researchers looking for opportunities to conduct cutting edge research in the areas of genomics, bioinformatics and genetic medicine.

3.2.2 Method of promotion

Arizona State University has reorganized its leadership management structure and has established goals and objectives for each component of this group. Working together, the Office of the Vice President for Research and Economic Affairs and the Vice President for Public Affairs will accomplish the following:

- Develop and implement an aggressive science and technology awareness program, and
- Articulate and communicate a distinctive research development agenda.

3.2.3 Advertising and promotion plans

Recruitment has been initiated for a national media relations director. This position will be responsible for dramatically improving ASU's presence in major markets relative to its excellence in research, among other areas. The Arizona Biodesign institute will be a focal point of this promotional effort.

ASU will develop and launch high profile annual scientific conferences related to the Arizona Biodesign institute and other strategic research thrusts to raise the profile of its research programs among federal funding agencies, industry, and the national and international research communities. The aim of these events shall be to not only

promote ASU as a magnet for attracting talent, but also to stimulate additional collaborations.

3.3 Project Management

3.3.1 Organizational setup

A search firm has been identified to recruit a nationally prominent individual to lead the Arizona Biodesign institute. This person shall possess a highly distinguished record in research and intellectual leadership in the field. The Director of the Arizona Biodesign Institute will be charged with: (1) attracting the highest caliber research talent to the Institute, (2) establishing and maintaining a cutting-edge intellectual research agenda for the institute, and (3) ensuring the effective transfer of new knowledge into the community and state for the purpose of stimulating associated economic development.

The Director will report to the Vice President for Research and Economic Affairs and shall have adequate support staff and authority to carry out this mission.

Additionally, the Director will be empowered to establish internal faculty committees to assist in the pursuit of new research opportunities and partnerships, as well as to provide advice and support to the growth of the Institute.

3.3.2 Advisory board

The existing advisory board for the previously established AzBio initiative, will be expanded and made a more central component of the Arizona Biodesign Institute's strategy for growth.

In addition to oversight and advice, the advisory board will be engaged actively in the identification and attraction of new talent, the securing of industrial support, and advocacy.

3.3.3 Support services – Technology Transfer

Technology Transfer will develop an integrated program by focusing on marketing, licensing, and business development planning. This includes several components:

- Integrate ASU into a national partnership for technology transfer among other elite universities,
- Encourage more invention disclosure activity,
- Provide an enhanced system and procedure whereby new inventions are evaluated in a more due-diligent manner,
- Advance the development state of ASU inventions through a special pre-seed grant program,
- Enhance ASU's effectiveness in marketing new technologies, and
- Create a climate in which faculty are encouraged to be more entrepreneurial.

The Office of Technology Collaborations & Licensing (OTC&L) is charged with implementing ASU's technology transfer program. It assists ASU faculty establish and manage collaborative research relationships with industry. OTC&L is part of the Office

of the Vice President for Research and Economic Affairs and the service point for Intellectual Property matters for all ASU colleges and departments, as well as those for Northern Arizona University.

ASU has just launched a national search for a new OTCL Director, who will need to have strong entrepreneurial credentials with a thorough grasp of global, national, regional, and local economic trends.

ASU licensing revenues have increased by over 400% in the past five years, to \$1.75 million in FY2001. The technology transfer office has been ranked as the fifth most productive in the U.S. when measured by invention disclosures scaled against total university research funding. While OVPREA serves all faculty members at ASU, OTC&L focuses primarily on those in fields that typically produce new inventions, including all sub-disciplines of engineering and the life, physical, and behavioral sciences. Faculty members from other parts of the University, including education, business, and communications, also have participated in technology transfer. ASU currently holds over 100 U.S. and 800 foreign patents covering technologies that include: new computer architectures; biocompatible polymers for wound healing; new pharmaceuticals for various diseases; genetic systems for making crops more drought-tolerant; micro-electromechanical switches; new lasers for optical telecommunications; new semiconductor materials; and many others.

Using funds from Proposition 301, Arizona State University will develop a more comprehensive system for technology transfer to facilitate a more intense and sustained level of collaboration between university researchers and local industry. This collaboration will encompass the entire technology transfer lifespan of an innovation or technology, from its discovery by ASU scientists to its licensing with Arizona private industries and entrepreneurs seeking marketable products. We envision a completely integrated program designed to incorporate technology mining from faculty research programs, patenting new inventions, technology development, technology assessment and marketing, private sector collaborations, licensing, and business development including the formation of new Arizona companies.

ASU recognizes that education of both the faculty and the local community is key to the successful advancement of technology transfer and industrial research collaboration at the University. Our objectives are two-fold: 1) to educate faculty as to the benefits of patenting and licensing the fruits of their scientific research; and 2) to educate the local community and the private sector about university policies and procedures related to research and intellectual property as well as the nature of university research.

In total, OTC&L's education and outreach efforts included at least 275 individual contacts and over 350 people attending various events over the past year.

TiE (The Indus Entrepreneur - <http://www.tie.org>) is a professional trade organization with a significant operational presence in Arizona. TiE Arizona was founded to inspire, foster and support entrepreneurship in Arizona. Professionals and students working at startups, working with startups or seeking to learn from other entrepreneurs will gain

access to invaluable educational, networking and partnership opportunities through TiE. TiE has three main objectives on its charter: 1) to foster entrepreneurship and nurture entrepreneurs; 2) Provide a networking platform for its members; and 3) to help members integrate with the mainstream community. TiE Arizona is focused on providing its membership and the community with activities and events that further its goals of fostering and nurturing the entrepreneurial environment. These include speaker events (with keynotes and panels) and networking meetings for entrepreneurs, educators, investors, etc.

OTCL has developed a significant working relationship with TiE in which a regular program of Saturday morning seminars and events are being sponsored. The venue is the Memorial Union at ASU and a continental breakfast is served. The topics are wide ranging including educating faculty about entrepreneurship; developing a sophisticated operational model for evaluating and advancing university innovations; success stories about ASU spinout companies and educating local private companies about university policies & procedures for industrial research collaboration. The program was started in Fiscal Year 2002 using funds from Proposition 301 and has thus far been a huge success. We anticipate continuing the program into Fiscal Year 2003 and beyond.

3.4 Risks and Plans to Overcome Risks

3.4.1 Legal risks and means to minimize them

Potential perceived legal risks involving the activities of the Arizona Biodesign Institute are two-fold.

- A potential legal risk involves industry partnering as it relates to various aspects of technology transfer and intellectual property rights as governed by the Intellectual Property Policy of the Arizona Board of Regents. ASU's Office of Legal Council and the Office of Technology Collaboration and Licensing are both available to advise university researchers as to matters of this nature.
- A second potential legal risk involves the conduct of human and animal trials. The Institutional Review Board and the Institutional Animal Care and Use Committee govern such experiments, under the charter of the Office of the Vice President for Research and Economic Affairs.

Other University units such as the Office of Risk Management and the Office of Radiation Safety are available for consultation as necessary.

3.4.2 Regulatory problems and how to address them

As noted above, the Institutional Review Board, the Institutional Animal Care and Use Committee, the Office of Risk Management and the Office of Radiation Safety are each responsible for advising researchers of relevant local, state and federal statutes impacting their proposed research.

3.4.3 Political risks and how to ameliorate them

There is general wide spread support for biomedical and biotech research among the public and political communities. Issues that need to be watched and managed include, (1) potential negative implications of genetics research which some opponents link to

genetic profiling and the potential health and environmental risks of genetically modified foods, and (2) any association with embryonic stem cell research or cloning (with which ASU is not currently associated).

3.4.4 Business risks and other competitive risks

As a largely research based initiative, the Arizona Biodesign Institute is subject to the same risks as any other large university initiatives. These risks include the following.

Maintaining Faculty Performance

By nature of its design, the Arizona Biodesign Institute is intended to appeal most to highly productive, “star” performers among the larger faculty body. Measures need to be in place to help guarantee that faculty, once made a part of the Biodesign Institute, are able to maintain and even improve upon these performance levels. Likewise, mechanisms need to be in place to transition less active faculty out of the Institute once their performance levels begin to lag or their research is no longer central to the future research agenda of the Institute.

Industrial Partnering

In the current economic climate obtaining substantial commitments from industry to participate in university-industry partnerships is challenging. The Arizona Biodesign Institute must continue to explore alternative ways to involve local industry in the objectives of the Institute, including recruiting firms from other parts of the county to Arizona.

Faculty retention

Proposition 301 funding has made it possible to hire outstanding young faculty members at competitive salaries. A by-product of these hires and the current difficulties in the state budget is salary compression and (in some cases) even salary inversions. Retention of existing excellent faculty becomes difficult in such situations, and presages retention problems in the near future for those outstanding faculty hires this year.

Senior leadership

Hiring world-class leadership is essential to establish both the reputation and agenda for the Arizona Biodesign Institute. The Institute requires a leader with both the ability to interface with and strengthen ties to local and national industry as well as someone who understands the federal research funding environment and the political considerations involved therein.

Competition for federal research support

It is expected that the seed funding for new initiatives will be rapidly replaced by external funding, and the largest source of such support is from federally funded research programs at NIH, NSF, and DARPA. To continue the growth that has been established in recent years ASU has to build on the momentum that has been developed, but must also recognize that the competition has become increasingly stiff as the size of other programs grow. ASU must now compete with very well established research programs, and do so rapidly and with a relatively young faculty. There is a

tendency to make “safe” research investments at federal agencies and ASU must grow in visibility and inspire confidence.

3.5 Sustainability

The Arizona Biodesign Institute faces several hurdles to long-term sustainability, mostly centering on faculty retention, external funding development and institutional/industry partnering. Some of these issues are presented below.

- A commitment on the part of University and College administration to transition faculty hired using 301- funds to department lines following cessation of 301 funding is necessary to entice young and promising faculty to commit to coming to ASU.
- The University must also make an ongoing commitment to retaining highly productive, faculty who will become increasingly attractive targets for hire by other universities as their individual research programs gain in prominence.
- Active monitoring of seed grants is necessary to ensure that these grants lead to significant external funding while continuing to invest in other new and promising areas.
- The Institute researchers must continue to seek new ways to effectively engage both other state educational institutions such as U of A and NAU as well as local industry in effective and highly productive research partnerships.

Most aspects of the Arizona Biodesign Institute will become self-sustaining with external funding from the federal government, foundations and industry support, and licensing and other revenues within five years. ASU will review each segment of the Institute annually. Should any portion or portions of the Institute appear to be at serious risk for not reaching this goal, the University will either take corrective action or amend the development plan for the Institute to reinvest TRIF resources in projects or human resources that exhibit the ability to provide a suitable return on investment.

4. Goals/Metrics/Outcomes

4.1 Measurable goals

4.1.1 Return on investment

Arizona State University

Arizona Biodesign Institute (AZBio) and Ancillary Project Investments

Performance Measures and Deliverables

FY 2003 Through FY 2007

| | <i>FY 2003</i> | <i>FY 2004</i> | <i>FY 2005</i> | <i>FY 2006</i> | <i>FY 2007</i> |
|--|--------------------|--------------------|--------------------|--------------------|--------------------|
| | <i>PROJECTED</i> | <i>PROJECTED</i> | <i>PROJECTED</i> | <i>PROJECTED</i> | <i>PROJECTED</i> |
| Return on Investment | | | | | |
| 1. External funding: new federal awards | \$8.50M | \$11.00M | \$14.00M | \$17.00M | \$20.00M |
| 2. External funding: new industrial contracts and donations | \$3.20M | \$3.40M | \$5.00M | \$6.50M | \$8.00M |
| 3. Value of new startups to ASU | \$120K | \$240K | \$360K | \$540K | \$700K |
| 4. New products in marketplace | 3 | 4 | 5 | 6 | 7 |
| 5. Value of new products to ASU | \$420K | \$780K | \$1,200K | \$1,740K | \$2,000K |
| Work Force/Access Contributions | | | | | |
| 1. Increase in number of teachers who graduate with math/science certification | 10 | 15 | 25 | 25 | 25 |
| 2. New post-doctoral students in pipeline | 5 | 5 | 5 | 5 | 5 |
| 3. New post-doctoral students entering workforce | 0 | 3 | 5 | 5 | 5 |
| 4. New graduate students in pipeline | 45 | 50 | 55 | 55 | 55 |
| 5. Graduate students earning degrees and entering workforce | 0 | 20 | 27 | 30 | 35 |
| 6. Undergraduate students with research experience | 50 | 52 | 55 | 60 | 65 |
| Curriculum Innovations | | | | | |
| 1. Tier 1 introduction to Information Technology for all students | | | | | |
| 2. Tier 2 package of 3 courses | | | | | |
| 3. Tier 3 concentration for BIS degree | X* | | | | |
| 4. BS Applied Computing (ASU West) | X* | | | | |
| 5. High school students completing software design material | 30 | 50 | 50 | 50 | 50 |
| 6. Internships (industry or Software Factory) | 40 | 50 | 50 | 50 | 50 |
| Technology Transfer | | | | | |
| 1. New software packages distributed | 2 | 2 | 3 | 3 | 3 |
| 2. Form industry-university nationwide research consortium | X | | | | |
| 3. Create research road map in collaboration with industry | | | | | |
| 4. Invention disclosures | 27 | 36 | 48 | 60 | 75 |
| 5. Patent applications | 8 | 12 | 16 | 20 | 25 |
| 6. Patents | 2 | 3 | 4 | 5 | 6 |
| 7. Startup companies | 1 | 2 | 2 | 3 | 3 |
| 8. Fund proof of concept grants to faculty | 5 | 5 | 5 | 5 | 5 |
| 9. Business plans written | 3 | 4 | 5 | 6 | 7 |
| 10. Technology transfer portal inquiries from industry | 10 | 15 | 20 | 25 | 30 |
| 11. Licenses/options signed (technologies adopted by industry) | 3 | 4 | 5 | 6 | 7 |
| Partnerships | | | | | |
| 1. New research collaborations with industry and national laboratories | 7 | 8 | 8 | 8 | 8 |
| Economic Development | | | | | |
| 1. Companies identifying ASU as a factor for relocating or expanding in AZ | 1 large 3 small | 1 large 4 small | 1 large 4 small | 1 large 4 small | 1 large 4 small |

4.1.2 Technology transfer

By FY 2006, ASU's goal is to double its level of performance and to continue on that trend line through the balance of the decade.

4.1.3 Companies relocating

The Arizona Biodesign Institute intends to be an active participant in the recruitment of new companies to Arizona, as well as a research platform for the expansion of existing companies by using matching funds for generating jointly written research proposals

with industrial partners. ASU has already played a prominent role in luring the International Genomics Consortium to the Phoenix area as well as in the establishment of the TGEN. It is anticipated that as the Arizona Biodesign Institute's prominence grows it will become an even greater magnet for attracting both young startup and more established companies to Arizona and the Phoenix Metroplex.

4.1.4 *Work force contributions*

ASU made great progress on its Access/workforce plan over the past year and one-half. Proposed curricular changes for all tiers of the Technology Across the Curriculum program will be institutionalized by the end of FY04. Faculty hires in the disciplines will migrate off 301 funds over the next two years and the proposed classroom upgrades are complete. Funds, as they become available, will support three work force areas related to the Arizona Biodesign Institute (See section 6).

4.1.5 *Specific curriculum innovations*

The recently funded NSF IGERT in Biomolecular Photonics will lead to a substantial system-wide change in graduate education. Specifically, a new formal interdisciplinary emphasis in Ph.D. programs of Physics, Chemistry, Plant Biology, and various Engineering disciplines will be created in the design and fabrication of molecular-scale devices based on the principles learned from photobiology. New courses and laboratory experiences will be designed and implemented.

4.1.6 *Partnerships/collaborations*

In addition to the developing partnership with IGC and TGEN (see previous) Partnerships and research collaborations are being developed with medical institutions and companies including: Mayo, Sunhealth, VA, NIDDK, Barrow Neurological Institute, Scottsdale Healthcare, Bannerhealth, Arizona Health Sciences Dental School, Advanced Bionics, Medtronics, CreaAgri, Arizona heart Institute, and Intel. Additionally:

- Motorola, Inc. – ASU is a subcontractor on a large DARPA contract aimed at developing DNA analysis on a microchip. Another group of ASU researchers in Biomolecular Photonics is collaborating with Motorola research labs on creating prototypical functional organic nanoscale optoelectronic devices. Motorola is also a partner in our NSF IGERT grant on Optical Biomolecular Devices.
- Kodak – is a partner in our NSF IGERT grant on Optical Biomolecular Devices.
- Lockheed Martin – ASU has teamed with Lockheed Martin on a DARPA proposal that is likely to be awarded on development of a molecular recognition biosensor on a chip.
- QTL – This small photonic materials company is a partner in our NSF IGERT grant on Optical Biomolecular Devices.
- Molecular Imaging -- This small startup company, spawned by ASU, develops atomic force microscopy technology, and is a partner in our NSF IGERT grant on Optical Biomolecular Devices.
- Sandia National Laboratories – is currently actively supporting our activities in the growth and characterization of wide bandgap group III-nitride materials, that have potential applicability to biomedical devices.

4.2 *Timeline for achievement of goals FY 03*

The key tasks and their associated timelines for implementing the Arizona Biodesign Institute in FY 03 are as follows:

- Announce new Arizona Biodesign Institute – December 2002
- Recruit new Director – January 2003
- Reconstitute External Advisory Council – January 2003
- Targeted faculty hires (achieve 80%) – June 2003
- Open Search faculty hires (achieve at least 50%) – June 2003
- Facility Plan submitted to ABOR for approval – December 2002
- Implement promotional activities for the Arizona Biodesign Institute – January 2003
- Achieve a twofold increase in technology transfer indicators – June 2003
- Show evidence of 2 major joint proposal submissions each with the U of A, NAU, and TGEN – June 2003

4.3 *Early proof of performance*

The indicators for early proof of performance are the following:

- Ability to secure new strategic hires,
- Ability to attract a new Arizona Biodesign Institute Director,
- Restructuring of the AzBio External Advisory Council,
- New investment-related research proposals either submitted from ASU or submitted in partnership with the U of A, NAU, and/or TGEN, and
- Completion of financing package for new facility.

5. Pro Forma Financials

5.1 Income statement (resources and planned expenditures).

Arizona State University
Proposition 301 Revenue and Expenditures
Arizona Biodesign Institute (AZBio) and Ancillary Project Investments
FY 2003 Through FY 2007

| | <u>FY 2003</u> | <u>FY 2004</u> | <u>FY 2005</u> | <u>FY 2006</u> | <u>FY 2007</u> | <u>Total</u> |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| REVENUE⁽¹⁾ | \$ 25,892,000 | \$ 15,900,000 | \$ 16,900,000 | \$ 18,200,000 | \$ 18,500,000 | \$ 95,392,000 |
| EXPENDITURES | | | | | | |
| Arizona Biodesign Institute (AZBio): | | | | | | |
| Personal Services (PS) | 1,932,600 | 3,594,200 | 3,792,200 | 3,743,300 | 4,342,000 | 17,404,300 |
| Employee Related Expenses (ERE) | 387,900 | 704,000 | 742,900 | 732,400 | 858,700 | 3,425,900 |
| All Other Operating (AOO) Expenses ⁽²⁾ | 8,961,200 | 2,766,000 | 6,170,000 | 7,765,600 | 9,119,900 | 34,782,700 |
| Capital Projects | 1,000,000 | 500,000 | 462,200 | 1,000,000 | 1,000,000 | 3,962,200 |
| Subtotal | \$ 12,281,700 | \$ 7,564,200 | \$ 11,167,300 | \$ 13,241,300 | \$ 15,320,600 | \$ 59,575,100 |
| Ancillary Project Investments: | | | | | | |
| Personal Services (PS) | 4,765,800 | 3,357,800 | 2,761,100 | 1,424,700 | 482,000 | 12,791,400 |
| Employee Related Expenses (ERE) | 841,500 | 639,100 | 530,900 | 290,300 | 97,400 | 2,399,200 |
| All Other Operating (AOO) Expenses | 5,518,200 | 4,238,900 | 1,902,900 | 3,243,700 | 2,600,000 | 17,503,700 |
| Capital Projects | 2,484,800 | 100,000 | 537,800 | - | - | 3,122,600 |
| Subtotal | \$ 13,610,300 | \$ 8,335,800 | \$ 5,732,700 | \$ 4,958,700 | \$ 3,179,400 | \$ 35,816,900 |
| GRAND TOTAL EXPENDITURES | \$ 25,892,000 | \$ 15,900,000 | \$ 16,900,000 | \$ 18,200,000 | \$ 18,500,000 | \$ 95,392,000 |

⁽¹⁾ FY 2003 revenue includes FY 2002 carry forward.

⁽²⁾ FY 2003 all other operating expenses include \$4.5 million in commitments to TGen.

6. Ancillary Project Summaries

Access/Workforce

A new program will be developed within The Institute for Strengthening the Understanding of Math and Science (SUMS Institute). The highly acclaimed Math Science Honors Program for financially disadvantaged high school students will be expanded to undergraduate students. The goal is to produce more scientists and Mathematicians from the ranks of underrepresented minorities. A distinguished Hispanic science educator has been recruited from Cornell to lead this effort.

The second area of investment will be the Center for Research on Education in Science, Mathematics, Engineering and Technology (CRESMET). CRESMET, an alliance of Arizona State University's colleges of Education, Engineering and Applied Sciences, and Liberal Arts and Sciences, unites people and organizations to improve science, mathematics, engineering and technology education at all levels (K-20). ASU has begun recruiting for a nationally recognized scholar to lead the CRESMET agenda into new cutting edge research areas, one of which, we anticipate, will concentrate on K-12 and undergraduate education in the life sciences. A linkage will be built between the Arizona Biodesign institute and CRESMET for the purpose of translating new knowledge production at ASU into curricular design and new experimental models for advanced learning.

The third area will be to underpin the development of a School of Life Sciences at ASU. This new entity will substantially refashion the delivery of curricula, thus offering undergraduate students many more options for tailoring their degrees to a knowledge-based economy. Additionally, the proposed School of Life Sciences will enhance further the interdisciplinary research that serves as the foundation for the Arizona Biodesign Institute. Such interdisciplinary research lies at the core of graduate student training and will produce a larger cadre of M.S. and Ph.D. prepared graduates capable of working at the interface between the life sciences and the physical sciences, or the life sciences and engineering.

Information Technology

Activity: Continued development of university-industry partnerships such as the Consortium for Embedded and Inter-networking Technologies (a partnership with Intel and Motorola), Connection-One (C1 is a consortium of ASU and seven companies with NSF support in wireless technologies) and the Center for Advancing Business through Information Technology (a new research center in the College of Business developing a consortium relationship with industry both in the public and private sector focused on IT implications for business processes).

Consortium for Embedded and InterNetworking Technologies. In April 2001, a year and a half long negotiation to create CEINT was completed with ASU, Intel, and Motorola as the charter members with very substantial financial commitments. In August, an Executive Director was hired. In its first year of operation, CEINT awarded \$370,000 in research seed funding, \$170,000 in curriculum development funds, and 32 internships for academic credit and pay. The curriculum development support immediately drew NSF support in \$771,000 in new awards. The Consortium has drawn national attention in Electronic Times and ASEE, as well as in the local press.

Connection One. In April 2002, *Connection One* became a second consortium formed with support from Proposition 301, this one focused on wireless technologies. C1 is receiving NSF support as well to seed development of the consortium and has grown to six participating companies.

Both consortiums continue to actively recruit new industry participants.

Center for Advancing Business through Information Technology. CABIT is making rapid progress both organizationally and in terms of developing industry partnerships. In May 2002, it named Ajay Vinze as the Director of the Center, and has since formed a research relationship with Intel Corporation. Intel has authorized \$63,000 to initiate three projects in Summer, 2002. There is every expectation that ongoing support for these projects for the coming academic year and beyond will be realized. Research relationships are developing with a number of public and private sector organizations.

1. *Faculty Hires* – Two senior hires per year and three junior hires per year for the next two years will be made in key areas of each of these interrelated projects.

2. *Staff Support* – Two technical staff hires will be made in FY 03.

3. *Seed Grants* - \$1 million in seed grant funding will be made available to these projects in FY 03 with the expectation that at least a 2:1 return on investment for these projects is expected in FY 04.