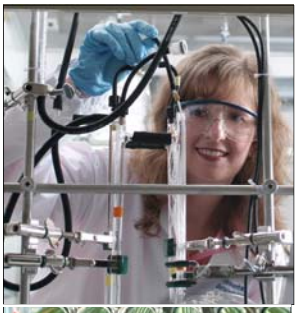
ARIZONA STATE UNIVERSITY TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)



The Biodesign Institute's research engages diverse capabilities for use-inspired projects. See pg. 4 for examples.

ASU BIODESIGN INSTITUTE
ARIZONA STATE UNIVERSITY

The Biodesign Institute is ASU's flagship TRIF initiative. The hundreds of researchers at the Biodesign Institute are driven by a passion to solve some of the world's most urgent problems affecting human health and the health of our planet.

Today's scientific discoveries are increasingly dependent on large, interdisciplinary teams working together to solve well-defined problems. The Biodesign Institute is committed to:

- improving health care through more personalized diagnostics and treatment;
- providing renewable sources of energy and cleaning our environment; and
- outpacing the global threat of infectious disease.

We focus on translating our research into useful technologies, treatments and solutions. The result is that our research includes such ambitious projects as identifying unique disease signatures to diagnose illness before symptoms appear, using microbiology-based technologies for more sustainable sources of fuel and energy, developing vaccines against the world's most devastating diseases, and creating technologies to more rapidly produce vaccines against emerging pandemics.

Success hinges on the convergence of new technologies from vastly different fields of science, and translating these discoveries to commercial uses for societal benefit.

Complementary investments in capacity building project areas support research that demonstrates promise for high impact economic development and future integration with the major Biodesign Institute initiatives.

BIOSCIENCES

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 2009

Contents

Dr. Alan Nelson
Executive Director
The Biodesign Institute

ASU

September 1, 2009

PERFORMANCE ANALYSIS

Biosciences PERFORMANCE MEASURES/IMPACT	FY10 Proj	FY11 Proj
Return on Investment ($ amounts in millions)		.
Federal and non-federal awards	58.80	67.60
Royalty income	0.00	0.00
Foundation funding	0.50	0.50
Return Total	59.30	68.10
Technology Transfer		
New invention disclosures	150	151
New patent applications filed	160	162
New patents issued	21	21
Total start-up companies licensing ASU technology	4	4
Licenses or options signed (as indication of technology adoption by industry)	33	34
Work Force Contributions		
Post-doctoral appointments	81	93
Post-doctoral researchers leaving to enter the workforce	12	13
Graduate students employed	253	278
Graduate students earning degrees and entering the workforce	45	47
Undergraduate students involved	214	225
Partnerships/Collaborations		
The number of research grants/contracts involving funding from non-government entities	35	39
The number of research grants/contracts involving subcontracts to non-ASU researchers	6	8

EXPLANATION OF PERFORMANCE ANALYSIS

Return on Investment measures include federal and non-federal awards, royalty income and foundation funding for Biodesign and capacity building project investments. The sum of these three components (the Return Total) is then divided by the related TRIF expenditures for the fiscal year to arrive at the Return on Investment ratio included in the financial table below.

Technology Transfer measures provide results for ASU's technology transfer initiative, Arizona Technology Enterprises (AzTE). Measures for inventions, patents and licensing activity are included. AzTE facilitates the development of ASU's intellectual property, promotes industrial linkages, drives technology marketing, and accelerates the successful transition of ASU discoveries into the marketplace.

Workforce Contributions measures show the impact of TRIF funding and research participation by undergraduate students, graduate students, and post-doctoral appointments within the TRIF projects. The measures also include the number of graduate students and post-doctoral researchers leaving ASU to enter the workforce.

Partnerships/Collaborations are an important component for growth of the Biodesign Institute and capacity building project initiatives. Increasing involvement with non-government and non-ASU researchers such as the Mayo Clinic, TGen and Barrows Neurological Institute provides additional opportunities to expand and enhance ASU research.

ASU Consolidated PERFORMANCE MEASURES/DELIVERABLES	FY02 Actual	FY03 Actual	FY04 Actual	FY05 Actual	FY06 Actual	FY07 Proj	FY07 Actual	FY08 Proj	FY08 Actual	FY09 Proj	FY09 Actual	FY10 Proj	FY11 Proj
Biosciences (Incl Capacity Building Project Investments)													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards												58.80	67.60
Royalty income												0.00	0.00
Foundation funding												0.50	0.50
Return Total												59.30	68.10
Technology Transfer													
New invention disclosures												150	151
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Graduate students employed												253	278
Graduate students earning degrees and entering the workforce												45	47
Undergraduate students involved												214	225
Partnerships/Collaborations													
The number of research grants/contracts involving funding from non-government entities												35	39
The number of research grants/contracts involving subcontracts to non-ASU researchers												6	8
Sustainability													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards												32.20	40.00
Royalty income												0.10	0.30
Foundation funding												1.50	2.50
Return Total												33.80	42.80
Work Force Contributions													
Post-doctoral appointments												29	35
Post-doctoral researchers leaving to enter the workforce												13	18
Graduate students employed												114	142
Graduate students earning degrees and entering the workforce												43	60
Undergraduate students involved												77	87
Partnerships/Collaborations													
The number of research grants/contracts involving funding from non-government entities												24	33
The number of research grants/contracts involving subcontracts to non-ASU researchers												21	27
Advanced Electronic Materials													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards												31.20	27.60
Royalty income												0.02	0.05
Foundation funding												0.04	0.04
Return Total												31.26	27.69
Work Force Contributions													
Post-doctoral appointments												20	23
Post-doctoral researchers leaving to enter the workforce												10	14
Graduate students employed												7	4
Graduate students earning degrees and entering the workforce												3	4
Undergraduate students involved												4	6
Partnerships/Collaborations													
The number of research grants/contracts involving funding from non-government entities												8	6
The number of research grants/contracts involving subcontracts to non-ASU researchers												3	5
Biodesign Institute and Capacity Building Project Investments													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards	11.92	8.63	27.09	35.88	47.00	51.60	52.09	56.76	80.88	62.44	50.60		
Royalty income						0.50	0.48	0.52	1.05	0.55	0.36		
Foundation funding						0.47	0.57	0.50	10.70	0.52	8.40		
Return Total						52.57	53.14	57.78	92.63	63.50	59.36		
Value of new startups to ASU	.05	.09	1.40	2.53	3.8								
New products in marketplace	5	3	5	10	7								
Value of new products to ASU	.42	.40	1.40	2.53	3.8								
Technology Transfer													
New invention disclosures	97	91	98	166	152	145	158	147	145	148	151		
New patent applications filed	108	106	128	168	82	156	140	157	83	159	184		
New patents issued	11	17	18	41	22	20	15	20	12	21	23		
Total start-up companies licensing ASU technology	3	3	4	4	4	4	7	4	0	4	5		
Licenses or options signed (as indication of technology adoption by industry)	9	20	24	28	32	32	22	33	43	33	25		
New software packages distributed	-	6	10	2	N/A								
Form industry-university nationwide research consortium	-	In Progress	4	2	N/A								
Create research road map in collaboration with industry	In Progress	Completed	4	1	N/A								
Fund proof of concept grants to faculty	6	6	5	9	6								
Business plans written	2	6	9	8	2								
Technology transfer portal inquiries from industry	1	13	15	20	27								

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ASU Consolidated (*Continued*) PERFORMANCE MEASURES/DELIVERABLES	FY02 Actual	FY03 Actual	FY04 Actual	FY05 Actual	FY06 Actual	FY07 Proj	FY07 Actual	FY08 Proj	FY08 Actual	FY09 Proj	FY09 Actual	FY10 Proj	FY11 Proj
Biodesign Institute and Capacity Building Project Investments													
Work Force Contributions													
Post-doctoral appointments	5	48	44	64	88	37	56	38	110	38	70		
Post-doctoral researchers leaving to enter the workforce	-	19	24	32	39	26	26	27	53	27	11		
Graduate students employed	29	120	106	121	103	113	324	114	404	115	230		
Graduate students earning degrees and entering the workforce	-	33	67	63	71	75	95	75	136	76	43		
Undergraduate students involved	39	84	139	177	160	172	157	173	645	175	204		
Increase in number of teachers who graduate with math/science certification	9	-	7	(14)	7								
Growth in CS/CSE Graduates	-21	10	37	53	30								
Partnerships/Collaborations													
The number of Biodesign Institute research grants/contracts involving funding from non-government entities						17	25	17	37	17	47		
The number of Biodesign Institute research grants/contracts involving subcontracts to non-ASU researchers						18	35	18	22	18	31		
New research collaborations with industry and national laboratories	9	13	19	14	49								
Curriculum Innovations													
Tier 1 Introduction to Information Technology for all students - Completed FY 2002	Completed												
Tier 2 package of 3 courses	Partially		Partially	Partially	Partially								
Tier 3 concentration for BIS degree		Partially	Partially	Partially	Partially								
BS Applied Computing (ASU West) Begins Fall 2005	Approved				X								
High school students completing software design material	88	227	200	N/A	N/A								
Internships w/ industry	32	88	136	71	50								
New courses introduced (Bio, Info, Nano)	4	6	16	13	5								
Economic Development													
Companies identifying ASU as a factor for relocating or expanding in AZ	2 large	0 large 2 small	1 large 3 small	7 large 3 small	3 large 4 small								
Biomedical Informatics													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards						0.80	1.76	2.00	8.13	2.83	2.20		
Royalty income						0.02	0.00	0.02	0.00	0.03	0.00		
Foundation funding						0.03	0.00	0.04	0.02	0.04	0.00		
Return Total						0.85	1.76	2.06	8.15	2.90	2.20		
Economic Impact													
BMI tenure-track faculty hired by the Department [FTE]						2	2	7	7	11	10		
BMI research faculty hired by the Department [FTE]						3	3	4	2	6	3		
New invention disclosures and patent applications filed						N/A	N/A	3	3	5	2		
Total start-up companies licensing ASU technology						N/A	N/A	N/A	N/A	1	1		
Work Force Contributions													
Graduate students earning concentrations in BMI						10.00	Begin Fall 07	10	13	10	10		
Graduate students earning masters degrees in BMI						N/A	Begin Fall 07	10	0	13	11		
Graduate students earning doctoral degrees in BMI						N/A	N/A	N/A	N/A	5	0		
Undergraduate students earning concentrations in BMI						N/A	N/A	N/A	N/A	N/A	N/A		
Medical students trained in informatics						N/A	N/A	24	24	48	72		
Partnerships/Collaborations													
Number of parternships with biomedical providers						4	6	8	12	12	12		
Number of parternships with industry						2	1	4	2	8	4		
Solar Energy													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards								N/A	N/A	4.10	7.30		
Royalty income								N/A	N/A	0.10	0.07		
Foundation funding								N/A	N/A	0.10	0.07		
Return Total								N/A	N/A	4.30	7.43		
Technology Transfer													
New invention disclosures								N/A	0	6	N/A		
New patent applications filed								N/A	0	3	N/A		
New patents issued								N/A	0	2	N/A		
Total start-up companies licensing ASU technology								N/A	0	0	N/A		
Licenses or options signed (as indication of technology adoption by industry)								N/A	0	1	N/A		
Work Force Contributions													
Post-doctoral appointments								N/A	0	2	11		
Post-doctoral researchers leaving to enter the workforce								N/A	0	0	7		
Graduate students employed								N/A	0	10	32		
Graduate students earning degrees and entering the workforce								N/A	0	2	22		
Undergraduate students involved								N/A	0	6	23		
Joint ASU-UA Biomedical Research Fund													
Return on Investment ($ amounts in millions)													
Federal and non-federal awards						N/A	N/A	1.25	0.87	1.25	0.00		
Royalty income						N/A	N/A	N/A	N/A	N/A	N/A		
Foundation funding						N/A	N/A	N/A	N/A	N/A	N/A		
Return Total						0.00	0.00	1.25	0.87	1.25	0.00		

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Research Foci

Center for Applied NanoBioscience
Dr. Frederic Zenhausern
Merges technologies from nanoscience and molecular biology to develop novel sensors and diagnostic tests to monitor health.

Center for BioOptical Nanotechnology
Dr. Neal Woodbury
Integrates biology, chemistry and physics to explore structure and function in biological and biomimetic systems, seeking molecules with desirable functions.

Center for Environmental Biotechnology
Dr. Bruce Rittmann
Focuses on microbiological systems that capture or develop renewable resources or clean up environmental pollution.

Center for Evolutionary Functional Genomics
Dr. Sudhir Kumar
Uses comparative DNA sequence analysis to understand the mechanisms and impact of evolutionary change within and across species and the time scale of those changes.

Virginia G. Piper Center for Personalized Diagnostics
Dr. Joshua LaBaer
Funded by a multimillion gift, the Center for Personalized Diagnostics will pursue improved diagnosis of diseases including lung cancer and diabetes.

Center for Ecogenomics
Dr. Deidre Meldrum
Focuses on genome analysis automation, microscale systems for biological applications, ecogenomics, robotics and control systems.

Center for Infectious Diseases and Vaccinology
Dr. Roy Curtiss
Focuses on host-pathogen interactions and identification of protective antigens to develop new technologies for rapid vaccine production and delivery.

Center for Innovations in Medicine
Dr. Stephen Johnston
Focuses on innovative solutions to major challenges in health care including a vaccine for cancer and pre-symptomatic diagnostics.

Center for Single Molecule Biophysics
Dr. Stuart Lindsay
Focuses on understanding processes on which life is based using the simplest model systems and advancing the tools to work at this scale.

Center for Bioelectronics and Biosensors
Dr. Nongjian Tao
Integrates device and materials functions to develop novel sensors to monitor health and potential hazards.

Center for BioEnergetics
Dr. Sidney Hecht
Research of mitochondrial diseases caused by defects in the body's energy production processes.

Financial Information

Biosciences	FY10 Rev Budget	FY11 Rev Budget
REVENUE		
Carry Forward	$ 2,049,900	
New TRIF Revenue	16,244,500	16,210,900
TOTAL REVENUE	**$18,294,400**	**$16,210,900**
OPERATING BUDGET		
Personal Services	7,692,700	6,630,100
Employee Related Expenses	1,810,000	1,560,000
Operating Expenses	5,581,000	4,810,100
Total Operating Budget	$15,083,700	$13,000,200
CAPITAL BUDGET		
Building Renovation	2,210,700	2,210,700
Debt Service	1,000,000	1,000,000
Total Capital Budget	3,210,700	3,210,700
TOTAL EXPENDITURES	**$18,294,400**	**$16,210,900**
Return On Investment	**3.2:1**	**4.2:1**

Note: The above amounts include the Biodesign Institute and capacity building project investments.

Goals & Results

ASU has invested its TRIF allocation in a select number of highly-integrated science and technology projects to ensure the critical mass and focus that will produce results. Because the Biodesign Institute is the cornerstone of this funding, the goals & results below focus on it. However, other capacity building projects, including the Arizona Institute for Nano-Electronics (AINE), the Decision Theater, Wireless Integrated Nano Technology (WINTech) and the Arizona Institute for Renewable Energy (AIRE) are included in the financial and performance metrics.

Goals:

- Increase governmental and private funding of research at the Biodesign Institute by 15 percent annually
- Increase the rate of technology transfer development from the bioscience / biotechnology / biomedicine areas
- Provide educational and workforce impact for the State
- Enhance interdisciplinary collaborative research in nanotechnology and advanced materials

Indicative Results:

- The Biodesign Institute consists of 56 faculty and 119 academic professionals. Total staffing approximates 540.
- For FY09, the Biodesign Institute posted $42 million in research contracts & grants awards which is $2.0 million greater than the prior year. Industrial partners accounted for 30% and Federal agencies accounted for 70% of total Awards.
- For FY09, the Biodesign Institute generated a record $375 million in new research contract proposals.
- Dr. Sudhir Kumar, a professor in life sciences and director of the Center for Evolutionary Functional Genomics launched the Timetree of Life Initiative which provides information on species' origins that can be mined by researchers and used as a classroom tool.
- Dr. Bruce Rittmann, director of Biodesign's Center for Environmental Biotechnoloty, was honored with the prestigious 2009 Simon W. Freese Environmental Engineering Award, in recognition of his outstanding contributions to the field.
- Dr. Roy Curtiss, with funding from the Bill and Melinda Gates Foundation, developed a vaccine candidate to prevent pneumonia in newborns that will soon enter human clinical trials.
- Dr. Cheryl Nickerson's experiments aboard several NASA space shuttle flights demonstrated that germs become more infectious during space flight, and we revealed the mechanisms for these changes, suggesting a possible means for protecting flight crews.
- Dr. Joshua LaBaer was appointed as Director of the Biodesign Institute's new Virginia G. Piper Center for Personalized Diagnostics. Dr. LaBaer formerly directed the Harvard Institute of Proteomics.

Management

Office of the Vice President for Research and Economic Affairs

R.F. "Rick" Shangraw: Vice President for Research and Economic Affairs
Sethuraman Panchanathan: Deputy Vice President for Research

The Biodesign Institute

Alan Nelson: Executive Director

Biodesign Institute Advisory Board

★ **= National Academy Member**
✪ **= Nobel Laureate**

Chairman:

★ **Dr. Stephen Benkovic**, Professor; Eberly Chair in Chemistry — Pennsylvania State University

Members:

★ **Dr. Allen J. Bard**, Director, Laboratory of Electrochemistry — University of Texas at Austin
★ **Dr. Carolyn Bertozzi**, T. Z. & Irmgard Chu Distinguished Professor, Department of Chemistry — University of California, Berkeley
★ **Dr. Charles R. Cantor**, CSO — SEQUENOM, Inc.
★ **Dr. John Donoghue**, Professor of Neuroscience Division of Biology & Medicine — Brown University
★ **Dr. David Eisenberg**, Director, Institute for Genomics and Proteomics — UCLA-DOE
★ **Dr. Drew Endy**, Assistant Professor, Department of Biological Engineering— Massachusetts Institute of Technology
★ **Dr. Larry Gold**, Chairman and CSO — SomaLogic, Boulder, CO
✪★ **Dr. Lee Hartwell**, President and Director — Fred Hutchinson Cancer Center, Seattle, WA
★ **Dr. Sidney Hecht**, John W. Mallet Professor of Chemistry; Professor of Biology — University of Virginia
★ **Dr. Daniel Nocera**, W. M. Keck Professor of Energy & Professor of Chemistry — Massachusetts Institute of Technology
★ **Dr. James Rothman,** Professor of Physiology & Cellular Biophysics, Columbia University.
★ **Dr. Lucy Shapiro**, Director, Beckman Center for Molecular and Genetic Medicine; Ludwig Professor of Cancer Research — Stanford University School of Medicine
★ **Dr. James Wells**, President and CSO — Sunesis Pharmaceuticals

Learn More

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