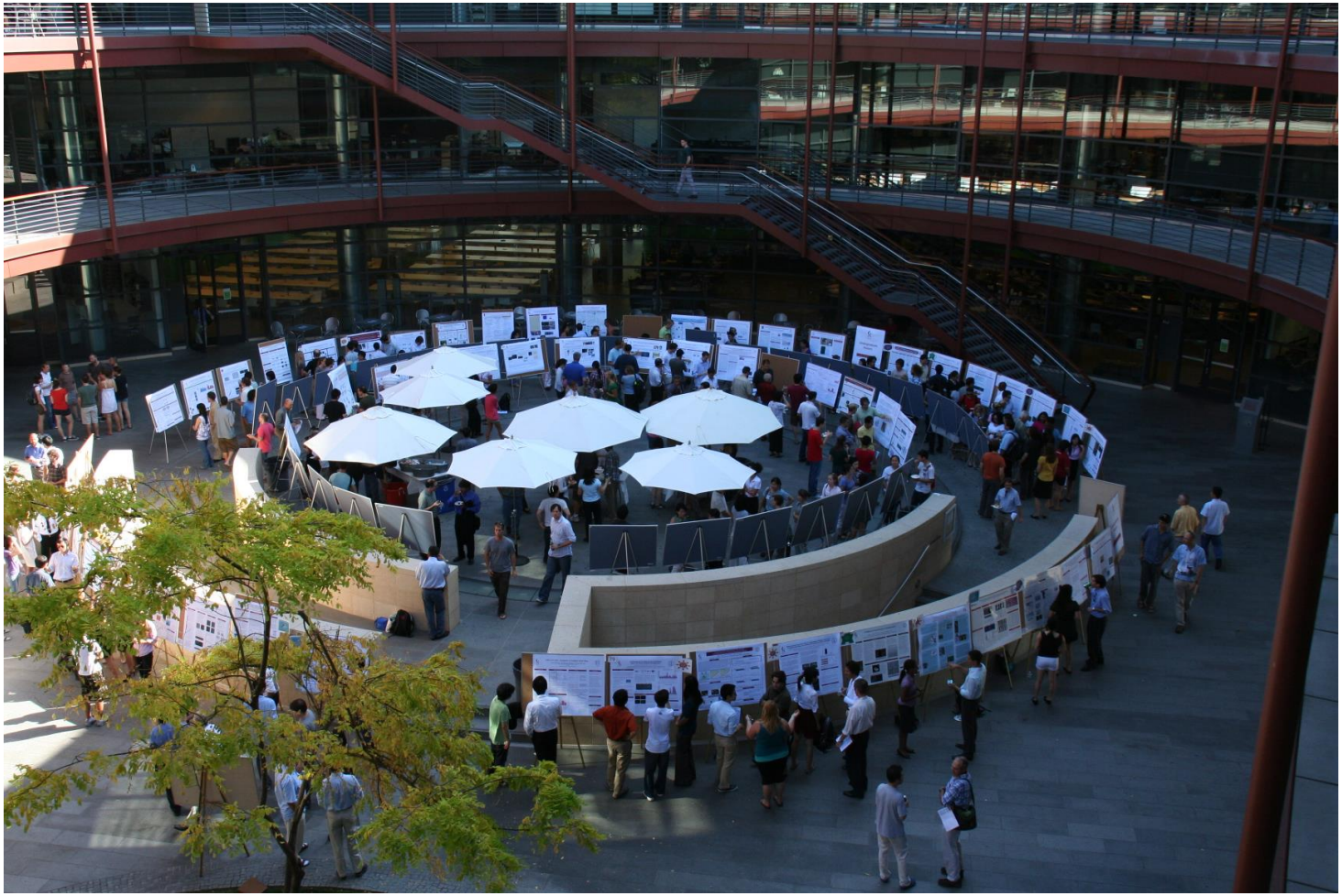
Bio-X
Stanford University

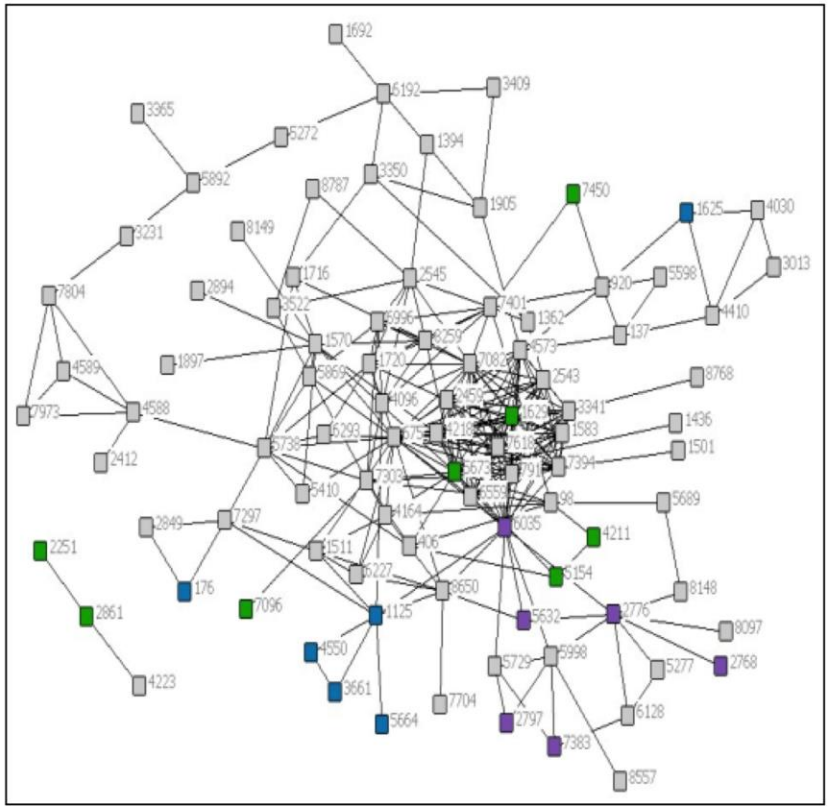


The Mission of Bio-X

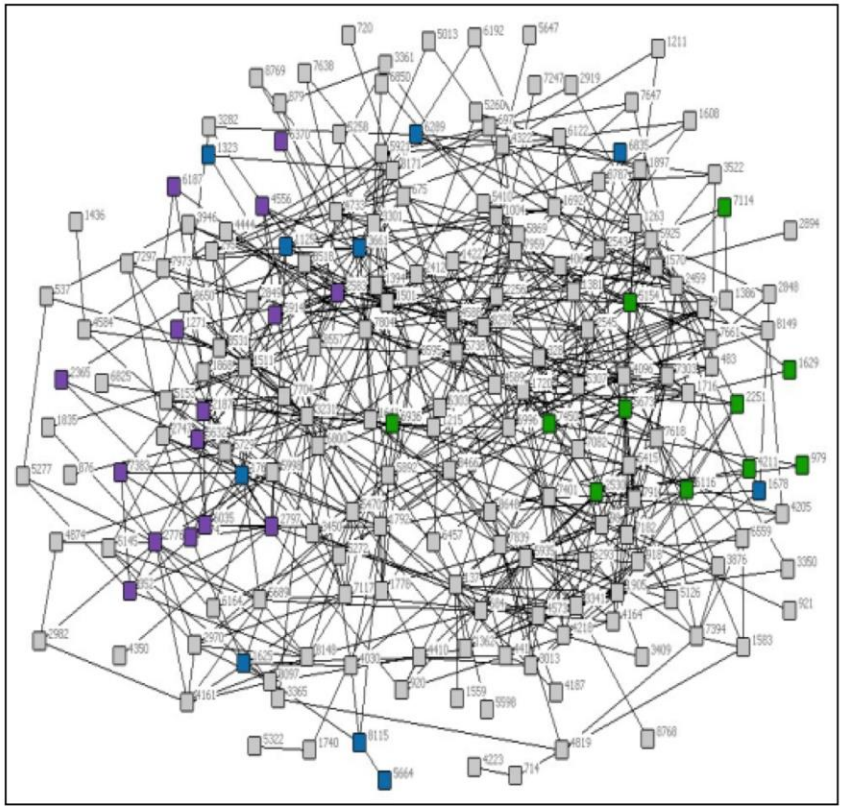
is to catalyze discovery by crossing the boundaries between disciplines, to bring interdisciplinary solutions and to create new knowledge of biological systems, in benefit of human health.

An interconnected web of faculty:

1995-97 Before Bio-X



2005-07 After Bio-X



Data: ties from coauthoring grants and publications or co-advising dissertations over 3 years.
Key: Green= Biology Dept members, Blue= Mechanical Engineering, Purple= Radiology
THANKS TO PROFESSOR DANIEL MCFARLAND, WOODY POWELL AND COLLEAGUES, Mimir Project, Stanford University

- **Web of interconnected and collaborative scientists across entire campus**

- Novel horizontal structure fuels interdisciplinary innovation and discovery across traditional vertical organization of departments and schools and over established walls between disciplines

- **Forum and culture facilitates rapid development and dissemination of discoveries that expand knowledge**

- Robust system for incubation and acceleration of new research areas (BioDesign, BioE, Neuroscience, Quantitative Biology on the horizon)

- **High performance model for how research universities can operate across disciplines**

Bio-X Impact: The Culture in 2013

- 600+ faculty from 60+ departments from 7 schools
- 500+ interdisciplinary research teams
- 152 PhDs from 24 departments
- 241 Undergraduate students
- A “new breed” of scientist
- Nobel laureates, highly sought after faculty, and rising young scientists and engineers ALL benefit

Bio-X Impact: Research Outcomes

- Rapid acceleration of discovery and innovation
- Extraordinary amount of new knowledge and technological advances
- Hundreds of publications; dozens of patents filed
- Bio-X PhDs driving new research directions
- Collaborative culture: curiosity and creativity flourish
- Leveraging over 10x on investment in seed grants
- Bio-X identified as “highly effective super structure”

Unexpected, Significant Outcomes

	Expected	Unexpected	Highlights
Seed Grants	little return expected on high risk projects	• **Over a 10x return from external sources**	NIH, NSF, DoE, DoD etc
Research	major vehicle for translation, patents and biotech startups	• **Substantial creation of "Intellectual Capital"** • **New knowledge at intersection of fundamental as well as translational fields** • **New technology to enable fundamental research** • **New training opportunities for students** •**Industry interested in collaborations and funding**	•Optogenetics •Pain control •BioDesign •Neural devices •Foldscope •Microfluidics •Imaging *Incubation of:* • BioE • Neuro • *On the horizon:* Quantitative and theoretical biology
PhDs	Graduate research and training	• **A new breed of scientist who can drive research and discovery in new directions**	Universities, Companies desire and hire them!

Bio-X Core Programs

- **Interdisciplinary Initiatives Program (Seed Grants)**
  - Funds via campus-wide competitions for high risk research with potential to transform knowledge
- **Bio-X Graduate Fellowships**
  - Training best and brightest (self nominated; open competition) Stanford PhDs desiring to work at the intersection of disciplines
  - Unique program investing in a new breed of scientist
- **Bio-X Ventures and Innovation Labs**
  - Inventing new research areas and technologies
  - Disseminating them rapidly by teaching and sharing
- **Undergraduate Summer Research**
  - Hands-on exposure to the Bio-X mentality of interdisciplinary research with over 60 students + faculty participating each summer

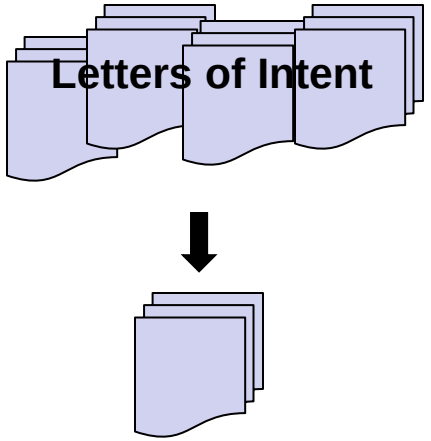
Seed Grants for Success
Interdisciplinary Initiatives Program (IIP)

Criteria

Collaborative
Interdisciplinary
High-risk, high-reward

$150k for 2 yrs

Application Process



Only 20-25% selected through a 2-round process

2012 ~ 27 new winners for Round 6

Total of 141 selected IIP Seed Grant projects (from 560 applications)

Bio-X
Seed Grants 360° Success

5 rounds of IIP

=

$15M Internal Investment

10-fold+ return

$[illegible]+ in external support

Bio-X
Seed Grants 360° Success

---

6 rounds of IIP = 141 IIP Projects → 40+ Patents So far

Seed Grants Success Stories

Oncology

(2010) Computational Analysis of Tumor Morphology to Build Prognostic Models and Discover Biological Networks in Breast Cancer

Computer Science & Pathology

IP filed, Science Translational Medicine Publication

Cardio

(2008) An Integrated Approach To Cardiac Repair: Predictive Computational Models, Engineered Biomaterials, and Stem Cells

Materials Science & Engineering, Mechanical Engineering, Vascular Surgery

$2.4M patent, NIH Innovator Award, 2 NSF Early Career Awards, Faculty Scholar Funding

Neuro Technology

(2008) Optoelectronic Retinal Prosthesis

Ophthalmology, Electrical Engineering, Neurobiology

Nature Photonics Publication, International Media Interview with Brazil

Imaging Technology

(2008) Development and Applications of Real-Time fMRI Technology

Anesthesia, Radiology, Psychology, Psychiatry, Psychology

NIH NCCAM P01 Grant – budgeted for $10M over 5 years, NIH NIDA R21 - $975K over 3 years, P41 Renewal - over $7.3M over 5 years, another P01 for $9M

Seed Grants Success Stories

Neuro

(2006) Inventing a microendoscope to measure sarcomere lengths in humans

Bioengineering, Neurology & Neuroscience, Biological Sciences, Molecular and Cellular Physiology

IPs filed, Bio-X Fellowship, NIH Biotechnology Training Grant, $100K Coulter Translational Research Award, $1.2M Keck Foundation Award

Oncology Chemistry

(2006) Carbon Nanotube Mediate Therapy of Lymphoma

Chemistry, Medicine-Oncology

IP, Bio-X Fellowship, $1M follow-on funding from NCI

Chemistry

(2002) How Myosin V Walks: 3D Simulation Brings Life to Atomic Structures of Motor Proteins

Bioengineering, Structural Biology, Chemistry, Biochemistry

$20M NIH Center (Simbios) established at Stanford

Chemistry

(2002) Artificial Cornea

Ophthalmology, Biochemistry, Chemistry, Chemical Engineering

IP filed, Bio-X Fellowship, Start-up with $2.4M VC funding (Biomimedica)

Fellowships

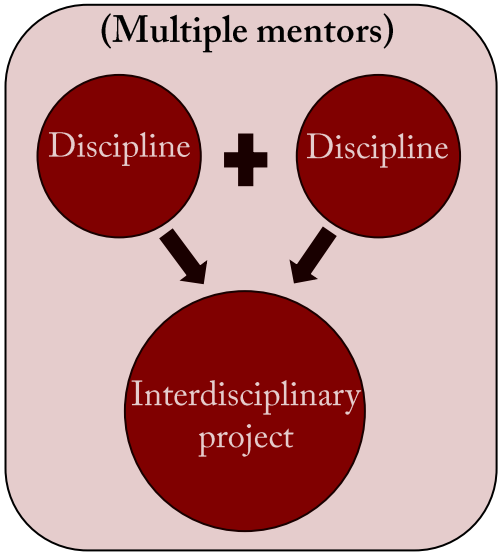
Program Goals

To train graduate students pursuing interdisciplinary projects – *investing in future of human health*

10 complete rounds (2004-2013)

- Avg of 12-17 awards per round
- Fellowship lasts for 3 years
- Support from various donors, and industry *(Affymetrix, Amgen, Genentech, Medtronic, Pfizer)*
- To date, 152 PhDs and 7 postdocs funded

★Self-nominated★

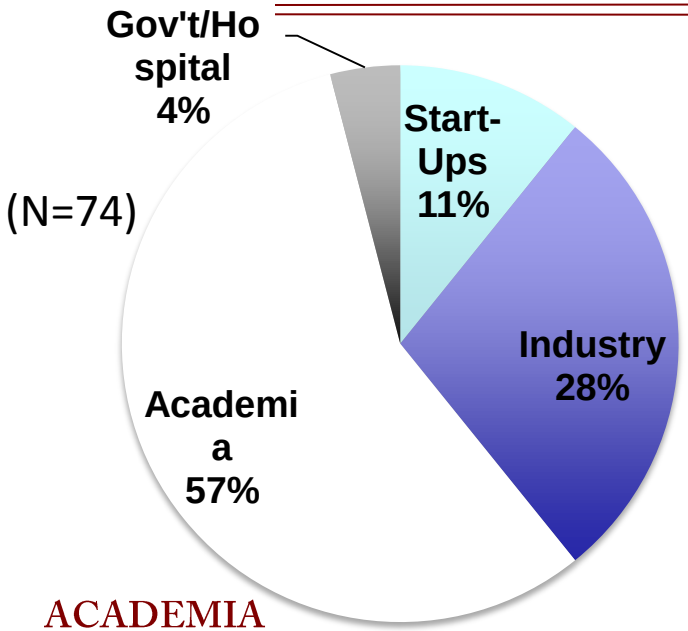


<u>Providing our fellows with:</u>

- Connections to industry and venture communities
- Opportunities to conduct riskier research
- Chance to bringing teams together to solve otherwise unanswerable questions

Bio-X Fellowships

Investing in the future of bioscience



ACADEMIA

- Professorships – Duke, Stanford, CalTech, Fuzhou University, Tufts
- Postdoc – MIT, Scripps, Rockefeller, Stanford, UCSF, UCSD, Aarhus, Berkeley, Ecole Polytechnique Federale de Lausanne, Rehab Institute of Chicago, NIST
- Medical School
- Residency – UPenn, UCSD, JHU, Columbia, Stanford
- MBA, Biodesign

GOVERNMENT/HOSPITAL

- St. Jude Medical
- Hong Kong Government
- State Legislature

START-UPS

- MicroInterventional Devices
- Survata
- Amunix
- Boosted
- DNAnexus
- Biomimedica
- Praedicat, Inc.
- Maraxi, Inc.

COMPANIES

- L.E.K. Consulting
- Exponent
- Intel
- Medtronic
- Intuit
- Abbott Vascular
- Apple
- 23andMe
- Exponent
- Oracle
- McKinsey & Comp
- Boston Consulting Group
- Goldman Sachs
- Misfit Wearables
- Twitter
- Coursera
- Biogen Idec
- Auritec Pharmaceuticals
- Walt Disney Co
- Amgen

Bio-X Fellowships Success Stories

David Myung (2008) *(Chemical Engineering)*

3 patents
6 first-author publications
Biomimedica startup - $2.4M VC funding

"The Bio-X Program and Fellowship allowed me to do riskier research for my Ph.D."
Amanda Malone, Ph.D. (Bio-X Bowes Fellow 2004)

"… getting me initially connected to people in the device and venture community, and these connections led to others that helped get the company started and funded."
David Myung, Ph.D. (Bio-X Bowes Fellow 2005)

Viviana Gradinaru (2010) *(Neuroscience)*

Sammy Kuo Prize (best neuroscience research paper)
Nature, Cell, and Science publications
2 patents, professor at CalTech

Gaurav Krishnamurthy (2011) *(Mechanical Engineering)*

Medtronic Fellow
2 patents
6+ different publications

" … bringing teams together to help solve these otherwise unanswerable questions. It gives you the freedom to ask a challenging question, and facilitates the means to pursue it.
Jennifer Brady, Ph.D. candidate in Microbiology & Immunology

Summer Undergraduate Fellowship Program

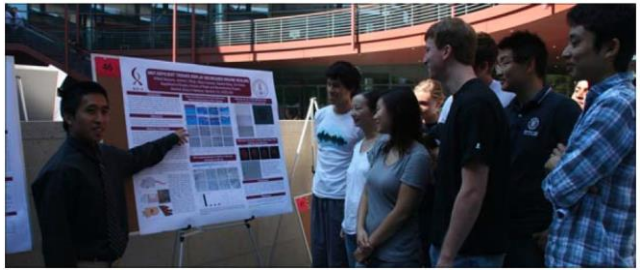
Program Goals

Supporting undergraduates conducting research for 10 weeks in a Bio-X affiliated lab (~$6000 stipend)

8 complete rounds (2006-2013)

Highlight: Weekly Lunch Seminars for 10 weeks with participating faculty

Just completed 8th round (2013)
With 64 awardees
[selected from nearly 100 applications]

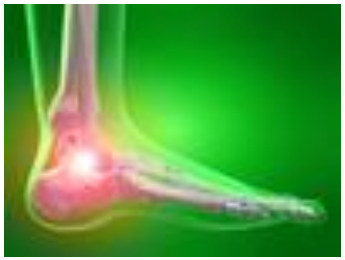


Poster presentation by participating students at the end of program

Results: 1st author publications, Best Poster awards, Dean's award, conference presentations, and more

Bio-X Ventures

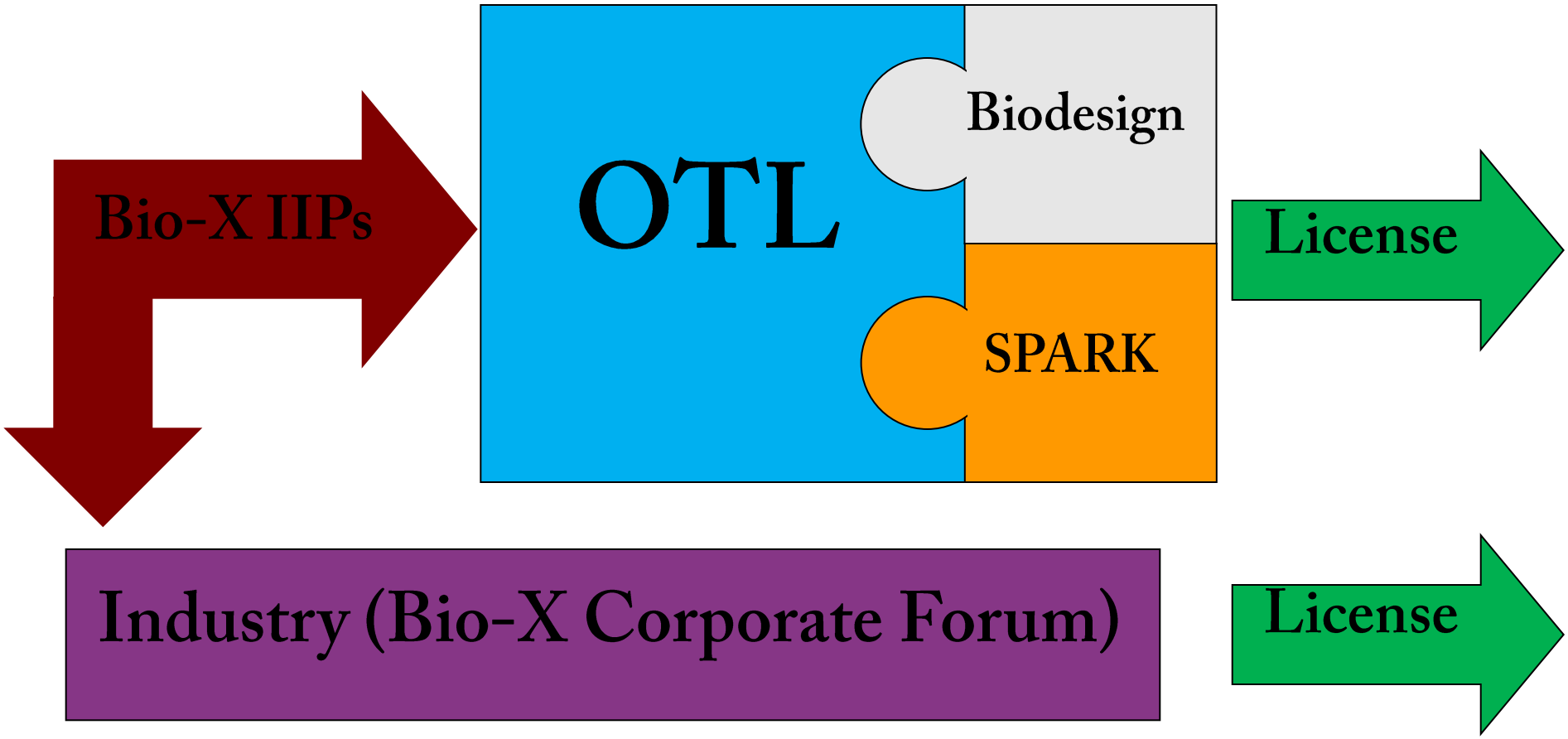
- Invention, development and dissemination of new technology and science; not a core facility



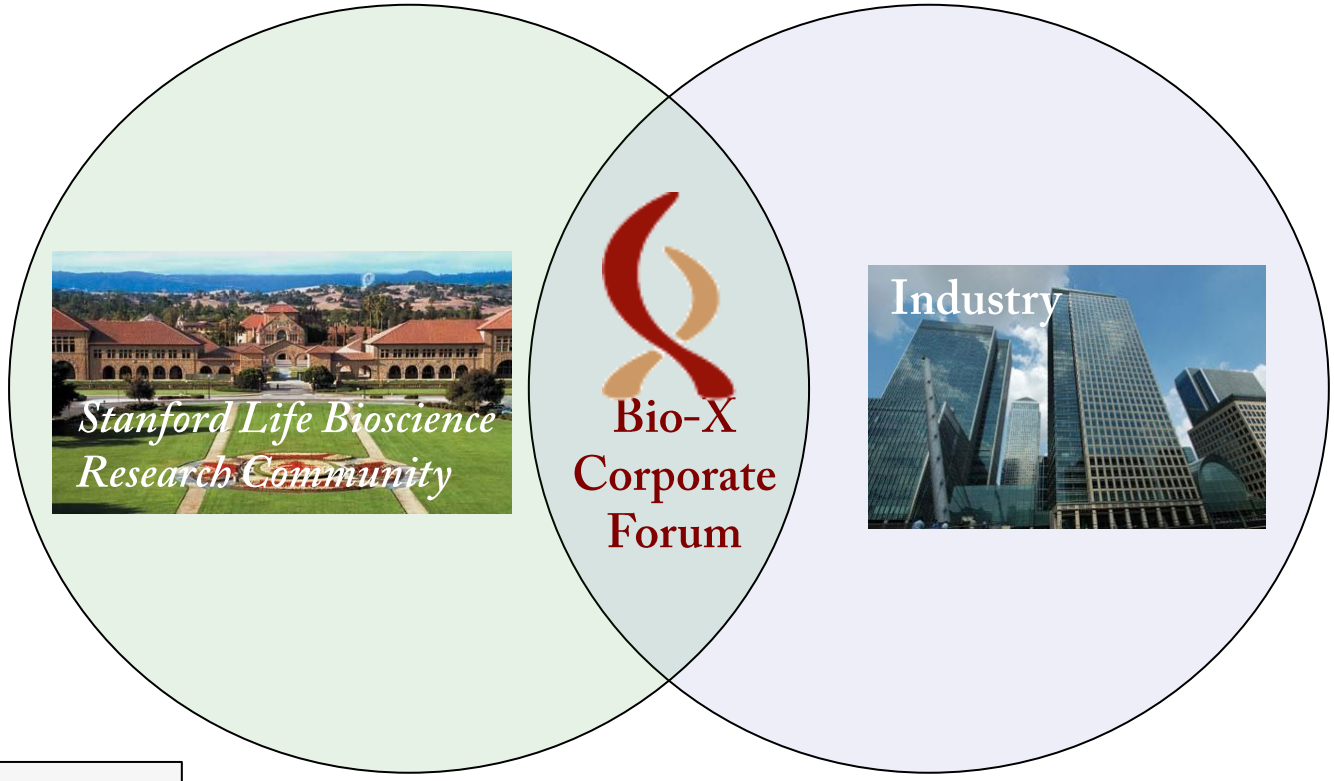
- Exceptional projects with unusual potential to change the way academic science is done

- Larger scale enterprises needing rapid development and innovation beyond scope of any one department, school or discipline

Translating Bio-X



Translating Bio-X:
Corporate Forum Affiliate Program



Purpose:

- ✧ *Foster stronger academic-industry relations with Bio-X as the portal*
- ✧ *Matching research interests, networking, recruiting*
- ✧ *Developing breakthrough technologies & leading-edge discoveries*

Bio-X: *Collaborations with Industry*

Membership

Agilent
GE
Lockheed Martin
Merck
Panasonic
Philips
Pfizer
University of Aarhus

Sponsored Research Gift

Celgene
Gilead
Novo Nordisk
Johnson & Johnson
Sanofi

In-Kind

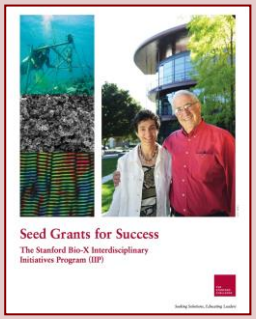
Novartis

Fellowships

Amgen
Genentech
Medtronic

Corporate Forum Affiliate Program:

Identifying mutual research interests



Letters of Intent

Share Titles

BioSTAR

In collaboration with Sanofi

8 IIPs funded; currently in the 3rd round;
2 SRAs

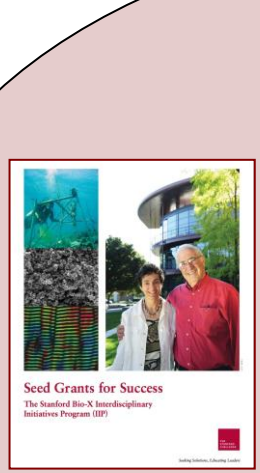
Translational Innovation Partnership Awards Program

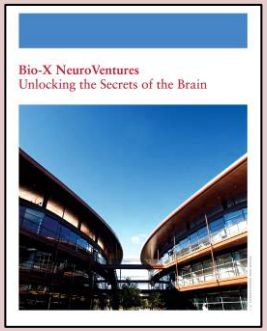
In collaboration with Johnson & Johnson

5 projects funded;
2 were IIP projects

Corporate Forum Affiliate Program:

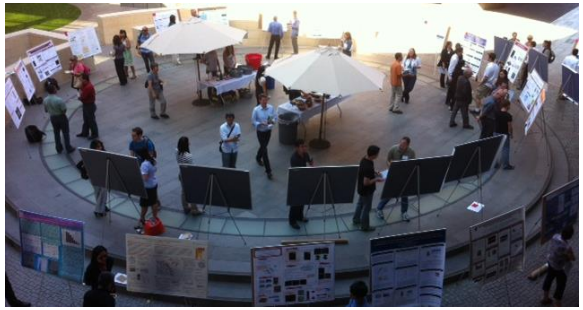
Portal for industry to life bioscience research





600+ Bio-X affiliated faculty

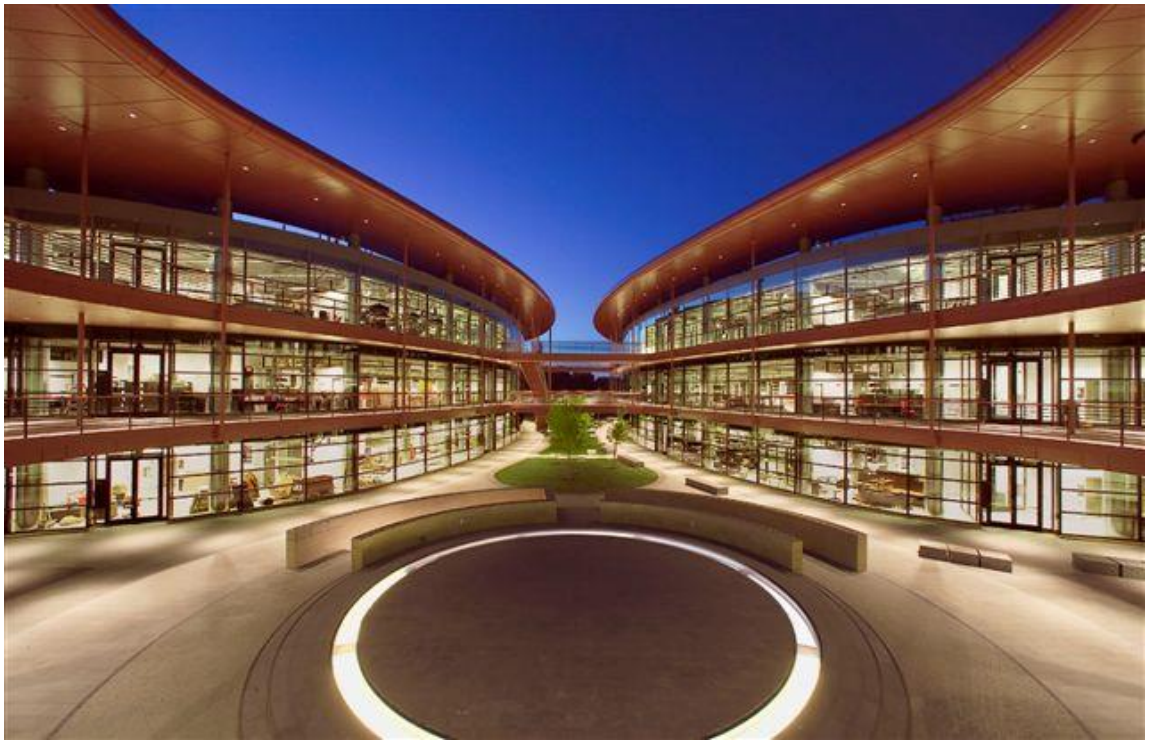
Bio-X Corporate Forum Affiliate Program:
How Bio-X develops & builds those relationships



Half-day symposium focusing on specific disciplines & projects based on company's research interest

- ✧ Customized technical summits (round-table discussions)
- ✧ Faculty Liaison
- ✧ Visiting Scholar Program
- ✧ Invitations to Symposia & Seminars
- ✧ Newsletter
- ✧ Networking
- ✧ Liaison to Stanford Office of Technology Licensing
- ✧ Stanford Center of Professional Development

Bio-X: Let X = Engineering, Chemistry, Physics, Computer Science, Medicine etc. Mix them together

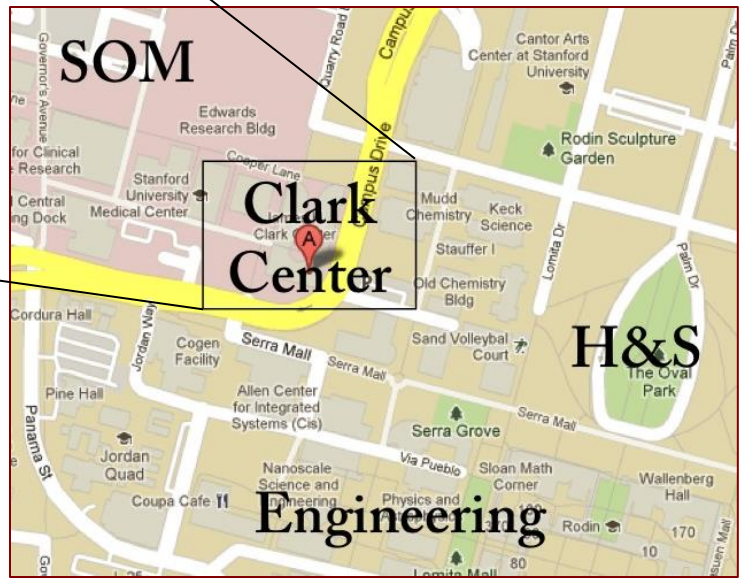


Home for 44 core faculty in James H Clark Center

James H. Clark Center

Bio-X Hub in the heart of Silicon Valley

Location, Location, Location!!!



3 Pods – 3 Stories High – Open Lab Space
44 Faculty from 23 different departments

Nexus Restaurant, Peet's Coffee and Tea
Clark Auditorium, 8 Conference Rooms, 4 Seminar Rooms

The Clark Center: Bio-X Hub

- Epicenter of Stanford Bio-X
  - Modern lab facility at intersection of engineering, science, medicine
  - 44 labs, 850 occupants from 26 departments
  - Good Cafeteria and Peet's Coffee
- Primary gathering place for Bio-X community working to incubate and teach new research areas
  - bioengineering, neuroscience, 3D imaging, optogenetics, prosthetics, molecular imaging, mircofluidics, computational biology, tissue engineering and more
- Recruiting: Faculty want to come to Stanford thanks to Bio-X and the Clark Center
- Clark Center 10 year anniversary: Oct 9, 2013

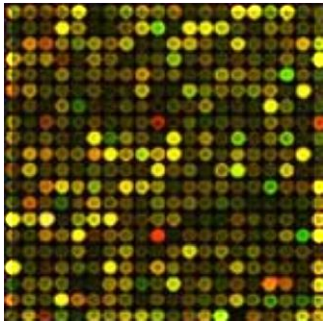
Bio-X Shared Resources

Clark Center

Biodesign Collaboratory and Teaching Areas
Optogenetics Innovation Lab
Small Animal Imaging Facility
Machine Shops
Motion Laboratory
Seminar Rooms, Auditorium
Shared Visualization Room
Special Projects Rooms
Supercomputers
Ultra-low Vibration Laser Laboratories

Stanford University

Bioinformatics Resource
Cell Sciences Imaging Facility
Electron Microscopy Core Facility
Mass Spectrometry Laboratory
Microarray Core Facility
Nuclear Magnetic Resonance Facility
Product Realization Lab
Stanford Shared FACS Facility
Stanford Synchrotron Radiation Lab
Stanford Tissue Bank
Transgenic Animal Facility

Ingredients for Success

- Founding faculty chosen for entrepreneurial spirit and proven record of collaboration across disciplines
- Participating faculty capable of innovation and entrepreneurial spirit- just empower them!
- Support needed at highest levels of University: President,Provost, Vice Provost and participating Deans
- Strong Departments and Schools are a must: Bio-X does not hire or promote faculty
- Only carrots, no sticks: Bio-X Program Funds come from new sources rather than by taxing Schools or Departments

Ingredients for Success

- Resources available to all faculty and students:
  Membership by simple request.
  Open, university-wide competitions for Seed Grants and Fellowships.
  Faculty selection committees diverse and broadly representative.

- Emphasis on innovative, high risk projects that might not be funded initially by other sources

- Bio-X Community built and stimulated by ongoing **dissemination of project results, symposia, workshops, poster sessions and shared students**

- Physical home for Bio-X in Clark Center in close proximity to majority of participating schools and departments

Contact Information

Heideh Fattaey, Ph.D.

Executive Director of Bio-X Programs and Operations

650-725-7882

hfattaey@stanford.edu