Creating an Innovation Ecosystem

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Innovation

- There are numerous innovative definitions of Innovation
- There are multiple elements in the Innovation Process
- For purposes of THIS presentation:

  Focus on **NSF-funded research** that has led to direct, **quantifiable economic benefit** (a product, process, practice, service, social change)

Science of Science and Innovation Policy (SciSIP)

- **UC Davis**

  How the DOE can accelerate the rate of progress in energy innovation
- **UNC Greensboro**

  Assessing the Innovative performance of University Research Parks
- **U Georgia**

  Impact of programmatic university resource investments on innovation
- **U Kansas**

  Contributions of foreign students to knowledge creation and diffusion
- **Arizona State U**

  Innovation as characterized by public values contribution

Innovation Through Translational Research

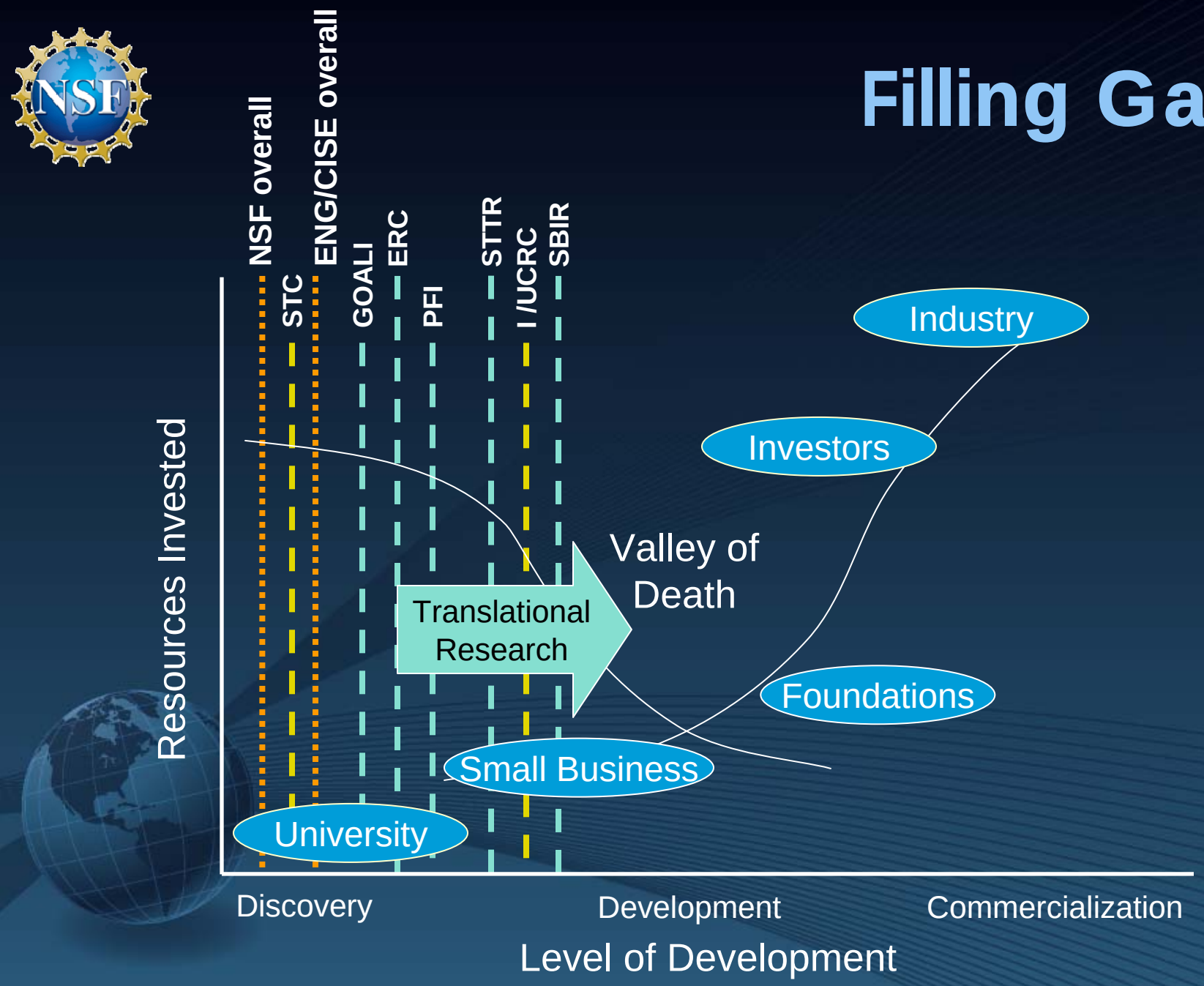
Translational Research

- Is interdisciplinary by nature
- Involves a team
- Relies on partnerships
- Results in clear benefit to society

NSF Programs for Translational Research

- Science and Technology Centers (STC)
- Engineering Research Centers (ERC)
- Materials Research Science and Engineering Centers (MRSEC)
- Grant Opportunities for Academic Liaison with Industry (GOALI)
- Industry/University Cooperative Research Centers (I/UCRC)
- Partnerships for Innovation (PFI)
- Small Business Technology Transfer (STTR)
- Small Business Innovation Research (SBIR)
- Nanoscale Science and Engineering Center (NSEC)
- Nanoscale Interdisciplinary Research Teams (NIRT)
- Emerging Frontiers of Research and Innovation (EFRI)
- Other ENG programs

Filling Gaps



Some concrete examples

- SBIR
- ERC
- I/UCRC
- STC
- GOALI
- Single PI Awards
- CISE

Disclaimer

- NSF doesn't claim SOLE responsibility for these successes, but
- NSF played a clear and definable role in the intellectual evolution of all these innovations.

SBIR Support of Qualcomm

- In 1985, Andrew Viterbi and 6 colleagues formed "QUALity COMMunications"
- In 1987–1988 SBIR provided $265,000 for single chip implementation of Viterbi decoder
  - Led to high-speed data transmission via wireless and satellite
- Now the $78B company holds more than 10,100 U.S. patents, licensed to more than 165 companies

QUALCOMM®

Engineering Research Centers

Engineered Yeast Produce the Anti-Malarial Drug Artemisinin

- Synthetic Biology ERC, Univ. of California, Berkeley, director Jay Keasling
- Artemisinin is 90% effective against the malarial parasite, but it is naturally produced in small quantities and expensive to extract.

The leaves of *Artemisia annua*, the sweet wormwood tree, are the source of artemisinin. *Lawrence Berkeley National Laboratory*

Sanofi-aventis is scaling up the engineered yeast cells, with **drug production expected in 2010**.

Industry/University Cooperative Research Centers

I/UCRC for Engineering Logistics and Distribution (CELDi)

- Collaboration between Univ. of Arkansas and Sam's Club
- Created an Excel-based simulator to replicate the functionality of the Sam's Club inventory and logistics software
- Resulted in more than 4% reduction in inventory costs in categories where applied
- Expected savings of approximately $10M in annual cost-of-inventory.

Sam's Club

Sam's Club: When complete, cost savings from inventory reductions could be as much as **$70M annually**.

Science and Technology Centers

Magnetic Resonance Imaging

- STC for Magnetic Resonance Technology for Basic Biological Research at UIUC established in 1991
- PI Paul Lauterbur discovered the possibility of creating a two-dimensional image by producing variations in a magnetic field

Lauterbur was awarded a **Nobel Prize** in 2003 for discoveries leading to magnetic resonance imaging.

Individual Awards

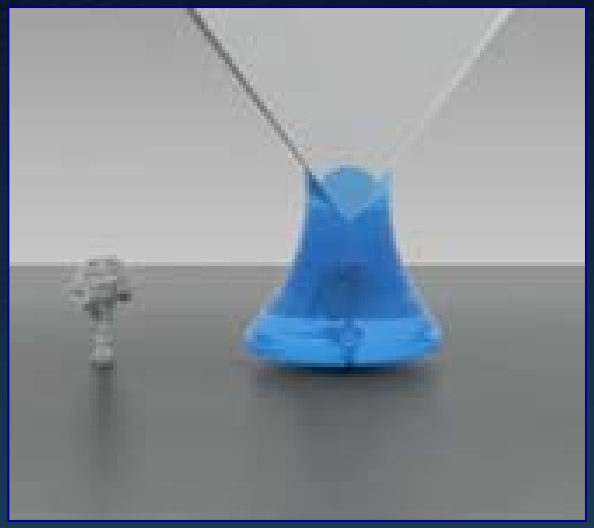
Membranes for Purification of Gases and Water

- Benny Freeman, UT Austin
- NSF (0515425) partially supported research used for the Polaris™ line of membranes, now sold by Membrane Technology and Research, Inc.
- Results from an NSF Graduate Fellowship and a CBET grant (0554109, 0637040) were the basis for Advanced Hydro, Inc., a start-up focusing on water purification membranes with improved fouling resistance.

Polaris™ membranes remove CO2 from Syngas.
Credit: MTR

Nanopatterning and Detection Technologies

- Chad Mirkin, Northwestern Univ.
- NSEC for Integrated Nanopatterning and Detection Technologies (0647560)
- Mirkin holds more than 350 patents
- NanoInk (founded in 2001) offers Dip Pen Nanolithography (DPN) tools for fabricating MEMS and other nanoscale devices.
- Nanosphere (founded in 2000) offers nanotechnology-based molecular diagnostic testing.



Dip Pen Nanolithography for nanofabrication. *Credit: NanoInk*

Nanosphere is now valued at **$164.5M**.

Characteristics of the Innovation Ecosystem

- University research is key, often driven by industrial needs.
- Faculty are involved along the innovation continuum, working with industry at all stages.
- A focus on translational research smoothes the handoff of technology from universities to industry—resulting in rapid, efficient innovation.

NSF Resources for the Innovation Ecosystem

- Grow the existing portfolio and strengthen the translational phase
- Extend the reach of industry-driven research initiatives
- Educate to innovate
- Better understand the social dimensions of innovation (SciSIP)