# Building a 21st Century Research Enterprise: Roles of the Research University

*Where we are*
*Where we could be*
*What it will take to get there*
*Why it matters*

Keith R. Yamamoto
keith.yamamoto@ucsf.edu
National Academies Committee on Research Regulations
San Francisco
May 28, 2015

# RESEARCH UNIVERSITIES AND THE FUTURE OF AMERICA

Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security

Committee on Research Universities

Board on Higher Education and Workforce

Policy and Global Affairs

National Research Council

- Stable, effective Federal policies, practices, funding
- Greater autonomy for public research universities
- Strengthened partnerships with business
- Increased university cost-effectiveness, productivity
- Strategic federal investment in university education and research
- Full federal funding of research
- Reduced regulatory burden
- Reformed graduate education
- Improved STEM pathways and diversity
- Support for international students and scholars

# Research Universities: excellence across three missions

- Educating next gen researchers and "enablers"
- Creation of new knowledge and concepts
- Exchange and export of knowledge and tools

# Federal support for fundamental discovery

Basic scientific research… provides scientific capital.

*Vannevar Bush*
*1945*

An investigation… might not pay off for a year, or a decade, or at all. And when it does, the rewards are… enjoyed by those
who bore its costs, but also by those who did not. That's why the private sector under-invests in basic science – and why the public sector *must* invest in this kind of research.

*President Barack Obama*
*2009*

# Research at an inflection point

*discovery and understanding from transdisciplinary synergies; broad societal impact*

*data collection, discovery within disciplines; broad academic advances*

## How move through the inflection point?

- *Build a research continuum: transdisciplinary science*
- *Integrate across stakeholder sectors: .edu, .com, .gov, .org*
- *Adjust policies in academia, government, private sector*
- *Change education: specialization w/ literacy, quantitation, discovery*

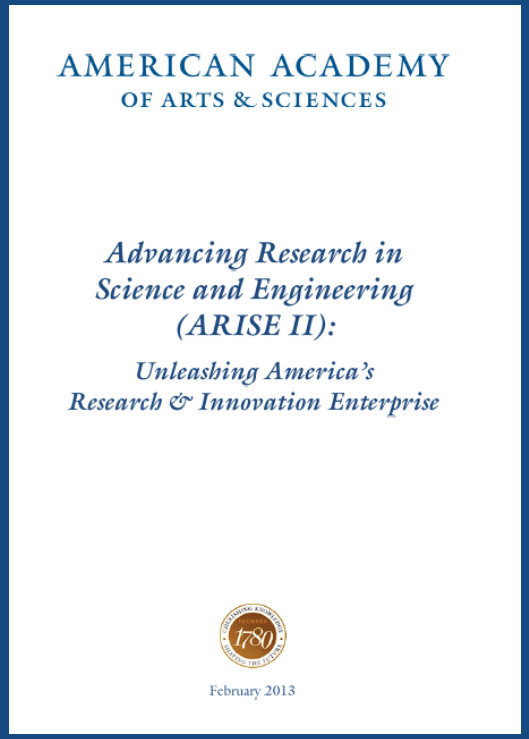
# Integrating research to advance research

## Create transdisciplinary research

Provide incentives and remove barriers so that concepts and tools developed *within* disciplines cooperate to produce novel concepts and tools *across* disciplines.

## Build synergies amongst *.edu, .gov, .com, .org*

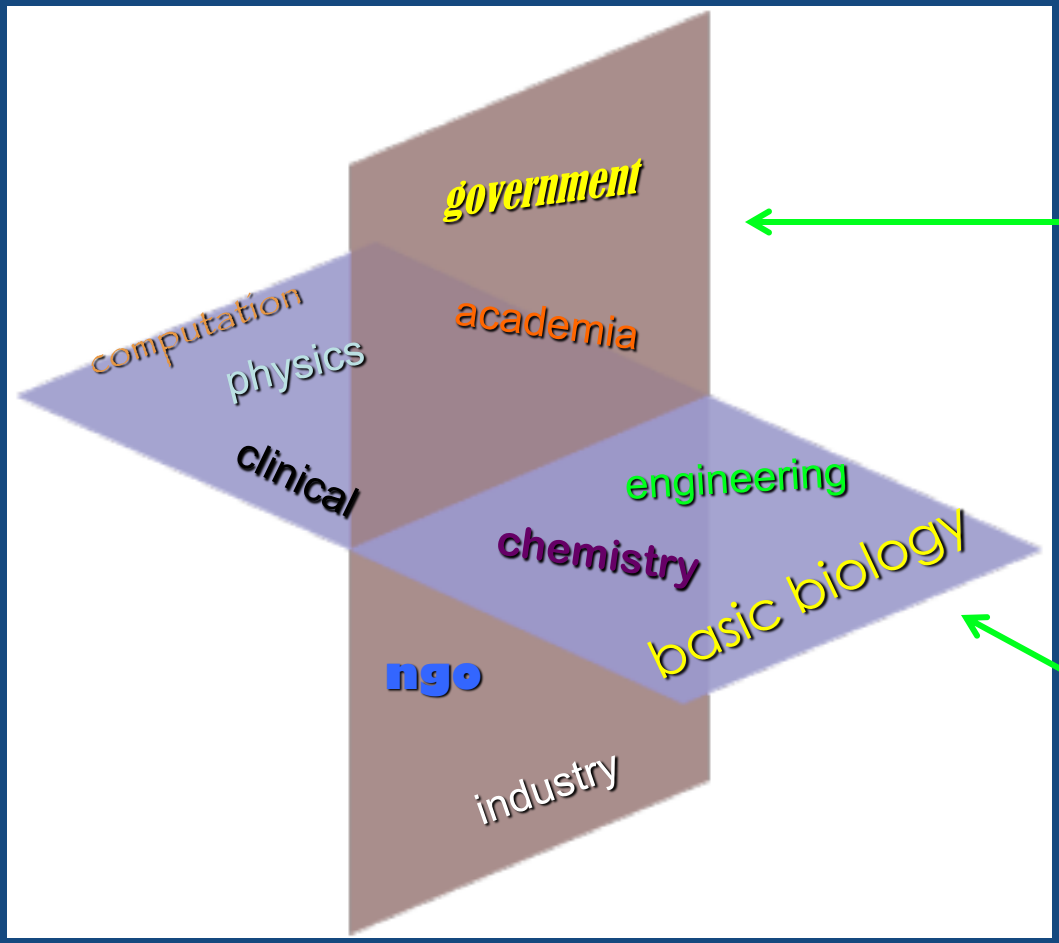
Develop policies that motivate academic, government, and private sectors to establish a common research/development/deployment environment.




AMERICAN ACADEMY OF ARTS & SCIENCES

http://www.amacad.org/arise2/pdf

# Integrate practices and policies across two planes




Stakeholder synergy:
*Cooperate across academia, industry, government sectors*

Trans-disciplinary science:
Merge physical and life sciences theory, concepts, applications

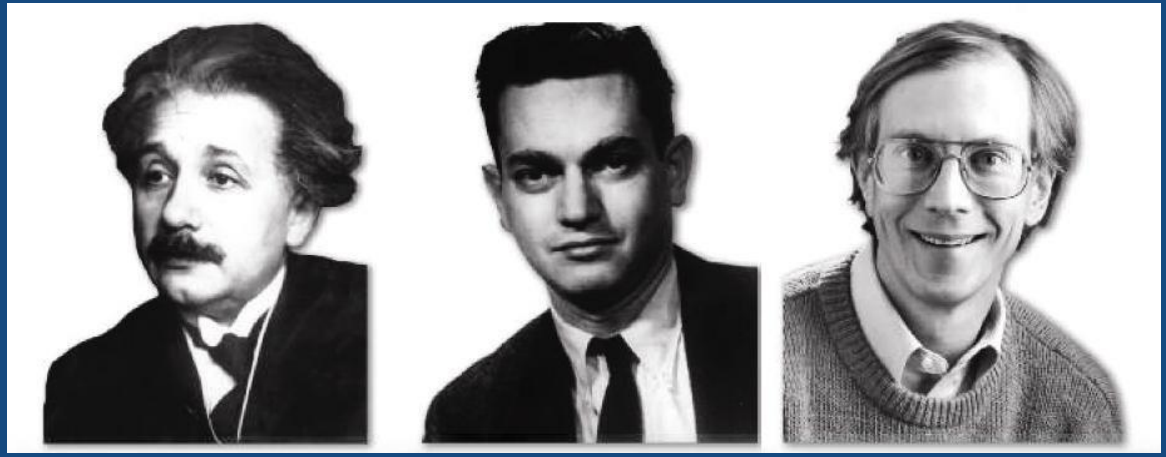
# Complications and Barriers

- Siloed disciplines
- Insufficient funding for discovery
- Conflicting cultures, goals
- Unbalanced workforce, trainee excess
- Outmoded, uninspired education

Address with thoughtful policies and regulations, but don't build restrictive policies/regulation *in place of* direct approach to issue/problem

# The Perilous, Slow Transition to Independence

- Median age, first independent position: 38
- Median age, first R01: 42
- Percent NIH awards to new investigators: 4

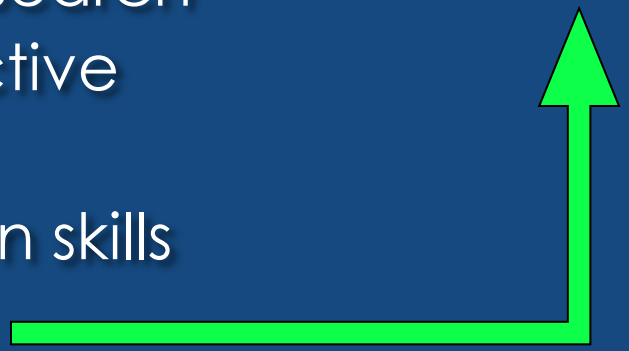


| | Einstein | Nirenberg | Cech |
|---|---|---|---|
| *First Position:* | *32* | *33* | *31* |
| *Nobel Prize:* | *42* | *41* | *42* |

>> Need to train more efficiently: 4-8 years?

# Challenges/Expectations for Research Education

*Identify important problem*
*Design experiments*
*Select results for follow-up*



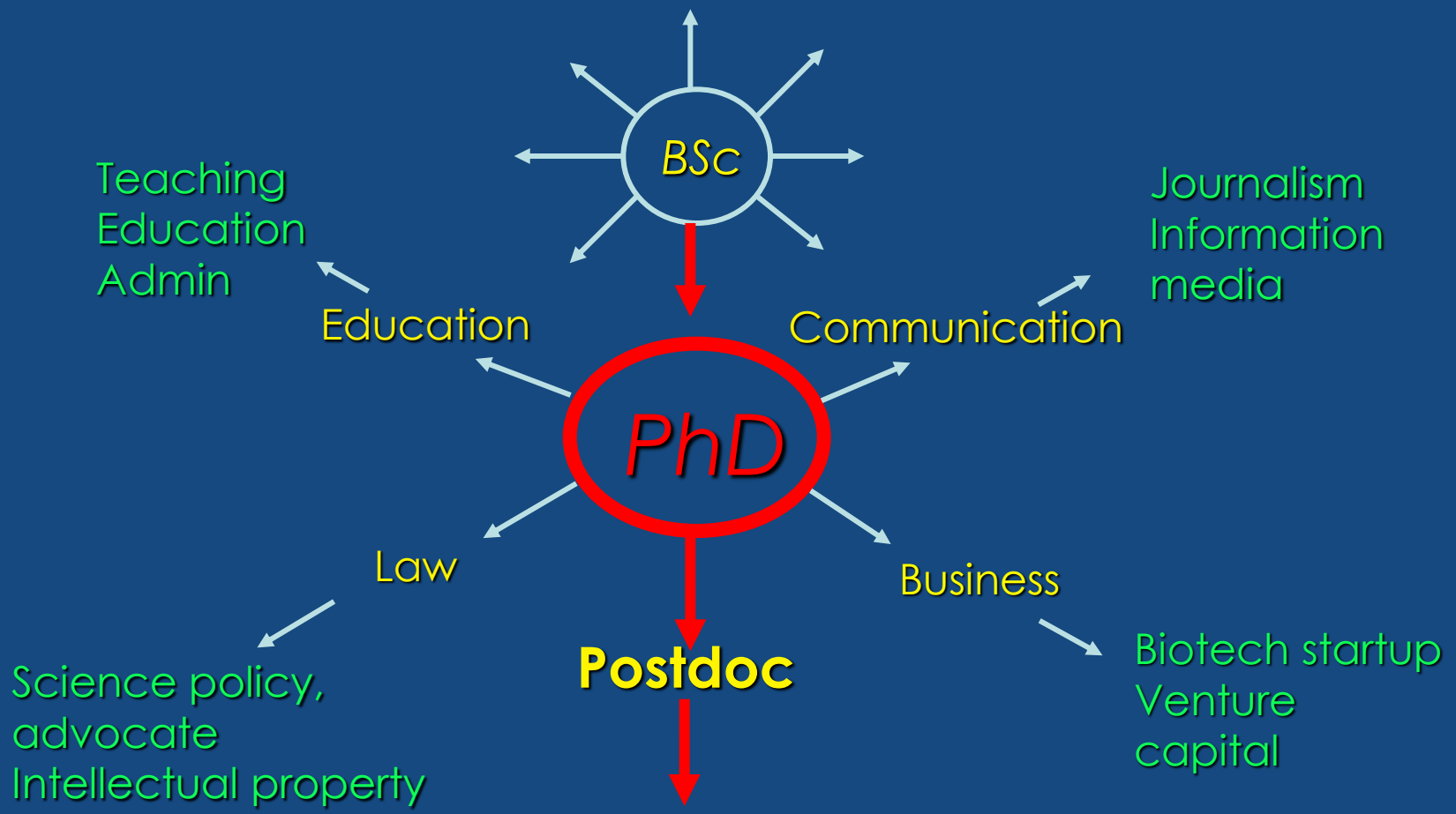
## Mission/Goals for the PhD

- Specialized expertise
- Mentored, original, bold research
- Broad literacy and perspective
- Team-based research
- Math/statistics/computation skills
- Three "tools of the trade"
- Working familiarity with career options

## Mission/Goals for the Postdoc

- Progression to independent team-based research
- Management skills for the practice of science

# GOAL: PhD "hub" with career option "spokes"




***Outcomes:***

- ***Informed/empowered students***
- ***Postdoc education imperative***
- ***Postdocs market appropriate***
- ***Other options market driven***
- ***Lab demographics change***

Day science calls into play arguments that mesh like gears, results that have the force of certainty… Conscious of its progress, proud of its past, sure of its future, day science advances in light and glory.

By contrast, night science wanders blind, it hesitates, stumbles, recoils, sweats, wakes with a start. Doubting everything, it is forever trying to find itself, question itself, pull itself back together.

Night science is a sort of workshop of the possible, where what will become the building material of science is worked out.

-Francois Jacob

If at first the idea is not absurd, then there is no hope for it.

-Albert Einstein

# Missions/Goals for Research & Education

## For graduate students:

- Broad literacy with specialized expertise
- Math/statistics/computation skills
- "Tools of the trade": *[a] identify important problems; [b] design experiments; [c] choose which results to pursue*
- Working familiarity with career options

## For postdocs:

- Management skills for the practice of science
- Progression to independent research: *"bold and owned project" development; independent "fellows programs"*

## Potential outcomes:

- Greatly reduced training period: *4-8 years total*
- Appropriate training for next gen leaders
- Right-sizing the workforce

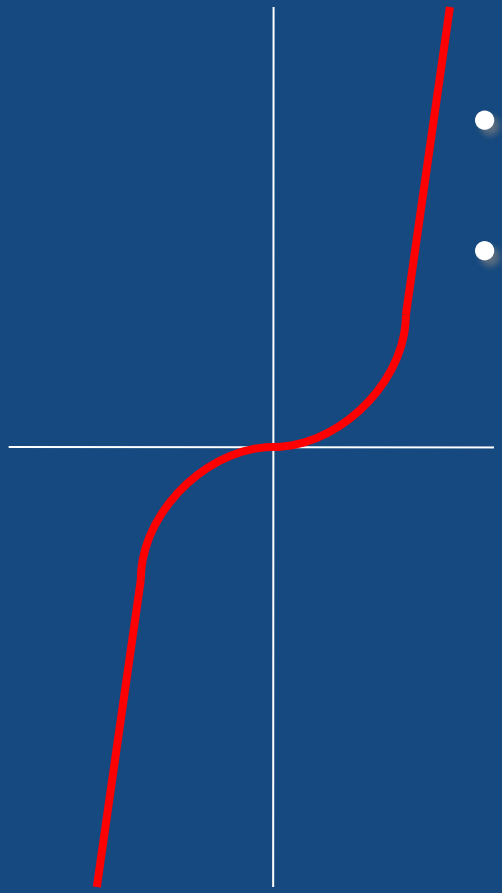
# Research Universities: excellence across three missions

- Educating nextgen researchers, practicioners
- Creation of new knowledge
- Exchange and export of knowledge

Scientific discovery takes … the occasional flash of brilliance; … it takes time and hard work and patience; it takes training; it requires the support of a nation. But it holds promise like no other area of human endeavor.

President Barack Obama
2009

# Promise and Impact



- Richer, more vibrant culture
- Societal crises and needs addressed