

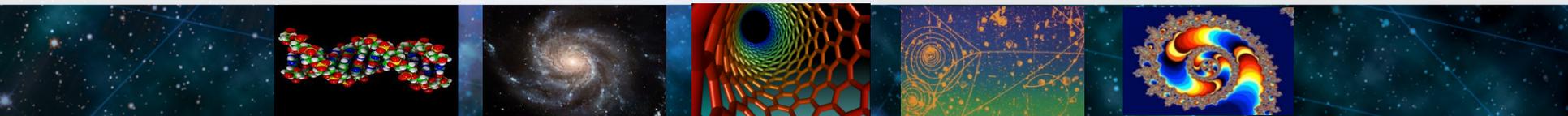
The National Science Foundation

Why? How? What next?



F. Fleming Crim
Assistant Director for
Mathematical and Physical Sciences

American Astronomical Society
January 8, 2014

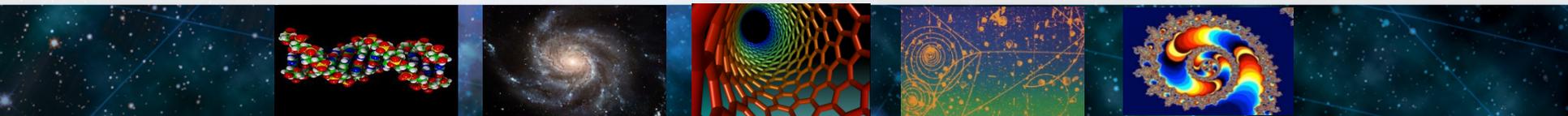
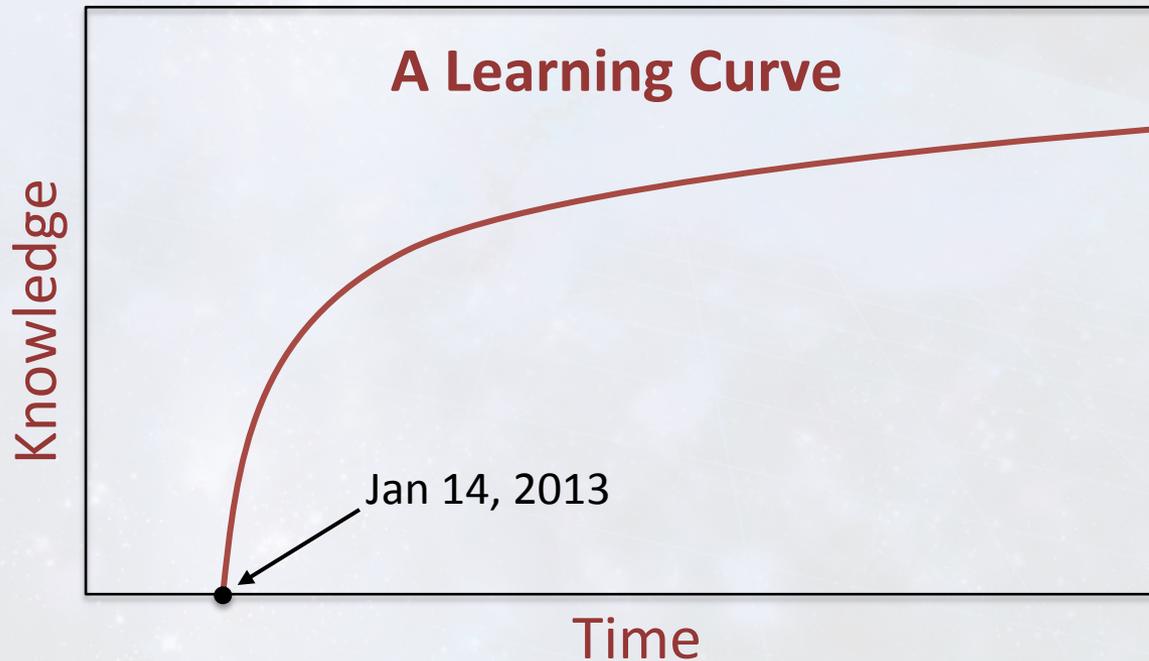


What I Learned in My First Year at NSF

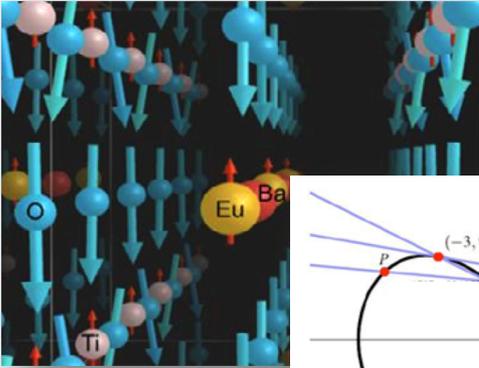
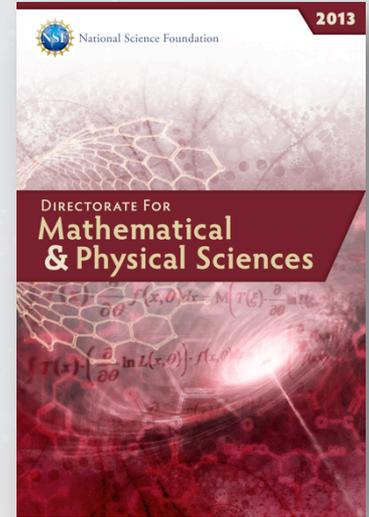
Mission: Support fundamental science across all of science and engineering

A complex agency, filled with dedicated and able people

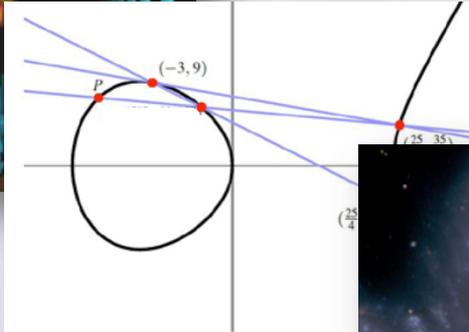
Intellectual opportunity and difficult decisions



The National Science Foundation



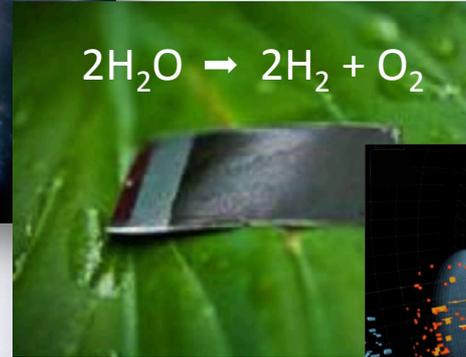
Materials



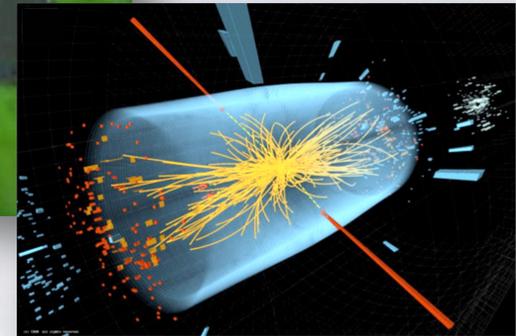
Mathematics



Astronomy



Chemistry

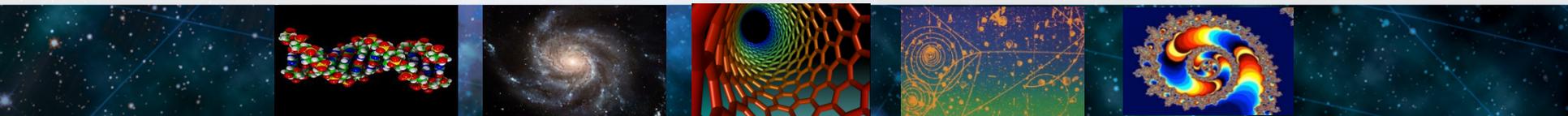


Physics

Why?

How?

What next?



The National Science Foundation

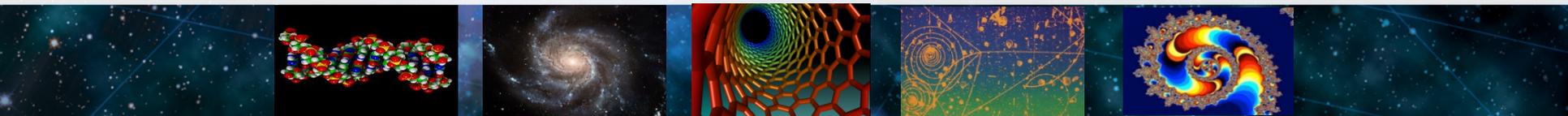


The NSF Act of 1950 (Public Law 81-507) sets forth the mission
“to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes.”

Basic research ... provides scientific capital. It creates the fund from which the practical applications of knowledge must be drawn. ... **Today, it is truer than ever that basic research is the pacemaker of technological progress.** ... A nation which depends upon others for its new basic scientific knowledge will be slow in its industrial progress and weak in its competitive position ...

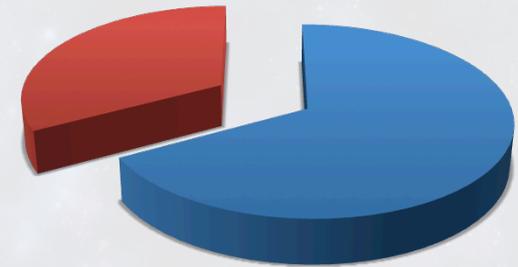
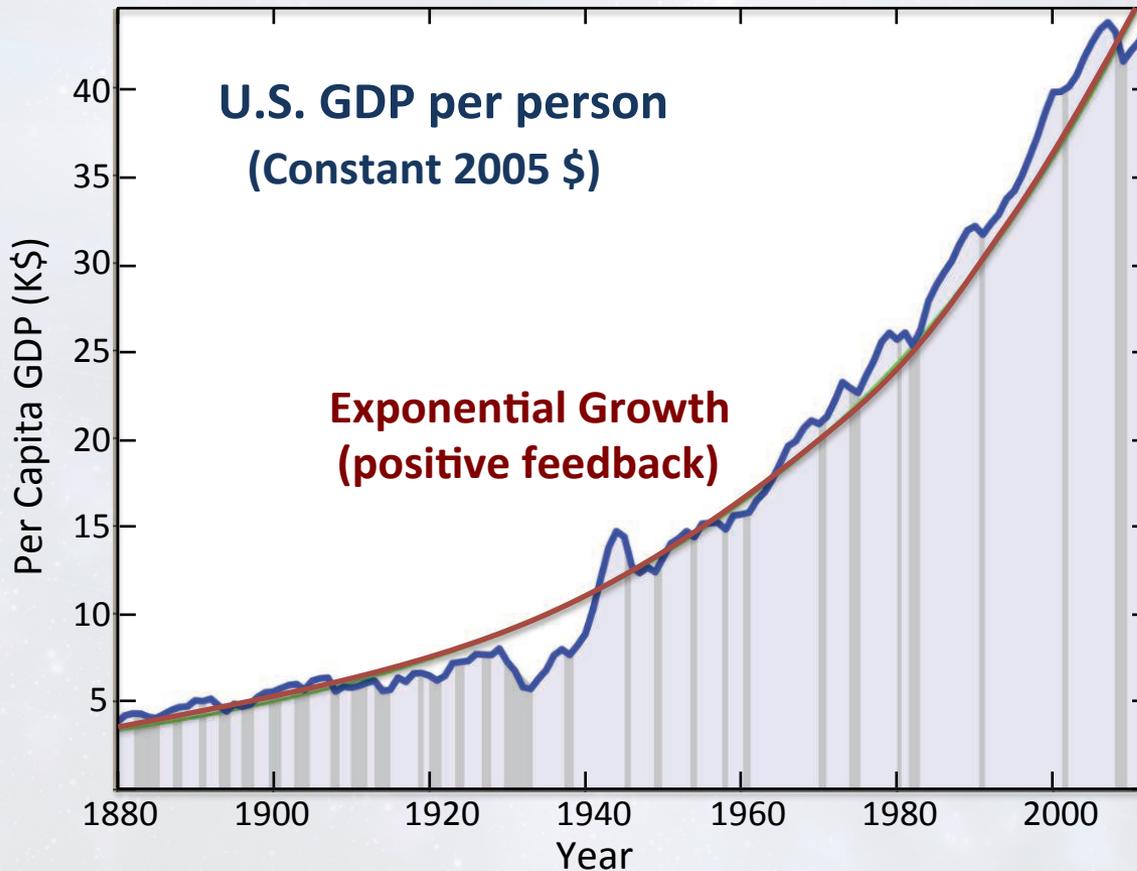


Vannevar Bush, *Science, The Endless Frontier* (1945)



What's So Special About Science (And How Much Should We Spend on It?)

W. H Press, Science **342**, 817 (2013)

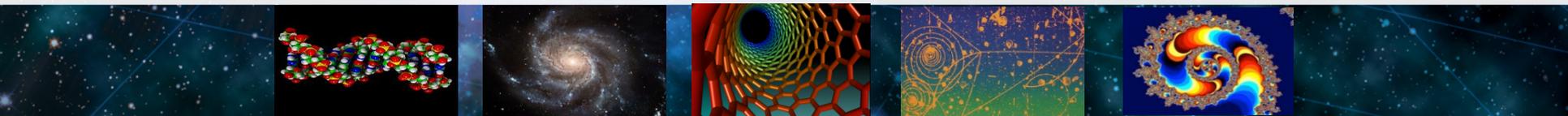


50% – 75% of economic
growth from fruits
of basic research

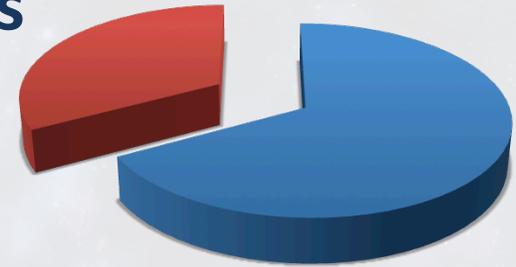
“Solow residual”



Investment in
fundamental research
returns 20% to 60%
per year

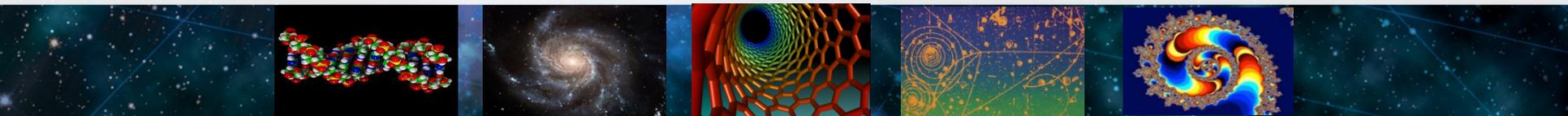


Prosperity and Welfare Start a Lot of Horses

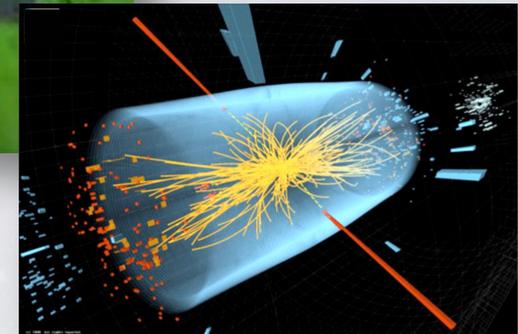
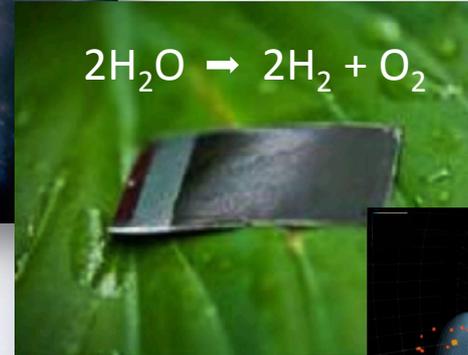
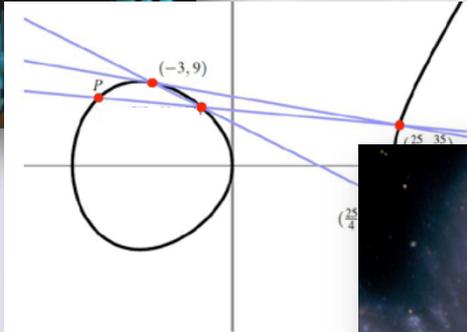
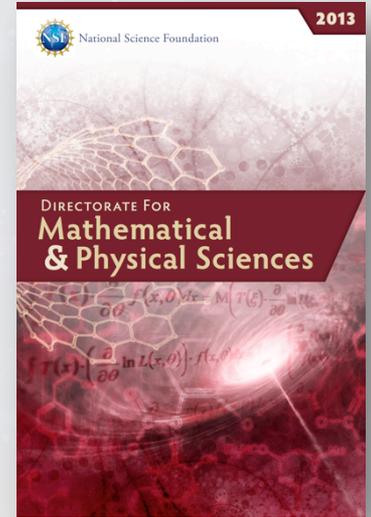
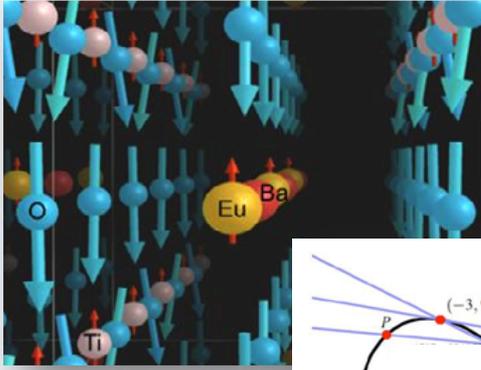


50% – 75% of economic
growth from fruits
of basic research

Exploiting scientific discovery
having a “heavy tailed”
distribution



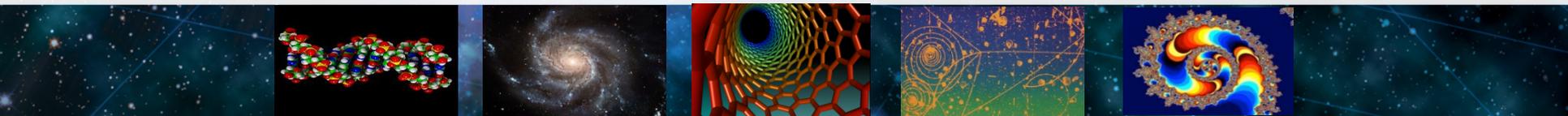
The National Science Foundation



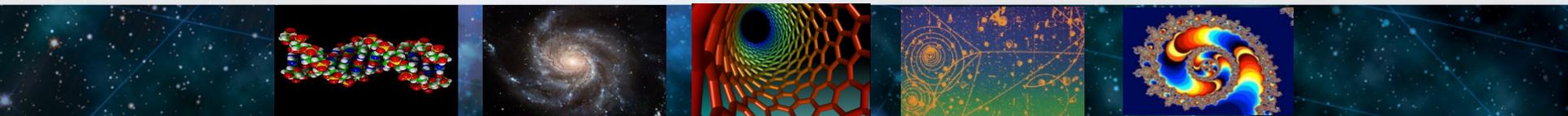
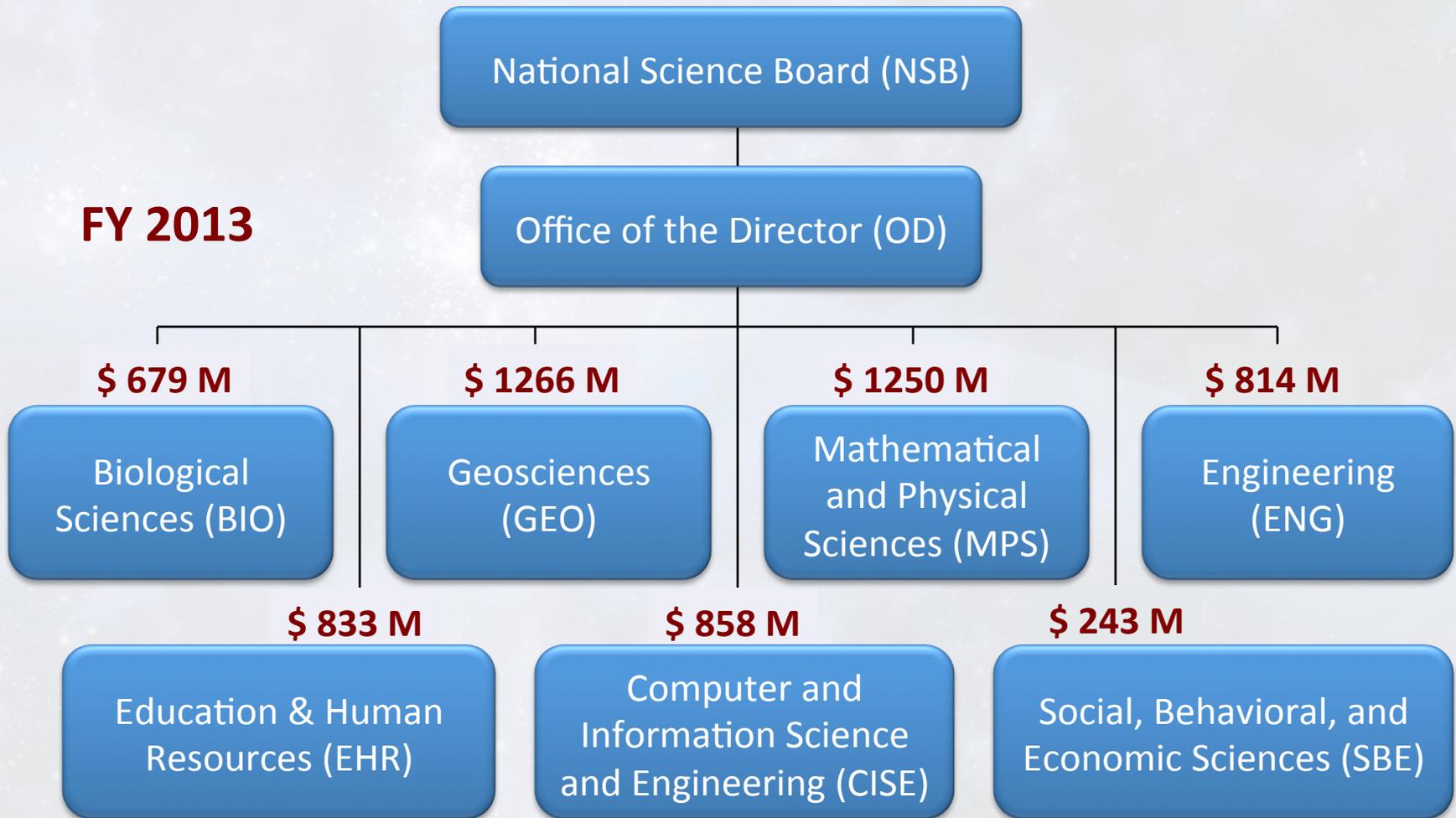
Why?

How?

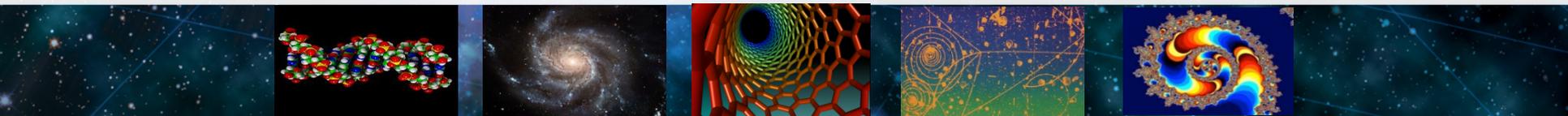
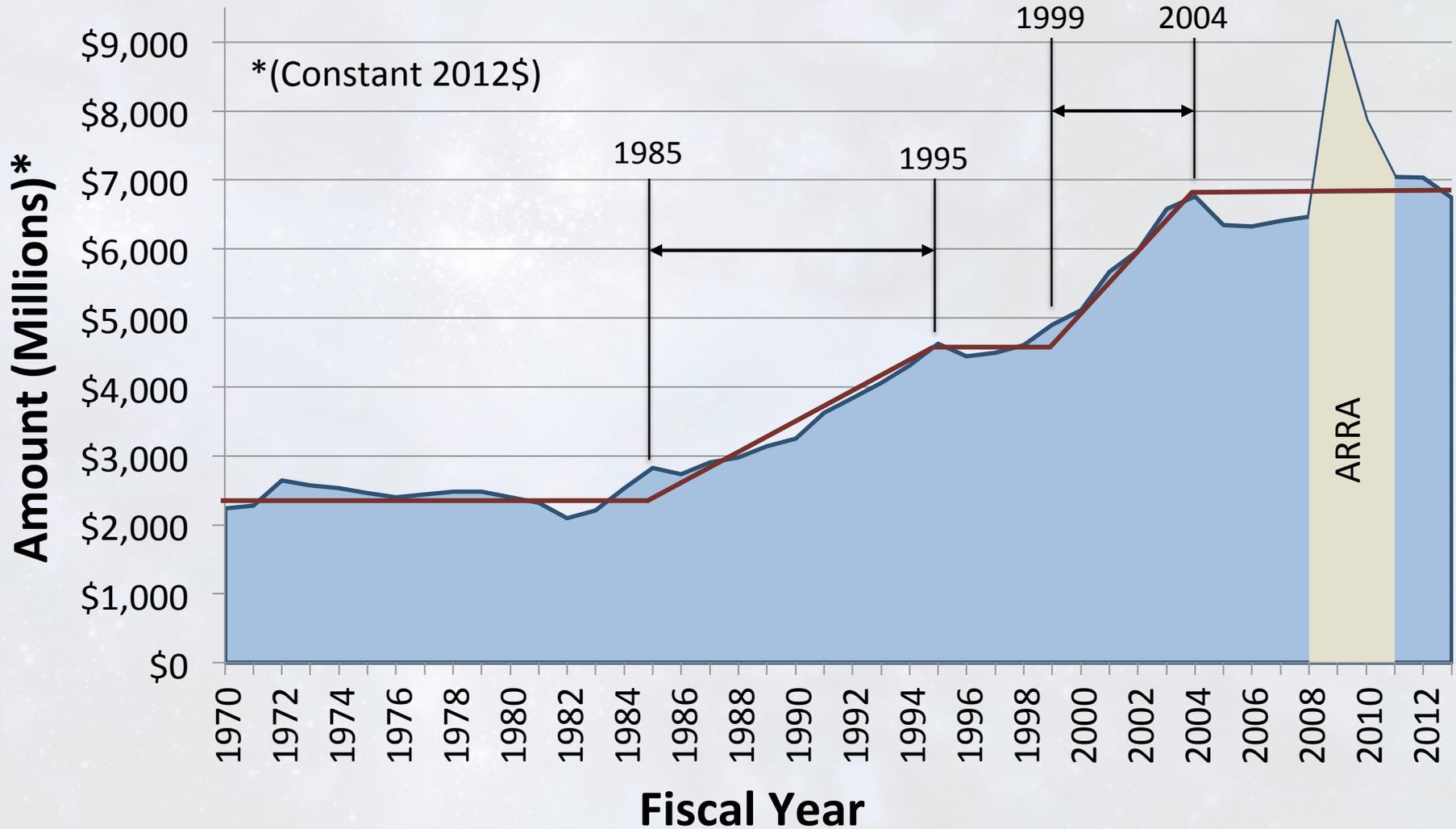
What next?

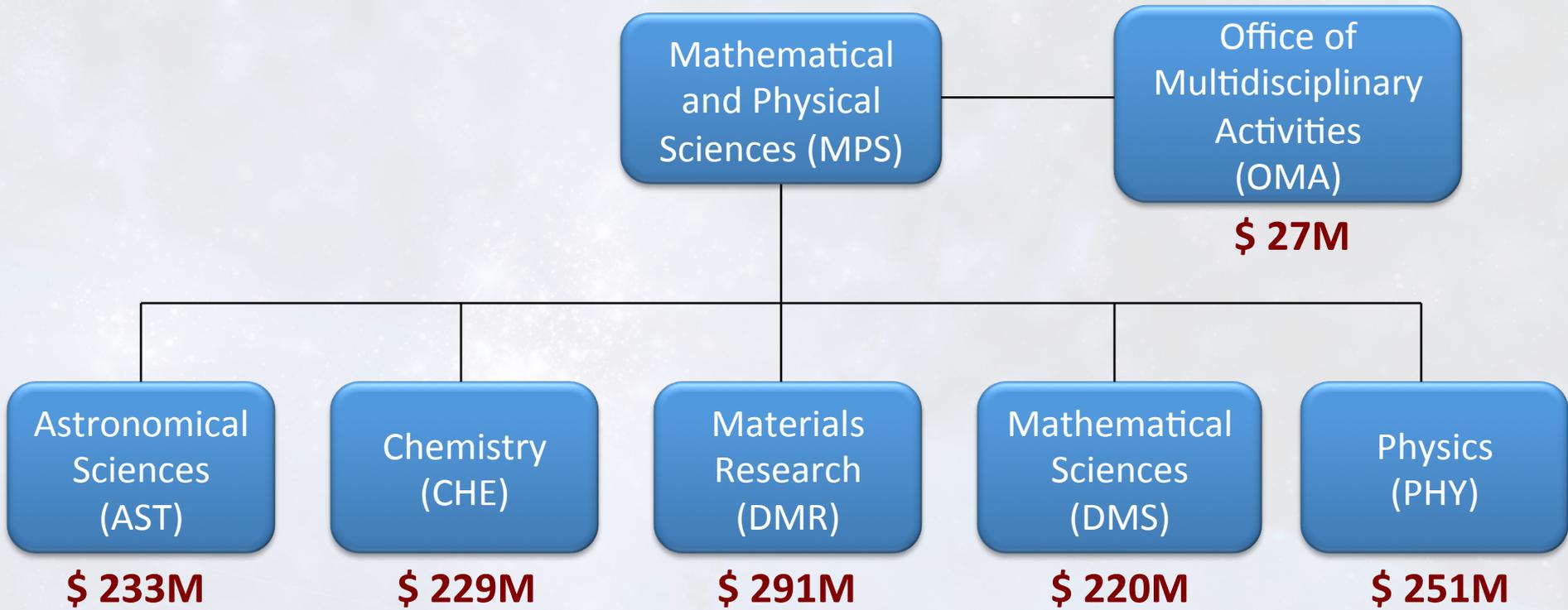


The National Science Foundation

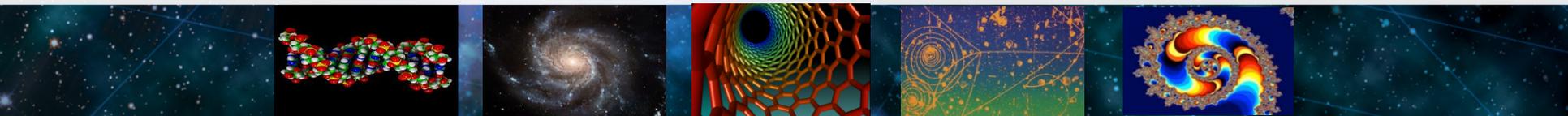


NSF Funding History





FY 2013: \$ 1250M



Mathematical and Physical Sciences (MPS)

Astronomical Sciences (AST)

\$ 233M

Chemistry (CHE)

\$ 229M

Materials Research (DMR)

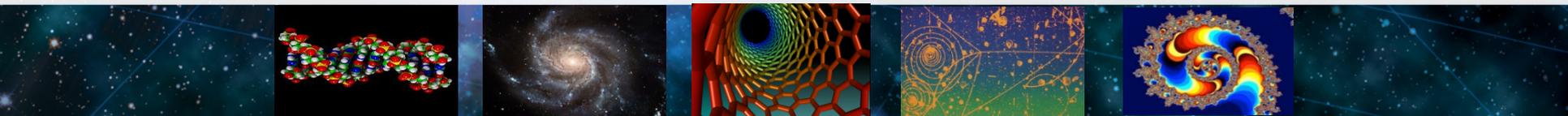
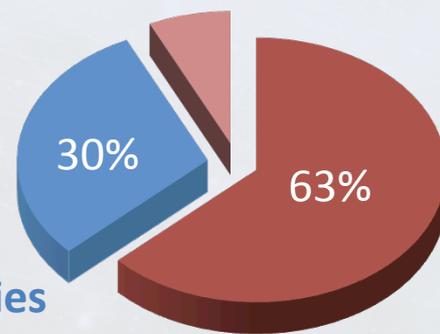
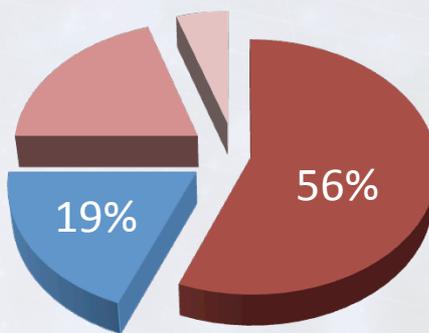
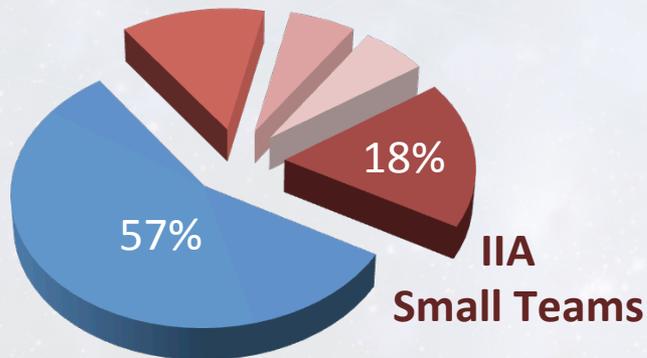
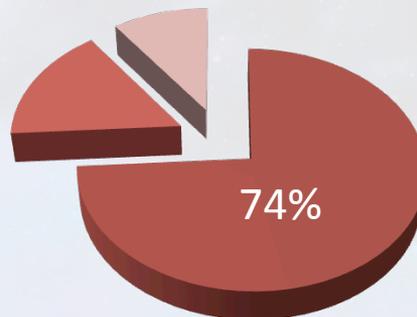
\$ 291M

Mathematical Sciences (DMS)

\$ 220M

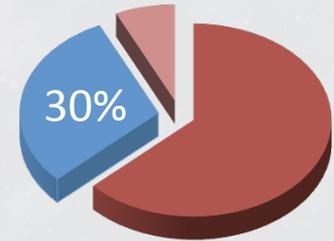
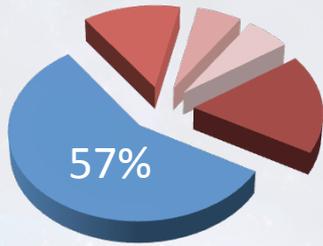
Physics (PHY)

\$ 251M



Astronomy (AST)

- Daniel K. Inouye Solar Telescope (DKIST (ATST))
 - Arecibo Observatory
- Atacama Large Millimeter Array (ALMA)
 - Gemini Observatory
- Large Synoptic Survey Telescope (LSST)
- National Optical Astronomy Observatory (NOAO)
- National Radio Astronomy Observatory (NRAO)
 - National Solar Observatory (NSO)

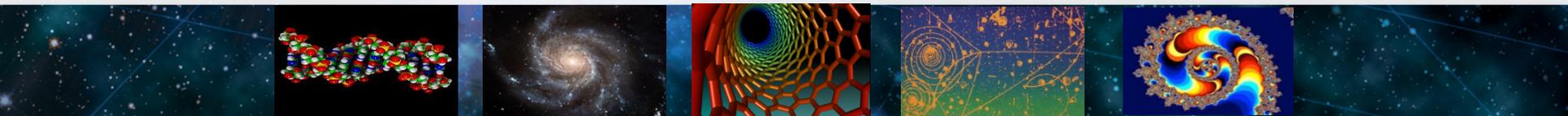
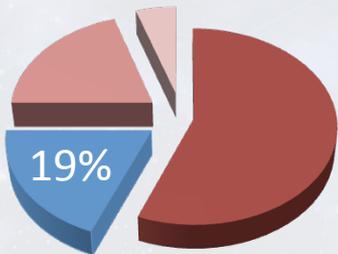


Physics (PHY)

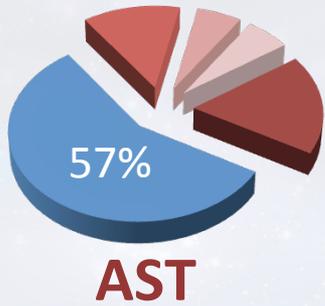
- Ice Cube Neutrino Observatory
 - Large Hadron Collider (LHC)
- Laser Interferometer Gravitational Wave Observatory (LIGO)
 - National Superconducting Cyclotron Laboratory (NSCL)

Materials Research (DMR)

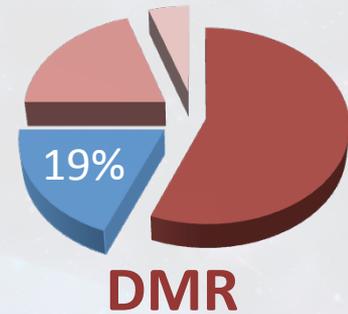
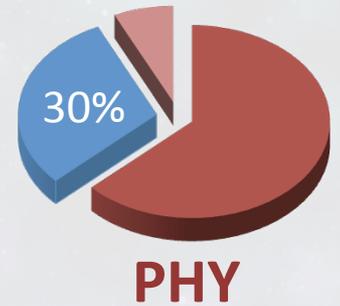
- Cornell High Energy Synchrotron Source (CHESS)
 - National High Magnetic Field Laboratory (NHMFL)
- National Nanotechnology Infrastructure Network (NNIN)



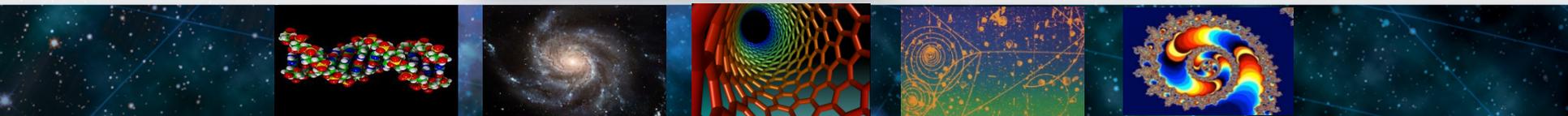
Two Different Appropriations for Facilities



Operations (R&RA)



**Major Research
Equipment and
Facilities Construction
(MREFC)**



Budget Realities and Scientific Opportunities

Facilities Enable Fundamental Research

**Budgets make it impossible
to support existing facilities AND seize new opportunities**



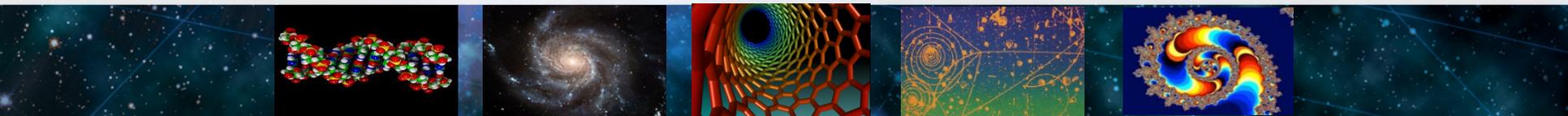
**Make and communicate difficult decisions with
careful planning and community involvement**

AST: NAS Decadal Survey, Portfolio Review

DMR: NAS Magnetic Field Report, Facilities Opportunities Review

PHY: P5 (Particle Physics Priority Planning Panel)

MPS and GEO Directorates are facing these decisions



Budget Realities and Scientific Opportunities

Facilities Enable Fundamental Research

**Budgets make it impossible
to support existing facilities AND seize new opportunities**

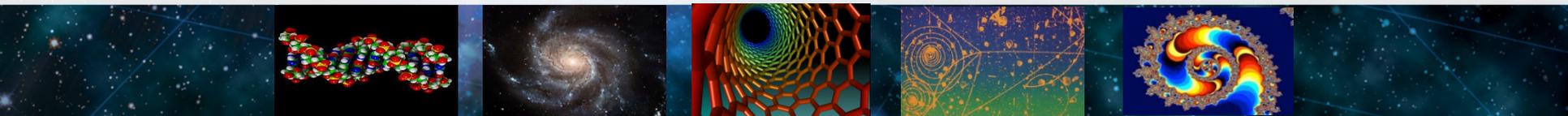


**Make and communicate difficult decisions with
careful planning and community involvement**

Focus on cutting-edge science for all of MPS

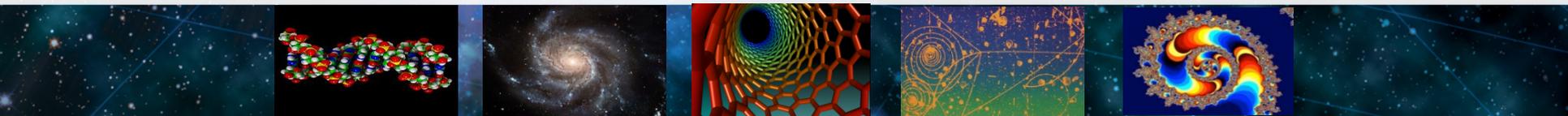
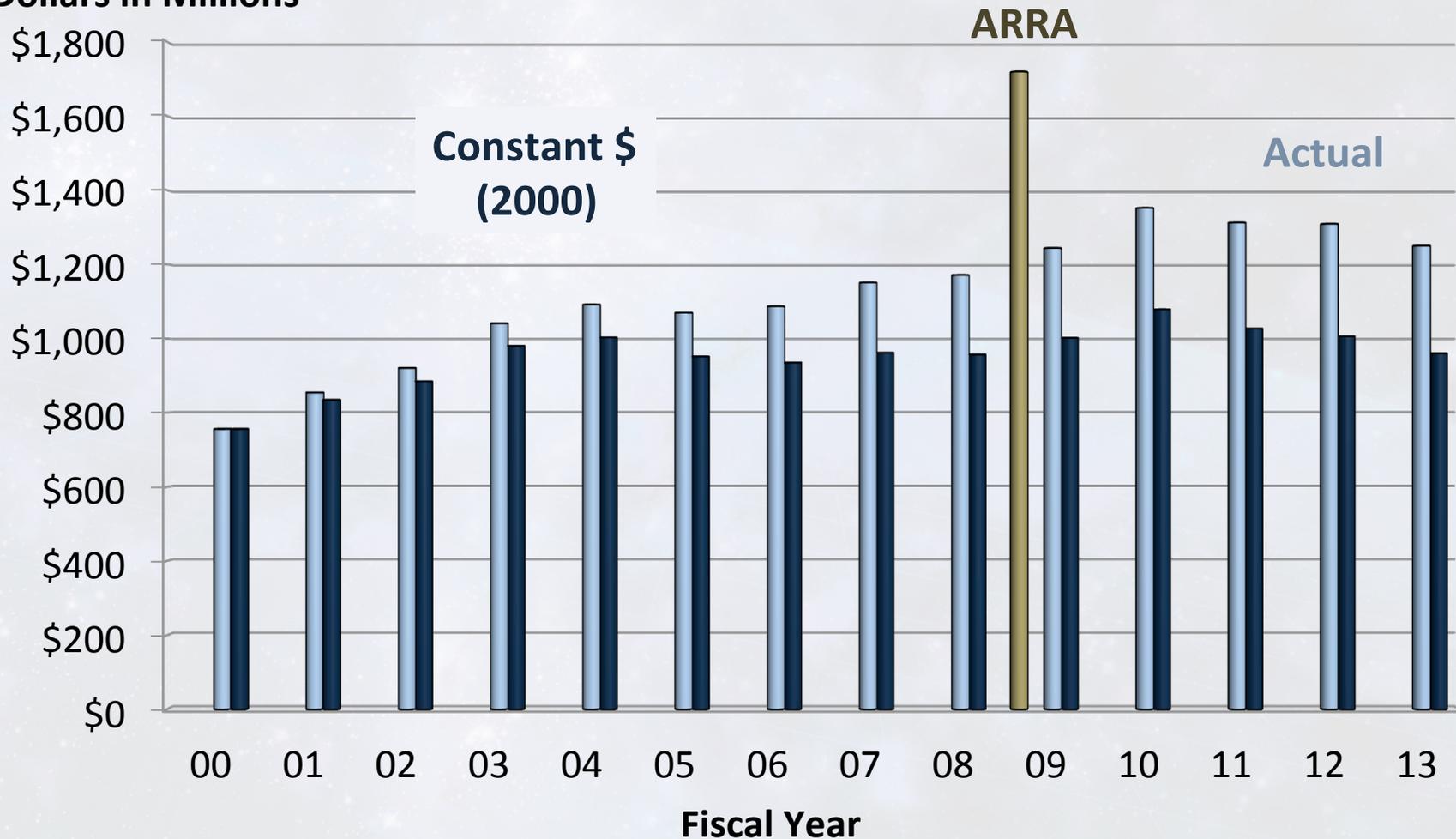
Build partnerships to fund and manage divested facilities

(divestiture \neq closure)

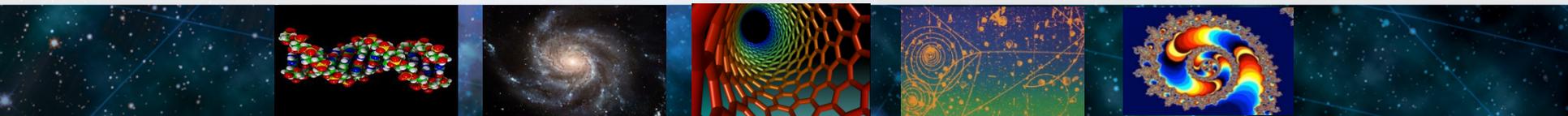
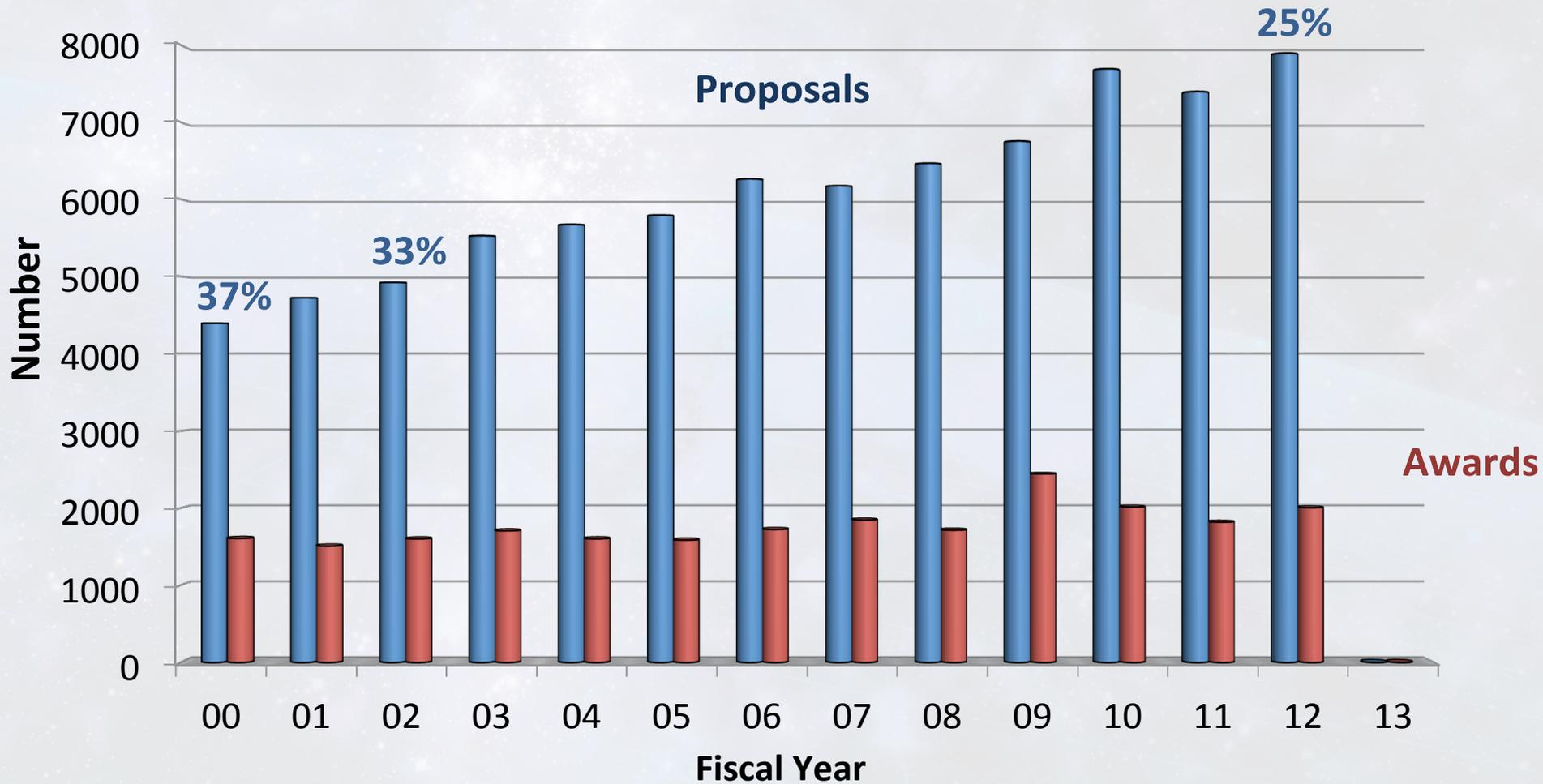


Funding remains “flat” for MPS...

Dollars in Millions

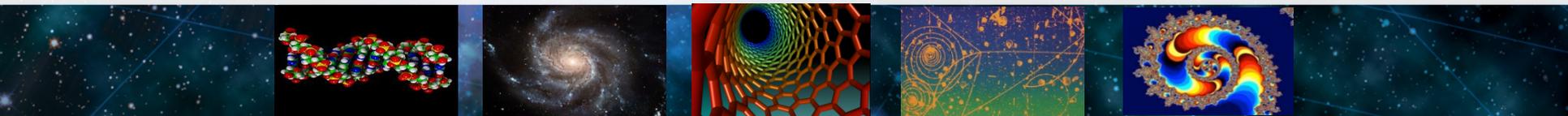
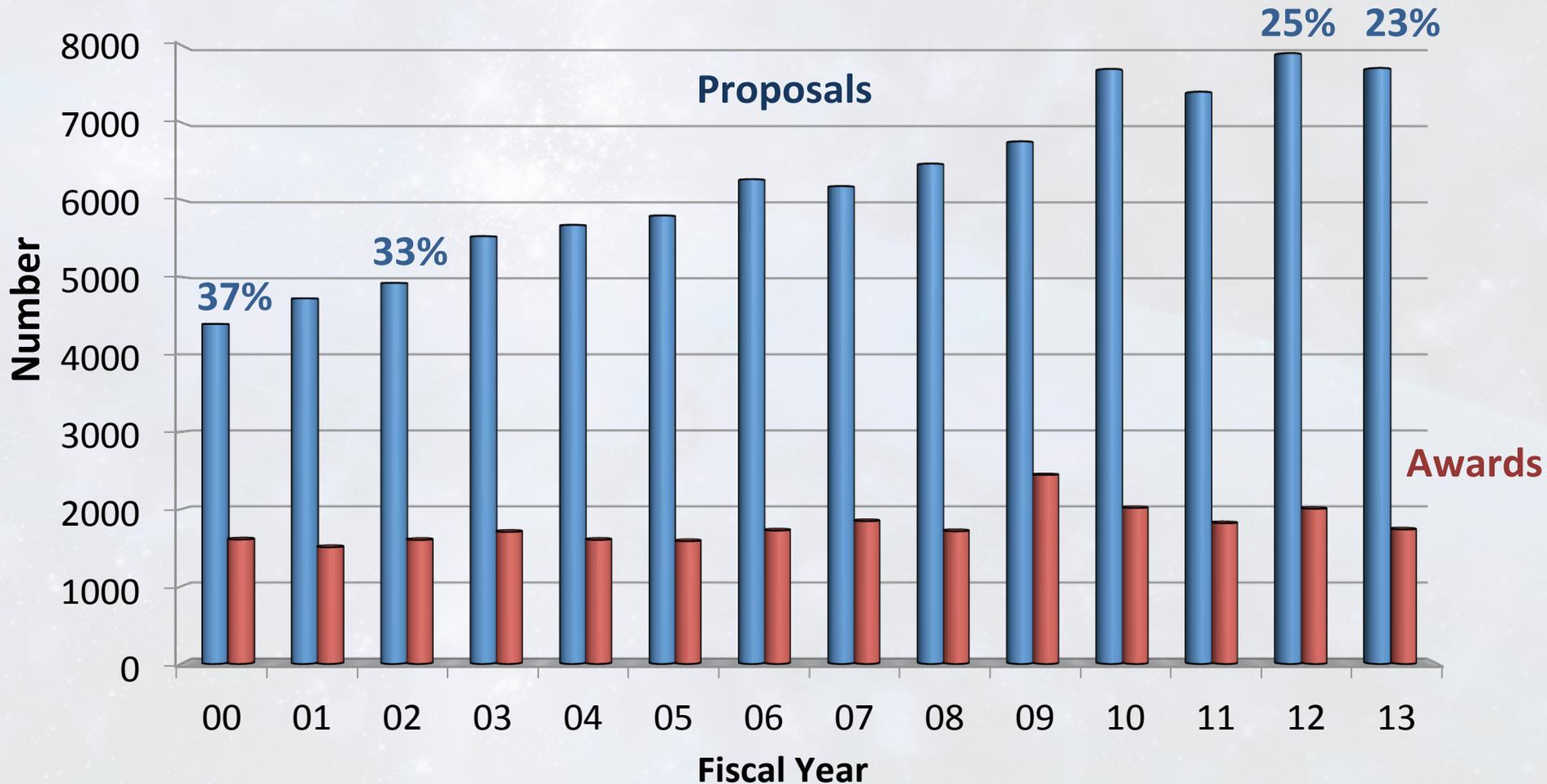


... causing the funding rate to go down ...



... and then sequestration reduces the number of awards.

(258 fewer in FY 2013)



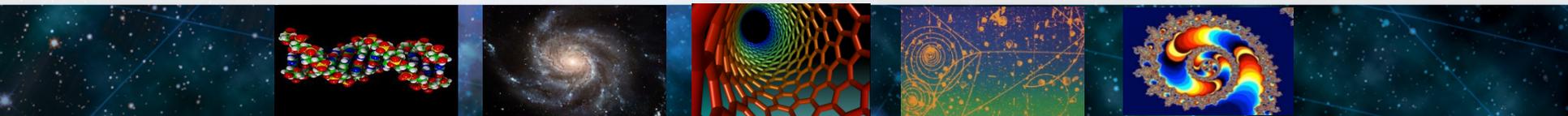
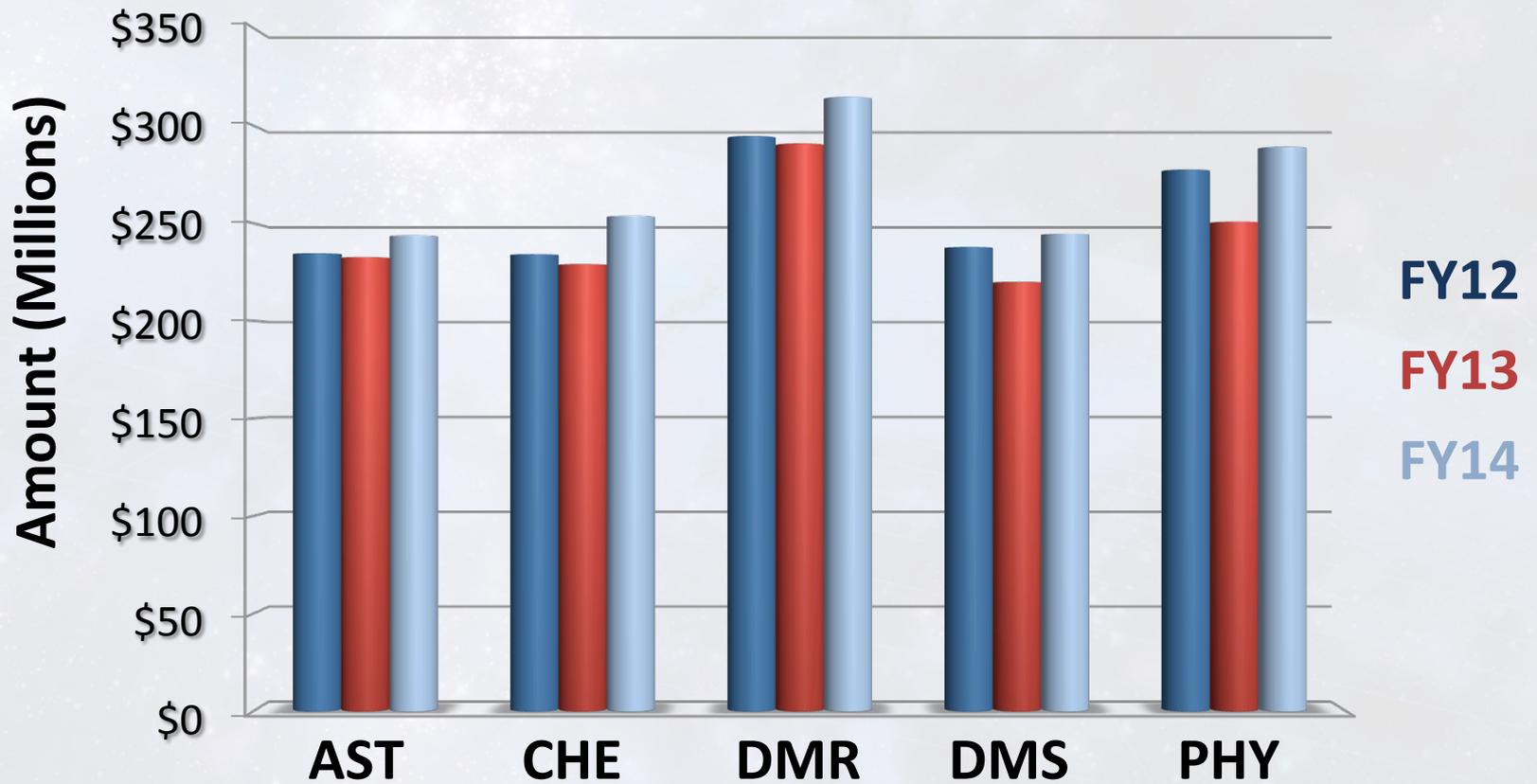
FY 2012
\$ 1309 M

- 4.5%
 →

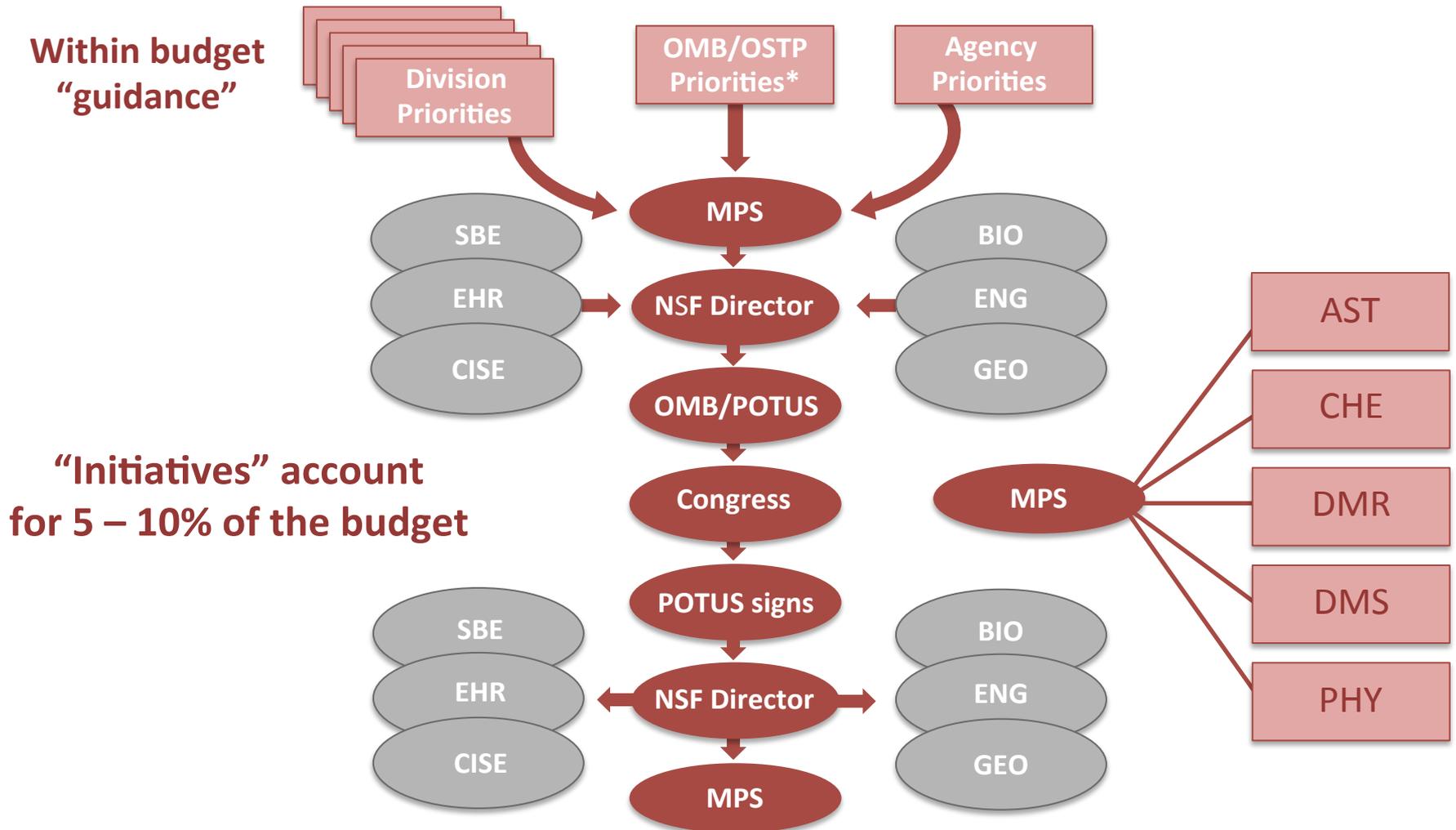
FY 2013
\$ 1250 M

10.9%
 →

FY 2014
\$ 1386 M
(Request)

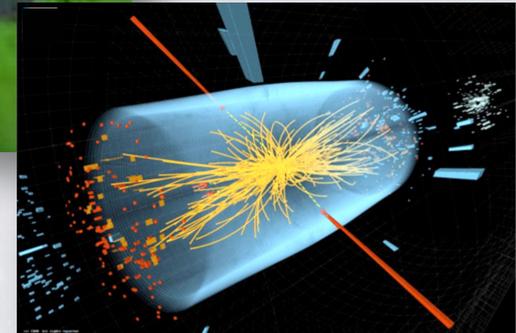
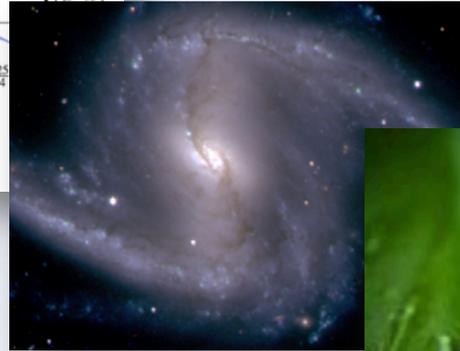
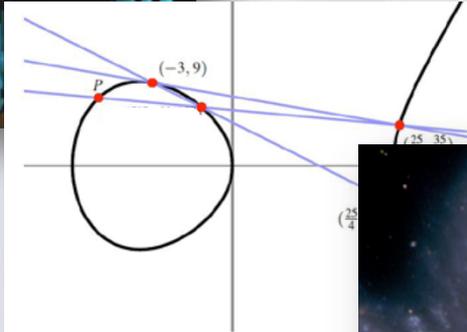
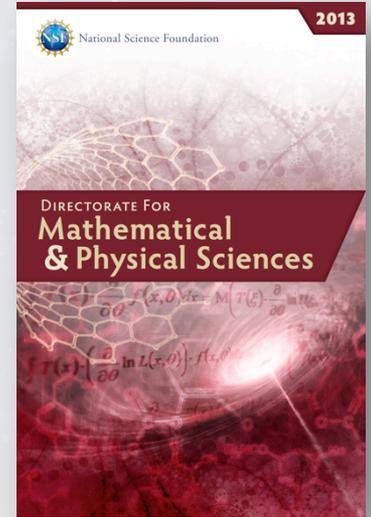
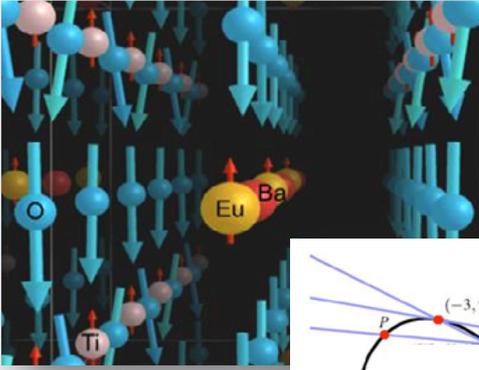


Budget Process



* "Science and Technology Priorities for Fiscal Year"

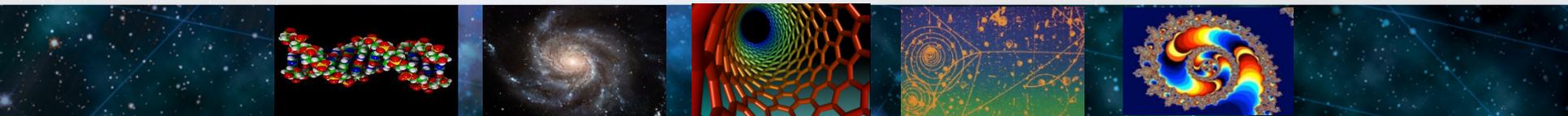
The National Science Foundation

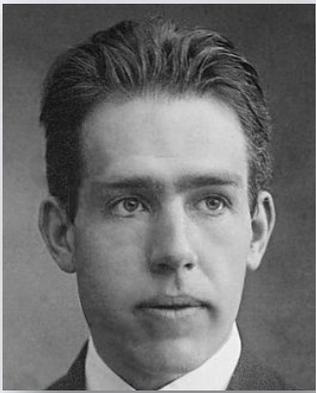


Why?

How?

What next?



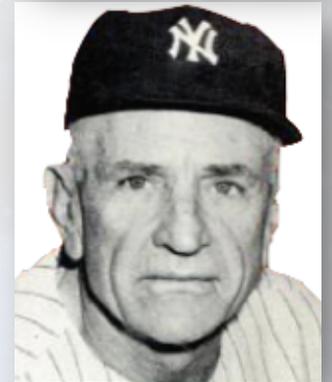
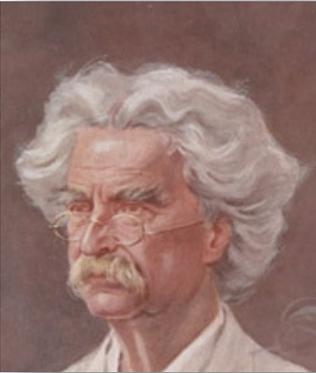


**“It’s difficult to make predictions,
especially about the future”**

Yogi Berra



Niels Bohr



Casey Stengel

Mark Twain

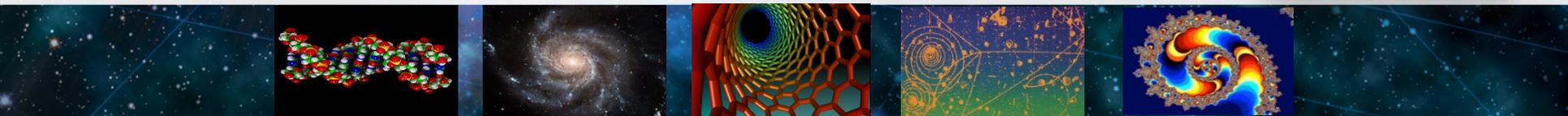


Groucho Marx

Freeman Dyson

-
-
-

(Images from Wikipedia Commons)



The Research Landscape



Intellectual Opportunity

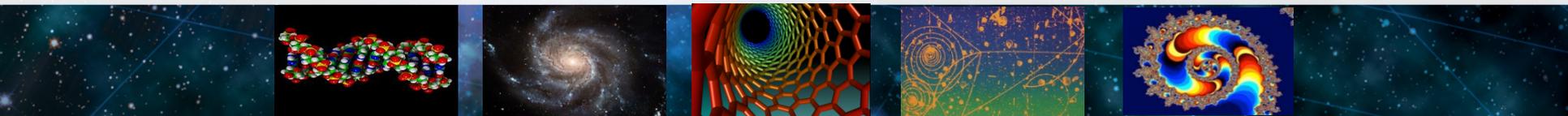
Resource Limitations

Global Community

Changing Demographics

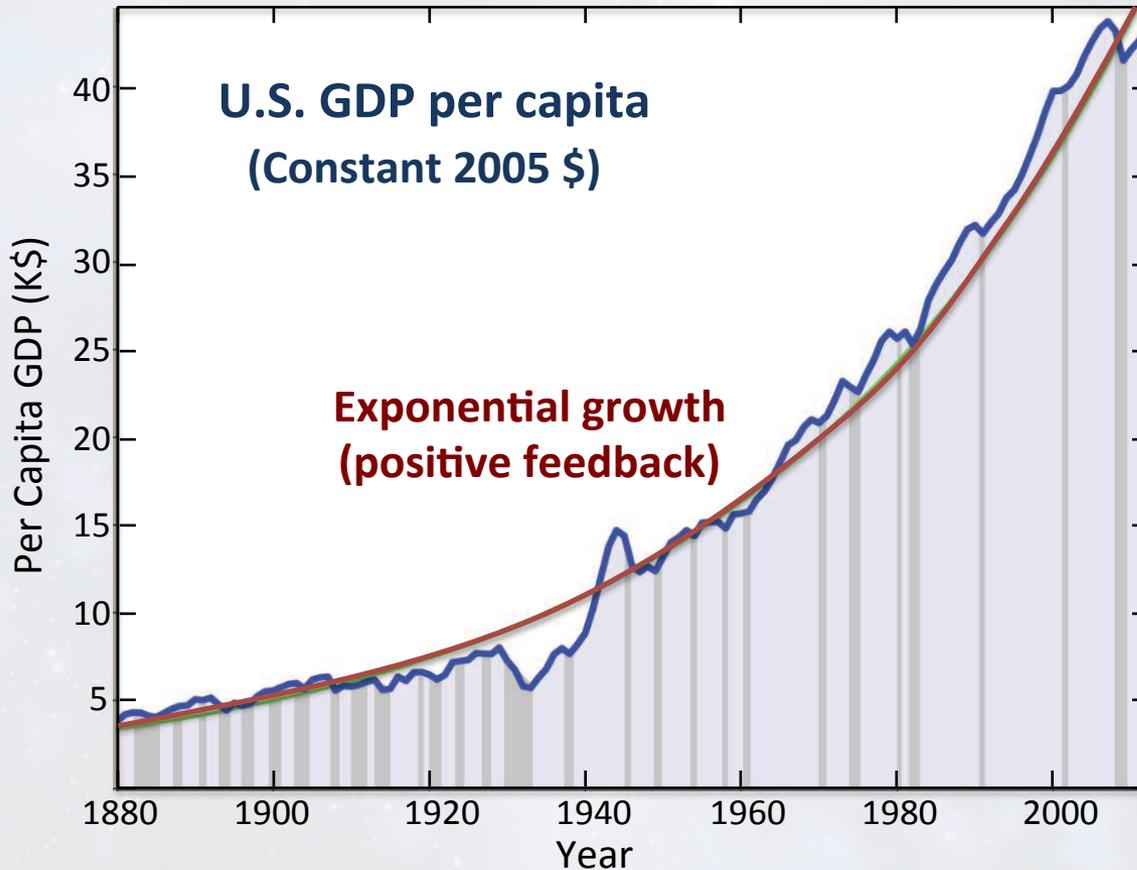
Workforce Challenges

Changing Universities



What's So Special About Science (And How Much Should We Spend on It?)

W. H Press, Science **342**, 817 (2013)



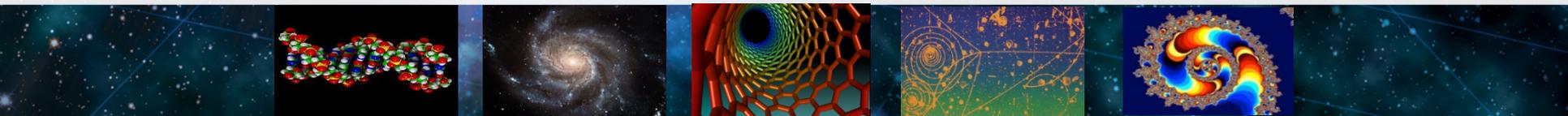
Investment in
fundamental research
returns 20% to 60%
per year

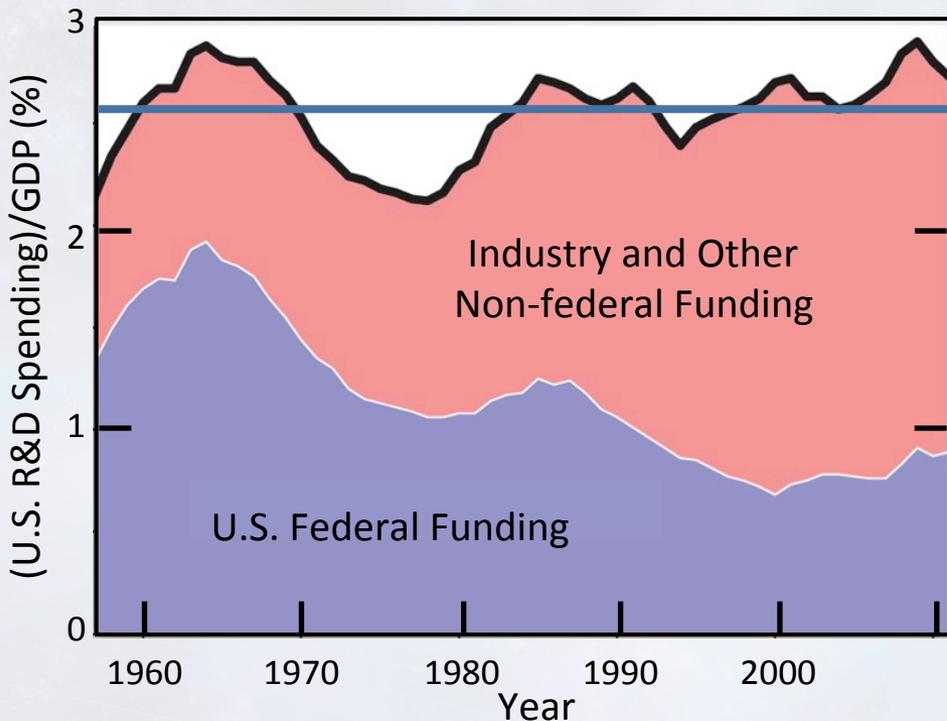
Why not buy “basic
research stock” as an
investment plan ?



“Appropriability”

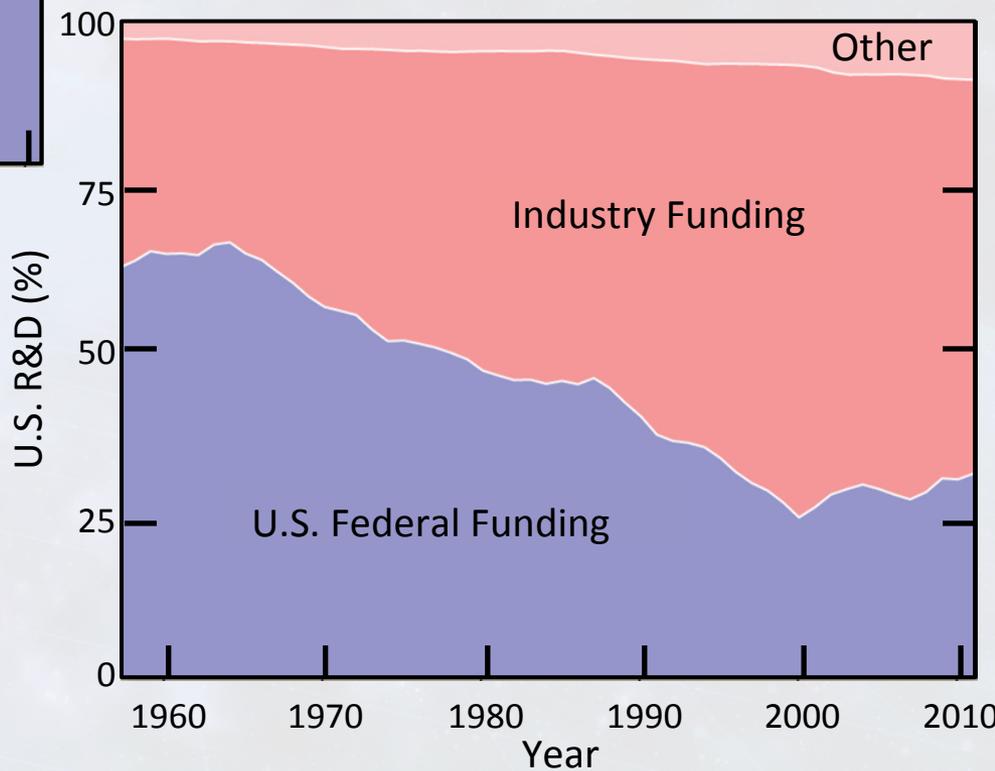
Who gets the rewards
of the basic research
“commons”



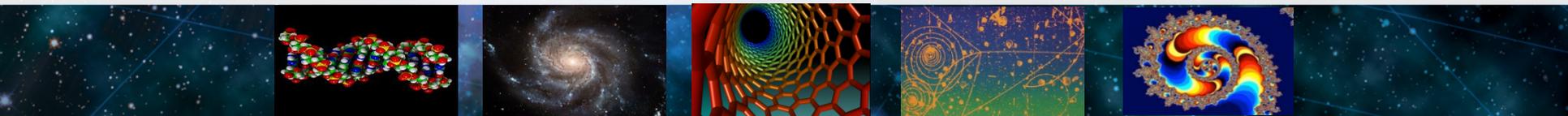


U.S. Investment has fluctuated around 2.8% of GDP, but the distribution has changed

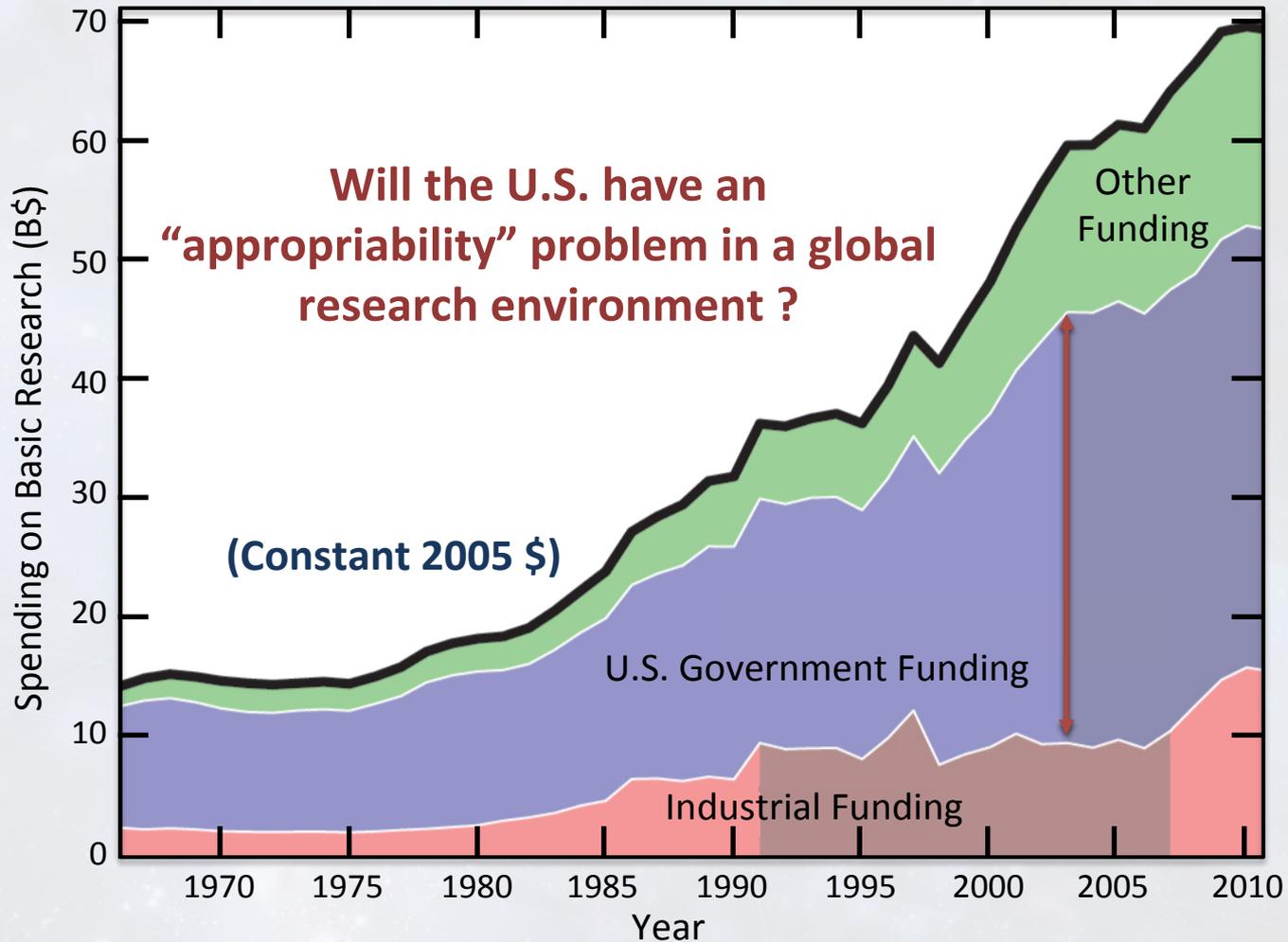
Industry invests in the more “appropriable” D of R&D



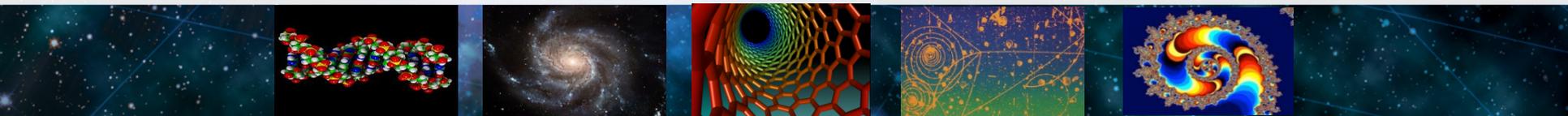
W. H Press, Science **342**, 817 (2013)



U.S. Spending on Basic Research



W. H Press, Science **342**, 817 (2013)



Some Words for the Wise

House Science Committee Chairman Sherwood Boehlert*
March, 2004

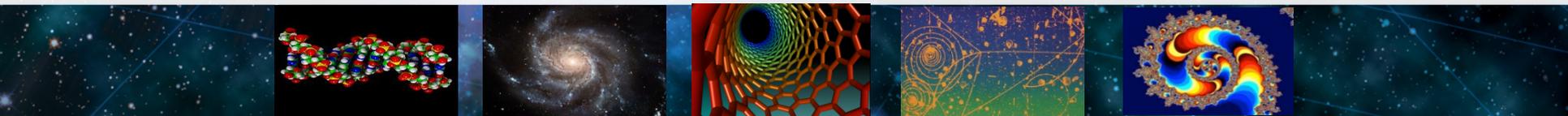
Congress is not besieged by groups asking for money that they describe as necessary to help their own narrow interests in the short run. The argument that science funding is a long-term national investment does nothing to set scientists apart.

All that sets you apart is that scientists are the only group that thinks they're making a unique argument.



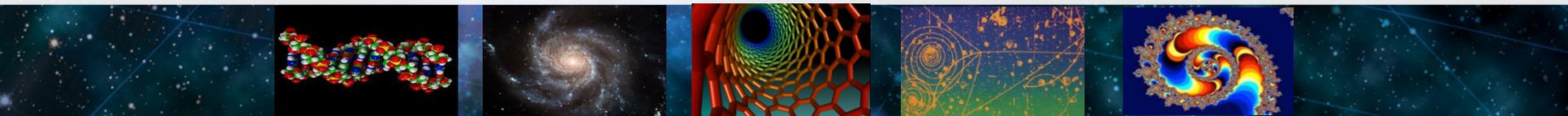
We must make a sophisticated and effective case broadly based on more than economics alone

*with thanks to Joel Parriott



Broadening Participation and Developing the Workforce

Why Broaden Participation?

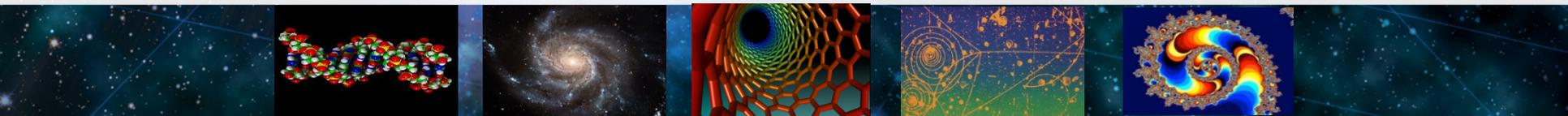




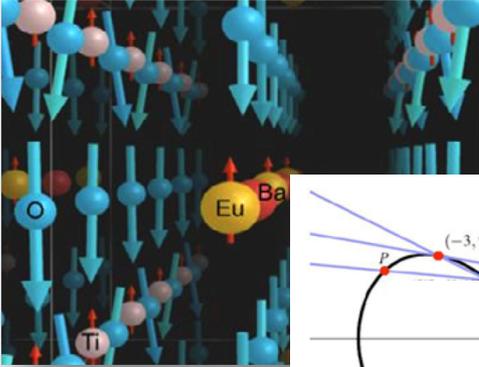
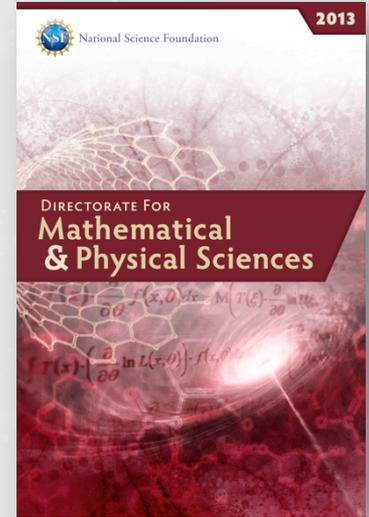
www.soteradefense.com

- **Demographics** **Attract the best to science**
The US will be “majority minority” by 2042*
- **Renew the workforce** **The biological imperative**
- **Invigorate science** **Culture and style matter**

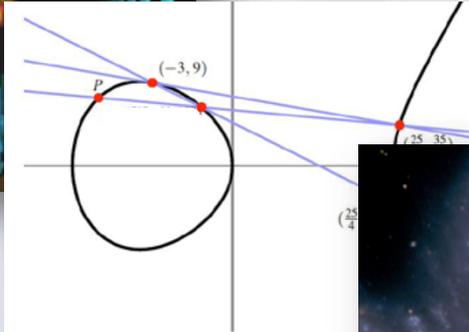
* US Census estimate



The National Science Foundation



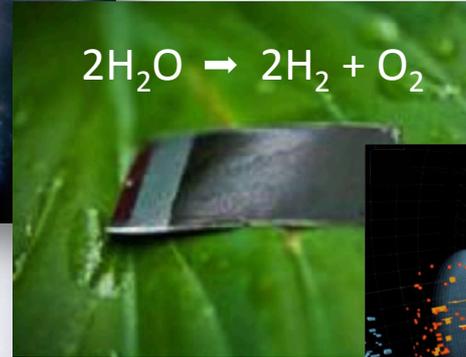
Materials



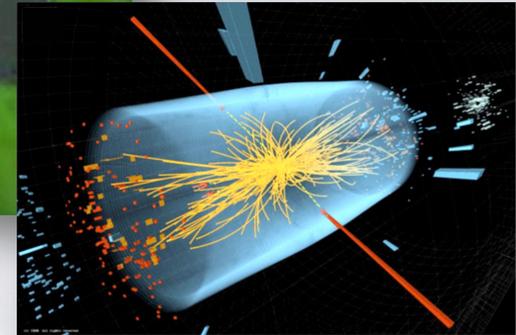
Mathematics



Astronomy



Chemistry



Physics

Why?

How?

What next?

