

Biology in FY 2016



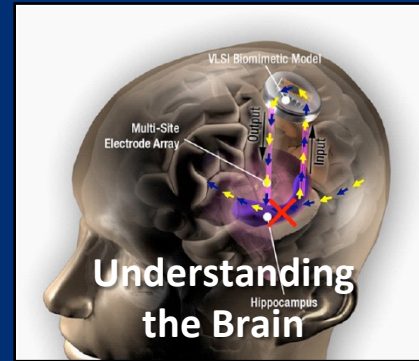
National Association of Marine
Laboratories (NAML)
Winter Meeting
March 1-2, 2015
Washington, D.C.



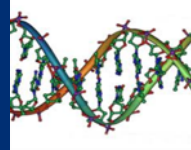
Charles D. Liarakos
Senior Policy Advisor
Office of the Assistant Director
Directorate for Biological Sciences
National Science Foundation

Biology in FY 2016

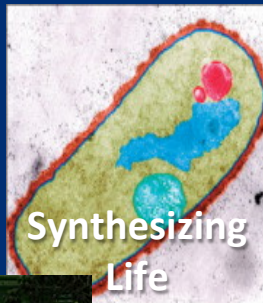
A perspective from NSF



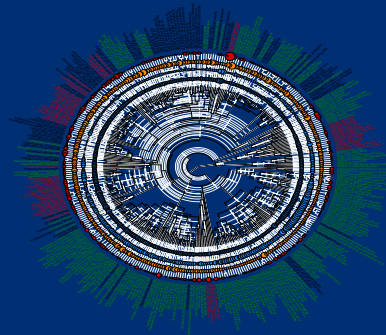
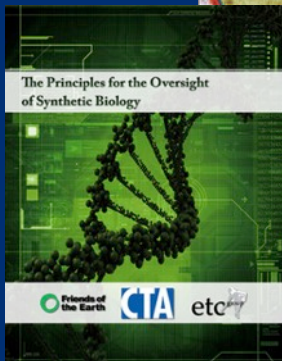
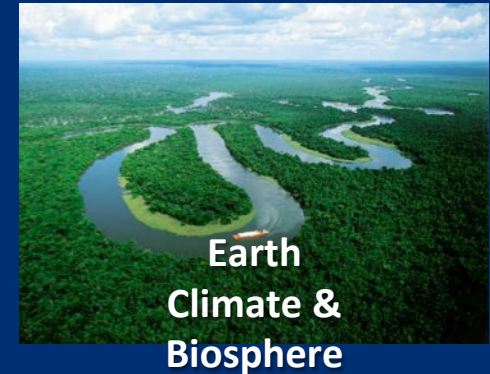
Molecular and Cellular Biosciences



Integrative Organismal Systems



Biological Infrastructure



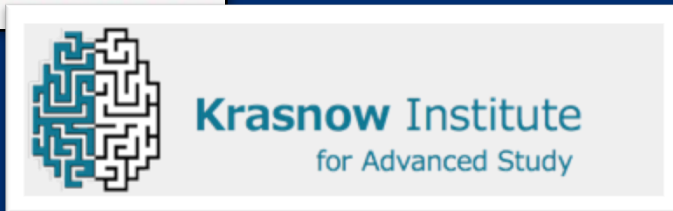
Environmental Biology

Dr. James L. Olds Assistant Director Directorate for Biological Sciences

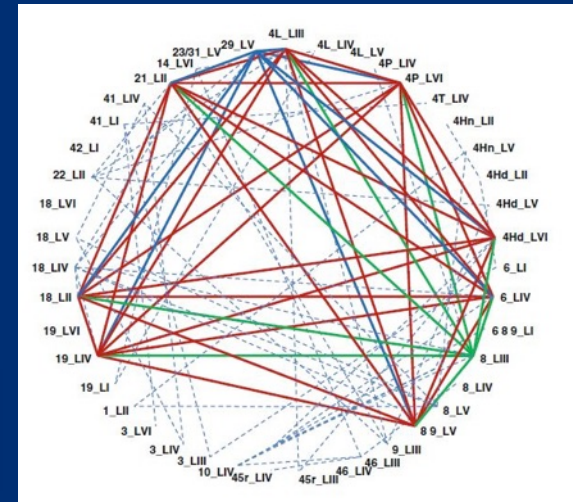
Greetings!



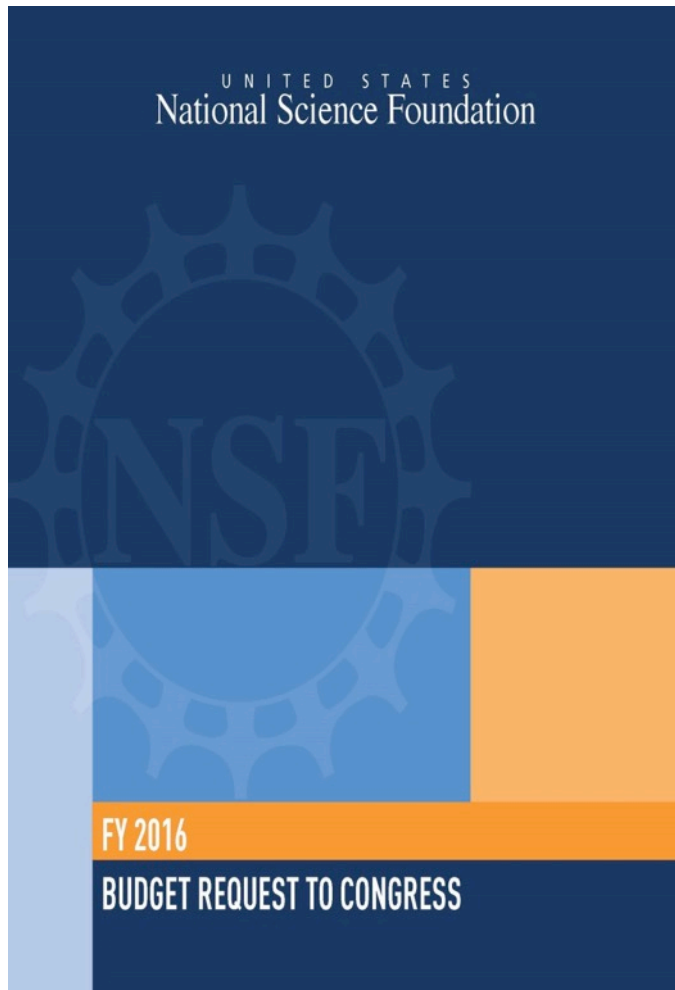
National Science Foundation
WHERE DISCOVERIES BEGIN



Neurobiologist James L. Olds Named
10th Editor of *The Biological Bulletin*



NSF FY 2016 BUDGET REQUEST



NSF FY 2016 Budget

Total: \$7.72 billion

Increase: \$379.34 million

+5.2% over FY 2015



BIO FY 2016 BUDGET REQUEST

**TOTAL BIO R&RA: \$747.92 million,
2.3% Increase**

Research: \$553 million

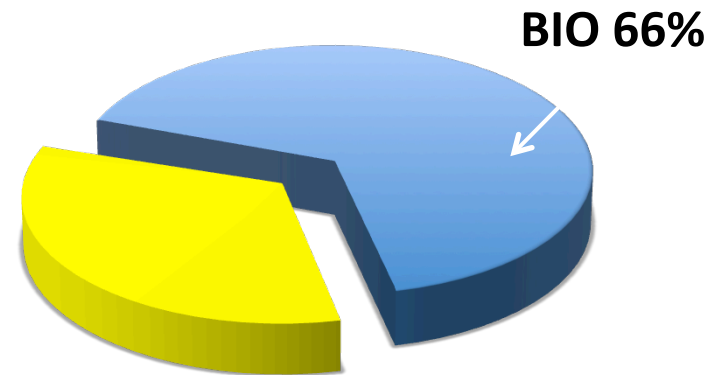
Learning: \$33 million

Infrastructure: \$149 million

Administration: \$13 million

**NEON Operations & Management:
\$44.04 Million**

NEON Construction: \$80.64 Million



**Federal Support for Basic
Research in Non-Medical
Biological Sciences at
Academic Institutions**



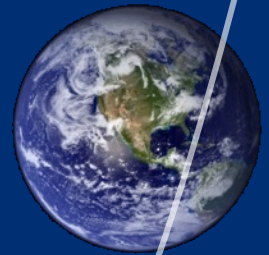
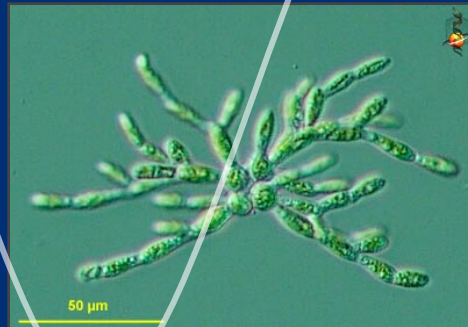
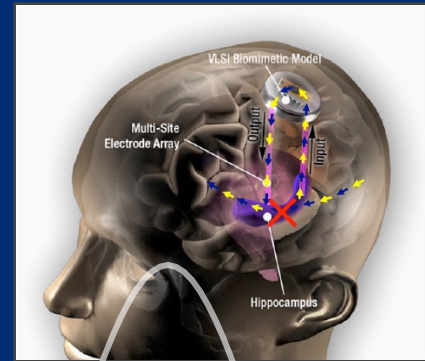
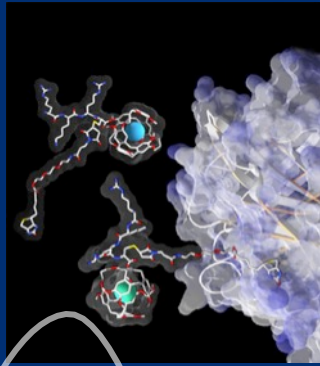
BIO MAJOR INVESTMENTS

Five Grand Challenges (2010 National Research Council Report)

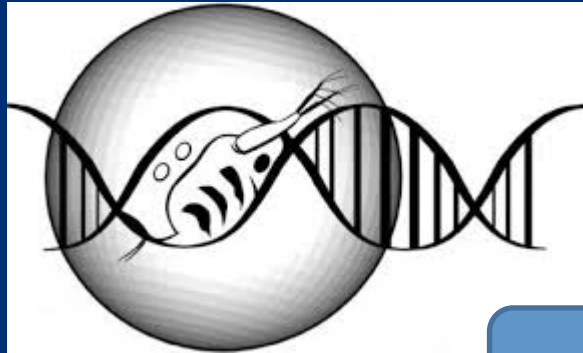
- **Understanding the Brain / Brain Research through Advancing Innovative Neurotechnologies (BRAIN)**
- **Research at the Interface of Biological, Mathematical and Physical Sciences, and Engineering (BioMaPS)**
- **Synthetic Biology**
- **National Ecological Observatory Network (NEON)**
- **BioData: BIO participation in Cyberinfrastructure Framework for 21st Century Science Engineering, and Education (CIF21)**
- **Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)**



Biology is Changing

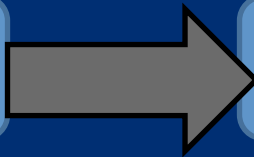


Biology is integrating new knowledge across scales of Size, Place and Time

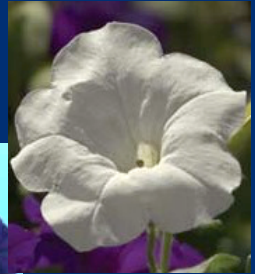


Gene & Genome

Genomes

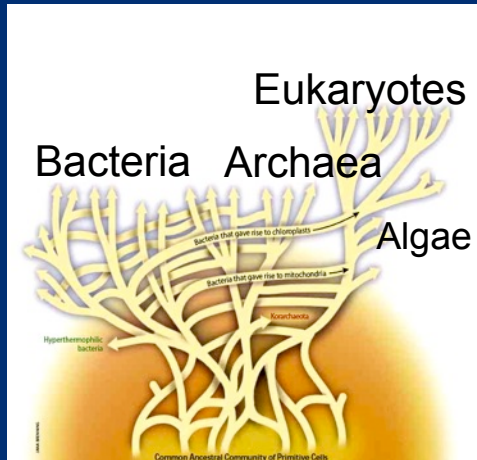


Phenomes



RNAi

EpiGenetics

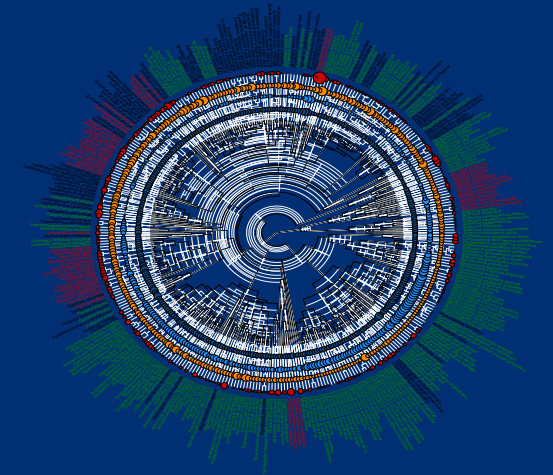
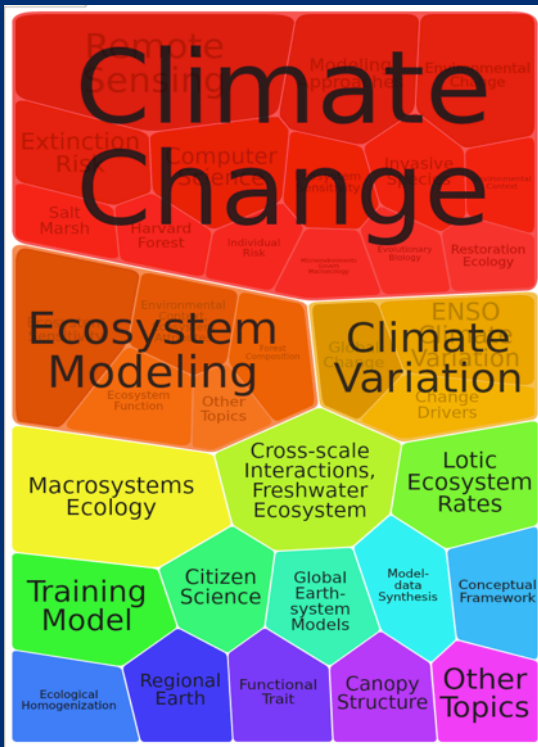


Horizontal Gene Transfer



Identical Phenotypes?

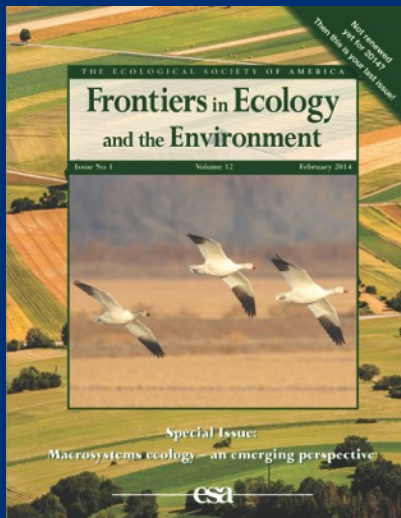
Biology is producing large and diverse sets of molecular, organismal and environmental research data



Genealogy of Life (GoLife)

MacroSystems Biology

Discovery and Analysis

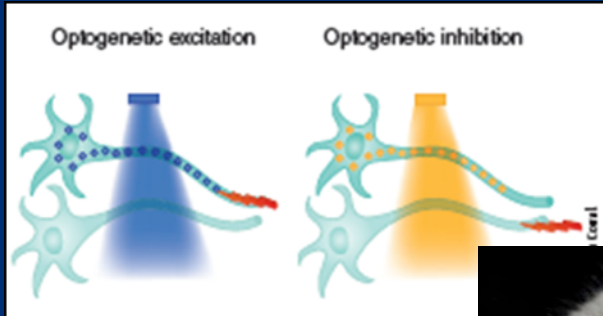


Biodiversity Science



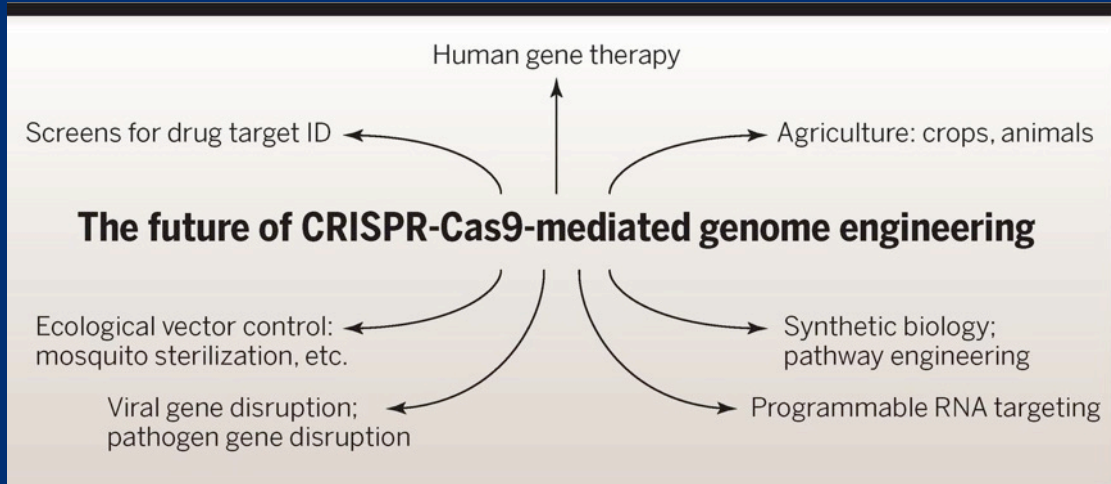
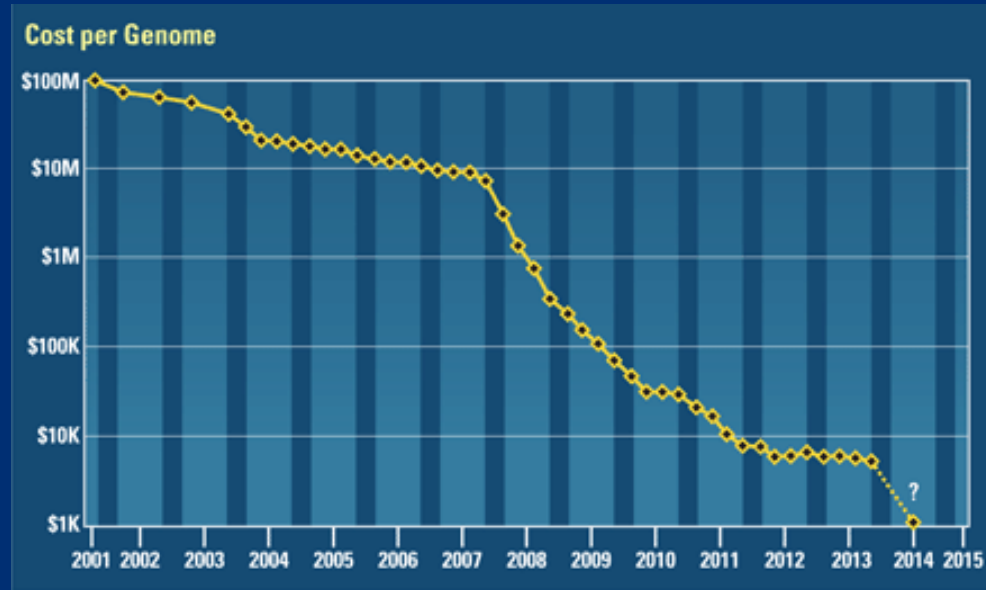
Biological Collections (iDigBio)

Biology is using powerful new Research Tools



Optogenetics

[Algal channel rhodopsins]



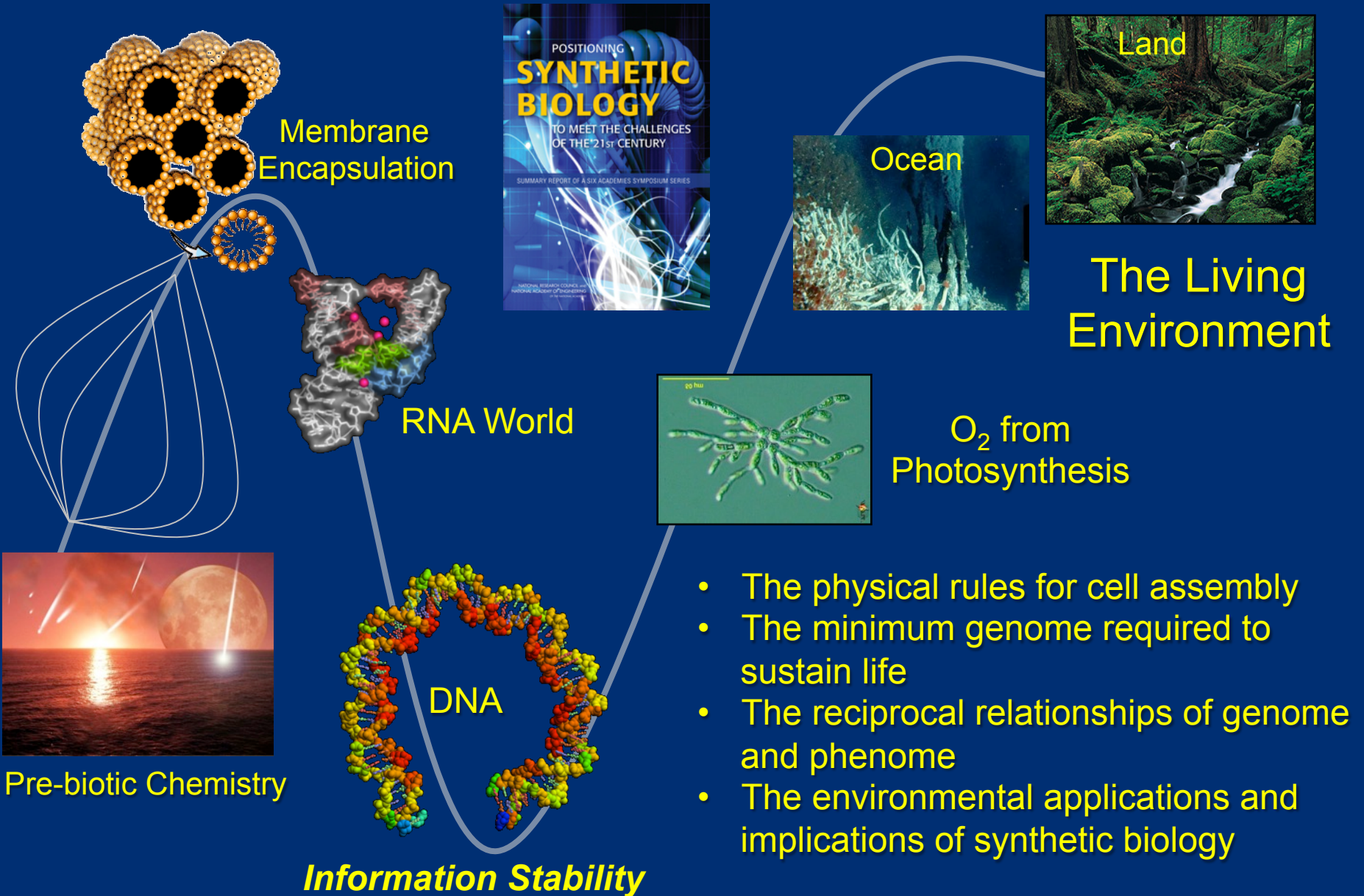
Next Gen. Sequencing

Science 21 Feb 2014

**Nanopore
DNA
Sequencing**



Synthetic Biology is exploring life's indispensable requirements

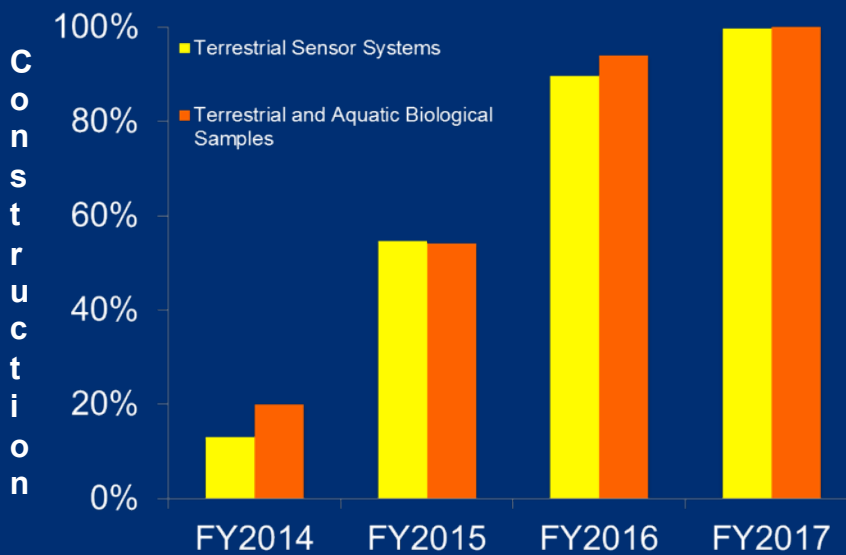


will continuously collect standardized regional to continental scale data:



NEON Headquarters

Control Center; Fabrication, Maintenance; QA/QC Labs; Education/Outreach



Sensor/Instrument Packages: (~12,000 sensors generating ~30 TB data/yr)

- » 60 Fundamental Instrument Units
 - 20 Permanent – Continental Scale
 - 40 Relocatable – Regional Scale
- » 30 Stream Sensor Nets & 6 Lake Buoys
- » 10 Experimental Stream Systems
- » 10 Mobile Labs

Biological Assessments:

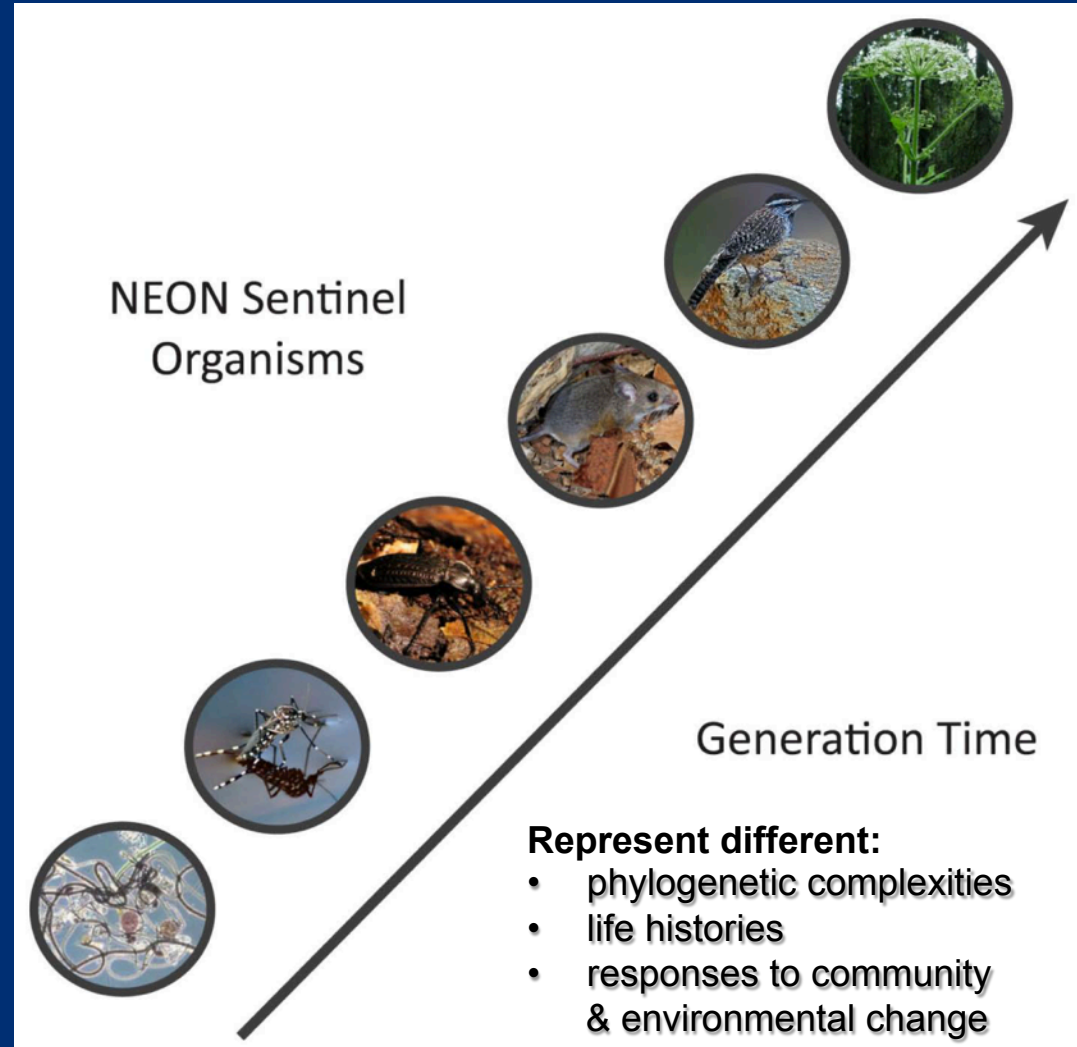
Plant, Animal, Microbe: ~3 TB data/yr

NEON Organismal Biology

- Standardized, diverse measurements
- Plant biomass, leaf area, chemical composition
- Biodiversity & Invasive Species
- Phenology
- Population Dynamics
- Microbial Diversity & Function
- Biogeochemistry & Productivity
- Ecohydrology
- Infectious Disease



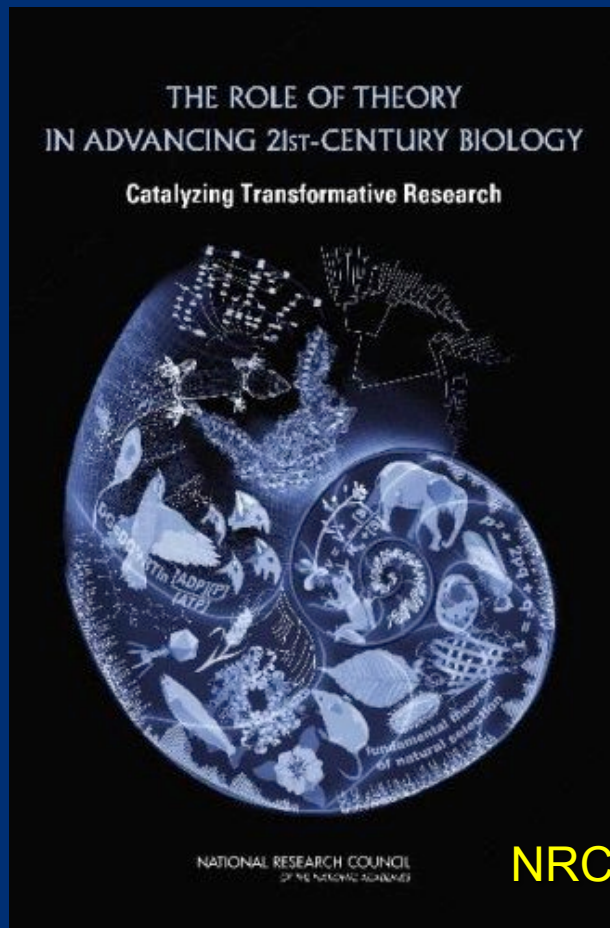
**Field
Laboratory
Bio-Archive**



Integrating Knowledge: Theory & Data

“Technology gives us the tools to analyze organisms at all scales, but we are drowning in a sea of data and thirsting for some theoretical framework with which to understand it.”

Sydney Brenner (Nobel Laureate)
Nature **482**: 461, February 23, 2012



“The use of computers in biology has radically transformed who biologists are, what they do, and how they understand life.”



“It’s possible to turn data into something resembling knowledge when it is not. It’s difficult to know when this has happened.”

BioData: Data Integration Across Scales of Time, Place and Size



National Socio-Environmental Synthesis Center



neon



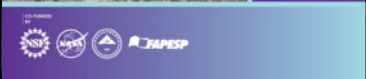
Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century



NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES



Dimensions of Biodiversity
NATIONAL SCIENCE FOUNDATION



ILTER



Museum collections and Field Stations

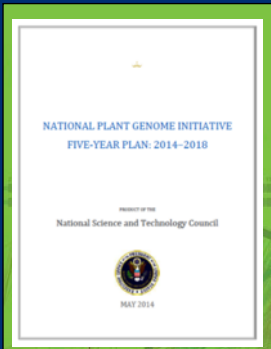


Integrated Digitized Biocollections



iPlant Collaborative™

Cyberinfrastructure for the Life Sciences



NATIONAL PLANT GENOME INITIATIVE
FIVE-YEAR PLAN: 2014-2018

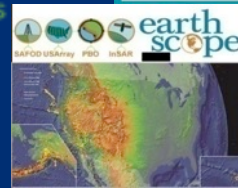
REPORT OF THE
National Science and Technology Council



MAY 2014



EARTH CUBE
TRANSFORMING GEOSCIENCES RESEARCH



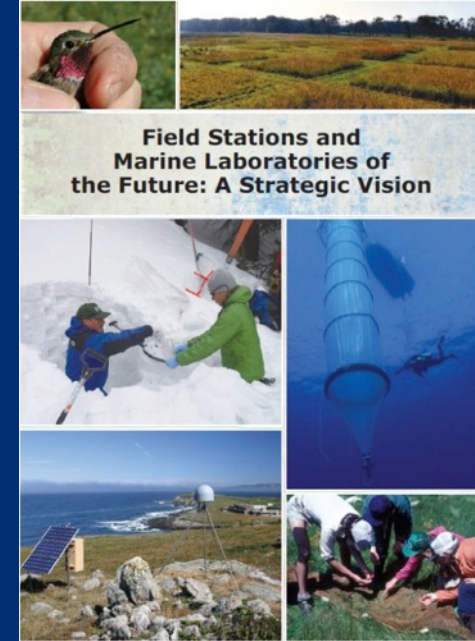
GLEON
global lake ecological observatory network



OOI
OCEAN OBSERVATORIES INITIATIVE

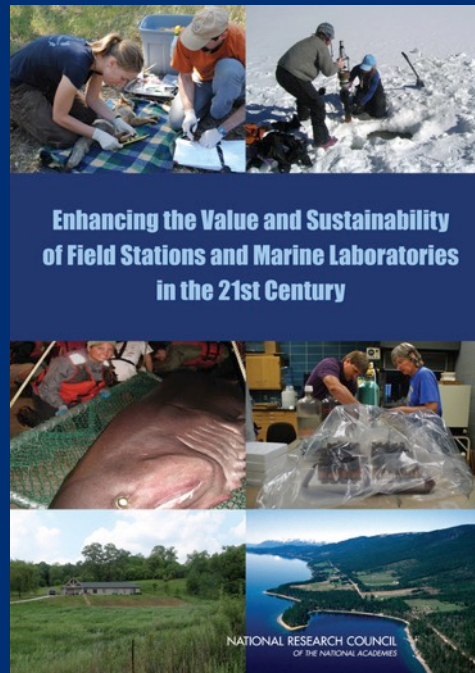
1126161: Positioning Field Stations and Marine Laboratories for Emerging Initiatives in Scientific Research and Training

Ian Billick, Ivar Babb, James Sanders, Jo-Anne Leong,
Brian Kloeppe
Rocky Mountain Biological Laboratory



1346972: Value and Sustainability of Biological Field Stations, Marine Laboratories, and Natural Reserves in 21st Century Science, Education, and Public Outreach

Keegan Sawyer, Deborah Glickson
National Academy of Sciences



FSML: Improving Communications and Facilities at Biological Field Stations and Marine Laboratories

- 🌐 Planning grants - \$25K
- 🌐 Infrastructure grants - up to \$350K
- 🌐 Supplements
- 🌐 Cross directorate activity (NSF 12-505)
 - 🌐 BIO: Peter McCartney
 - 🌐 GEO:Kandace Binkley
 - 🌐 EHR: Dave Campbell

1318455: FSML: Enabling the next generation of cell analysis at Horn Point Laboratory

Alyson E. Santoro

University of Maryland Center for Environmental Sciences

Microbial cell analysis facility to support research and training on the ecology and physiology of phytoplankton and bacterioplankton.

New instrumentation for high-throughput cultivation experiments

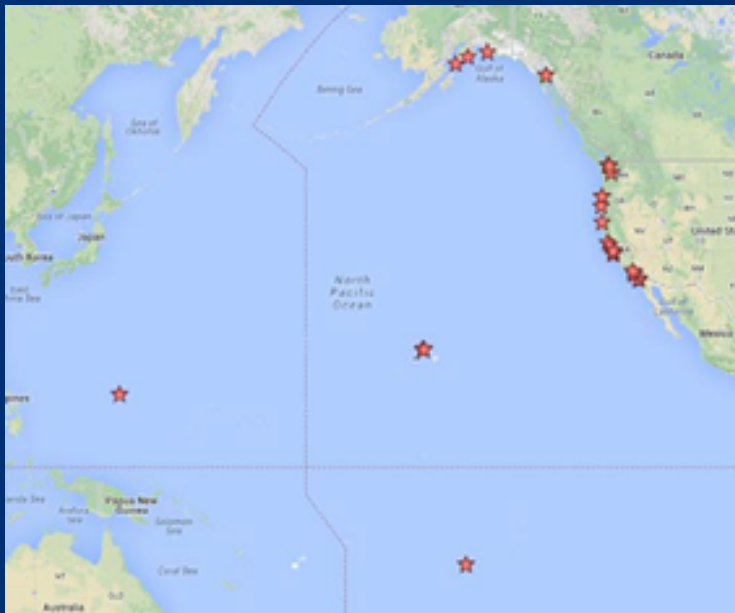
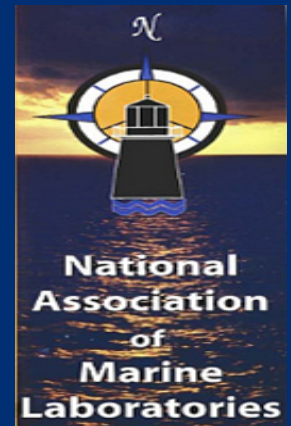
Single-cell substrate uptake analysis using micro-autoradiography

Winter-term courses on phytoplankton physiology for graduate and advanced undergraduate students from around the world.



1418841: Planning a Marine Laboratory Network on Ocean Acidification

Roberta Marinelli
University of Southern California



Workshop of west coast marine laboratories (members of the Western Association of Marine Laboratories) to plan a research and observation network around the subject of ocean acidification in coastal systems.

- Couple long-term ecological data from diverse west coast ecosystems - kelp forests, coral reefs, estuaries, coastal waters – with corresponding ocean acidification measurement technologies at FSML labs
- Provide data integration and access through existing organizational frameworks.

1318991: Planning for a Marine Science Village at Moss Landing Marine Laboratories

James T. Harvey
San Jose State University Foundation

A planning activity to develop an academic village that will attract national and international scientists, host students from within and beyond the MLML consortium, foster interactions among Monterey Bay region institutions, and promote synergy and innovation in marine science and ocean sustainability research.



NSF-funded Research

Nancy Rabalais



- RAPID awards
- REU Sites
- Postdoctoral Fellowships
- Collaborative Research
- LTER

Award Abstract #1057787

MRI RAPID: Acquisition of an Integrated Detection and Oil Sampling Array in Louisiana Estuaries

Award Abstract #1141354

Collaborative Research: RAPID: The 2011 Atchafalaya River Flood and a possible altered system state for the Atchafalaya River Delta Estuary

Award Abstract #1063036

REU Site: Interdisciplinary Research Experiences in Changing Coastal Environments

Award Abstract #1155571

Collaborative Research: Microbial Interactions with Marine Plastic Debris: Diversity, Function and Fate

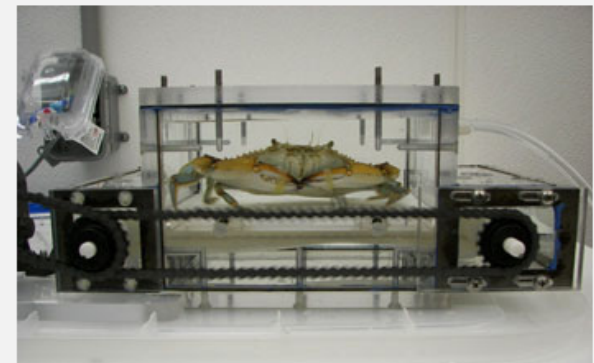
Award Abstract #1237517

LTER: FCE III - Coastal Oligotrophic Ecosystems Research

Discovery

Taking the Pulse of Marine Life in Stressed Seas

Researchers study responses of crustaceans to human-caused environmental stresses



While walking on a treadmill, a crab's vital signs are measured to help define its fitness level.

NSF-funded Research

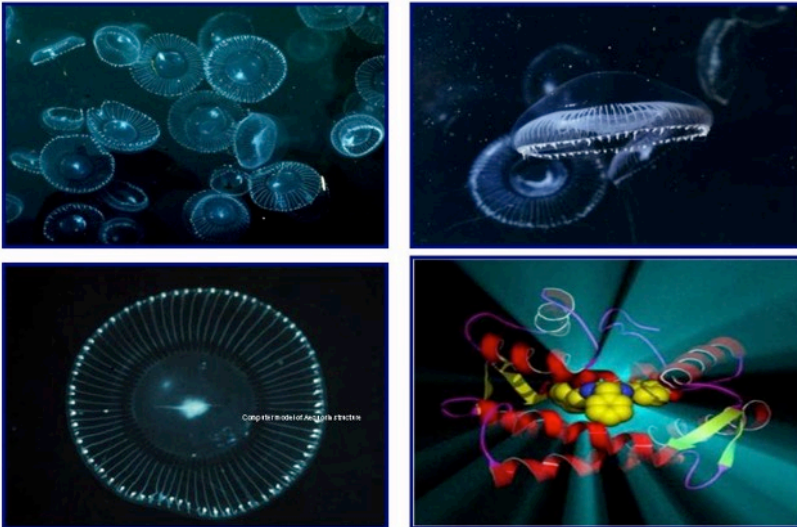
Press Release 08-059

And the First Animal on Earth Was a ...

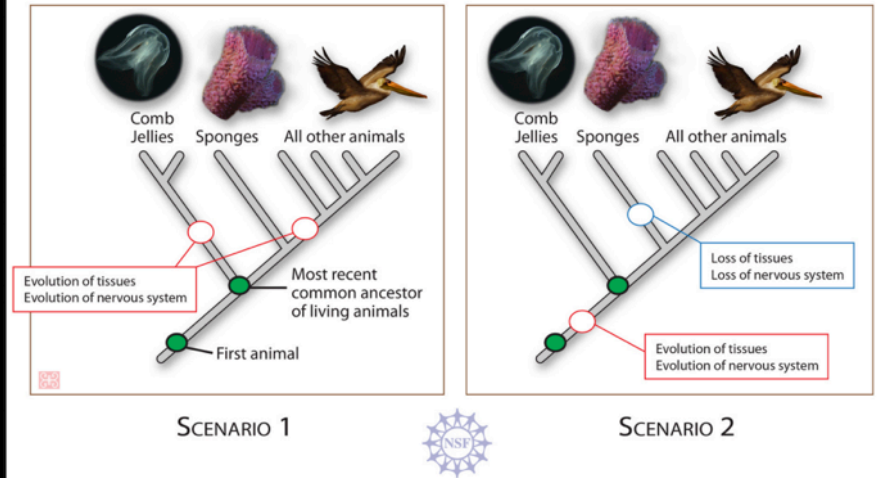
Evolutionary history of the comb jelly reveals surprising clues about Earth's first animal

Green Fluorescent Protein
2008 Noble Prize in Chemistry :
Shimomura*, Chalfie, and Tsien*
*NSF Investigators

Photoproteins as Signals and Tools



The Tree of Life Reconsidered



http://www.nsf.gov/news/news_summ.jsp?org=NSF&cntn_id=111408&preview=false

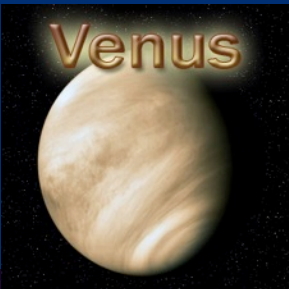
2011 Waterman Award

Casey Dunn

http://www.nsf.gov/news/news_summ.jsp?cntn_id=112451

What will be the trajectory of life on Earth?

Hot
lifeless
planet

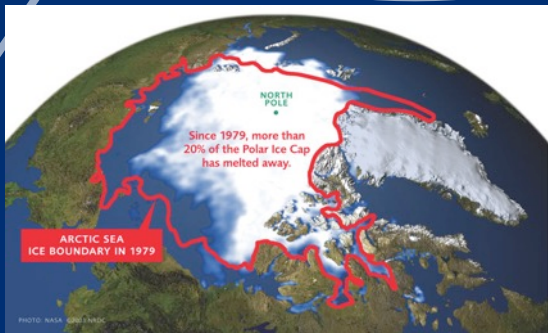


Atmosphere
+
Geosphere



Runaway
CO₂

- Biosphere +



A Living
Environment

Earth's Climate and Life Support Systems are Changing in Unusual and Unexpected Ways

Wildfire



Estes Park, CO
2012

Drought



Oakton, IN 2012

Dust Storm

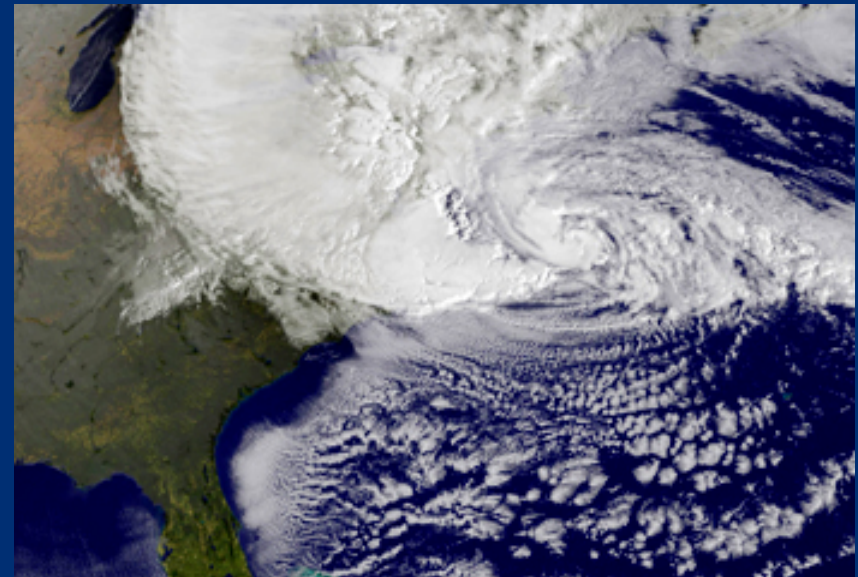


Phoenix, AZ 2012

Flood



Duluth, MN 2012



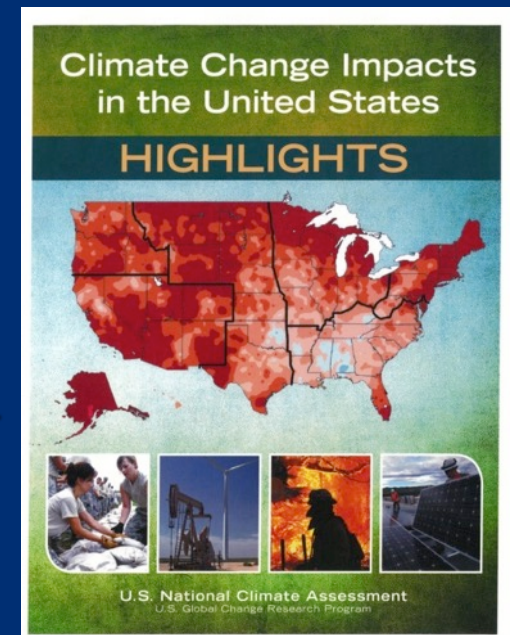
Hurricane Sandy 2012

...requiring new understanding of the Biological, Chemical and Physical processes that drive, respond and adapt to multi-scale planetary change

- New data streams linked to proven approaches
- New theory to link scales of inquiry and analysis
- Observation, experiment and modeling that integrate function and organization across scales



2014: *Highlights of Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program



A black frog with bright green spots is perched on a green lily pad. The frog's body is covered in large, irregular black spots with a bright green outline. The frog is facing right, and its legs are visible. The lily pad is a vibrant green color, and there are some water droplets on its surface. The background is a soft, out-of-focus green.

...to secure the future of life on Earth