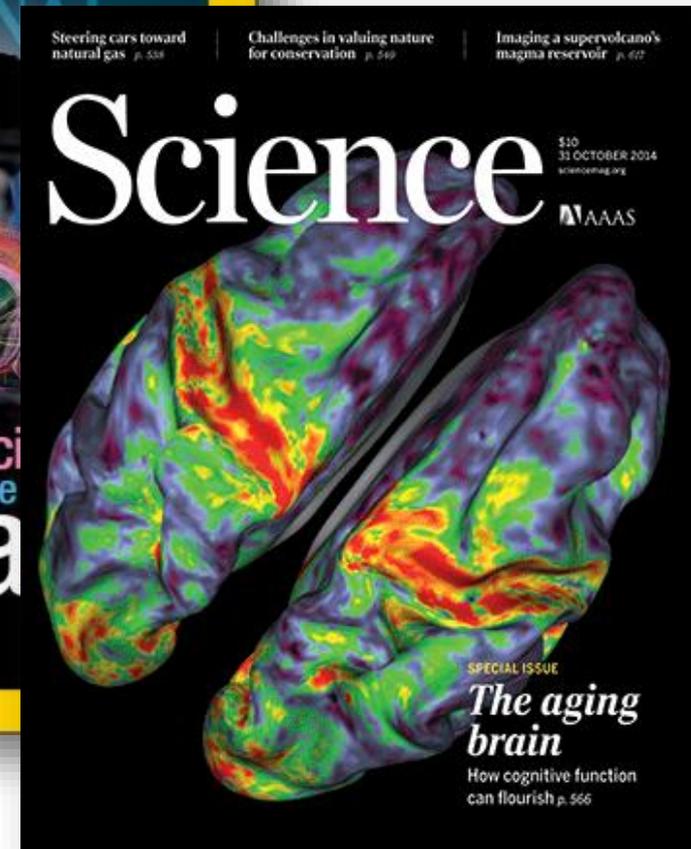
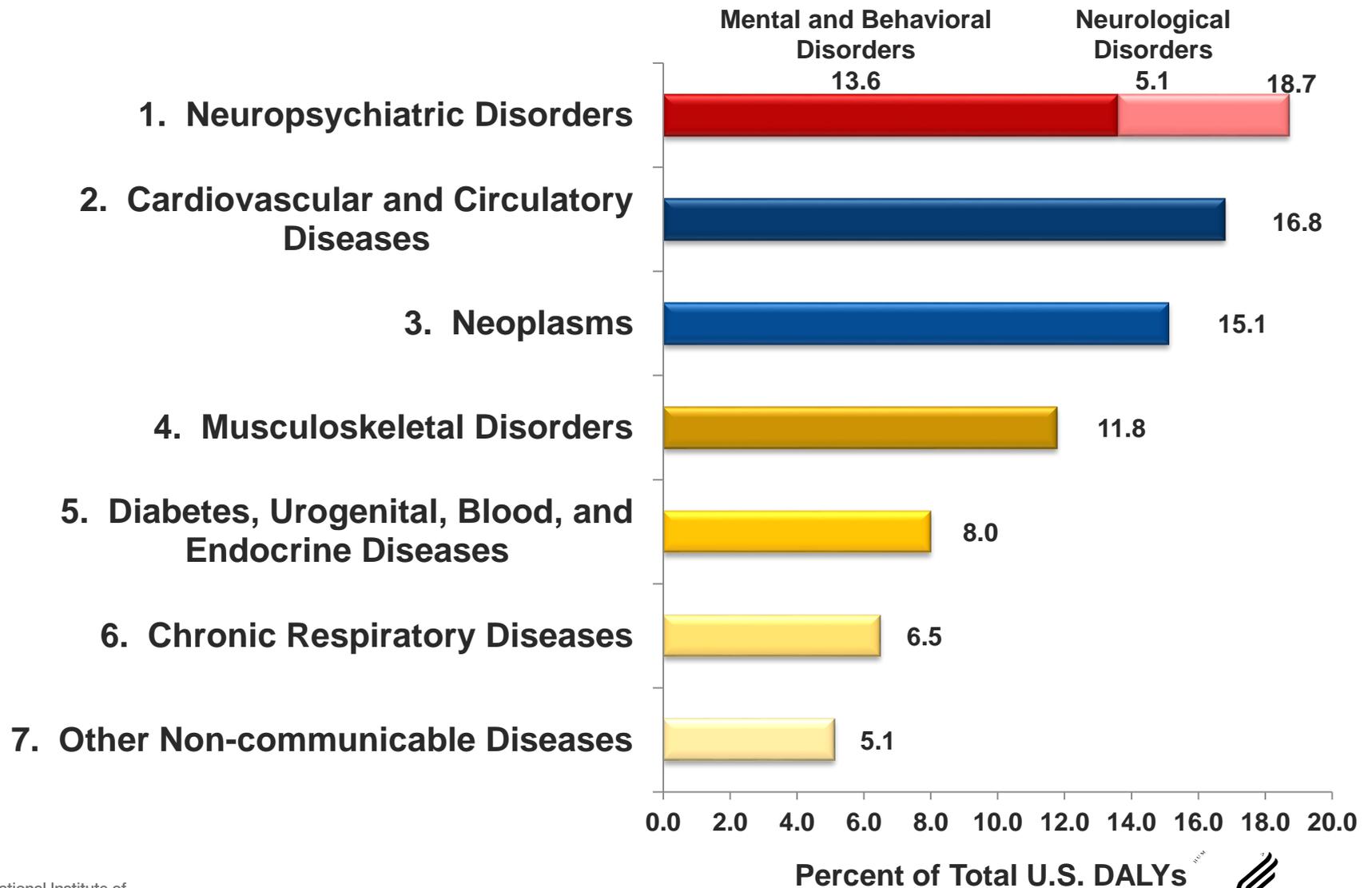


The Era of the Brain



U.S. Burden of Diseases: 291 Diseases and Injuries

Leading Categories of DALYs 2010



The Challenge for the 21st Century

- Chronic non-communicable diseases will be in the 21st century what infectious diseases were in the 20th century.
- Brain disorders – both **neurodevelopmental** and neurodegenerative – will be the most disabling and most costly of these chronic diseases.
- **We do NOT know enough about the brain to meet this challenge.**



The BRAIN InitiativeSM

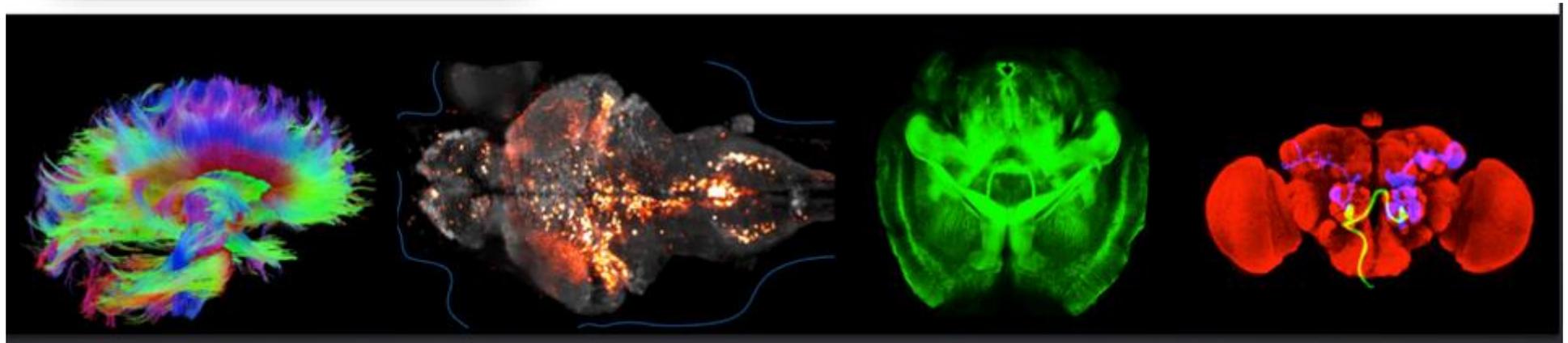
BRAIN 2025 *A SCIENTIFIC VISION*

Brain Research through Advancing Innovative
Neurotechnologies (BRAIN) Working Group
Report to the Advisory Committee to the
Director, NIH

June 5, 2014



- A focus on circuits and networks
- Measure the fluctuating electrical and chemical patterns within circuits
- Understand how all of this helps generate our unique thoughts and actions



The BRAIN Initiative

“a public and private effort”



I A R P A

+

Private
Investments



SIMONS FOUNDATION



The NIH BRAIN Scientific Plan



FIRST FIVE YEARS

Emphasize technology
development

SECOND FIVE YEARS

Emphasize discovery
driven science

Seven High Priority Research Areas

1. **Discovering diversity:** Identify and provide experimental access to the different brain cell types to determine their roles in health and disease. ***also during development**
2. **Maps at multiple scales:** Generate circuit diagrams that vary in resolution from synapses to the whole brain. ***also during development**
3. **The brain in action:** Produce a dynamic picture of the functioning brain by developing and applying improved methods for large-scale monitoring of neural activity. ***also during development**
4. **Demonstrating causality:** Link brain activity to behavior with precise interventional tools that change neural circuit dynamics. ***also during development**

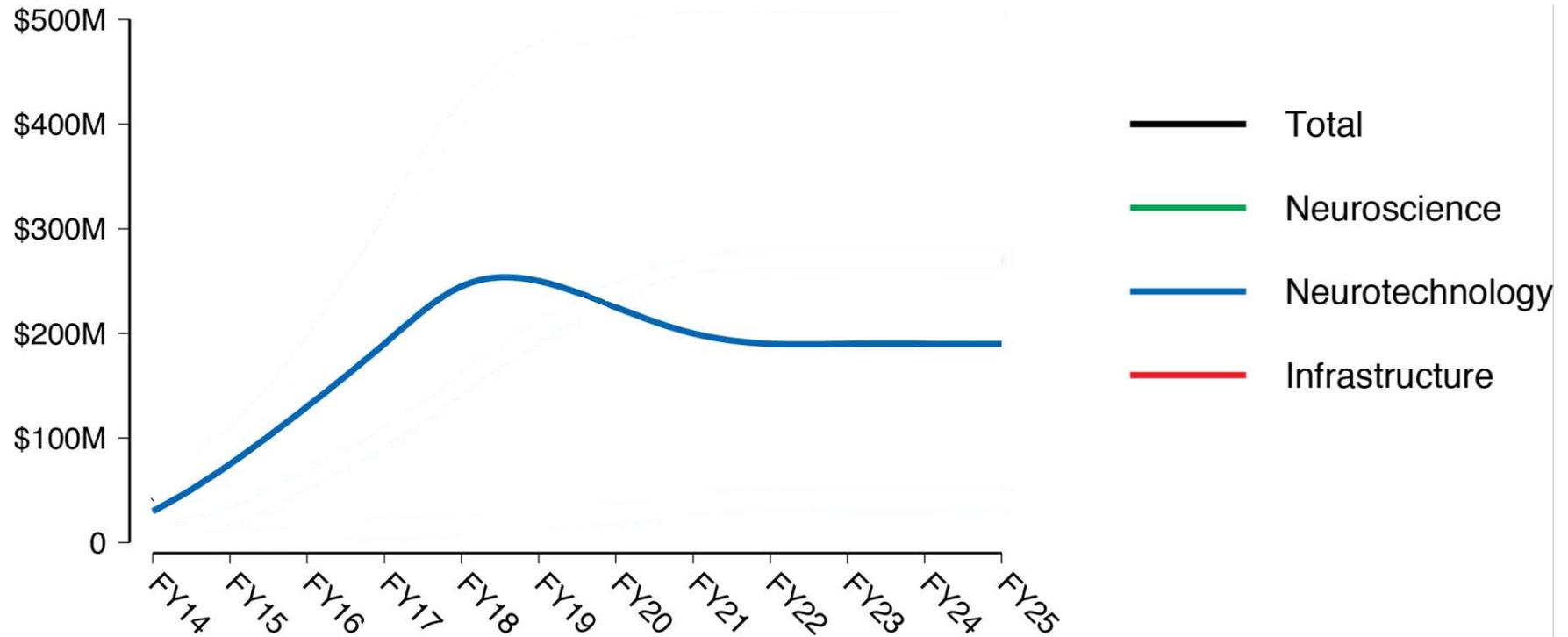
Seven High Priority Research Areas

5. **Identifying fundamental principles:** Produce conceptual foundations for understanding the biological basis of mental processes through development of new theoretical and data analysis tools. ***also during development**
6. **Advancing human neuroscience:** Develop innovative technologies to understand the human brain and treat its disorders; create and support integrated human brain research networks. ***also during development**
7. **From BRAIN Initiative to the brain:** Integrate new technological and conceptual approaches produced in goals #1-6 to discover how dynamic patterns of neural activity are transformed into cognition, emotion, perception, and action in health and disease. ***and lifespan effects of developmental brain states and disorders**

How to Accomplish These Goals: *Principles*

- 1 Pursue human and non-human animal studies in parallel
- 2 Cross boundaries in interdisciplinary collaborations
- 3 Integrate spatial and temporal scales
- 4 Establish platforms for sharing data and tools
- 5 Validate and disseminate technology
- 6 Consider ethical implications of neuroscience research
- 7 Accountability to NIH, taxpayers, and the scientific community

Estimated Budget



Ramp up to \$400M/yr by FY 2018 \implies Plateau at \$500M/yr by FY2021

Total investment of \$4.5B by FY 2025

Addressing *BRAIN* 2025 Recommendations

Brain Cell
Types

Tools for
Circuit
Diagrams

Tech. to
Monitor
Neural
Activity

Precise
Inter-
ventional
Tools

Theory and
Data
Analysis
Tools

Advance
Human
Neuroscience

Integrate
Approaches



Cell-Type Classification



Novel Tools - Cells and Circuits



Next Generation Human Imaging



Large scale Recording & Modulation Technologies



Integrated Approaches to Understanding Circuit Function



Early Stage Research for Recording & Modulation *



Next-Gen Human Brain Recording & Modulation Devices *



Short Courses *



SBIR announcements *

* *New in FY 2015*

Summary: BRAIN Initiatives by Fiscal Year

- 2014: **Six** BRAIN Funding Opportunities
- 2015: **Ten** BRAIN Funding Opportunities
 - Five reissues, Five new
 - Three SBIR/STTR initiatives
- 2016: Notice of Intent, Concepts for Clearance, Workshops
 - NOI: Research Opportunities Using Invasive Neural Recording and Stimulating Technologies in the Human Brain
 - Defining Cellular Phenotypes Workshop (4/21-4/22/15)
 - Industry Partnerships Workshop (6/3-6/4/2015)

NICHD-related topics

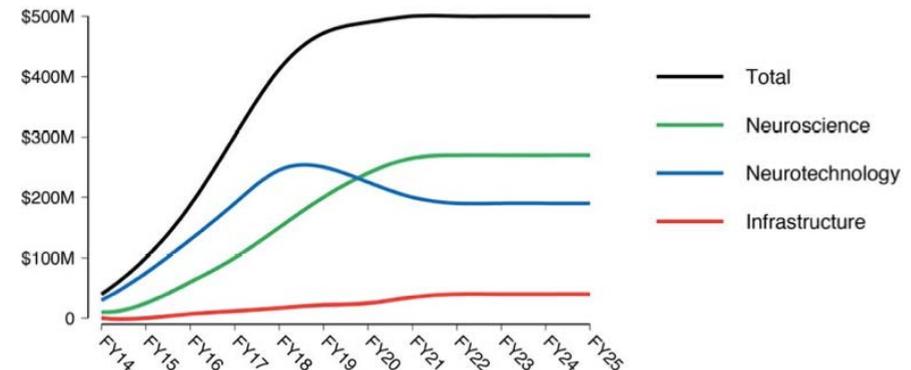
- **Brain development a key issue** in almost all of the RFA's
 - Encourage neurodevelopmental research community to submit and engage
- **Age specific mechanisms of brain function**
 - Inform mental health, education, as well as pediatric and adolescent neuropsychiatric disorders
- **Lifespan approach**
 - Influence of environment and disease on developing pediatric and adolescent brain has impact on adult brain function

Budget Summary:

Will We Have Enough Gas in the Car?

Think big
Start small
Scale fast!

Innovation



Fiscal Year	Actual Budget	ACD WG Professional Judgment Budget
FY14	\$46M	
FY15	\$80M	\$100M
FY16	\$150M	\$190M
FY17		\$300M
FY18		\$400M
FY19		\$500M

BRAIN Initiative Investigators' Meeting

First, Kick-off Meeting Nov. 20-21 2014

- Joint NIH-NSF meeting w/ DARPA and HHMI



Health & Science

“This can’t be business as usual ... This is a new culture bridging physicists, engineers, biologists, chemists ... with a big emphasis on showing new results and discoveries.” -- Cori Bargmann

Brainstormers: Obama’s big research push kicks off with a meeting of the minds

BRAIN Initiative: *Exciting Advances Beginning to Emerge*

BRIEF COMMUNICATIONS

NATURE METHODS

High-speed label-free functional photoacoustic microscopy of mouse brain in action

Junjie Yao¹, Lidai Wang¹, Joon-Mo Yang¹, Konstantin I Maslov¹, Terence T W Wong¹, Lei Li¹, Chih-Hsien Huang², Jun Zou² & Lihong V Wang¹

ARTICLES

An acetylcholine-activated microcircuit drives temporal dynamics of cortical activity

Naiyan Chen¹⁻³, Hiroki Sugihara^{1,3} & Mriganka Sur¹

Cell

Resource

Highly Parallel Genome-wide Expression Profiling of Individual Cells Using Nanoliter Droplets

Evan Z. Macosko,^{1,2,3,*} Anindita Basu,^{4,5} Rahul Satija,^{4,6,7} James Nemesh,^{1,2,3} Karthik Shekhar,⁴ Melissa Goldman,^{1,2} Itay Tirosh,⁴ Allison R. Bialas,⁸ Nolan Kamitaki,^{1,2,3} Emily M. Mardersteck,⁹ John J. Trombetta,⁴ David A. Weitz,^{5,10} Joshua R. Sanes,⁹ Alex K. Shalek,^{4,11,12} Aviv Regev,^{4,13,14} and Steven A. McCarroll^{1,2,3,*}

Cell^{press}

Neuron

NeuroResource

A New DREADD Facilitates the Multiplexed Chemogenetic Interrogation of Behavior

Eyal Vardy,^{1,8} J. Elliott Robinson,^{2,3,4,8} Chia Li,^{5,6,8} Reid H.J. Olsen,^{1,3} Jeffrey F. DiBerto,² Patrick M. Giguere,¹ Flori M. Sassano,¹ Xi-Ping Huang,¹ Hu Zhu,¹ Daniel J. Urban,¹ Kate L. White,¹ Joseph E. Rittiner,³ Nicole A. Crowley,^{1,3,4} Kristen E. Pleil,^{1,3,4} Christopher M. Mazzone,^{1,3,4} Philip D. Mosier,⁷ Juan Song,^{1,3} Thomas L. Kash,^{1,3,4} C.J. Malanga,^{2,3,4} Michael J. Krashes,^{5,6,*} and Bryan L. Roth^{1,3,*}

nature
neuroscience

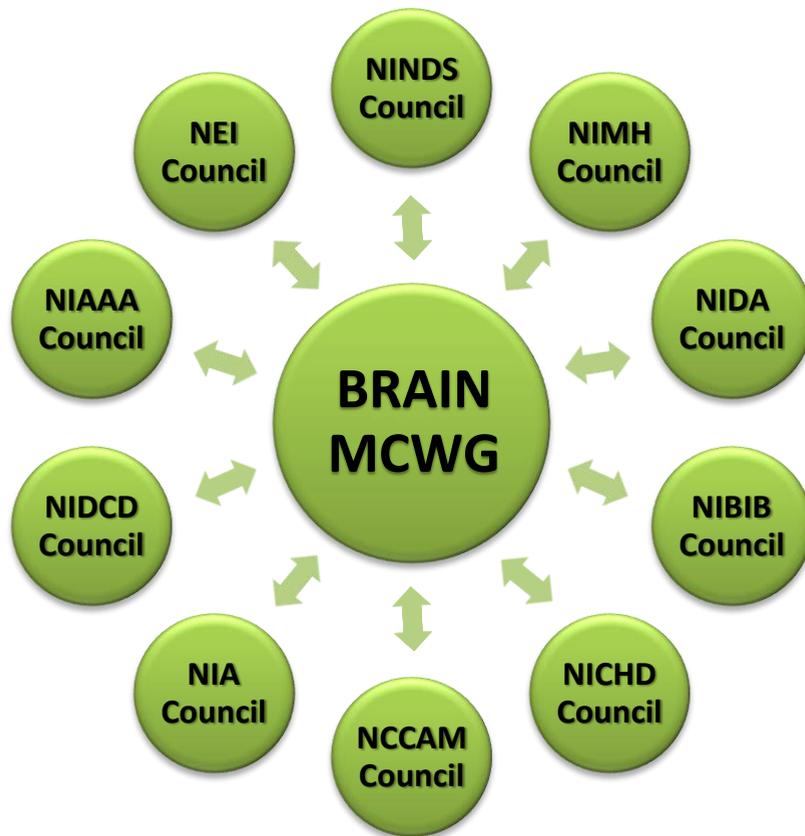
NATURE | LETTER

日本語要約

Distinct relationships of parietal and prefrontal cortices to evidence accumulation

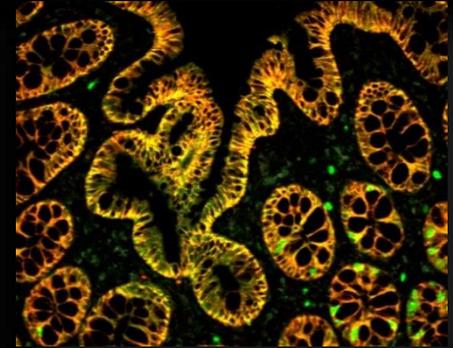
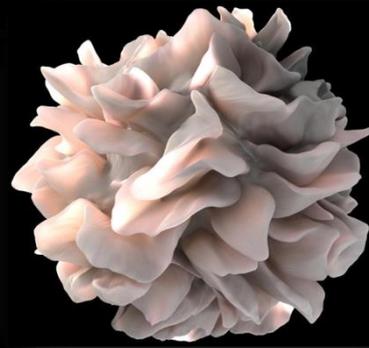
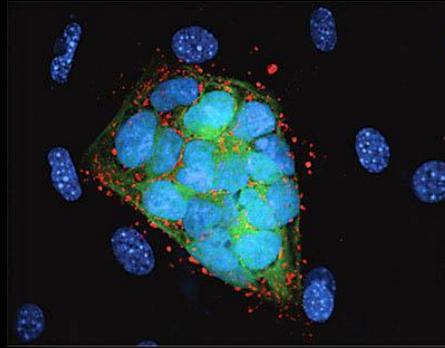
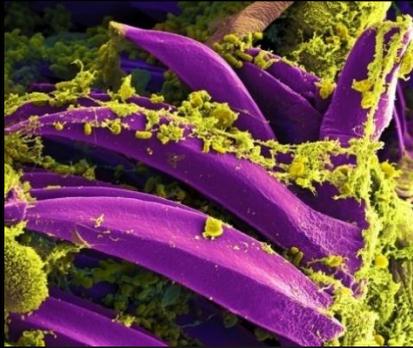
Timothy D. Hanks, Charles D. Kopec, Bingni W. Brunton, Chunyu A. Duan, Jeffrey C. Erlich & Carlos D. Brody

Multi-Council Working Group (MCWG)



MCWG:

- Respected experts looking at whole BRAIN initiative rather than at discrete parts
- Includes *ex officio* members from BRAIN agencies (IDARPA, FDA, IARPA, NSF)
- Connects to ICs and agencies with BRAIN-focused research
- Discuss funding plans and provide feedback for IC Councils
- Discuss concepts for potential FY 15 solicitations



NIH...

Turning Discovery Into Health

