Human Microbiome Research: Grand Challenges and Platform Technologies

Robbie Barbero, PhD
White House Office of Science and Technology Policy
rbarbero@ostp.eop.gov

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Outline of Talk

- The White House Office of Science and Technology Policy
- Grand Challenges
- Platform technologies
- Future directions for human microbiome research

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OSTP's mission

1. To provide the President and his senior staff with accurate, relevant, and timely scientific and technical advice on all matters of consequence
2. To ensure that the policies of the Executive Branch are informed by sound science
3. To ensure that the scientific and technical work of the Executive Branch is properly coordinated so as to provide the greatest benefit to society

Examples of OSTP Tools

- Statements of national policy (Executive Orders, Presidential Policy Directives, agenda-setting documents, etc.)
- President's Budget
- Work with Congress on legislation
- Presidential events and speeches
  - "And so today, I am pleased to announce that …"
- Ability to convene
  - "All hands on deck" – public-private partnerships
  - If you could call anyone, who would you call and what would you ask for?

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Grand Challenges

Attributes of Grand Challenges

1. Significant impact in areas of national and global priority
2. Ambitious yet achievable
3. Compelling, motivating, capture the public imagination
4. “Goldilocks” level of specificity and focus
5. Able to harness innovation and advances in science and technology

the WHITE HOUSE PRESIDENT BARACK OBAMA

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21st Century Grand Challenges

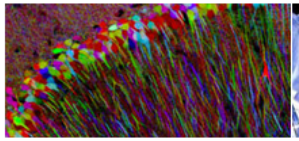
Grand Challenges are ambitious but achievable goals that harness science, technology, and innovation to solve important national or global problems and that have the potential to capture the public's imagination.

Grand Challenges are an element of the President's *Strategy for American Innovation* because they help catalyze breakthroughs that advance national priorities. On April 2, 2013, President Obama called on companies, research universities, foundations, and philanthropists to join him in identifying and pursuing the Grand Challenges of the 21st century.

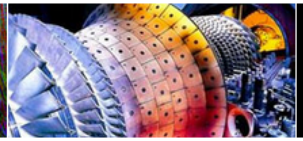
Grand Challenges Can:

- Help create the industries and jobs of the future;
- Expand the frontiers of human knowledge about ourselves and the world around us;
- Help tackle important problems related to energy, health, education, the environment, national security, and global development; and
- Serve as a "North Star" for collaboration between the public and private sectors.

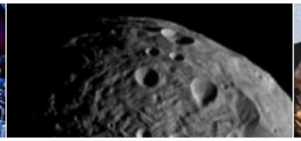
Current Grand Challenges



NIH, DARPA, and NSF's BRAIN Initiative, to revolutionize our understanding of the human mind and uncover new ways to treat, prevent, and cure brain disorders like Alzheimer's, schizophrenia, autism, epilepsy, and traumatic brain injury



DOE's SunShot Grand Challenge, to make solar energy cost competitive with coal by the end of the decade, and **EV Everywhere Grand Challenge**, to make electric vehicles that are as affordable as today's gasoline-powered vehicles within the next 10 years.



NASA's Asteroid Grand Challenge, to find all asteroid threats to human populations and know what to do about them.

USAID's Grand Challenges for Development, including **Saving Lives at Birth** that catalyzes groundbreaking prevention and treatment approaches for pregnant women and newborns in poor, low resource communities

http://wh.gov/grand-challenges

Can you identify and articulate a Grand Challenge for human microbiome research?

- Potential implications across many Administration priorities
  - Food safety
  - Nutrition and health
  - Agriculture

Source: Hannah Whitaker for The New York Times.

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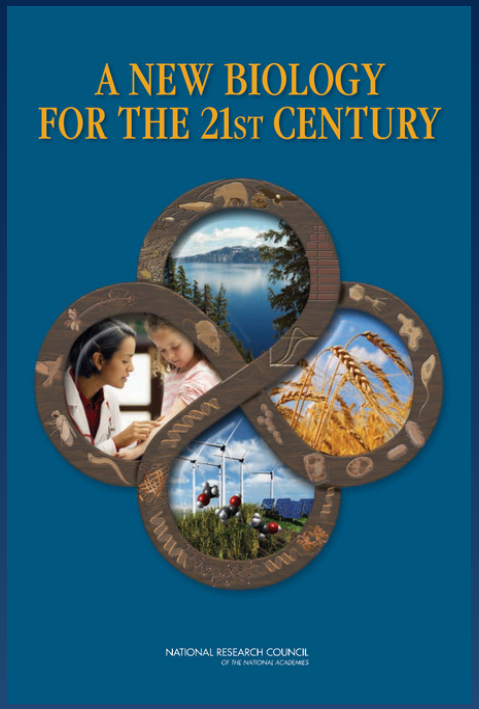
The important role of platform technologies



"Recent technological advances in a number of fields outside biology make possible unprecedented quantitative analyses of biological systems. These fields are diverse, including physics, electronics, chemistry, nanotechnology, computer science, and information technology… **in many cases the complexity of biological systems presents new challenges that call for creative solutions and additional innovation**."

National Research Council, 2009

What are platform technologies?

- Tools, instruments and techniques that enable wholesale new research capabilities
  - Offer significant improvements in fundamental aspects such as accuracy, precision, resolution, throughput, flexibility, breadth of application, costs of construction or operation, or user-friendliness.
- Examples
  - Next-gen DNA sequencing: reduced cost and higher throughput
  - Graphical user interfaces: user-friendliness
  - Polymerase chain reaction: breadth of application, sensitivity
  - Photolithography: higher resolution, cost-effective

Why is OSTP interested in platform technologies?

- Leaps in knowledge are often preceded by technological advances.
- They offer huge leverage for the investment, because they enable many others to approach scientific problems differently, more precisely, or more efficiently than before.
- They can have broader societal and economic impact.

Platform technologies and the microbiome

- Potential implications across many Administration priorities
  - Food safety
  - Nutrition and health
  - Agriculture
- What if we had:
  - Platform technology to assess functionality of complex microbial systems?
  - Real time measurement of bacterial communities in humans?
  - Your idea here?

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What are the future directions for microbiome research?

- Is there a Grand Challenge for microbiome research?
- What question do you wish you could ask and what platform technology do you need to answer that question?
- Who are the natural partners?
  - Private sector/Public sector
  - Engineers, computational biologists, ecologists, microbiologists, etc.
- What can OSTP do to help?
  - –rbarbero@ostp.eop.gov

Source: Hannah Whitaker for The New York Times.