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MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

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SUBJECT: Science and Technology Priorities for the FY 2016 Budget

Scientific discovery, technological breakthroughs, and innovation are the primary engines for expanding the frontiers of human knowledge and are vital for responding to the challenges and opportunities of the 21st century. The Nation depends on science, technology, and innovation to promote sustainable economic growth and job creation, maintain a safe and sufficient food supply, improve the health of all Americans, move us toward a clean energy future, address global climate change, manage competing demands on environmental resources, and ensure the security of the Nation.

Federal government funding for research and development (R&D) is essential to address societal needs in areas in which the private sector does not have sufficient economic incentive to make the required investments. Key among these is the fundamental, curiosity-driven inquiry that has been a hallmark of the American research enterprise and a powerful driver of unexpected, new technology.

This memorandum outlines the Administration's multi-agency science and technology priorities for formulating FY 2016 Budget submissions to the Office of Management and Budget (OMB). The priorities covered in this memo require investments in R&D; support for activities, such as science, technology, engineering, and mathematics (STEM) education, technology transfer, R&D facilities, and scientific data collection and management, that enable a robust science and technology enterprise; and cooperation among multiple Federal agencies. They build on priorities reflected in this Administration's past budgets and documents.

Agencies should explain in their budget submissions how they are redirecting available resources from lower-priority areas to science and technology activities that address the priorities described below. Agency submissions must meet the requirements outlined in OMB's FY 2016 Budget Guidance memorandum M-14-07. Agencies engaged in complementary activities should consult with each other during the budget planning process so that resources are coordinated to maximize their impact and to avoid inappropriate duplication, and include summaries of these discussions in their OMB budget submissions.

Multi-agency R&D priorities

In the FY 2016 Budget, agencies should balance priorities to ensure resources are adequately allocated for agency-specific, mission-driven research, including fundamental research, while focusing resources, where appropriate, on the following multi-agency research activities that cannot be addressed effectively by a single agency.

- Advanced manufacturing and industries of the future. The Administration is committed to revitalizing America's manufacturing sector, which will require innovation in the products that are manufactured and the manufacturing systems themselves. Agencies should give priority to those programs that advance the state of the art in manufacturing, with particular emphasis on government-industry-university partnerships and enabling technologies for industries of the future (such as nanotechnology, robotics, materials development, and cyber-physical systems) that benefit multiple sectors, as described in the *National Strategic Plan for Advanced Manufacturing*.
- Clean energy. The President's all-of-the-above approach to energy includes a goal to lead the world in clean energy. His Climate Action Plan outlines several key objectives in this domain that should be given priority in the 2016 Budget, including promoting American leadership in renewable energy (including manufacturing for these technologies and a modernized electric grid); unlocking innovation in other key clean energy technologies; building a clean and efficient 21st-century transportation sector; and cutting energy waste in homes, businesses, and factories. In transportation, there is a particular need to reduce the current fragmentation of R&D activities and funding and to promote a more cohesive R&D framework that links the capabilities of the Departments of Energy, Defense, and Transportation.
- Earth observations. Earth-observation data serve as the foundation for services that protect human life, property, the economy, and national security, as well as advancing fundamental understanding of the Earth system. Enhanced interagency coordination is required to ensure adequate observational coverage for public services and Earth-system research and to ensure complementarity and integration of the resulting data. Agencies should participate in the coordination efforts of the National Science and Technology Council's (NSTC) Committee on Environment, Natural Resources, and Sustainability (CENRS) and align their R&D investments with the 2014 National Plan for Civil Earth Observations, and comply with the Executive Order on Open and Machine Readable Data.
- Global climate change. Agencies should advance the goals and objectives of the 2012-2021 U.S. Global Change Research Program (USGCRP) Strategic Plan, as well as the complementary science agenda that underpins the President's Climate Action Plan. In improving the nation's ability to understand, assess, predict and respond to global change, agencies should prioritize

activities that strengthen the scientific basis for, as well as the development and use of, actionable science, information, and related tools needed to prepare for and reduce climate-related risks.

- Information technology and high-performance computing. Agencies should give priority to investments that address the challenges and opportunities afforded by the expansion of big data to advance agency missions and further scientific discovery and innovation while providing appropriate privacy protections for personal data. Agencies should also prioritize research guided by the *Trustworthy Cyberspace: Strategic Plan for Cybersecurity R&D Programs* to develop technologies that can protect U.S. systems against cyber-attacks, as well as research to advance technologies for more efficient use of spectrum and cyber-physical systems. Agencies should coordinate with each other and with the private sector to promote innovation in high-performance computing to support national security, scientific discovery, and economic competitiveness.
- Innovation in life sciences, biology, and neuroscience. Agencies should give priority to programs that support fundamental biological discovery research that could generate unexpected, high-impact scientific and technological advances in health, energy, and food security, particularly in platform technologies as described in the Administration's 2012 *National Bioeconomy Blueprint* (e.g. technologies for the design of biological systems, understanding systems biology, and high-throughput biology), the President's BRAIN Initiative, and the *National Strategy for Biosurveillance*. Agencies should prioritize research to fulfill the Cross-Agency Priority Goal for Service Members and Veterans Mental Health by supporting research to identify and develop more effective diagnostic and treatment methodologies and metrics to improve mental health and substance use outcomes.

The Administration is committed to combatting the public health and national security challenges associated with the rise in antibiotic-resistant bacteria. Effectively addressing antibiotic resistance will require departments and agencies to support multi-sectoral efforts that promote new and next-generation antibiotic and diagnostics development, strengthen surveillance for resistance in animals and humans, and enhance antimicrobial stewardship practices in clinical medicine and agriculture. Departments and agencies should prioritize funding for the identification and development of new bacterial countermeasures, including engineering the microbiome, use of small molecules as both antibiotics and synergists, novel vaccines, probiotics, and other innovative mechanisms. Agencies should also boost both foundational and translational research and development that leads to rapid, point-of-care diagnostics to determine with certainty whether antibiotics treatment is warranted.

- National and homeland security. National and Homeland Security and Intelligence mission agencies should invest in science and technology to meet the threats of the future and develop innovative new security capabilities. In order to provide cutting-edge capabilities to meet current and future mission requirements, national security agencies need to support a balanced portfolio of basic and applied research and advanced technology development. In particular, priority should be given to investments to develop capabilities in hypersonics, countering weapons of mass destruction, accelerated training techniques, and handling large data sets for national-security mission requirements.

- R&D for informed policy-making and management. A diverse range of agency missions (e.g. natural resource management protecting health and the environment) benefit from R&D that strengthens the scientific basis for decision-making. Both mission-centered agencies and R&D agencies should focus on user-driven information and tools to ensure science investments more directly support decision-making.

Research Tools and Infrastructure

Agencies should support the research tools and infrastructure needed to ensure that U.S. science and engineering remain at the leading edge of discovery. Proposals for development, construction, and operations costs must be fully justified and balanced against funding for research activities and operations of existing facilities. In supporting tools and infrastructure, agencies should look for opportunities to leverage resources from other agencies and the private sector. OSTP and OMB encourage agencies to consider the best practices for Federal facility partnerships identified in the Science and Technology Policy Institute’s recent report *Best Practices for Federal Research and Development Facility Partnerships*.¹

Other R&D Program Guidance

Within research portfolios, Federal agencies are encouraged to identify and pursue clearly defined “Grand Challenges” – ambitious goals that require advances in science, technology and innovation to achieve – and to support high-risk, high-return research.

Agencies should consider, where appropriate and authorized, supplementing traditional R&D “push” mechanisms (e.g., grants and contracts) with “pull” mechanisms – results-based market incentives designed to overcome market failures, engage a wide range of solvers, and catalyze innovation, such as incentive prizes and advanced market commitments.

International scientific partnerships should be pursued to advance the Administration’s priorities in global health and development, share the financial burden of large research projects, and capitalize on complementary research and technology capabilities. Because of the complexity of international collaborations, agencies should ensure that such activities adhere to the highest management standards.

At its January 31 meeting, the President’s Council of Advisors on Science and Technology discussed concerns about the reproducibility of scientific research². These concerns cut across fields of science. Agencies should engage stakeholders to develop ways to improve the reproducibility of research in the fields they support.

In accordance with OMB Circular A-11 and the GPRA Modernization Act of 2010, agencies should describe the targeted outcomes of R&D programs using meaningful, measurable, quantitative metrics where possible and describe how they plan to evaluate the success of those programs.

The preservation of knowledge is critical to solving current problems and meeting future challenges. Many agencies have collections representing the work of thousands of scientists over

¹ <https://www.ida.org/~media/Corporate/Files/Publications/STPIPubs/2014/ida-p-5148.ashx>

² <http://www.whitehouse.gov/administration/eop/ostp/pcast/meetings/past>

many years. Preserving and providing access to important and often irreplaceable collections should be a priority for agencies with an R&D portfolio. Therefore, agencies are strongly encouraged to work together to implement the March 2014 policy on *Improving the Management of and Access to Scientific Collections* to make the most effective use of these important sources of information.

STEM Education Guidance

Investments in STEM education should adhere to the priorities outlined in the Federal STEM Education 5-Year Strategic Plan, by the Committee on STEM Education (CoSTEM) under the NSTC, and should continue to pursue the goals of reducing program fragmentation and enhancing program effectiveness that were supported in the past two budgets. This includes giving priority to programs that use evidence to guide program design and implementation or that build evidence about what works in STEM education, using appropriate metrics and improving the measurement of outcomes. Agencies should also ensure that programs are designed to identify and effectively meet the needs of those we're trying to serve—students, teachers, schools, districts and post-secondary institutions. The 2016 Budget proposals should align STEM education investments with the Strategic Plan, with attention to initiatives presented in the President's Council of Advisors on Science and Technology (PCAST) reports *Prepare and Inspire* and *Engage to Excel* and be coordinated with other Administration priorities.