American Institute of Biological Sciences

Outside Witness Testimony
"Driving Innovation through Federal Investments"

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The American Institute of Biological Sciences (AIBS) appreciates the opportunity to provide testimony regarding federal investments in innovation. We thank the Committee for recognizing the importance of research in driving U.S. innovation, global competitiveness, and economic growth.

The AIBS is a nonprofit scientific association dedicated to advancing biological research and education for the welfare of society. AIBS works to ensure that the public, legislators, funders, and the community of biologists have access to and use information that will guide them in making informed decisions about matters that require biological knowledge. Founded in 1947 as a part of the National Academy of Sciences, AIBS became an independent, member-governed organization in the 1950s. Today, AIBS has more than 140 member organizations and is headquartered in Reston, Virginia, with a Public Policy Office in Washington, DC.

In addition to the agencies represented at the April 29th hearing, other federal programs support research that expands our foundational knowledge. The Departments of Agriculture and Interior, as well as the Environmental Protection Agency and Forest Service are important elements of the innovation ecosystem. Research from these programs leads to scientific breakthroughs that improve food security, human health, and natural resource management, and result in technology transfer through the licensing of products.

There are myriad of ways that federally supported research drives innovation. This testimony highlights three promising areas.

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Digitization of Scientific Collections

Scientific collections are a vital component of our nation's research infrastructure. Whether held at a museum or in a university science department, natural science collections contain genetic, tissue, organism, and environmental samples that constitute a library of Earth's history.

These specimens and associated data drive cutting edge research on the significant challenges facing modern society, such as improving human health, informing environmental management, and combating the spread of invasive species and pathogens. For instance:

- A natural history collection containing deer mice specimens was integral in determining the cause of the deadly Hantavirus outbreak in the southwestern United States in 1993.
- Another collection was used to distinguish an innocuous wheat fungus from Karnal bunt, which threatened to shutdown a $70 million wheat export market to Algeria in 2005.
- A U.S. Department of Agriculture program maintains seed banks containing thousands of species of plants; this living collection is a genetic repository that can provide disease or pest resistance to crops.

The federal Interagency Working Group on Scientific Collections recognized the value of collections in its 2009 report, which found that "scientific collections are essential to supporting agency missions and are thus vital to supporting the global research enterprise."

Increasing access to natural science collections through innovative new imaging and database technologies will help to unlock the full potential of these irreplaceable resources. Short of traveling in person to access a collection, many specimens and their associated data are unavailable to researchers. In recent years, some museums and collections have begun to digitize their scientific specimens. Digitization involves capturing a digital image of a specimen, and making the images—as well as associated data about when and where the specimen was collected—available online.

The National Science Foundation (NSF) is supporting a decade long initiative to digitize specimens held by university departments, museums, and other research institutions. The effort is bringing together biologists, computer science specialists, and engineers in multi-disciplinary teams to develop innovative imaging, robotics, and data storage and retrieval methods. These tools will expedite the digitization of collections and contribute to the development of new products or services of value to other industries.

Long-Term Environmental Research

In ecology, historical change is key to understanding current environmental conditions and predicting future change. Given the long time scales for some environmental changes, such as a drought that lasts for decades, long-term data is needed to understand slow changes or rare events.

Long-term ecological research provides a baseline of environmental conditions. This information is critical in being able to detect when conditions change. This research also furthers our understanding of basic ecological phenomenon, such as how nutrients cycle through an ecosystem or how biological species diversity (biodiversity) changes over time.

The Long Term Ecological Research Network, supported by NSF, conducts research on ecological issues that can last decades and span huge geographic areas. For instance, the Baltimore Ecosystem Study integrates biological, physical, and social sciences to understand how Baltimore's ecosystems are changing. Importantly, this effort also considers the human dimensions of ecosystems and how social and ecological systems interact. The results of this research have implications for watershed management, urban forestry, and human wellbeing in urban settings.

The U.S. Department of Agriculture also supports longer term agricultural research. The Long-Term Agro-Ecosystem Research network will assess research questions regarding agricultural resilience to rapid environmental change, the provision of ecosystem services from agricultural lands, and tradeoffs associated with different agricultural systems.

Long term research centers are also serve as test beds for new technologies, such as robotic systems and environmental sensors. At the University of New Mexico, "smart traps" have been deployed to capture a rodent, identify it, analyze its urine for Hantavirus, and release the animal—all without human intervention.

The National Ecological Observatory Network is a continental-scale observatory that measures the causes and effects of land use change, climate change, and invasive species on U.S. ecosystems. The NSF-funded project is currently under construction and will ultimately collect environmental data from 106 sites using advanced instrumentation, field sampling, and remotely sensed data.

There is a unique role for the federal government in supporting long-term environmental research. The ongoing nature of this work, as well as the basic research questions posed, do not make it an attractive candidate for industry funding. The outcomes of this research, however, improve our understanding of the living world and contribute to informed decision-making.

Big Data

Fast paced advancements in computing capabilities are opening new doors for scientific research. In the field of biology, researchers are turning to big data to investigate the expression of our genes, causes of coastal algae blooms, and the diversity of microbes living in the human body.

Big data refers to the collection, storage, access, and transfer of data sets that are so large and complex that it is difficult, if not impossible, to process using traditional computing tools.

One of the challenges that face the big data effort—as well as more traditional data sharing efforts within biology—is the diversity of the data. Biological research measures a wide range of factors and generates an equally broad range of data, everything from DNA sequences to lists of species to environmental conditions.

Federal science programs are in a unique position to help coordinate data sharing.

- At the Department of Energy, the Systems Biology Knowledgebase enables researchers to collaboratively generate, test, and share new hypotheses about gene and protein functions and to model interactions among microbes, plants, and their communities.
- The Global Earth Observation System of Systems is a collaborative, international effort to share and integrate Earth observation data in order to better predict outcomes of forest fires, land use change, and other events. The program is supported by the National Aeronautics and Space Administration, Environmental Protection Agency, and National Oceanic and Atmospheric Administration.
- At the John Wesley Powell Center for Analysis and Synthesis, supported by the U.S. Geological Survey, teams use existing data to produce new knowledge about water resources, invasive species, and climate change.

Conclusion

Federal investments in science play an essential role in supporting research and the development of new technologies. Innovation drives economic growth and creates new jobs. New knowledge gleaned from research will help to solve the most challenging problems facing society.

These efforts require a sustained federal investment. Unpredictable swings in federal funding can disrupt research programs, create uncertainty in the research community, and stall the development of the next great idea.

Thank you for your thoughtful consideration of this testimony and for your prior efforts on behalf of scientific research.