



# Fundamental Research in Support of National Security

## Defining the Challenge

Fundamental research in a wide variety of areas provides the United States with a competitive edge that improves the human condition, secures our military advantage, and propels our economy. The 2015 U.S. National Security Strategy lays out the vision to protect U.S. interests in an uncertain world. This vision includes advancing a strong, innovative and growing U.S. economy in an open and highly competitive economic system, promoting respect for universal values at home and around the world, and fostering an international order that promotes peace, security, and opportunity through stronger cooperation. Achieving this vision involves addressing a wide range of multidisciplinary challenges. WSU brings world-class expertise and the necessary multidisciplinary approach to a number of particular challenges identified in the U.S. National Security Strategy, including:

- ◆ Preserving strategic stability via a safe, secure, and effective nuclear deterrent, and preventing the spread of weapons of mass destruction.
- ◆ Strengthening the security and resilience of U.S. critical Infrastructure.
- ◆ Reducing hunger through investment in nutrition, agricultural capacity, and sustainable development.
- ◆ Developing a global capacity to prevent, detect, and rapidly respond to biological threats through the Global Health Security Agenda.

Strong research partnerships between universities, government, and the private sector, including international partnerships, will be necessary in today's increasingly interconnected world to address these and other elements of the U.S. National Security Strategy.

## WSU's Role in the Solution

WSU is exceptionally well positioned to address the specific issues above, with strong scientific capabilities and a multidisciplinary approach that enables the full range of technical, economic, biologic, behavioral, social, and cultural issues to be addressed. WSU houses the Department of Energy (DOE) National Nuclear Security Administration (NNSA) Institute for Shock Physics, one of the world's premier university laboratories for the study of matter at extreme conditions. The university has a leading program in nuclear science and technology, including a

1 MW research nuclear reactor and strong collaborations with the DOE national laboratories. The WSU International Research and Agricultural Development program, funded via the U.S. Agency for International Development and other sponsors, has a long and distinguished track record of supporting agricultural and community development in Asia, the Middle East, Africa, and South America. The Paul G. Allen School for Global Animal Health provides innovative solutions to infectious disease challenges through research, education, global outreach, and application of disease surveillance and control at the human–animal interface, positioning WSU as a leader in addressing the national global health security agenda. In addition to these specialized capabilities, research conducted in support of each of the other WSU Grand Challenges will also help advance the specific issues identified above, as well as national security more broadly.

## Key Research Themes

- ◆ **The study of matter at extreme conditions and its application to fundamental science and support of U.S. nuclear security**
  - Fundamental material properties at extremes of temperature and pressure
  - Computational materials science
  - Advancing nuclear nonproliferation and nuclear safeguard goals through basic research
- ◆ **Advancing nuclear nonproliferation and nuclear safeguard goals through basic research**
  - Actinide science
  - Radioanalytical methods for nuclear forensics and treaty verification
- ◆ **Increasing quality of life in underdeveloped countries through a community based approach to development of agriculture and education**
  - Scientific exchange and capacity building
  - Food, agriculture, and natural resources
  - Higher education for development
  - Economic, behavioral, social, and cultural influences
  - Monitoring and evaluation
- ◆ **Disease detection, prevention, and response in underdeveloped areas to promote global health security**
  - Disease surveillance, monitoring, and associated computational modeling
  - Innovative solutions to infectious disease
  - Health care access in rural and underserved areas
  - Economic, behavioral, social, and cultural influencers of health and economic security

## Descriptive Sentences of Each Key Research Theme

1. **The study of matter at extreme conditions and its application to fundamental science and U.S. nuclear security.** The study of matter at extreme conditions of temperature and pressure is a rapidly evolving area of physical science important to astrophysics, materials science, national security, and other areas. Rapid progression in experimental capabilities, including the WSU Institute for Shock Physics, is enabling researchers to study matter under physical conditions previously inaccessible in the laboratory. Research in this area involves established collaborations with universities and national laboratories in the United States and abroad. Specific topics to investigate include fundamental properties of materials at extreme conditions, related theory and computational modeling, and development of advanced materials.
2. **Advancing nuclear nonproliferation and nuclear safeguard goals through basic research.** Nuclear technologies are an essential aspect of advanced societies as they afford significant benefits such as nuclear energy, but also less well recognized applications in nuclear medicine, food preservation, water resources, and other areas. Such peaceful applications of nuclear technologies are encouraged via international agreements that require safeguards and verification to discourage proliferation for military or terrorism purposes. WSU

supports international efforts to prevent the spread of weapons of mass destruction through basic research in chemistry, physics, and engineering. Using unique university facilities and infrastructure, WSU faculty engage in multidisciplinary research on matter in radiation environments and on radioactive materials. Through these research activities, WSU-led research teams are discovering the fundamental principles that enable key nuclear verification technologies, support nuclear forensics capabilities, facilitate development of adaptive materials for high radiation environments, and implement sustainable recycle and disposal options for nuclear wastes. These research efforts are enhanced via enduring collaborative relationships with the DOE national laboratories.

3. **Increase quality of life in underdeveloped countries through a community based approach to development of agriculture and education.** This research utilizes intensive dialogue, hands-on training, and Extension delivery methods to empower and expand the capacity of people while working within traditional leadership structures associated with the communities supported. In this way, the cultures of communities are respected while development is enhanced. Agricultural and educational technologies that are tested, affordable, and adapted to the local climate and/or culture are identified, designed, and implemented. Impacts are multiplied through the design and implementation of extension programs, increasing collaboration at the village level, providing access to materials and equipment, supporting marketing initiatives, and addressing cross-cutting health and social issues. This is important to developing strong and stable communities and thus a more secure global environment.
4. **Disease detection, prevention, and response in underdeveloped areas to promote global health security.** Global health security relies on the ability to recognize and respond to disease. As witnessed most recently in the Ebola disease crisis in West Africa, disease outbreaks can cripple the governmental, social, and economic fabric of a country, with lasting impacts that reach nations around the globe. Research is needed to carefully investigate the sustainability of developed country paradigms for disease surveillance in resource-poor environments. Objective, data-driven methods for disease detection and response that are sustainable in low income settings will be developed using a multidisciplinary “One Health” approach that addresses challenges from national to local levels, including trans-boundary issues. Political, economic, social, behavioral, and cultural drivers that impact disease emergence, as well as the sustainability of disease surveillance and response systems, will be investigated and incorporated into new models that serve the global community.