SFA Categories – April 2020

BER SFA Categories

All Science Focus Areas (SFA) will be identified as belonging to one of the following six (7) SFA categories.

1. Foundational Genomics

Foundational genomics supports fundamental systems biology research to achieve a predictive understanding of gene function and regulatory networks at the genome scale. Through interdisciplinary approaches that integrate multiomics data and computational modeling, this research advances towards a comprehensive understanding of genotype-phenotype relationships in microbes and plants relevant to DOE. The results yield an increased range of microorganisms and plants as model systems to expand and complement available microbial and plant species for bioenergy and biotechnology research. These efforts underpin leadership advances in biotechnology crucial for competitiveness in a global market.

2. Environmental Genomics

Environmental genomics supports research focused on understanding plants and soil microbial communities and how they impact the cycling and fate of carbon, nutrients, and contaminants in the environment. This research area includes the study of a range of natural and model microbiomes in targeted field environments relevant to BER's research efforts. With a long history in plant and microbial genomics research coupled with substantial biotechnological and computational capabilities available within the DOE user facilities, BER is well positioned to make transformative contributions in biotechnology and understanding microbiome and phytobiome function.

3. Biosystems Design

Biosystems Design develops the fundamental understanding of genome biology needed to design, engineer, and optimize plants, microbes, and biomes for sustainable production of biofuels and bioproducts from renewable sources. By developing novel genome-scale synthetic biology technologies and computer-aided design tools, Biosystems Design accelerates the "design-build-test-learn" cycle to engineer biological systems. Biosafety risks posed by engineered organisms are addressed through Secure Biosystems Design research that develops strategies to prevent and respond to biological threats as well as built-in biocontainment systems to enable a sustainable and secure bioeconomy.

4. Biomolecular Characterization and Imaging Science

Biomolecular Characterization and Imaging Science (BCIS) supports approaches to systems biology that focus on translating information encoded in an organism's genome to those traits expressed by the organism. These genotype to phenotype translations are key to gaining a predictive understanding of cellular function under a variety of environmental and bioenergy-relevant conditions. The effort seeks to develop new bioimaging, measurement, and characterization technologies in standalone systems or in association with BER-supported end stations at the DOE Synchrotron Light and Neutron sources to visualize the structural, spatial, and temporal relationships of key metabolic processes and critical biomaterials governing phenotypic expression in plants and microbes.

5. Earth and Environmental Systems Modeling

BER's Earth and Environmental Systems Modeling (EESM) SFAs develop and apply high fidelity models representing Earth system changes in order to improve understanding of the significant drivers, feedbacks, and uncertainties within the integrated Earth system and to provide vital information needed for effective energy and connected infrastructure planning. Earth system, in this context, is defined as the interdependency of the atmospheric, oceanic, cryogenic, terrestrial, and human components that in turn influence a region's climate, hydrology, and land use. The EESM Program supports the development of advanced computational, numerical, statistical, dynamical, biogeochemical and physical representations of the Earth system; seeks to understand the factors that determine regional variability and change; develops modeling capabilities that involve next-generation terrestrial and atmospheric algorithms for global models and validation of datasets spanning scales from process-to-global; and seeks to advance scientific understanding of the complex interactions, interdependencies, and co-evolutionary pathways of human and natural systems, including interdependencies among sectors and infrastructures.

6. Environmental System Science

The Environmental System Science (ESS) SFAs support research to provide a robust predictive understanding of terrestrial surface and subsurface ecosystems, including the roles of geomorphology, inorganic and organic hydro-biogeochemistry, soil-ecosystem-atmosphere interactions, and water and nutrient cycling that extend from the subsurface to the top of the vegetative canopy. Laboratory and field experiments, along with ecosystem and watershed-scale models, are used to study a variety of scale-aware processes that act on time scales extending from sub-seasonal to decadal and over spatial scales that span from molecular to global. Research focuses on perturbed environmental systems, e.g., where environmental response and resilience is explored as a consequence of variable patterns of temperature, precipitation, nutrients, and exogenous influences (e.g., pests). Research within ESS is intended to fill knowledge gaps in the science of Earth system modeling and to extend predictability on local, regional, and global scales.

7. Atmospheric System Research

The Atmospheric System Research (ASR) activities address the interdependence of clouds, atmospheric aerosols, and precipitation that in turn influences Earth's radiation balance. ASR coordinates with the Atmospheric Radiation Measurement (ARM) user facility, using continuous long-term datasets that in turn provide three-dimensional measurements of radiation, aerosols, clouds, precipitation, and thermodynamics over a range of environmental conditions at diverse geographic locations. The long-term observational data sets are supplemented with laboratory studies and shorter-duration, ground-based and airborne field campaigns to target specific atmospheric processes at various locations and under diverse atmospheric conditions. Earth System models incorporate ASR research results to both understand the processes that govern atmospheric components and to improve Earth system model predictions with greater certainty.