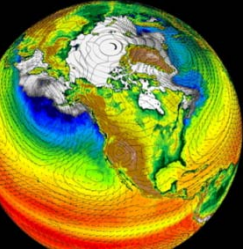
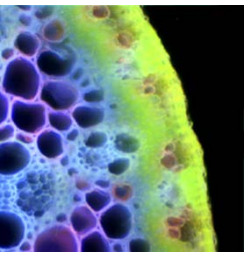
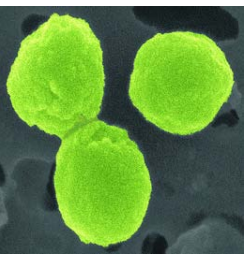
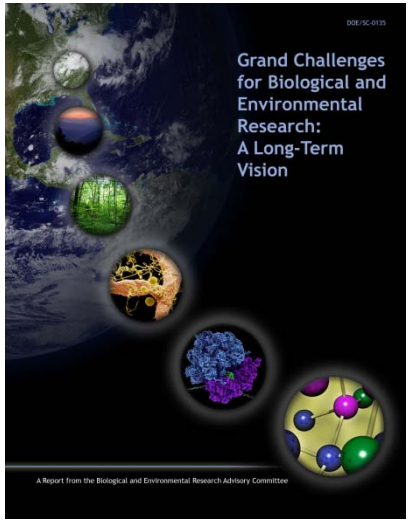


A Long Term Vision for Grand Challenges in Biological and Environmental Research

BERAC
March 10, 2011



- Cross-cutting themes
  - Complex systems science across scales
  - Multidisciplinary research
  - Computation and mathematics
  - Broad view of human impacts and feedbacks
  - Uncertainty quantification and data management

Key recommendations

Biological Systems

Systems biology provides the approaches needed to address biological complexity, while synthetic biology tests this understanding through application.

Computational Bioscience

Biology is becoming a data-intensive, informational science that requires new paradigms to deal with data management and complexity.

Climate Research

Issues of climate change and sustainability require that we develop a better understanding of earth system processes.

Energy Sustainability

An essential component of energy sustainability is fundamental knowledge of relevant natural and physical processes, their interactions and human influences.

Path Forward

- Clean Energy by Biodesign
  - Identify fundamental biological design principles
  - Develop synthetic molecular and genetic toolkits
  - Develop computer-aided biodesign testbeds
  - Workshop planning is underway
- Scaling—from Genome to Climate
  - Ongoing need for modular add-ons
  - Improved data assimilation and uncertainty quantification
  - Extension of models to more rapid climate change requires more accurate prediction of terrestrial domains
  - Next Generation Ecosystem Experiment
- Multi-dimensional climate data and knowledge management
  - Need for adaptable model physics and parameterizations as scales change
  - Integration of atmospheric models with surface hydrology, ecology, and soil biogeochemistry—interdependencies, impacts, and feedbacks
  - Climate Knowledgebase and uncertainty quantification