A New Biology for the 21st Century

Committee on a New Biology for the 21st Century
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Sponsors: NIH, NSF, DOE

http://www.nap.edu/catalog.php?record_id=12764
A moment of unique opportunity --

Past and current research has brought biology to an inflection point

- Technological advances enable biologists to collect data unprecedented in quantity and quality
- Poised on the brink of major advances to solve societal problems
- Time is ripe to undertake a bold experiment
- Augment current life sciences research with urgent and inspiring 10-year challenges that are unreachable without a coordinated approach that aligns the separate strengths of multiple agencies
Why is a new approach needed?

• The science is ready

• We are missing important synergies and opportunities to leverage advances made across the life sciences

New Biology is intended to be an additional and complementary effort not a replacement for current life sciences research.
Why now?

• The fundamental unity of biology has never been clearer or more applicable.
• New skills and ideas are entering the field
• A strong foundation has already been built
• Past investments are paying big dividends
• New tools and emerging sciences are expanding what is possible
What is the New Biology?

**Integration and Broadened Scope**

- re-integration of the many sub-disciplines of biology
- working integration into biology of physics, chemistry, engineering, mathematics and computation

*Will create a discovery engine able to tackle extremely complex biological and societal problems*
A National New Biology Initiative

A National Initiative is recommended that:

– accelerates the emergence and growth of the New Biology, and propels understanding of complex biological problems and processes

– achieves solutions to societal challenges in food, energy, environment, and health
Why major challenges?

• The problems are urgent!

• Big goals can inspire both scientists and the public

• Big goals provide explicit accountability
Call for visionary scientists and engineers to identify challenges in each area that seem impossible now, but within reach if attacked in a coordinated way.

**Food**
Adapt any food crop to any growing condition

**Environment**
Diagnose and repair ecosystem damage

**Energy**
Expand sustainable alternatives to fossil fuels

**Health**
Achieve individualized monitoring and care
A National New Biology Initiative

**Crosscutting imperatives**

- Develop the information sciences and technologies that will be critical to the success of the New Biology

- Develop interdisciplinary undergraduate curricula, graduate training and educator training to create and support New Biologists
Undergraduates need to understand the process of science, the *interdisciplinary nature of the new biology*, and how *science is closely integrated within society*.

Students should... have a certain level of *quantitative competency*, and a basic ability to understand and interpret data.

To be current in biology, students should also have experience with... *computational and systems-level approaches to biological discovery* and analysis, as well as with using large databases.
The Committee strongly endorsed key recommendations of NRC’s 2003 *Bio2010* Report

• Design curricula to ensure biology students well grounded in quantitative sciences—include biology concepts in all science courses

• Laboratory courses should be interdisciplinary and independent research experiences offered as early as possible

• Development time should be provided for faculty to integrate biology with physical sciences, math and engineering into curriculums
Educating the New Biologist

Education in undergraduate biology, as well as graduate and educator training, should create:

• broad appreciation of integration across science: that biology is anchored in the principles of chemistry and physics

• deep expertise in a specific discipline together with highly developed computational and quantitative skills

• working knowledge across several disciplines and technologies to facilitate broad dialogue and participate in integrated research

• skills and aspirations to attack complex biological problems that can address critical social issues
Biology is at a tipping point--poised to contribute to solving major societal problems.

Relatively small investment in inspiring and crucial challenges will lead to development of cross-cutting technologies and education that will leverage the value of all biological research.

RECOMMENDATION: Launch a National New Biology Initiative

a multi-agency, multi-year, multi-disciplinary initiative to capitalize on the extraordinary advances recently made in biology and address four crucial societal challenges.

THE CHALLENGES

- Food
- Environment
- Energy
- Health
Board of Life Sciences staff

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