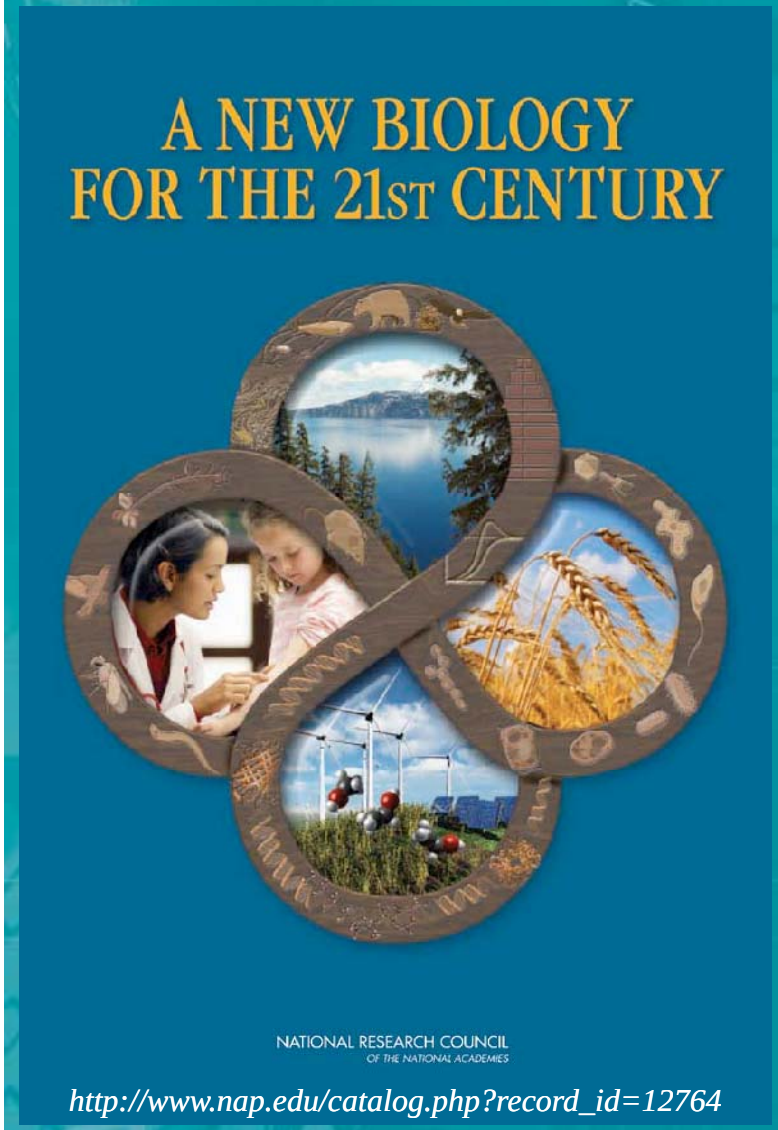

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THE NATIONAL ACADEMIES

DIVISION ON EARTH AND LIFE STUDIES
Board on Life Sciences

A New Biology for the 21st Century

Committee on a New Biology for the 21st Century
Co-Chairs:
Thomas Connelly, DuPont Company
Phillip A. Sharp, MIT
Study Director:
Ann Reid, BLS

Sponsors: NIH, NSF, DOE

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine
National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

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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

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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

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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

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DIVISION ON EARTH AND LIFE STUDIES

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

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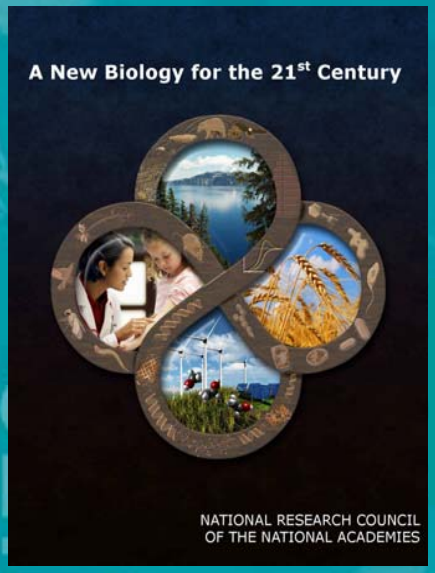
Why major challenges?

- The problems are urgent!
- Big goals can inspire both scientists and the public
- Big goals provide explicit accountability



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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

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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

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VISION AND CHANGE

IN UNDERGRADUATE BIOLOGY EDUCATION
A CALL TO ACTION

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.

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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

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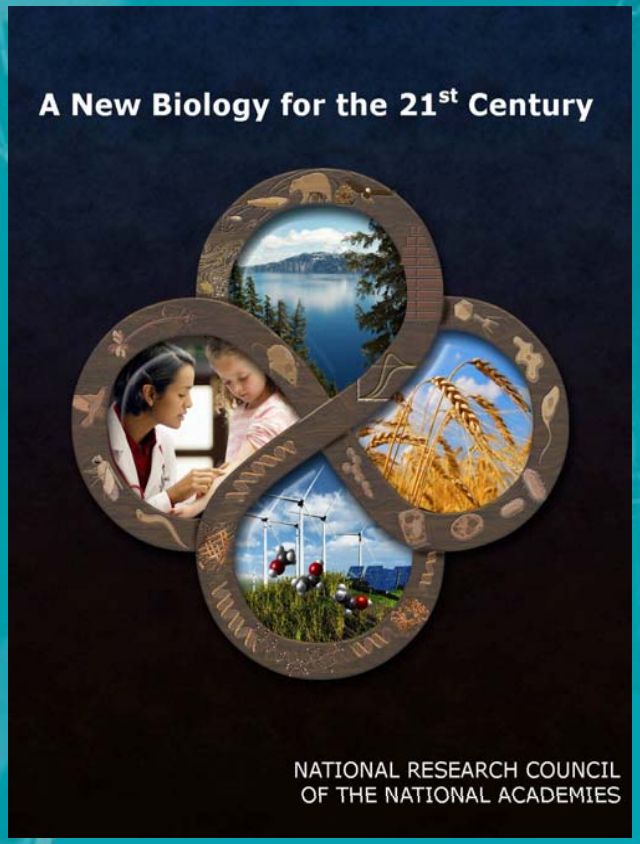
Educating the New Biologist

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



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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

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Board of Life Sciences staff

Committee who prepared the report

Keith Yamamoto and Ann Reid

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