EMERGING FRONTIERS $77,900,000

The FY 2005 Budget Request for the Emerging Frontiers (EF) Subactivity is $77.9 million, a decrease of $1.86 million, or 2.3 percent, from the FY 2004 Estimate of $79.76 million.

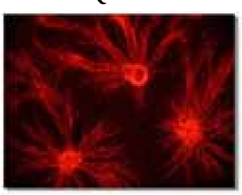
Emerging Frontiers Funding
(Dollars in Millions)

	FY 2003 Actual	FY 2004 Estimate	FY 2005 Request	Change over FY 2004 Amount	Change over FY 2004 Percent
Emerging Frontiers	73.37	79.76	77.90	-1.86	-2.3%
Total, Emerging Frontiers	$73.37	$79.76	$77.90	-$1.86	-2.3%

The Emerging Frontiers Subactivity is an incubator for 21st Century Biology. EF supports multidisciplinary research opportunities and networking activities that arise from advances in disciplinary research. By encouraging synergy between disciplines, Emerging Frontiers provides a mechanism by which new initiatives will be fostered and subsequently integrated into core programs.

Reduced funding in EF is a result of the termination of Information Technology Research (ITR) as an NSF Priority Area. In keeping with the incubating mission of EF, $7.0 million from ITR will be distributed to all BIO divisions in FY 2005 and used to support cyberinfrastructure activities such database development and management and information networking.

In FY 2005 BIO will increase support for Frontiers in Integrated Biological Research (FIBR). FIBR invites new ideas for integrative research on major biological questions from a multidisciplinary point of view. Questions addressed in the first FIBR awards in 2003 include: How do species arise? Do species matter among microbes? Why do some individual cells in the community of slime molds pictured here give up their chance to reproduce so others can? The projects employ boldly creative approaches and draw upon recent breakthroughs in genomics, information technology, high-throughput instrumentation, imaging and wireless technologies, sophisticated sensors, improved GIS systems and other recent advances.



BIO continues support for Research Coordination Networks (RCN), which supports groups of investigators to coordinate their research efforts across disciplinary, organizational, institutional and geographical boundaries. Networks are formed around a focal theme and can involve a broad research question, group of organisms, or particular technologies or approaches.

NSF-wide Priority Areas will be supported out of EF in order to introduce new ideas into these model 21st Century Biology activities and to provide a mechanism through which the priority areas can be integrated with disciplinary activities. Support includes:

Biocomplexity in the Environment (BE) supports research on the dynamics that occur within biological systems and between these systems and the physical environment. Support will continue at the FY 2004 Estimate of $39.86 million for the NSF-wide BE competition as well as for the Tree of Life Project, and two interagency programs, Ecology of Infectious Disease and Microbial Genome Sequencing.

Nanoscale Science and Engineering (NSE) research, focused on studying the structure and regulation of macromolecular machines and macromolecular complexes that are capable of self-replication and self-assembly, will increase by $540,000 to $5.85 million in FY 2005. The increase will specifically support research on nanoscale biosensors and information processors that could provide new tools for understanding cellular communication and detection of environmentally important signals.

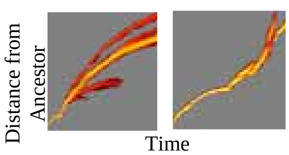
Mathematical Sciences (MSI) will continue to support interdisciplinary research involving mathematics, science and engineering, and focus on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex, non-linear systems. Funding will remain at the FY 2004 Estimate of $2.21 million.

Human and Social Dynamics (HSD) will support research in behavior, cognition, development and neuroscience. Funding will remain at the FY 2004 Estimate of $500,000.

Highlights of areas supported:

Multidisciplinary team tackles how plant cell walls form. WallBioNet is a RCN that fosters interactions among biologists, chemists, physicists, and informaticists to understand the biosynthesis of the plant cell wall, an extremely complicated matrix of carbohydrates and proteins. This coordinated effort to address cell wall biosynthesis will lead to fundamental discoveries about plant development and to improvements of cell-wall based products such as fiber, paper, and wood.

Evolution in silico. A team of microbiologists, computer scientists and a philosopher, used an artificial life computer program to create a road map detailing the evolution of complex organisms, an old problem in biology. They found that the path to complex functions is built up from simpler functions, each unremarkable if viewed in isolation. The computer program called Avida, not only reproduces but also performs mathematical calculations to obtain rewards; more computer time that they use for making copies of themselves. Avida is a way to watch evolution, which for living organisms would require thousands of years, in real time. Many computer scientists and engineers are now using processes based on principles of genetics and evolution to solve complex problems, design robots, and more.



Evolution of Digital Life

Overturning a Paradigm. Humans rely on green plants for food, shelter, clothing, and even the oxygen we breathe. As one of the oldest and most diverse branches of the Tree of Life, green plants provide an unparalleled system in which to approach questions concerning the diversification of life on earth. Tree of Life supported research revealed that the traditional belief that the so-called "land-plant invasion" was led by seawater plants is wrong. Instead, primitive freshwater plants were the ancestors of all green land plants, whether extant or extinct.


Freshwater Elodea plants

One NSE project has studied vaults, small, intracellular particles made of RNA and protein that were discovered almost 20 years ago, but whose cellular function is still a mystery. Recent work has clarified that the structure of these unique, naturally occurring nano-capsules is a hollow cage, with a very thin (about 2 nanometer) shell (see image). The interior volume is large enough to enclose hundreds of proteins. This work points the way to controlled assembly of vaults loaded with small molecules or enzymes useful for measuring or altering metabolism within specific cells. Such modified vaults could be targeted to specific cell types or even to specific sites within cells, and may prove useful both in basic studies of cellular function, and in applications such as biosensing and drug delivery.