

NIMBioS Strategic Plan

Objective: This plan provides a set of guidelines for the various components of NIMBioS over the first five years of its existence. The objective is to provide a coherent set of goals, procedures for reaching those goals and commitment to these goals by the participating parties (e.g. the NIMBioS Leadership Team, the NIMBioS Advisory Board and the sponsoring agency partners).

Mission and Goals of NIMBioS:

The mission of NIMBioS is to foster the maturation of cross-disciplinary approaches at the interface of mathematics and biology and foster the development of a cadre of researchers who are capable of conceiving and engaging in creative and collaborative connections across disciplines to effectively use appropriate and necessary mathematics to address fundamental and applied biological questions. The nature of the questions addressed at NIMBioS spans all of biology, impacting both basic and applied science.

The specific goals of NIMBioS in order to achieve its mission are to efficiently utilize our resources: 1) to address key biological questions by facilitating the assembly and productive collaboration of interdisciplinary teams; and 2) to foster development of the critical and essential human capacity to deal with the complexities of the multi-scale systems that characterize modern biology.

Specific Strategies to Achieve our Goals:

A variety of routes are planned to achieve the above goals, based upon the successes of our leadership team in developing new interdisciplinary collaborations nationally and internationally, and on the successful efforts of other Synthesis Centers supported by NSF BIO Division and the Mathematics Institutes supported by the NSF MATH Division. These routes may be classified as (1) ***Collaborative Intensive Research Activities***; (2) ***Investigative Research Activities***; (3) ***Education Activities***; and (4) ***Outreach Activities***. Though listed here as distinct activities, by intention there are connections between these and their methods to contribute to reaching the goals of NIMBioS.

An overarching strategy for all these routes is that NIMBioS activities are ***community-driven***. That is, there are advantages to requesting suggestions from a broad array of the constituents for NIMBioS and not to rely greatly on the suggestions and requests of a small group of researchers and educators. Given the enormous potential breadth of scientific areas across life sciences and mathematics in which NIMBioS could be involved, some prioritization of effort needs to be made beyond that provided by the emphases inherently associated with the main funding agencies for NIMBioS. As NIMBioS is established through a cooperative agreement with NSF, activities focused explicitly on human health will generally not be supported, though there are many areas of biology which impinge on human health

and are within the purview of NIMBioS. The method used to prioritize NIMBioS support is therefore to rely on requests from the community, and evaluate these requests through a formal process utilizing the broad set of expertise available through the external Board of Advisors (BOA).

As NIMBioS develops, it may be appropriate for the BOA to suggest that NIMBioS solicit requests in particular areas as a method to focus some attention on general research areas the BOA believes to be fruitful to investigate but which have not as yet drawn requests to NIMBioS from the general community. At the same time, there may be community-suggested activities which better fit the missions of other NSF Centers, and NIMBioS will develop mechanisms for collaboration as appropriate with other NSF or other agency-funded Centers to create synergies rather than overlap.

Collaborative Intensive Research Activities are the central activity supported by NIMBioS to address focused research questions requiring a mixture of disciplinary backgrounds to address. These are mainly developed through ***Working Groups***, consisting of approximately 10-15 researchers, generally beyond the stage of their graduate education, who spend several brief periods at NIMBioS in conjunction with work at-a-distance over a total of two to three years. These groups focus on specific research objectives, in emphasis areas at several levels of biological organization, that will benefit from interdisciplinary efforts applying necessary and appropriate mathematics. A successful working group will develop transformative publications or products that will drive additional research at the interface of math and biology in the focus area. The majority of these working groups will be established based upon requests from the community, but several areas of initial emphasis have been chosen, with leadership provided by faculty of UT, in order to quickly initiate activities at NIMBioS. Some working groups may be formed in response to requests from a government agency partner in order to meet specific national needs. In addition to such working groups, NIMBioS provides a mechanism for shorter-term intense research activities of smaller groups of researchers through a ***short-term visitor program***. This program may support small groups (e.g. up to five) of collaborators to work intensively at any stage of an interdisciplinary research project, including collaborating to develop basic models, gathering to evaluate results of previous model development, or near the final stages of a collaboration in finalizing products of an ongoing collaborative research project.

Investigative Research Activities are those carried out either without a sufficiently-focused set of questions to be appropriate for a Working Group, or those carried out mostly through the effort of individual researchers based at NIMBioS.

- ***Investigative Workshops*** assemble larger groups of researchers than are involved in a Working Group to assess somewhat broader problems, with dual goals of fostering language-building across disciplines and defining specific issues to be addressed by future Working Groups. Investigative Workshops have 30-40 participants and attempt to summarize/synthesize

the state of the art and identify future directions. They thus have potential for leading to one or more future Working Groups, although that may not be their main objective. Participants will include post-docs and graduate students with less experience in the particular topic than those participating in Working Groups.

NIMBioS sponsors individual researchers through several mechanisms, although in each case there is an explicit research project that is the focus of the effort.

- **Postdoctoral Fellows** are selected through a rigorous evaluation process involving the BOA based upon the importance of the synthetic project proposed, whether it requires an amalgam of mathematical and biological approaches, and whether the proposed effort includes explicit opportunities to expand the scholar's previous education. While NIMBioS encourages its Postdoctoral Fellows to collaborate with established faculty locally and globally, to participate in Working Groups and Investigative Workshops and to interact with visiting scholars, the NIMBioS Postdoctoral Fellows are expected to be independent researchers. Given the breadth of backgrounds needed to be successful interdisciplinary researchers, NIMBioS assigns two mentors to each Postdoctoral Fellow, with one mentor having more biological experience and the other having more mathematical/computational experience. These mentors provide research suggestions and assist the Fellow to broaden his/her experience, but they do not direct the Fellow's research.
- **Sabbatical Fellows** come to NIMBioS for a few months to a year with the length of stay determined by the objectives of the proposed project. Fellows may propose to include a mixture of Working Group, Investigative Workshop and outreach activities as part of their effort while in residence, and are encouraged to suggest creative ways to expand their expertise while in residence. Fellows are expected to interact with other NIMBioS resident and visiting researchers. **Short-term Visitors** may be individual researchers supported for periods from a few days to a month to assist their efforts in carrying out research that conforms to the mission of NIMBioS.

Assessment by the Advisory Board and NIMBioS Leadership Team of whether a requested activity should be supported depends upon whether: the mathematical models and approaches for the activity are appropriate to the biological questions being addressed; the biological questions have significant impact; the mathematics can provide new insight into the biological questions; the parameters and variables for the models in the activity are estimable from observation or, if the objective is general theory, whether the activity can provide broadly useful new insight.

Education Activities at NIMBioS encompass the entire range from elementary education through postdoctoral mentoring. These include efforts to enhance high school students' connections between mathematics and biology through elaboration

of mathematics materials linked to the Biology-in-a-Box project based at UT, a 'research experience for undergraduates' (REU) program that incorporates high school teachers, and a summer research experience program for veterinary students (REV) which incorporates mathematical modeling. **Tutorials** are designed to enlighten biologists about key quantitative methods and to encourage collaborative educational efforts across biology and mathematics, particularly in undergraduate curricula. The **Teacher Collaboration Program** is intended to provide links between teachers, scientists, and educators with interest in mathematical biology. Human capacity building is also fostered through establishment of **partnerships with institutions serving under-represented groups** in Science, Technology, Engineering, and Mathematics (STEM) disciplines with a dual objective of providing information to students about the opportunities at the interface of math and biology while assisting these institutions to develop their own programs at this interface.

Outreach Activities are intended in general to enhance the appreciation among disparate audiences that mathematics is intimately connected to many fascinating questions in modern biology. This includes the use of various **communication methods** to broadly transmit information about NIMBioS activities through traditional media outlets and an array of new media tied to social networking. A week-long summer program **Biology by Numbers** for students in grades 4-7 provides hands-on measurement of biological objects with basic mathematical analysis. NIMBioS is **partnering with the Great Smoky Mountains National Park** (GSMNP) for collaboration in both research and education projects, including working together on teacher workshops, student camps, and modules about research projects designed for outreach to the public.

Partner relationships will strengthen NIMBioS' ability to achieve its goals. Four focus areas are: *i*) interaction with our key 'national needs' partner: Great Smoky Mountains National Park; *ii*) fostering NIMBioS' capacity for response to national needs raised by our sponsoring Agencies; *iii*) interaction with our two key industry partners – IBM and ESRI – and with Oak Ridge National Laboratory (ORNL); and *iv*) development of other potential industry/academic partnerships consistent with NIMBioS' mission.

Action Plan to Carry out our Strategies

The above strategies require an intense effort of many individuals in order to be successful. NIMBioS has identified a set of professional staff whose skill sets are appropriate to provide the infrastructure necessary to effectively carry out these strategies. These staff include those in Information Infrastructure, Business and Logistics, Evaluation and Communication. Each of these groups is essential, and they must work well together in order to achieve NIMBioS' objectives. Effective management of this staff, carried out through the Deputy Director and members of the Leadership Team, is essential and needs to be evaluated and revised as appropriate. Staff interaction with GSMNP and Sponsoring Agencies occurs through education/outreach activities and involvement of Park and Agency staff in

proposing and participating in Working Groups and Investigative Workshops. Interactions with ORNL occur in various facets of NIMBioS' activities, with ORNL staff taking a lead role in some cases. Developing and enhancing **Formal industry and academic partnership agreements** (e.g., with Minority Serving Institutions) are a goal for NIMBioS.

NIMBioS has on staff a professional with expertise in evaluation and formal evaluations are carried out for all NIMBioS-supported activities following procedures in our **Evaluation Plan**. These evaluations are made available to organizers of all activities and an objective is to provide guidance for prospective organizers, based upon these evaluations, on best practices for the activity. As a Center focused on scientific research, it is our intention to utilize evaluation results as part of research on effective interdisciplinary scientific collaborations, including the potential for new media to aid collaborative efforts. Overall evaluation of NIMBioS involves metrics including new collaborations initiated, the quantity and quality of research and education products derived from activities, the education of individuals capable of carrying out research at the interface of math and biology, and contributions to the general public's understanding of the utility of mathematics in the life sciences.

NIMBioS has a **Diversity Plan** to assist in consideration of all aspects of diversity across the array of activities supported. Additionally, there is a **Leadership Evaluation Procedure**, involving a committee of the BOA, to provide yearly evaluations of the NIMBioS Leadership Team and provide feedback to the BOA and the University regarding any suggestions for modifications to the management of NIMBioS. An integral part of the actions needed to be effective involve the **facilities** available to NIMBioS, and one focus of the evaluation of the Leadership will be the effectiveness of the design and implementation of facilities. Given that the initial phase of NIMBioS is being housed in a temporary location, a critical component of the long-term success of NIMBioS will be the design of the permanent facility and a goal is to ensure that all current staff and postdoctoral fellows are given the opportunity to contribute ideas for the design of the permanent space.

Modification of this Strategic Plan

The Cooperative Agreement under which NIMBioS is structured provides a mechanism for formal external site review evaluation of NIMBioS at two points prior to the completion of the first funding period. It is expected that the first of these reviews will be held at approximately the midpoint of the funding cycle and at the BOA meeting prior to that mid-cycle review, the BOA will be asked to provide comments on any aspect of NIMBioS that they suggest would benefit from modification of this Strategic Plan. These comments will be considered by the NIMBioS Leadership Team and appropriate modifications to the Plan will be made prior to the mid-cycle external review. A similar process will be carried out prior to the second external site review specified in the Cooperative Agreement.

Revision History:

This Plan was revised February 2010 as per suggestions at the Advisory Board Meeting of October 2009 in preparation for the mid-cycle review to be held in June 2010.