NAME: Undergraduate Program

INSTITUTION: Howard Hughes Medical Institute

Howard Hughes Medical Institute
Office of Grants and Special Programs
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DRAFT: HHMI CURRICULUM DEVELOPMENT : INTEGRATION OF MATH INTO INTRO BIO COURSE

Inputs	Strategies	Outputs	Outcomes		Impacts
			(Short Term-Learning)	(Medium Term-Action)	(Long Term-Conditions)
Undergraduate Students Curriculum Development Teams (Faculty, Instructors, Postdoctoral fellows, and Graduate and Undergraduate Students) Biology Faculty Applied Science Faculty Mathematics Faculty New Scientific/Pedagogical Discoveries—from work on teaching biomath Examples from Teaching and Research Laboratories Equipment and Supplies Institutional Commitment College BioMath Initiative Expertise/experience from other Institutions Supportive Teaching and Research Environment and Infrastructure: Teaching Seminars/Workshops/Lunch Meetings; Charles Center Teaching Mentoring Faculty Release Time Department Curriculum Review Opportunities/External Review Biology Departmental Staff, e.g. lab coordinator , graduate teaching assistants HHMI – Staff, Leadership and Funding Other Funding Sources	"Introductory Biology " committee review of strategies and resources: ongoing as courses are developed Continued interaction with faculty as course is developed : for faculty buy-in and input Develop new introductory course that begins with quantitative approaches to reflect new scientific discoveries and teaching approaches Ensure that lectures are integrated with ongoing research, faculty research if possible Provide opportunities for attendance at national workshops Provide training opportunities and resources for faculty, lab coordinators, and graduate and undergraduate teaching assistants Provide for faculty release time as courses are being developed and implemented Provide support for others such as undergraduates, graduate students, and postdocs engaged in curriculum development efforts Upgrade computational facilities (Matlab and other software licenses) Establish TA-staffed computer lab	Thorough overhaul of Introductory Biology lectures: lectures begin with quantitative data that leads to descriptive data Lectures reach ~350 students per semester in two introductory biology courses: ecology-evolution and cell-molecular biology Development of course materials/ manual for implementation of this approach Faculty and other instructors (lab coordinator and grad students) develop new quantitative skills	Students have better understanding of process of science, i.e, how data requires quantitative analysis to become knowledge Students develop stronger skills in mathematics and in the application of mathematical principles Students have better understanding of the content covered in the lab because they understand the basis for this knowledge Students are more confident and less fearful of mathematics in biology in other courses Students develop deeper understanding of math principles Students are more interested and engaged in science issues and continue in science Implementation of new labs lead to new collaborations among faculty developing labs Labs lead to better attendance and attention in labs; better understanding in lecture	Students take more biology courses in which they employ quantitative approaches Students take additional math/statistics courses Students have a long-term interest or engagement in science activities; they remain in science major More students enter research labs as undergraduates Students willing to employ quantitative approaches in their own research Students understand science concepts better Those who took lab perform better in related courses and labs Faculty receive recognition for input into curriculum and teaching new course with reduced workload in other areas Faculty continue to be involved in modifying or developing courses with less or no HHMI support Institutional or other sources of support expand for curriculum development Additional faculty become involved in course development for introductory labs Faculty use this lab as basis for upper level lab design—as a continuation of introductory labs	Students continue to be engaged in science-related activities and professions; in particular students will enter biomath programs Students are more open to use bio-math approaches in their post-graduate careers Faculty and instructors continue to modify what and how they teach science, in particular weaving quantitative approaches throughout the curriculum Faculty develop a freshmen-through-senior research-based curriculum, expanding opportunities for research at all levels of the curriculum A cadre of faculty members begin to be employed in variety of other departments, e.g. psychology Similar approaches spurred in all science departments Faculty receive recognition, awards, tenure, promotion for their efforts; Institutions reward faculty for better teaching and curriculum development activities Institutions commit funds and other support for ongoing curriculum revision

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DRAFT: INTEGRATION OF MATH INTO INTRO BIO COURSE: EVALUATION FRAMEWORK

Evaluation Questions for OUTCOMES		Possible Data Collection Methods and Information Sources	Rank/Priority (include brief rationale)
1. How effective was the integration of mathematical approaches in teaching contemporary science to students? 2. Did the students' attitudes towards the use of quantitative approaches change for the positive? 3. How effectively did the students apply quantitative approaches beyond the course in future scientific work? 4. What was the effect of the integration of math into the introductory curriculum development changes to the faculty and department/major? 5. What impacts were there beyond the department for the curriculum development activities?	1. a. Students show increased interest in mathematical approaches in science b. Students learn introductory material better and retain material long term c. Students value quantitative approaches d. Students less wary of math applications e. Students continue in science (majors and careers) and continue taking quantitative courses 2. a. Students value math and quantitative approaches b. Students less math-phobic c. Students seek out quantitative courses d. Students recommend quantitative courses to friends 3. a. Students take additional courses with quantitative component b. Students pursue research opportunities with quantitative of course experiences 4. a. Course(s) integrated into curriculum b. Course enrollment increases c. Department student majors increases d. Department creates additional courses modeled on this course e. Department creates upper level courses that are extensions of this course and build upon it 5. a. Lab courses in other departments employ similar strategy for introductory lab courses b. Effect on science pedagogy c. Additional curriculum development grants and awards that stress quantitative approaches d. Other department creates upper level courses that are extensions of this course and build upon it; new multidisciplinary courses created	1,2. a. Pre-Post Tests b. Entrance and Exit Questionnaire c. Interview d. Focus Group e. CURE f. Course/Classroom Observations g. Course Surveys 3. a. Data collection on course/curriculum changes (e.g., Enrollment for students) b. Student data for independent research activities 4. a. Data on offerings in curriculum and departmental major b. Interviews/reports from faculty and other curriculum developers c. Focus Group of faculty and other curriculum developers d. Faculty CVs and portfolios 5. a. Review of course offerings, syllabi, and catalogs for research based courses b. Review of teaching workshop topics and teaching seminars c. Assessment of teaching by department, institution d. Faculty CVs and portfolios e. Annual report of HHMI-funded activities and their impact f. Grant funding information g. Institutional funding reports	Items are ranked based on how soon they can be captured during and after program activities (strategies) have occurred. However all questions and measures will be evaluated during and after each activity in order to capture the ongoing, longer-term changes in impact. That is, we except to see increasing impact over time.