Track I, 2000-2001 Instructional Innovation Grant Program
Final Proposal March 27, 2001

Dr. Steven Rissing, Director of Introductory Biology Program
College of Biological Sciences
104 General Biology Annex
688-4989, rissing.2@osu.edu

Technologically Enhanced Visualization for Introductory Biology Program

The instructional problem to be addressed

Each year OSU's biological sciences department reaches ~9,000 students through their Introductory Biology Program (IBP). The biological concepts and the molecular interactions that underlie these concepts, studied by these students are part of everyday life—and so, inherently relevant. Yet for many students the concepts remain esoteric and they are unable to establish a connection between a concept and its molecular cause.

The proposed solution

Advances in computer graphics can give students the ability to "see" molecular interactions and the biological concepts those interactions support. Textbooks attempt to represent this material with the use of two-dimensional, static visuals but this affords students little help with complex, time-dependent, three-dimensional processes. Alternatively, computer graphics allow students to see these processes as multi-dimensional, multi-colored images and sequenced events.

The proposed technology needed to implement this solution

- WebCT
- WebCT video server
- Alias|Wavefront animation software, Maya 3.0
- Windows NT/2000 workstations

The programs and academic areas served by the innovation

- Undergraduate education (8,000 students/year) including high-demand GEC course BIO 101.
- Graduate education in Life Sciences in terms of demonstrating how to incorporate new technological opportunities into teaching portfolios.
- Graduate education in the College of Arts in terms of the animation, integration, and cross-disciplinary collaboration processes.
- Graduate and teacher education in the College of Education in terms of integrating technology, current content knowledge, and collaboration, as this project is shared via education courses.

The project narrative

Fundamental concepts in biology are often best understood in light of the interactions of the biological molecules that "cause" these concepts. For example, understanding the human immune response in light of antibody/antigen interactions. Understanding these concepts is of profound importance for all levels of biological education. Students *majoring* in biology will find that the pressing research questions are concerned with the specific interactions of biological macromolecules with their targets while *non-majors* will find that their "scientific literacy" depends on their ability to grasp that there are molecular phenomena underlying the concepts of interest. Despite this importance, students typically have trouble understanding a complicated three-dimensional molecular interaction—let alone its connection to the larger biological function or concept.

The activities in this proposal are directed at the design, development and implementation of new, visually enhanced components of the online IBP curriculum that will address this problem. These components, to be created at The Advanced Computing Center for the Arts and Design (ACCAD), will use advanced graphics and animation to model the three-dimensional structure of pertinent molecules, the interaction of molecules, and the resulting biological activity. ACCAD, an instructional and research center supported by the College of the Arts, has a long history of innovation with the convergence of high

technology in visualization applications. Unlike static, flat textbook representations, these renderings will be able to demonstrate time-dependent 3D interactions, and unlike the auxiliary electronic materials provided by textbook publishers, these components will place the 3D representations in their biological context. For example, our components will demonstrate the intricately folded hemoglobin interacting with oxygen, the dependence of the interaction on the 3D folding, and the dependence of the biological activity—in this case, reversibly binding oxygen—on both.

These representations are important in the instruction of biology but they also impact pedagogy more broadly. Dr. Rissing's demonstration of instruction that incorporates advanced technologies as well as considers diverse (such as visual) learners, models pedagogy consistent with science education reform efforts. If it is true that we teach as we were taught, this is an effective strategy for dissemination of sound pedagogy for those within that 9,000 that will go on to teach in *any* field.

We are at the front end of the changes technology is bringing to education, yet technology-enhanced instruction seems already part of so many curriculums. Just as it wasn't true that having a good text made for good instruction, having advanced visuals will not ensure a good pedagogy in using those visuals. Thus it is important for the College of Education (COE), and specifically those groups

responsible for educational technologies, to have a presence here. Such a presence will help to ensure that the design and implementation process is consistent with educational theories and research.

This proposal continues and extends the IBP's commitment to the revision of OSU undergraduate education. This revision, supported by TELR and extramural funds, is being achieved in part via the integration of web-based exercises into teaching laboratories. In addition, this proposal marks a cross-disciplinary step toward further instructional innovation via the augmentation of courses and laboratory exercises with pedagogically sound, technology-enhanced, three-dimensional visualizations of content.

The detailed implementation plan

Working collaboratively, The College of Biological Sciences, The College of Education, and the College of the Arts, will create educationally sound, visually enhanced components to augment the IBP course content. We will use 3D animation to clearly convey the time and scale of molecular interactions. These visualizations/animations will be delivered via the web and WebCT video server to supplement on-campus and WebCT courses in the IBP. Acting ACCAD Director, Maria Palazzi, will supervise the animation carried out by ACCAD graduate students. Dr. Steve Rissing, Director of the IBP, and his graduate students, will guide content selections and integration of visualization

components into the online content. Dr. Janet Russell from the College of Education will integrate educational theory. And through the COE's Suzanne Damarin, the interactive materials developed will be made available to the College's Technology Enhanced Teaching and Learning Project for use in demonstrating to COE faculty and students some of the promises of these technologies for education.

Our assessment efforts are an integral part of this proposal and will map onto the ongoing efforts of the IBP/CBS. Matching funds will cover the costs of program assessment. In addition to using the data resulting from these assessments to revise the visualization components, we believe that such data are crucial in securing off-campus funding for our long-term goals.

Summary of implementation plan

Summer 2001:	Collaboratively conceptualize modules. Begin writing, formatting and animation of modules. Arrange for implementation within IBP classes. Prepare assessment instrument.
Fall 2001:	Begin implementation of modules. Ongoing review and revision of modules.
Winter 2002:	Ongoing implementation, review and revision of modules.
Spring 2002:	Planning and preparation of dissemination materials.