THE INITIATIVE ON
IMPROVING K–12 EDUCATION
STANFORD UNIVERSITY

Bringing Life to Physical Sciences

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Abstract

As we enter an era in which biomedical scientists and engineers are revolutionizing medical and environmental technologies, we are developing exciting new tools for high school science programs.

We will inspire students with a bio-physics curriculum and **easy-to-use** software – inspired by the tools used by researchers and professionals in medicine, biomedical engineering, sports performance, physical therapy and rehabilitation.

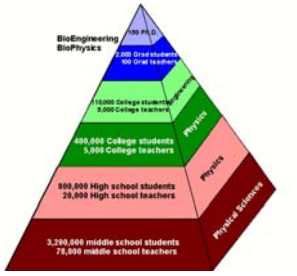
Education Challenge

"**Bringing life to physical sciences**" identifies the need to combine biology with physics to equip the next generation of scientists and engineers for the vast and growing opportunities in biosciences.

Our team is creating a bio-physics curriculum and software that is correlated with National and State Standards for Physics and Physical Sciences.

The greatest education challenge is "Promoting the Use of Computational Biology in Education."

Source: "Top Ten Challenges of the Next Decade", Biomedical Computational Review, 2005. Eric Jacobsson, Director, NIH Center for Computational Biology.



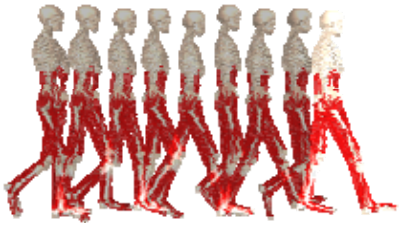
Project Goals

Phase 1 focuses on development of easy-to-use, interactive, software, simulations, and curriculum. The simulations demonstrate Newton's laws with muscle-actuated human motion.

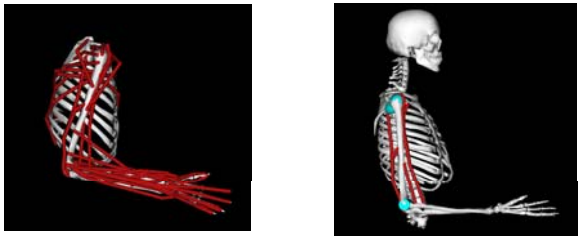
Phase 2 focuses on testing and teacher-based feedback for the software, curriculum, and simulations. Phase 2 also includes some dissemination, teacher training, focus groups, and early refinement.

Year 2 will add interactive simulations and curriculum exercises and greatly expand and refine Year 1curriculum and experiments based on teacher and student feedback and testing.

Year 2 deployment focuses on teacher impact via dissemination, e.g., Physics Teacher training for Northern California and Nevada physics teachers, PHET (Physics Education Technology), and other public/private software and curriculum websites, catalogues, trade shows, conferences, textbooks, and workshops with hands-on training and evaluation



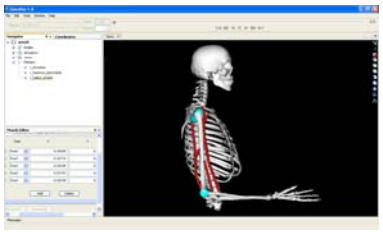
Project Design and Results/Plans for 2009

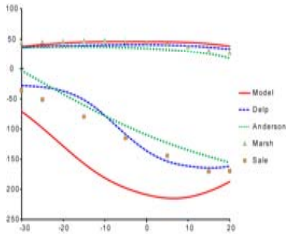


Complex biomechanical model of the arm used in research (left panel) and a simplified model used in the simulation exercises.

Curriculum experiments

- Big muscles and strong motion
- Long bones and weight-lifting
- Weight, mass, gravity and affects on bone and muscle biology
- Muscle strength and biology (nature and nurture)
- Muscles moments – the biology of muscle attachment





OpenSim, freely available software developed at Stanford, will be used to enhance learning of physical principals and biomechanics

Skills learned by students and teachers

- Mathematics, plotting, interpolation, extrapolation
- Computer skills, simulation, introduction to world-class tools
- The physics of forces (kinetics), motion (kinematics) and mass distribution
- Physics and Newton's law in humans and animal motion
- Biology, anatomy, and physiology of skeletal dynamics
- Discovery learning and exploring what-if-scenarios
- Hands-on, minds-on, can-do attitudes

Impact and Future Directions

The long-term goal is to motivate thousands of young people to master the basics of physics and biology by interacting with graphical simulations of living systems. Engaging students early in their academic careers, and inspiring them to pursue additional scientific knowledge, will increase the number of scientists and engineers working to enhance human health and promote environmental sustainability, two of the most pressing challenges facing our world.

We plan to release the first educational modules and simulations in summer 2009 and begin testing with students and teachers. The software and teaching materials will be posted at www.simtk.org.