PROMISING PROGRAM

# *The Maryland Virtual High School (MVHS) CoreModels Project*

# The Maryland Virtual High School (MVHS) CoreModels Project

## Program Description

The Maryland Virtual High School (MVHS) CoreModels Project has two primary goals: (1) to use computer modeling to help all high school students achieve state and national science standards, and (2) by developing and refining a process of network-based peer leadership and collaboration, to give teachers in their classrooms the support they need to integrate modeling activities into their instruction. Started in 1997, CoreModels is based on, and is intended to institutionalize, the gains achieved by the Maryland Virtual High School program that connected rural and underserved Maryland schools to a magnet high school via the Internet. Through this connection, MVHS supported teachers in developing and implementing computational science projects with their students. Crucial components of the MVHS program were: (1) its focus on using computational modeling to teach complex science content, and (2) its mentoring and support for remote teachers and students provided by magnet teachers and their students. The mentors won national recognition for their computational science projects and gained experience through a student-run laboratory at Montgomery Blair High School Magnet Program.

A model of distributed support that creates the conditions for sustainability of the changes and gains achieved by schools, the program is active in 6 to 15 schools in each of 3 CoreModels regional centers in Maryland.

Students construct their own models, utilizing the software STELLA, in areas of science such as wildlife populations, the carbon cycle, hurricane prediction, projectile motion, chemical reactions, and rock formation cycles. Students hypothesize about the results of their model based on the parameters used in the graphical model definition. They compare their results with other predictions, such as those from scientists or developed by other students, or with actual results as measured in practice, thus gaining an understanding of important recurring scientific concepts involving equilibrium processes, feedback, and multiple causal relationships, among others.

This process of learning brings students closer to science as it is practiced in the world outside of school. As an example of the conceptual core of the use of modeling, students not only learn about the laws of conservation of mass and conservation of energy, but they learn to apply them in many different situations; to identify control and independent variables; to collect data and analyze the results; and to write clear step-by-step instructions for investigating their hypotheses. In the

## Program Costs

For cost information, please contact program designee.

process, students apply higher-level mathematics skills, such as ratio and proportion and setting up equations. For example, in the glucose regulation model students simulate the glucose-insulin feedback process that the body uses in attempting to maintain homeostasis (equilibrium) and predict the effect on the body of eating a candy bar. They practice graph analysis by determining how the model output differs from their prediction and describe what the graphs mean in terms of the body's response. They also use the graphs to describe how the body's blood glucose and insulin concentrations differ when pasta is eaten instead of a candy bar.

The MVHS CoreModels project works through regional centers to integrate curriculum reform, staff development, and teacher professionalism in a sustainable manner. Technology enhances and facilitates this initiative by allowing educators and students to become better at teaching and learning. Teachers are recruited and trained to

- implement computer modeling to help students understand and learn more complex scientific concepts central to biology and physics;
- help students learn in a collaborative, problem-solving, interactive manner that brings them closer to the world of science; and
- implement innovative pedagogical practices by being provided with scientific and technology support.

Ideally, as more teachers are recruited and trained, the pool of trainers for new teachers becomes larger, and more and more teachers become trained in the use of CoreModels. The project had been in existence for 2 full years as of September 1, 1999.

## Quality and Educational Significance

### Learning

MVHS CoreModels increases students' in-depth understanding and competence in their current science subject area by focusing on an analysis of change over time and on the transfer of understanding from one activity to the next. One of the hallmarks of the project is the alignment of CoreModels activities with Maryland Science Core Learning Goals (CLGs). CoreModels materials also focus on the American Association for the Advancement of Science (AAAS) Benchmark common themes (similar to National Science Education Standards themes), which emphasize connections between seemingly disparate science content.

In using and creating computer models, student attention can be focused on similar structures and behavior across areas of study. For example, a predator-prey interaction model and a physical

### Usefulness to Others

The very structure of MVHS CoreModels lends credence to a claim of usefulness to others. The project includes regional centers, 15 local educational authorities, and 31 schools. Growth and dissemination have been extremely successful in regions with very different demographic and political characteristics, and the program has been adapted differently on the school, district, and regional levels.

The program's technology requirements are relatively simple, understandable, and affordable. Schools can purchase the site license for STELLA software for $500. Unlike subject-specific simulation software, STELLA is technology problem-solving software (National Educational Technology Standards). In addition to computers running STELLA, Internet access should be available for teachers to collaborate with peers and to access models and materials. In adapting the MVHS CoreModels program, leaders could access materials available through the MVHS site, as well as other system dynamic modeling archives such as the Creative Learning Exchange.

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spring model share the same mathematical oscillatory structure. Disruption and resumption of equilibrium can be found in both biological and Earth systems. Assimilating an understanding of such core structure and behavior concepts leads to acquisition of the "schemas" of science content, which have been shown to distinguish experts from novices (P. Chandler & J. Sweller [1991], "Cognitive Load Theory and the Format of Instruction," Cognition and Instruction 8, 293–332).

## Excellence for All

Modeling activities have been used with mainstreamed special education students as well as with advanced placement students. MVHS CoreModels developed Earth science and environmental science activities because these classes often target students considered less successful in previous science courses. In addition, center directors, who observe all teachers within their region, help teachers develop higher expectations for students in nonacademic classes by suggesting visits to teachers already successfully using activities with similar groups of students.

One reason exemplary science activities are not available to all students is that only a fraction of eligible teachers take the initiative to investigate and apply to summer training programs. Facilitating organizational change through the CoreModels Centers is needed to provide training for additional teachers and learning opportunities for all their students. The group of teachers thus targeted typically teach the non-AP and nonhonors classes so that affecting the practice of these teachers is one step toward contributing to educational excellence for all.

## Organizational Change

One vital component of the MVHS CoreModels project is the role of the teacher in developing activities and evaluating their effectiveness in the classroom. Extending the initial success of MVHS in developing a remote, network-based collaborative learning environment, the CoreModels program supports teachers' ability to change and integrate curriculum and technology through the use of peer mentors.

Capacity building is another important aspect of MVHS CoreModels. The project is deeply committed to the development of leadership among participating teachers; its predecessor, MVHS, was a teacher-developed, teacher-led program. Although the CoreModel program's institutionalization goals call for a leadership team (the project director, three regional center directors, and eight supporting teachers), the participating teachers collaborate with leaders in presenting outreach workshops and in developing materials. This expanding leadership has allowed the project to respond to opportunities to create districtwide and school-based training opportunities as well as to reach out to all teachers, meeting them where they are. Teachers are immersed in a profound form of professional development when they work together to adapt materials for the specific needs of a particular class; when they prepare a presentation for a group of colleagues; or when they think through how modeling can be used to facilitate and assess student learning in a new content or skill area.

## Evidence of Effectiveness

Preliminary results show that learning appeared to have been enhanced by the use of the CoreModels project. Students in one science class using the CoreModels project improved their scores 46 percent on the Force Concept Inventory test, while students in another school, regarded as the best in the county but not using the program, improved by only 27 percent. In addition, a school with all its biology teachers involved in the CoreModels project led its district in the initial results of the state biology exam.