

COMPUTER-BASED CURRICULUM PROFILES

Comprehensive Conceptual Curriculum for Physics (C³P)

Publisher and Developer: University of Dallas, Department of Physics

Grade levels: 9–10

Scientific domain: Physics

Web site: <http://phys.udallas.edu/>

Year profiled: 2002

C³P, developed in 1998, is a structured collection of lesson plans on CD-ROM, developed through a grant from the National Science Foundation. There are two routes for users to take to reach the activities: (1) The user can enter a virtual room containing various devices for accessing physics lessons and activities. Selecting a topic listed on a blackboard, the user can link to numerous learning objectives related to the topic chosen and then to lessons that pursue those objectives. There is also access to alternative activities appropriate to the lessons. (2) Users can access the list of topics from a computer screen in the room. Each topic takes the user to a list of related activities, which, in turn, are linked to the lessons for which the activities are suited. Throughout this process, the program provides a context for the activities, rather than presenting them in isolation or randomly. The virtual room contains a History of Physics Timeline and a “bookshelf” of resources that reflect the thinking of the developers, including background information on the learning objectives, story line, learning cycle, etc.

SCOPE/CONTENT

C³P is a physics curriculum organized around seven main topics: habits of mind, physics for the next generation, kinematics, forces and Newton’s laws, energy, electricity and magnetism, and waves. Under each topic are a number of subtopics. The topic “energy,” for example, includes sections on characteristics of energy, temperature and the first law, internal energy, transfer of energy, conservation of energy, conservation of momentum, collisions, conservation of momentum and relativity, work, and power. Each subtopic contains plans for structuring a teaching and learning context and for implementing related learning activities.

C³P also includes the following features:

- Terminology, which includes over 50 pages of terms with scientific definitions, reworded in everyday language, with related possible misconceptions.
- Learner Outcomes taxonomy.
- Web links.
- Overview of *C³P* in a slide presentation.
- Curriculum alignment with science standards of the states.
- Story Line, which discusses the major ideas behind the design of *C³P*.
- Assessment Items.
- Learning cycles discussion.
- Physics Cartoons and Physics Songs.

FORMAT

The CD-ROM provides a list of topics, subtopics, lessons, and activities for instruction. Each lesson is organized as a learning cycle consisting of three parts: Exploration, Concept Development, and Application. In most cases, the students perform the activity on their own according to the directions provided rather than on the CD. Some activities contain video clips and other forms of non-text media. The activities have been collected from various sources. Schools must provide physics lab equipment, a computer, graphing calculators, and computer-based laboratory equipment.

ASSESSMENT INSTRUMENTS

The program provides assessment materials through links in the Resources section of the CD-ROM. Assessment tools include portfolios, teacher observables, multiple choice, and open-ended essays. The program provides pre- and post-assessment tests that are aligned with the curriculum.

PROFESSIONAL DEVELOPMENT SUPPORT

Teachers must participate in a workshop in order to receive the CD-ROM. The CD-ROM includes a list of master teachers from around the country who are available to provide assistance as needed.

STAND-ALONE VS. SUPPLEMENTAL

The developers of *C³P* consider the program to be a comprehensive curriculum.

Constructing Physics Understanding in a Computer-Supported Learning Environment (CPU)

Publisher: The Learning Team

Developer: Center for Research in Mathematics and Science Education, San Diego State University

Grade levels: 9–12

Scientific domain: Physics

Web sites:

<http://learningteam.org/cpu.htm>

<http://cpuproject.sdsu.edu>

Year profiled: 2002

The *Constructing Physics Understanding in a Computer-Supported Learning Environment (CPU)* project, developed in 1995, is a set of laboratory and computer-based materials, available on CD-ROM, designed to assist students in the learning of physics concepts. The project presents a learning environment that incorporates computer technology and follows an inquiry-based pedagogy throughout its set of curriculum units and associated simulation software.

SCOPE/CONTENT

The *CPU* program comprises seven stand-alone curriculum units on the topics of force and motion, current electricity, static electricity and magnetism, light and color, waves and sound, the nature of matter, and a generic skills unit called “Underpinnings.” Units are divided into learning cycles intended to help students develop ideas that can explain a phenomenon within the topic of the unit. These cycles represent the pedagogical approach of the program. Each is broken down into three phases: elicitation, development, and application. Cycles in the “Underpinnings” unit focus on a particular science-thinking or experimental skill.

FORMAT

CPU consists of the Curriculum Units CD-ROM and a companion set of simulation software CDs. A teacher’s guide for each unit details information about each activity within each cycle, including common student ideas, a list of materials, information about the simulators, and target ideas for each cycle. An introductory software package CD—the “CPU IntroPak”—is also available from the publisher.

Each unit in the *CPU* program is broken into cycles, each of which focuses on a subset of the content in the unit. Guided inquiry activities in each cycle are directed towards a set of Target Ideas. Students identify, develop, and keep track of their thinking in series of activities that involve experimental, hands-on activities and simulations; use of computer simulators to receive model-based feedback; and the recording of predictions, observations, ideas, and explanations. Each idea is developed through a planned sequence and is, ultimately, prompted by a set of questions in Idea Journals, which help students describe and record their evolving ideas as they work through the cycles. The pedagogical structure frequently has students discuss and present their ideas in informal and formal settings to support development of their understanding.

CPU units consist of numerous activities, and each activity includes one or more embedded links to computer simulations and/or microcomputer-based lab (MBL) measurements. Units require student groups of two to four at a computer, where opportunities are provided that are not available in the alternative pencil-and-paper versions. For those classrooms not equipped

with multiple computers, the units can be printed out and simulations displayed on a single demonstration computer with an LCD panel.

The *CPU* simulation software comprises a series of pedagogically designed physics computer programs designed for demonstrations or to complement and extend hands-on laboratory activities. The simulators and MBL activities provide students with discernible quantified phenomena as well as model-based evidence to help them develop new ideas.

ASSESSMENT INSTRUMENTS

The learning activities of the curriculum are designed to bring students' ideas into the open. Teachers have opportunities for formative assessment, and students themselves can evaluate the progress of their ideas as they build new knowledge by recording their evolving explanations in the activity documents or electronic Idea Journals. Also, each phase of the learning cycle presents students with challenges, questions, and multiple opportunities for testing, describing, analyzing, interpreting, and reaching conclusions. Students are stimulated to defend their new ideas by developing explanations of their findings as they work through the activities. Homework assignments and sample tests are provided.

PROFESSIONAL DEVELOPMENT SUPPORT

CPU developers trained a cadre of 24 teams to provide professional development to teachers. These teams, distributed widely across the United States, are available to help teachers and/or districts adopt the *CPU* materials for use in high school physics courses. *CPU* offers training to elementary and secondary teachers. For the secondary school physics and physical science teachers, Implementation Workshops focus on strategies for implementing the *CPU* pedagogy, materials, and software in their classrooms.

STAND-ALONE VS. SUPPLEMENTAL

CPU is designed as a set of stand-alone units associated with simulation software appropriate for secondary classrooms, teacher workshops, and some university courses. *CPU*'s developers claim that the program is closely aligned with the *National Science Education Standards* (NRC) and the *Benchmarks for Science Literacy* (AAAS).

EcoBeakerHS

Publisher: SimBiotic Software

Developer: Eli Meir, BeakerWare

Grade levels: 8–12

Scientific domains: Biology, ecology

Web site: <http://ecobeaker.com>

Year profiled: 2002

EcoBeakerHS, developed in 2001, is a set of 10 labs on CD-ROM with a closely matched student workbook and teacher's guide. The labs are intended for use as part of a regular biology, environment, or ecology course. Each lab is a highly interactive simulation of an investigation in field phenomena. Students must make a number of decisions during the course of each investigation and record their findings.

SCOPE/CONTENT

EcoBeakerHS labs—covering topics in biology, environmental science, and ecology—explore population and community, ecosystems, pollution, evolution, genetics and heredity, diversity, diseases and epidemics, energy flow, and other topics. The labs are case studies in which students change variables to investigate their relationship to the case. Specific labs are listed below:

- Isle Royale: Study of wolves' impact on a moose population in various ecological dimensions.
- Keystone Predator: Study of the impact of predator removal on an intertidal food web.
- The Heterozygote Advantage: Study of the relationship between sickle cell anemia and malaria.
- Lake Sewage: Study of the impact of phosphorus on lake biota and algal bloom.
- Barnacles and Tides: Study of the different distribution of barnacle species in the rocky intertidal zone.
- Genes of the Nene: Study of genetic diversity and inbreeding in the nene bird of Hawaii.
- Cheetah Challenge: Study of the amount of plains area needed to save a cheetah population in Kenya.
- Sick Fish: Study of various strategies to control bacterial disease on a fish farm.
- Oil Spills and Logistical Bacteria: Study of the impact of bacteria in eating up an oil spill.
- Killer Ladybugs: Study of the impact of five ladybug species in the control of wheat-eating aphids.

FORMAT

The program is completely contained on a single CD-ROM that runs on Windows or Mac OS. Each lab consists of a number of exercises, often including large amounts of data that students can manage to affect the simulation. For example, upon entering the Cheetah Challenge, students learn background information on the shrinking plains in Kenya and become aware of the threat to the cheetah population. Students have access to key terms and descriptions of the species, as well as to the procedures for various exercises they will perform within the software. Students can also use the simulation software to pursue questions of their own, while recording their findings in the student workbook. The teacher's guide includes a list of the major concepts, recommended prior knowledge, science standards, and a summary of each lab. It also includes background information for the teacher, objectives, preparatory questions, supplementary student activities, and notes on each exercise, including the answers to the questions.

ASSESSMENT INSTRUMENTS

The teacher's guide contains two assessment instruments for each lab, each at a different level of difficulty. Answer keys are provided.

PROFESSIONAL DEVELOPMENT SUPPORT

In addition to the teacher's guide, the *EcoBeakerHS* Web site also provides information and recommendations on the use of the program. It also lists workshops that are conducted at various locations around the country. The program provides a free workshop to school districts that purchase a districtwide license.

STAND-ALONE VS. SUPPLEMENTAL

The *EcoBeakerHS* labs are considered supplemental, and should be used within an existing biology, environmental science, or ecology course.

The Fluid Earth/The Living Ocean (FELO)

Hawaii Marine Science Studies (HMSS) Project

Publisher and Developer: Curriculum Research and Development Group (CRDG) at the University of Hawaii

Grade levels: 9–12

Scientific domains: Marine physics, chemistry, geology, biology, and ecology

Web site: <http://www.hawaii.edu/crdg>

Year profiled: 2002

The Fluid Earth/The Living Ocean (FELO), developed in 1975, emphasizes the basic concepts of physical science, earth science, and chemistry by investigating the oceans through a central focus on marine environments. It consists of text materials supported by a Web-based database. It offers students the opportunity to learn and explore basic science concepts and skills in their applications to ocean phenomena. In laboratory and field investigations, the program leads students through inquiry methods to interpret phenomena and establish organizing principles.

SCOPE/CONTENT

FELO has two main components:

- *The Fluid Earth: Physical Science and Technology of the Marine Environment* explores the physics, chemistry, and geology of the oceans and their applications in ocean engineering and related technologies.
- *The Living Ocean: Biology and Technology of the Marine Environment* explores the biology and ecology of the oceans and other aquatic environments and their applications in aquaculture and related technologies.

FELO integrates the study of scientific concepts with the study of technologies in oceanography and ocean engineering, and investigates the problems in the global environment to promote awareness of and commitment to the wise use of natural and technological resources. Students learn to abstract from real-world experience to general principles and to identify the interrelationships of marine phenomena by engaging in hands-on study of real, simulated, or modeled environments.

FORMAT

The instructional materials are built around laboratory and field studies and include the following:

- A teacher's guide and student book for each component: *The Fluid Earth: Physical Science and Technology of the Marine Environment* and *The Living Ocean: Biology and Technology of the Marine Environment*.
- A packet of workbook masters.
- A set of ancillary materials on additional resources: a Water Resource Management stand-alone unit; a Descriptive Atlas of the coastal zones of the Pacific; a booklet on Hawaiian coral reef ecology; and a series of additional links to modern technology and the economics, politics, and social implications of managing resources in a marine environment.
- Booklets on correlation with the *National Science Education Standards* (NRC) and the *Benchmarks for Science Literacy* (AAAS) for each component.
- A Web-based database enhancement called SWIM (www.hawaii.edu/swim), containing pages and links to outside sites that relate to the topics covered in the books.

ASSESSMENT INSTRUMENTS

FELO units include questions at the end of each lesson along with options for further investigations to extend the activities. The teacher's guide includes suggested answers for the teacher. Also, there are charts and tables for students to fill out based on information given in the lesson and findings from the labs. The SWIM database provides information referenced in the student questions and/or the Further Investigation sections.

PROFESSIONAL DEVELOPMENT SUPPORT

The program recommends and offers a 10-day institute that covers both *FELO* components. Institutes are arranged on request anywhere in the United States, usually during the summer. University credits are available.

STAND-ALONE VS. SUPPLEMENTAL

FELO was designed to form a one-year multidisciplinary science course in a marine context for students in grades 9–12. The program is presented as an alternative to general science courses and recommends using each book either for a one-semester or one-year course—*The Fluid Earth* in the physical sciences and *The Living Ocean* in the biological sciences. Each component is an independent module; they may be taught in either order. Topics within each unit are sequenced, and the program requires that work in each unit begin with the first topic.

Geoscience Education Through Interactive Technology (GETIT)

Publisher: The Learning Team
Developer: Cambrian Systems, Inc.
Grade levels: 6–12
Scientific domain: Earth science
Web sites:
<http://learningteam.org/getit.htm>
<http://www.cambriansystems.com>
Year profiled: 2002

GETIT, developed in 2000, is a CD-ROM comprising 63 interactive activities for the study of earth science. The activities often include simulations, charting, graphing, and data collected by scientific organization. Activities are organized within six major content areas, listed in the *GETIT* Activity Matrix, available through the developer's Web site. The collection of activities is a resource for teachers who may be constructing a course. The product was developed in collaboration with the Geological Society of America and with funding from the National Science Foundation.

SCOPE/CONTENT

The CD-ROM is a collection of interactive tutorial and investigative activities covering the following topics: geology, hurricanes, seismology (earthquakes), plate tectonics, volcanoes, and rock melting. Teachers and students can access the activities through a conventional list or by moving through the corridors and rooms of a simulated earth science museum. The activities are located within exhibits and research lab stations throughout the museum. For example, the hurricane section of the museum houses an activity related to temperature and heat.

FORMAT

The program is available on CD-ROM with an accompanying teacher's guide. Students take notes directly on the CD-ROM, and teachers can access the Teacher's Administrative Tool to keep a roster of students and record information about each student's progress.

ASSESSMENT INSTRUMENTS

This program does not include a formal assessment instrument. However, students can keep their own notes on the CD's software. This feature provides a form of student work that teachers can access for review by way of a Teacher's Administrative Tool, which is built into the software. The teacher can also read students' replies to questions asked as part of some activities. From these, the teacher can assess the students' understanding of the activities.

PROFESSIONAL DEVELOPMENT SUPPORT

A teacher's guide that explains how to use the program accompanies the CD-ROM. No further professional development is provided.

STAND-ALONE VS. SUPPLEMENTAL

GETIT requires that the teacher provide a coherent earth science curriculum framework that can integrate the numerous *GETIT* activities as a supplement.

Global Learning and Observations to Benefit the Environment (GLOBE)

Publisher: U.S. government

Developer: GLOBE (a partnership between NASA, NSF, EPA, the State Department, and various universities)

Grade levels: K–12

Scientific domain: Environmental science

Web site: <http://www.globe.gov>

Year profiled: 2002

GLOBE, developed in 1995, is a Web-based international environmental science and education program. Teachers are trained in methods of collecting field data that are designed to be compatible with inquiry and cooperative learning models. Elementary and secondary students investigate their local environment with a series of learning experiences and enter the data on the *GLOBE* Web site. Scientists and other students use this data to further their understanding of these areas.

SCOPE/CONTENT

The *GLOBE* curriculum gives students a chance to make measurements and interpret data as part of their investigations into a variety of environmental science concepts. Students make observations; collect, organize, and evaluate data; and communicate their findings.

FORMAT

GLOBE is divided into six investigation areas: Atmosphere, Hydrology, Soil, Land cover, Global positioning systems (GPS), and Earth systems. Each investigation contains a variety of learning activities developed at TERC and SRI International. Students collect data through these activities and are able to share their findings with others on the *GLOBE* Web site. Protocols are available for each investigation on the Web site in PDF format and downloadable video.

ASSESSMENT INSTRUMENTS

The assessment instruments were developed independently by SRI International and are accessible through the *GLOBE* Web site. They address the *Benchmarks for Science Literacy* (AAAS), the *National Science Education Standards* (NRC), the *TIMSS Study* (International Study Center at Boston College), and *The New Standards* (National Center on Education and the Economy). The assessment instruments provide tools for aligning the *GLOBE* curriculum within a state or district and provide templates, rubrics, and guided examples as tools for the teacher.

PROFESSIONAL DEVELOPMENT SUPPORT

For a school to participate in *GLOBE*, at least one teacher must be trained in the *GLOBE* measurement workshops. Workshop dates are listed on the Web site and take place throughout the country year-round. Scientists and developers are available through a virtual “help desk.” All participants have access to teacher guides and professional development videos and can take part in an online discussion forum for teachers.

STAND-ALONE VS. SUPPLEMENTAL

GLOBE contains a fairly comprehensive curriculum in ecological measurement for high school-level environmental science. Depending on the level of the class, the teacher will need to provide varying degrees of background materials.

Hands-On Physics

Publisher and Developer: Concord Consortium

Grade levels: 9–12

Scientific domain: Physics

Web site: <http://hop.concord.org>

Year profiled: 2002

Hands-On Physics, developed in 1995, is a series of six project-based modules developed with funding from the National Science Foundation and disseminated through Concord Consortium's Web site. It is designed primarily to meet the needs of students entering advanced technical careers, but also describes itself as an alternative to standard high school or college physics courses. The modules' projects require equipment and materials that can be purchased at an electronic supply or hardware store or through kits from Kelvin Electronics (<http://www.kelvin.com>).

SCOPE/CONTENT

Each of the six units is approached through a project, with concepts developed as the students proceed through the unit. The electronics unit is designed to be an introduction, but implementation of other units is at the teacher's discretion. The available modules are listed below:

- Security System: an electronics module, addressing concepts that include electronic components, circuits, voltage, and current.
- Aircart: a mechanics module, with concepts that include energy, speed, and acceleration.
- Synthesizer: a sound module, with concepts that include properties related to human perception of sound and properties of sound waves.
- Incubator: a heat and temperature module, with concepts that include heat, temperature, flow, and mathematical representation.
- Bungee Escape: an advanced mechanics module, with concepts that include models and data, math modeling, free fall, electrical components, capacitors, and mathematics of the timer.
- Sun Photometer: a light and optics module, with concepts that include sun's angle, calibration, and photometer data.

FORMAT

Each of the six modules has five sections:

1. Information.
 - Unit Overview.
 - Notes for Teachers.
 - Index.
2. Concepts to be explored in the module.
 - Some modules include a glossary with formulas.
3. Messing Around (a relatively open-ended pursuit of a challenge).
 - Background: Things to think about while "messing around."
 - Questions: Challenge questions that the Messing Around research activities are designed to answer.
 - Tools: List and description of tools needed for the activities.

- Materials: List, description, and suggestions for use of materials needed for the activities.
 - Activities: Hands-on activities that investigate various aspects of the module’s concepts.
 - Reporting: Suggestions for collecting, synthesizing, and reporting the work done in the activities.
4. Core Project: a whole-class challenge to carry out a project applying ideas developed in Messing Around
 5. Extensions: elective projects for individual students related to the concepts of the module

ASSESSMENT INSTRUMENTS

The only assessment available is the guidance that the curriculum provides for students to report about each project. The extensions can serve as assessments in some cases.

PROFESSIONAL DEVELOPMENT SUPPORT

The last time such support was scheduled was in 2000. The contact for further information is habbott@mail.stcc.mass.edu.

STAND-ALONE VS. SUPPLEMENTAL

The *Hands-On Physics* curriculum modules can be used in conjunction with a complete physics curriculum. As supplements, they can still be a substantial component of a physics program.

Hands-On Universe

Publisher: Lawrence Hall of Science

Developer: Lawrence Hall of Science, TERC, Adler Planetarium, and Yerkes Observatory

Grade levels: 9–12

Scientific domains: Astronomy, physics, earth science

Web site:

<http://www.handsonuniverse.org>

Year profiled: 2002

Hands-On Universe (HOU), developed in 1999, is a high school-level curriculum that enables students to use high-quality astronomical images to explore science, math, and technology concepts, specifically the solar system, galaxies, variable stars, and supernovae. The program uses print materials, CD-ROM, and Internet. Students request their own observations from professional observatories and download telescope images to their classroom computers. They also use image-processing software to visualize and analyze their data. Students master problem-solving techniques and critical-thinking skills throughout the investigations.

SCOPE/CONTENT

The *HOU* program is presented through seven theme-based booklets, each on a different astronomical technique:

- Introduction to Image Processing
- Finding Features
- Supernovae Search
- Measuring Size
- Measuring Brightness
- Measuring Distance
- Measuring Color

Each theme contains discussion sheets, curriculum units, and supplementary activities. The discussion sheets provide explanations of new concepts and equations; the units introduce basic techniques for the software and images (including investigations and challenges); and the supplementary activities include enhancement, enrichment, and alternative activities.

FORMAT

The program includes the seven theme booklets, a CD-ROM, and special image-processing software. Teacher Notes are provided with each theme, and image lists and materials lists are included to help with preparation. Images for each theme booklet are available after the software from the CD is installed. Teachers should make sure the computer is ready to go before the start of class.

ASSESSMENT INSTRUMENTS

Various activities for follow-up and skills assessment are suggested throughout the theme booklets. Some apply to specific units or activities, while others examine overall understanding of the theme itself. A checklist of skills and concepts is also included to assist the teacher in evaluating student progress.

PROFESSIONAL DEVELOPMENT SUPPORT

The *HOU* program offers a number of professional development opportunities for the teacher, including a five-day training program and a one-day teacher workshop.

STAND-ALONE VS. SUPPLEMENTAL

The curriculum can be used as a core astronomy course or as 8- to 12-week modules to supplement a physics, earth science, or physical science program.

Investigating Life in the Universe: An Integrated Science Approach

The Astrobiology Curriculum

Publisher and Developer: TERC

Grade level: 9

Scientific domains: Chemistry, biology, physics, earth and space science

Web site: <http://astrobio.terc.edu>

Year profiled: 2002

TERC and NASA developed *Investigating Life in the Universe (ILU)* (also known as *The Astrobiology Curriculum*) in 2002 as an interdisciplinary high school course with a mix of print and Internet resources. Through a series of inquiry-based activities, students explore diverse concepts in chemistry, physics, biology, earth and space science, and engineering. The curriculum is a sequenced, year-long course composed of six units. Students develop research skills including modeling, setting up experiments, testing hypotheses, making systematic field observations, and doing image and data analysis. Research assignments, such as long-term investigatory projects that are done in conjunction with each unit of the course, enable students to be active participants in the science of astrobiology.

SCOPE/CONTENT

The Astrobiology Curriculum emphasizes five different learning goals for the student:

- To understand key ideas of astrobiology.
- To learn and apply concepts in chemistry, physics, biology, engineering, and earth and space science.
- To develop scientific thinking and problem-solving skills through lab experiments, fieldwork, modeling, and image and data interpretation.
- To develop research skills through inquiry-based projects.
- To develop technical skills.

Content covered includes the processes that have led to the formation of matter, stars, galaxies, planets, and other astronomical objects; the nature of life and its prospects in the universe, including the solar system and “extraterrestrial” conditions; why there is life on Earth and not on the moon through examination of the roles of atmosphere, temperature, water, energy, and chemical building blocks; and methods and techniques used to search for potential life in other worlds. Students also research and explore a topic of their choice.

FORMAT

The curriculum is designed around six units, covering a total of 18 chapters of material. The curriculum is presented as a continuous story, from the opening questions to the final conclusions. Each chapter begins with introductory sections—Setting the Stage, a Challenge, and What Do You Know?—and comprises four to six activities. The activities consist of the Purpose, an Overview, the Context, Key Concepts Covered, Key Skills Developed, and Materials Needed. Think About It and Checking In sections ask students questions to help make sure they are on the right track. Students use different technologies in each activity, including telecommunications, modeling, image and data interpretation, and the use of WebQuests. WebQuests enable student teams to practice the procedures and problem-solving techniques modeled by scientist research groups.

ASSESSMENT INSTRUMENTS

Assessments include embedded pre- and post-assessments (concept maps, performance-based student research projects, and posters) and What Do You Know? and Think About It questions in each chapter.

PROFESSIONAL DEVELOPMENT SUPPORT

Information is not available.

STAND-ALONE VS. SUPPLEMENTAL

This program is designed primarily as a core interdisciplinary program for use in grade 9.

Looking at the Environment (LATE)

Publisher and Developer: The WorldWatcher Project at Northwestern University

Grade levels: 9–12

Scientific domains: Environmental and earth science, geography, and technology

Web site:
<http://www.worldwatcher.nwu.edu/curriculum.htm>

Year profiled: 2002

Looking at the Environment (LATE), still in development, is a high school course with a geographic perspective on environmental science. The *LATE* curriculum employs geographic visualization and data analysis tools to support its inquiry-based pedagogy. Lessons and software are provided through the Internet. Its design intends to integrate technology with hands-on activities, group work, and discussions to help students understand scientific and social issues associated with changes in the environment.

SCOPE/CONTENT

LATE is designed as a research-based environmental science curriculum with a focus on technology and scientific visualization. The curriculum consists of four units centered on three issues: the relationship between population growth and resource availability, electricity generation and meeting the demand for energy, and water resources management for agricultural use and human consumption. The first three units focus on each of these subject areas, respectively. The fourth unit includes activities that are interwoven with the other three units over the year and allows students to apply their learning to study and investigate local, regional, and global environmental issues. These applications include understanding local ecosystems, collecting and analyzing data on basic physical properties, analyzing the environmental impacts of human activities, identifying the potential threats to the environment, and making recommendations based on an evaluation of alternatives.

The activities were designed to engage students in investigations of realistic environmental problems and to introduce them to a variety of research techniques and computer tools for the visualization and analysis of geographic data.

FORMAT

LATE is fully downloadable off of the World Wide Web. Its four units are available as PDF documents. The WorldWatcher Project's Web site includes descriptive sites for each component of the program, including the curriculum units; software description and directions for downloading; curriculum scope and sequence; and the program's correlation with the *National Science Education Standards* (NRC), *Benchmarks for Science Literacy* (AAAS), *National Educational Technology Standards* (International Society for Technology in Education), and *National Geography Standards* (National Council for Geographic Education).

Along with the units, *LATE* includes a set of computer tools: WorldWatcher, a visualization and analysis tool; My World, a geographic information system (GIS) tool; and ArcView, a commercial GIS.

ASSESSMENT INSTRUMENTS

The curriculum includes unit-embedded assessments. Teachers are able to track student progress on curriculum objectives, which, according to the developers, are aligned to the *National Science Education Standards*.

PROFESSIONAL DEVELOPMENT SUPPORT

The WorldWatcher Project is in the process of field-testing the *LATE* curriculum. Teachers implementing *LATE* receive materials, technology, and professional development. Field-test teachers receive a set of classroom materials and have the opportunity to collaborate with peers around the country, work closely with the development team at Northwestern University, and earn graduate credit (CPdUs).

STAND-ALONE VS. SUPPLEMENTAL

LATE is designed as a year-long stand-alone environmental science course.

Modeling Instruction in High School Physics

Publisher and Developer: Arizona State University

Grade levels: 9–12

Scientific domains: Physics

Web site: <http://modeling.asu.edu>

Year profiled: 2002

Modeling Instruction in High School Physics has been under development at Arizona State University for more than a decade under the leadership of David Hestenes, Professor of Physics. The program cultivates physics teachers as users of technology in science teaching, and infusion of technology into the classroom is a key component of this program. It also focuses on pedagogical reform by aligning with the national standards and by offering the Modeling Method as an alternative to the traditional lecture-demonstration method. The Modeling Method pursues course coherence by organizing the course around a small number of scientific models. All curriculum materials are available free from the project Web site, and hands-on materials are available through various providers. In 2001, the U.S. Department of Education recognized *Modeling* as one of two exemplary programs in K–12 education.

SCOPE/CONTENT

The curriculum materials provided by the *Modeling Instruction in High School Physics* program consist of units in physics (with developmental materials in physical science and chemistry) to be used at the teacher's discretion. The program sees the first part of the course (slightly longer than one semester) consisting of nine units focusing on issues around mechanics, with the rest of the course drawn from such units as "Models of Light," "Waves and Sound," and "Electricity and Magnetism."

Currently, the units for Mechanics are:

- Scientific Thinking in Experimental Settings
- Particle Moving with Constant Velocity
- Uniformly Accelerating Particle Model
- Free Particle Model: Inertia and Interactions
- Constant Force Particle Model
- Particle Models in Two Dimensions
- Energy
- Central Force Particle Model
- Impulsive Force Particle Model

FORMAT

The Web site offers free to workshop participants fully downloadable units and lessons that represent the approach of the program. The teaching materials include timelines, criteria for student presentations, lab report forms, and score sheets. For each unit, the program includes the instructional goals and overview, lab notes, instructional comments, description of student materials, deployment exercises in which the students apply their models to new situations, and tests and quizzes. Students experience a physical phenomenon, develop an explanation for it, then present and defend their conclusions. The schools must provide the requisite computer-based technology.

ASSESSMENT INSTRUMENTS

These are available on the Web site.

PROFESSIONAL DEVELOPMENT SUPPORT

The *Modeling Instruction in High School Physics* program is primarily dependent on the summer workshops conducted by Arizona State University and other universities. Workshop dates and locations are listed on the Web site. Workshops have a variety of formats—from a one-week introductory workshop to a four-week intensive workshop—but all are based on making models and modeling the central theme of the course.

STAND-ALONE VS. SUPPLEMENTAL

The curriculum materials provided are designed to be used in place of existing high school physics curricula, but can be modified by teachers as they see fit.

Science in a Technical World

Publisher: W.H. Freeman and Company

Developer: American Chemical Society

Grade levels: 9–12

Scientific domains: Interdisciplinary chemistry, biology, and earth science

Web sites: <http://www.whfreeman.com>
www.chemistry.org/education

Year profiled: 2002

Science in a Technical World, developed in 2000, consists of 12 units, each consisting of a separate student book, video, and CD-ROM. Each unit focuses on an industry that applies chemical, biological, or earth science principals in its work. The curriculum integrates science concepts and technological applications. The industrial connections also permit consideration of the nature of technology itself. The program was developed by the American Chemical Society with funding from the National Science Foundation.

SCOPE/CONTENT

Teachers (or districts) can choose the program units they want to teach and the order in which they teach them. In each unit, students try to find a solution to a realistic science- or technology-related problem in the spotlighted industry. The problem is presented in the unit's student book, with student support for solving the problem available on the video and CD-ROM.

Unit titles are listed below, along with their science focus and a brief description of each unit's primary investigation:

- Carbonated Beverages (chemistry): What might cause a can of carbonated soft drink to have an unusual (off-specifications) taste?
- The Plant Tissue Culture Industry (biology): How can a tissue-culture laboratory increase its yield of healthy sugarcane plantlets?
- Polymer Research and Development (chemistry and biology): How can a research and development technician acquire the skills needed to identify different polymers?
- Pulp and Paper Research and Development (chemistry): How is paper made and tested for its properties?
- Upgrading the Wastewater Plant (chemistry and biology): What new skills must wastewater treatment technicians learn when their plant undergoes an upgrade?
- Paint Research and Development (chemistry): How is a new paint developed and tested?
- Food Safety (biology and chemistry): How can technicians assist dairies in keeping the milk supply free of antibiotic contamination?
- Refining Petroleum (chemistry and earth science): How can the tests required on a sample of crude oil be performed in a logical, consistent, safe, and reliable manner?
- Discovering New Medicinal Drugs (chemistry and biology): What information do trainee technicians in the drug discovery process need to understand?
- Medicinal Laboratory Technology (biology): How can clinical laboratory technicians organize their work to best assist physicians in a large hospital?

- Forensic Science (biology and chemistry): How can forensic tests on physical evidence help to solve a crime?
- Making Semiconductors (physics and chemistry): How can training increase skills, knowledge, and teamwork to allow technician teams to build a small robot?

FORMAT

Each unit of the *Science in a Technical World* program includes a student book, a video, and a CD-ROM.

- The student book contains a challenge or problem associated with the unit's industrial theme. It identifies the concepts, information, processes, and skills students need to solve the unit's problem. It also provides information and a sequence of laboratory experiences designed to promote understanding of the issues related to the problem. Students can present their findings and offer solutions to the unit problem using the format included.
- The video (15–20 minutes) shows the processes and perspectives of the workers in the featured industry, as well as applications of science content.
- The CD-ROM comprises five sections of visuals and audio, with information and assessment that students can navigate in any order. For example, the "Polymer Research and Development" CD includes (1) an introduction to the unit, (2) five questions and answers about polymers with word-links to a glossary and encyclopedia, (3) illustrations of the tasks performed by four different technicians in the industry, (4) practice exercises and quizzes, and (5) an assessment.

There are two complete teacher's editions with wraparound Teacher's Notes, each covering the content in 6 of the 12 student books.

ASSESSMENT INSTRUMENTS

Science in a Technical World includes formative and summative assessments. Student books contain several prompts for students to reflect on their work. For summative purposes, students present their solutions to the unit problems for feedback from teacher and peers. The CD-ROM also includes questions that assess students' knowledge.

PROFESSIONAL DEVELOPMENT SUPPORT

The American Chemical Society sponsors workshops throughout the United States for teachers interested in *Science in a Technical World*. These workshops incorporate technology and hands-on activities and vary in length from one hour to three days.

STAND-ALONE VS. SUPPLEMENTAL

The publisher offers the units either as the primary material for a Tech Prep course or as a supplement to a standard basal chemistry, biology, earth science, or physics textbook.

