Reflective Teaching of Science

New technologies continue to supplement and enhance the learning process. These technologies can support new views of science teaching. For example, a high school biology course characterized by “model-based reasoning” emphasizes both the development of conceptual and strategic knowledge of classical genetics, as well as the development of insights regarding science as an intellectual activity. This nine-week course for seniors involved model revising problem solving in contrast with more common model using problem solving. In the model-revising approach, students work in research groups sharing their observations of phenomena, building models, and defending their models to groups of students who critique each other’s models. The critiques lead to model revising. The emergence of competing models increases student awareness of the need for models to explain existing data and predict additional observations. Students also get increased awareness that more than one model may be consistent with the data, and may predict and explain. The computer played an important role in the development of this course. Use of computers was guided by the perspective of students performing authentic activities like real scientists, including problem posing, probing deeply into a problem, solving problems, and communicating with others about the findings and conclusions. Software supplemented work with real organisms, and enabled students to learn genetics by engaging in activities like those of geneticists (Hartman, 2010).

http://www.nsta.org/

The National Science Teachers Association (NSTA), founded in 1944 and headquartered in Arlington, Virginia, is the largest organization in the world committed to promoting excellence and innovation in science teaching and learning for all. NSTA’s current membership of 60,000 includes science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in and committed to science education.

http://www.project2061.org/

Project 2061 (Science Education Reform)

http://www.nextgenscience.org/

Next Generation Science Standards (NGSS)

http://www.nap.edu/catalog.php?record_id=13165#

Framework for K-12 Science Education (Guiding Document for the Construction of the NGSS)

http://projectwet.org/

Project WET

http://www.projectwild.org/

Project WILD

http://www.plt.org/

Project Learning Tree (forestry)

http://quarknet.fnal.gov/

QuarkNet (particle physics)
List of Official Position Papers of the National Science Teachers Association

Home page of the Lawrence Hall of Science at the University of California at Berkeley.

goENC.com is a subscription service affiliated with the discontinued Eisenhower National Clearinghouse for Math and Science that provides resources related to math and science teaching.

Extensive list of links to other math-and-science-related sites.

Home page of the "Excelling in Math and Science."

Angela Calabrase Barton, a Michigan State University professor, studies science education. Her books include *Teaching Science for Social Justice* (New York: Teachers College Press, 2003), which was written with Jason L. Ermer, Tanahia L. Burkett, and Margery D. Osborne and reports on six years of research on after-school science programs situated in an urban context.

Bryan Brown is a professor at Stanford University. He studies science teaching, science literacy, and discourse in science classrooms. His "content-first approach" to teaching science allows students to access high-level science content through their everyday language before teaching the difficult jargon of science classrooms.

Lawrence Hall of Science at the University of California—Berkeley offers a collection of hands-on science activities and materials for preschool through high school that emphasize the “learning-by-doing” approach pioneered at the Hall. FOSS is an elementary-school science program with 27 modules that incorporates hands-on inquiry and interdisciplinary projects, building on recent advances in the understanding of how children think and learn.

The Exploratorium is a museum in San Francisco, California, and its website has many resources for teachers of all grade levels. Science videos, activities, links to other science websites, and recommendations for science teaching books are just a few of the many resources made available online.

The National Science Education Standards (NSES) are guidelines for K-12 science education in United States schools. They were established by the National Research Council in 1996 to provide a set of goals for teachers.
to set for their students and for administrators to provide professional development. The NSES have
significantly influenced various states' own science learning standards and state-wide standardized testing.

The InTime website http://www.intime.uni.edu/ has outstanding middle and high school lessons for
using a variety of technologies in science teaching. These include middle school lessons such as:

1. Aviation: includes use of a flight simulator, digital camera, computer, and projector;
2. The solar system: involves doing a WebQuest, and making PowerPoint slides;
3. Exercise that involves use of Polar Pacer Heart Rate Monitor, Polar Vantage XL Heart Rate
   Monitor;

InTime also includes high school science lessons such as

1. The ocean, which involves use of HyperStudio;
2. Biology lesson that involves use of the QX3 Computer Microscope;
3. Physics lesson on Newton’s second law that includes use of Photogates, ULI interface, and a
   computer.

The Comprehensive, Conceptual Curriculum for Physics (C3P) http://phys.udallas.edu/C3P/C3PBrochureDescription.pdf also has useful resources at its Web site, including their Learning Cycle-based course topics and materials. Hot links at the C3P Web site provide
more detailed information on these topics and subtopics. The whole project is available on a CD-ROM,
which includes curriculum materials and resources.

Other technology-based resources for learning science include online homework helpers and tutorials
in physics such as http://www.physics247.com/, “Physics Homework Help from Experts.” For assistance
with chemistry, “The Science Page” (http://sciencepage.org/chem.htm) offers a variety of on-line
resources for both teachers and students.

Free, online science resources for teachers, sponsored by the National Science Teachers Association,
are available at http://science.nsta.org/enewsletter/2007-06/news_stories_high.htm. This site includes
links to a variety of projects, such as “Urban Bird Studies,” “Court TV” for forensic science, and “Project
Oceanography.”

The graphic organizer software, Inspiration, has science-specific templates that are easily modifyable for
use by teachers and students. They are:

1. Concept maps
2. Lab reports
3. Scientific method
4. Simple cycles

A three-day free trial version is available at the Inspiration Software Web site.

Representative Studies on Reflective Teaching and Science
Agnello, M. F., & Carpenter, P. (2010). Integrating geospatial technologies, action research, and
curriculum theory to promote ecological literacy. Multicultural Education & Technology journal, 4(3),
188–197. doi: 10.1108/175049710110/5183

teacher’s professional development through action research. Science Education, 86,
417–435.

Capobianco, B. M., Lincoln, S., Canuel-Browne, D., & Trimarchi, R. (2006). Examining the experiences of
three generations of teacher researchers through collaborative science teacher inquiry. Teacher Education

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Resources in Technology and Science


