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The "National Science Education Standards" (NSES), developed by the National Research Council (NRC, 1996), provide educators in the United States with a broad

framework for developing science programs. Within that framework, the Earth and Space Science guidelines frequently refer to 'the earth system' as well as individual components within the system, such as plate tectonics, the water cycle, and the carbon cycle. For example, the Standards refer to the "structure of the earth system", "energy in the earth system", and the "origin and evolution of the earth system". According to the Standards, "the idea of systems provides a framework in which students can investigate the four major interacting components of the earth system-geosphere (crust, mantle, and core), hydrosphere (water), atmosphere (air), and the biosphere (the realm of all living things)" (NRC, 1996, pp. 158-159). In short, the "Standards" promote study of the Earth as a totality, as something more than a collection of parts to be studied in isolation.

The concept of "earth system" appears in other science education reform documents as well. The "Benchmarks for Science Literacy" (American Association for the Advancement of Science, 1993) also emphasized systems as one of the themes common to all the sciences. According to Mayer (1995, p.385), the Benchmarks can be "an important tool for earth systems educators as they locate more specific information for the construction of curricular models for their particular school districts. Also, Biological Science Curriculum Study (2000) indicated that "Earth systems" is used as a major theme of integrated science in many states. For instance, in the Utah science core curriculum, integrated science at grade nine focuses on the theme of "Earth systems" and the Ogden City School District integrates the Earth, physical, space, and life sciences around the theme with this being one of the primary goals: "Students will develop an understanding of interactions and interdependence within and between Earth systems and changes in Earth systems over time" (pp. 105-106).

EARTH SYSTEMS SCIENCE

During the last several decades there have been many advances in our understanding of planet Earth, its processes, and interactions among subsystems. Through our economic and technological activity, people as a part of the Earth system have also contributed to significant global changes in the system. These developments led the Earth System Sciences Committee (ESSC) to identify three reasons for adopting an Earth Systems Science (ESS) approach to science teaching: Science for practical benefits, global change, and the Earth as a planet (ESSC, 1988). So, what is Earth Systems Science? "ESS takes the main components of planet Earth-the atmosphere, oceans, freshwater, rocks, soils, and biosphere-and seeks to understand major patterns and processes in their dynamics. To do this we need to study not only the processes that go on within each component, but also interactions between these components. It is the need to study and understand these between-component interactions that defines ESS as a discipline in its own right" (Lawton, 2001, p. 1965).
Johnson, Ruzek, and Kalb (1997) stated that, "the Earth systems science concept fosters synthesis and the development of a holistic model in which disciplinary process and action lead to synergistic interdisciplinary relevance" (p. 688). The concept of the

Earth as a system has led to the development of an integrated science program, Earth Systems Education.

EARTH SYSTEMS EDUCATION

Earth Systems Education (ESE) has been described as a major effort to restructure school science education in the United States since the early 1990s (Mayer, Armstrong, Barrow, Brown, Crowder, Fortner, Graham, Hoyt, Humphris, Jax, Shay, & Shropshire, 1992). ESE is a grassroots movement supported by scientists, science educators, and strong theoretical bases. ESE can be defined as a wide-scale science education program which studies the planet Earth as a system of many interacting subsystems and focuses on the changes and evolution within and between subsystems of water (hydrosphere), land (lithosphere), air (atmosphere), ice (cryosphere), and life (biosphere). One of the important features of ESE for science curriculum restructuring is an emphasis on the use of Earth and Earth's subsystems as the context for the content to be covered (Mayer, 1993).
Fortner (1999) indicated that the relevant ESE components are derived from the traditional sciences: ESE primarily focuses on biology and Earth science, then adds physical sciences (Physics and Chemistry) as they relate to the Earth systems. In addition to those sciences, ESE includes some ideas and content from environmental education. Environmental issues and interrelationships provide excellent examples of systems interaction, and demonstrate the need to treat earth components as pieces of an integrated whole. Issue consideration is also justification for learning science as part of the real world that surrounds and affects students (Fortner, 1991, 1995). Attention to topics such as environmental stewardship and Earth appreciation distinguishes ESE from major previous science curricula.

SELECTED MATERIALS RELATED TO EARTH SYSTEMS EDUCATION

* Activities for the Changing Earth System (ACES)

This book includes 20 activities for middle and high school students, using an integrated earth systems approach to teach concepts in Earth, Biological and Environmental Sciences (Mayer, Fortner, & Murphy, 1993).

* Great Lakes Instructional Materials for the Changing Earth System (GLIMCES)

This book of activities provides a packet of scientific scenarios of how global warming could affect the Great Lakes region, a review of climate models, and methods of

teaching about those changes in secondary science and social studies classes (Fortner, Miller, & Sheaffer, 1995).

* A Set of Earth Systems Education Activities for Great Lakes Schools (ES-EAGLS):

1. Land & Water Interactions in the Great Lakes

2. Great Lakes Climate & Water Movement,

3. Great Lakes Shipping

4. Life in the Great Lakes

5. Great Lakes Environmental Issues

These books are designed to take a concept or idea from the existing school curriculum and develop it in a Great Lakes context, using teaching approaches and materials appropriate for students in middle and high school. The activities are characterized by subject matter compatibility with existing curriculum topics, including basic principles of lake effect, climate/water relationships, storm surges, and their relationship to the Great Lakes region.

* Science is a Study of Earth: A Resource Guide for Earth Systems Education

Provides a background in Earth Systems Education. The sections focus on a variety of themes that including: background articles, current national climate of science education, implementation strategies, assessment, sources of materials, and sample activities (Mayer & Fortner, 1995).

EARTH SYSTEMS EDUCATION ON THE WEB

* EarthComm

http://www.agiweb.org/earthcomm/ An Earth Science curriculum developed by the American Geological Institute (AGI) and supported by the National Science Foundation and donors of the American Geological Institute Foundation. EarthComm focuses attention on the national deficiency in high school Earth Science education (grades 9-12) and on development of a complete high-school Earth Science curriculum. The EarthComm vision is the teaching, learning, and practice of Earth science by all students in all U.S. high schools. This website contains resources for teachers, students and parents as well as information on the development of the curricula.

* Earth Systems Education (ESE)

http://earthsys.ag.ohio-state.edu/

The official website of Earth Systems Education Program at The Oho State University.

* TeachEarth.Com

http://teachearth.com/

This site provides resources and programs for teaching and learning about Earth system science

* Digital Library for Earth System Education (DLESE)

http://www.dlese.org/

Constructed cooperatively by the Earth System education community with the assistance of interested groups in information technology and library science. This site serves as an information system for the collection, enhancement, and distribution of

materials that facilitate learning about the Earth system at all educational levels.

* Earth System Science Education Alliance (ESSEA)

http://www.cet.edu/essea/

State-of-the-art, online courses to promote understanding of Earth Systems Science, to encourage communication and cooperation among teachers, and to facilitate the use of exceptional classroom materials.

* Earth System Science Online (ESSO)

http://www.usra.edu/esse/essonline/

Useful information about Earth System Science education and research resources at the undergraduate level, including primary research findings and data that related to the Earth as a system.

* Galileo Education

http://www.jpl.nasa.gov/galileo/education.html

Materials aimed at K-12 teachers and students for NASA's mission to study Jupiter and its moons.

* Destination: Earth

http://www.earth.nasa.gov/

An official website for NASA's Earth Science Enterprise.

REFERENCES

American Association for the Advancement of Science. (1993). "Benchmarks for science literacy." New York: Oxford University Press.
Biological Science Curriculum Study. (2000). "Making sense of integrated science: A guide for high schools." Colorado Springs, CO: Author.

Earth System Sciences Committee. (1988). "Earth system science: A closer view." Washington, DC: National Aeronautics and Space Administration.

Fortner, R. W. (1991). Back to the Earth for science education. "Science Activities," 28 (1), 6-7.

Fortner, R.W. (1995). Earth system changes: Using environmental data for science teaching. "International Journal of Geographical and Environmental Education," 4 (1), 107-115.

Fortner, R. W. (1999). Earth systems education: An introduction to the interdisciplinary science, examples of implementation, and implications [Course presentation]. Columbus, OH: Author.

Fortner, R. W., Miller, H., & Sheaffer, A. (1995). "Great Lakes instructional materials for the changing earth system." Columbus, OH: The Ohio State University.

Johnson, D. R., Ruzek, M., & Kalb, M. (1997). "What is Earth system science?" Paper presented at the 1997 International Geoscience and Remote Sensing Symposium, Singapore.

Lawton, J. (2001). Editorial: Earth system science. "Science," 292, 1965.

Mayer, V. J. (1993). "Earth systems education" (ERIC Digest EDO-SE-93-2). Columbus, OH: ERIC Clearinghouse for Science, Mathematics, and Environmental Education. [Available online at: http://www.ericse.org/digests/dse93-2.html]

Mayer, V. J. (1995). Using the Earth system for integrating the science curriculum. "Science Education," 79 (4), 375-391.

Mayer, V. J., Armstrong, R. E., Barrow, L. H., Brown, S. M., Crowder, J. N., Fortner, R. W., Graham, M., Hoyt, W. H., Humphris, S. E., Jax, D. W., Shay, E. L., & Shropshire, K. L. (1992). The role of planet Earth in the new science curriculum. "Journal of Geological Education, 40," 66-72.

Mayer, V. J., & Fortner, R. W. (Eds.). (1995). "Science is a study of Earth: A resource

guide for science curriculum restructure." Columbus, OH: The Ohio State University.

Mayer, V. J., Fortner, R. W., & Murphy, T. (1993). "Activities for the changing Earth system." Columbus, OH: The Ohio State University.

National Research Council. (1996). "National science education standards." Washington, DC: National Academy Press.

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