P1.7 METEOROLOGY AND OCEANOGRAPHY TOPICS IN THE NEW YORK STATE SCIENCE CURRICULUM

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1. INTRODUCTION

New York State public schools provide one of the most comprehensive Earth Science education offerings in the world. The Conference poster describes inclusion of weather and ocean-related topics in the curricula offered to hundred of thousands of NYS students in grades K – 4, 5 – 8, and 9 – 12.

2. NEW YORK STATE CURRICULUM/ ASSESSMENT

New York State has long played a role in geoscience history, with contributions dating back to the seminal work of James Hall in the 1840s. As far back as the 1870s, the Regents of the University of the State of New York offered examinations in such areas as geology, physical geography, and astronomy (http://emsc32.nysed.gov/osa/hsinfogen/hsinfogenarch/rehistory.htm). Over the ensuing decades, the number and topics changed, but a rigorous "Regents Exam" in Earth Science has been offered to NYS high school students since the 1950s, and to accelerated 8th graders since the 1980s. More than 150,000 take these exams each year.

In 1996, the State Education Department (NYSED) issued 28 "Learning Standards for New York State" (http://www.emsc.nysed.gov/ciai/pub/standards.pdf). The seven pertaining to science, mathematics, and technology include two dealing with analysis, inquiry, design, and information technologies (http://www.emsc.nysed.gov/ciai/mst/pub/mststa1_2.pdf); two concerning interconnectedness and interdisciplinary problem solving (http://www.emsc.nysed.gov/ciai/mst/pub/mststa6_7.pdf); and one each setting out in general terms important concepts in Mathematics, Technology, and, of particular value here, Science (http://www.emsc.nysed.gov/ciai/mst/pub/mststa4.pdf).

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These general statements guided NYSED in utilizing input from hundreds of teachers to create "Resource Guides with Core Curriculum" (http://www.emsc.nysed.gov/ciai/mst/scirg.html). These established fairly specific indications of what needs to be taught in courses developed by local school districts during Elementary Science (grades K – 4, http://www.emsc.nysed.gov/ciai/mst/pub/elecoresci.pdf); Intermediate Level Science (grades 5 – 8, http://www.emsc.nysed.gov/ciai/mst/pub/intersci.pdf); and at the high school level (grades 9 – 12).

Weather and ocean topics form significant portions of the Physical Setting/Earth Science Core Curriculum (http://www.emsc.nysed.gov/ciai/mst/pub/earthsci.pdf). Examples will be presented below.

Based on these documents, NYSED utilizes the talents of many classroom teachers to create examinations assessing mastery of the concepts. Archived versions of these can be found through http://www.emsc.nysed.gov/ciai/mst/sci.html. PS/ES exams are offered in June, August, and January. During this exam, students may use information available in the accompanying "Earth Science Reference Tables" (ESRT, http://www.emsc.nysed.gov/osa/scire/reftable.html).

The Elementary and Intermediate Level exams are used mainly to help districts identify individual student progress. Graduation from a NYS public high school requires passing a minimum of three years of science courses based on the Core Curriculum resource Guides, and at least one Regents Exam. Elementary and Intermediate Level exams are offered only once during the school year.

One version of key concepts in the high school level curriculum guide can be found at http://earth2class.org/curr_units/wx%20&%20clim%20core.php.

Some examples are:

>2.2a. Insolation (incoming solar radiation) heats Earth's surface and atmosphere unequally due to variations in: intensity (caused by variations in *atmospheric transparency* and angle of incidence which vary with time of day, latitude, and season); characteristics of the materials absorbing the energy (such as color, texture, transparency, states of matter, and specific heat);

and duration, with varies with seasons and latitude.

>2.1h. Atmospheric moisture, temperature and pressure distributions; jet streams, wind; air masses and frontal boundaries; and the movement of cyclonic systems and associated tornadoes, thunderstorms, and hurricanes occur in observable patterns.. Loss of property, personal injury, and loss of life can be reduced by effective emergency procedures.

>2.1i. Seasonal changes can be explained using concepts of density and heat energy. These changes include: the shifting of global temperature zones, the shifting of planetary wind and ocean current patterns, the occurrence of hurricanes, monsoons, rainy and dry seasons, flooding, severe weather, and ozone depletion.

Pertinent oceanographic concepts in the PS/ES Core Curriculum can be found at http://earth2class.org/curr_units/ocean%20core.php.

3. NEW YORK CITY DEPARTMENT OF EDUCATION

The New York City Department of Education operates the largest public school system in the United States (www.nycboe.net). In 2004, the New York City Council issued "Lost in Space: Science Education in New York City Public Schools" (http://www.nyccouncil.info/pdf_files/reports/lost%20in%20space%20science%20report.pdf). As a result of this critical report, the NYC Department of Education has undertaken extensive improvements in its science education offerings. During 2005, the Department issued "Scope and Sequence" documents to guide curriculum development at the high school (http://www.r9training.com/r9train/Docs/science/Scope%20and%20Sequence%20High%20School.pdf) and middle school (http://www.earth2class.org/standards/NYC%206%20-%208%20s%20&%20s.php) levels. Similar improvements are underway for New York City elementary school students.

NYC teachers and students are held to the same progress and graduation standards as the rest of the State, based on the assessments described above. But in addition, the NYCBOE has begun to introduce additional standards, such as an "8th Grade Science Exit Project" (http://www.nycenet.edu/offices/teachlearn/documents/whatdidyou/8/assessment.html). These provide opportunities for interested students to delve deeper into atmospheric and oceanic science questions (http://www.nycenet.edu/offices/teachlearn/documents/whatdidyou/8/science.html).

Selected portions of this document include:

>Understand and explain how the Earth's air, water and land continuously interact, evolve and change, such as how the movement of plates causes earthquakes and volcanoes and how uneven heating of the Earth's surface leads to weather changes.

>Understand that substances, such as carbon dioxide produced by automobiles, can enter Earth's air, water and land from human activity and can affect weather, climate and living things.

>Acquire information from observation, experimentation, print and non-print sources.

>Collect, analyze and record data using mathematical concepts such as mean (average), mode (most frequent amount) and probability (the likelihood of something happening).

>Plan and conduct at least one project drawn from one or more of these investigations: an experiment with controlled variables, such as how the contour of a landform affects erosion; field work, such as observing clouds and precipitation; design, such as designing, testing and refining insulation for clothing appropriate for wear on various planets in the Solar System; secondary research, such as researching the causes, effects and reduction of acid rain. (Note: By the end of Grade 8, students should have completed at least one of each of these four types of investigations.)

Over the next few years, efforts will be made to help students meet these requirements through weather and ocean topics .

4. ESPRIT LIST-SERVER

One of the most extensive list-server networks to support geoscience educators has developed at the State University of New York at Oneonta (http://external.oneonta.edu/mentor/Default.htm). During the academic year, more than 1,000 teachers in NYS and elsewhere exchange information, suggestions, and comments that provide an effective communication system for classroom educators. Participants exchange information about a variety of currents events, especially when the weather gets "exciting," and classroom activities. For newer teachers, this has been like having dozens of mentors, and for more experienced teachers, an effective way to share knowledge and experience.

5. AMS DATASTREME AND RELATED PROGRAMS

American Meteorological Society Education Resource Agents throughout NYS have provided teacher training to enhance student achievement through DataStreme Atmosphere (http://www.ametsoc.org/amsedu/dstreme/index.html); DataStreme Ocean (http://64.55.87.13/amsedu/DS-Ocean/home.html); and Water in the Earth Systems (http://64.55.87.13/amsedu/WES/home.html). NYS teachers have participated in the Project Atmosphere (http://64.55.87.13/amsedu/project_atmosphere.html) and the Maury Project (http://64.55.87.13/amsedu/MauryFrames.html). To date, more than 300 NYS teachers have taken these courses.

AMS-trained teachers provide many workshops to peers at local, statewide, and national conferences. Often, these programs include interaction with the NWS Offices serving New York State. More information about these programs can be found at http://ams.confex.com/ams/pdfpapers/98933.pdf.

Wolk, a participant in DataStreme Ocean during the Spring 2006 term, created a series of student investigations for her classes at Garden City Middle School. These can be downloaded at http://www.earth2class.org/amsldeo/wolk.php.

6. ADDITIONAL WEATHER AND OCEAN EDUCATION OPPORTUNITIES

Further support for students and teachers is provided through many organizations and institutions across the state. For example, the New York State Marine Education Association (http://www.nysmea.org/) will host the National Marine Education Association (http://www.marine-ed.org/) conference shortly after this meeting. Informal education programs for students and teachers are provided by the American Museum of Natural History (www.amnh.org), Wildlife Conservation Society's New York Aquarium at Coney Island (http://www.nyaquarium.com/), and many other institutions across the state.

7. EARTH2CLASS WORKSHOPS

Weather and ocean concepts have also been disseminated through the Earth2Class Workshops for Teachers at the Lamont-Doherty Earth Observatory of Columbia University (http://www.earth2class.org). This program brings classroom teachers together with research scientists through monthly workshops. The web site provides a wide variety of resources for students and teachers interested in learning more about meteorology and oceanography.

E2C has sponsored summer conferences for teachers leading to creation of a comprehensive set of curriculum unit guides that provide much about weather and ocean education (http://earth2class.org/curr_units/index.php). More information about this program is available in the Extended Abstract for **Paper 8A.6** in this Conference, as well as in Passow et al., 2006, and Passow et al., 2005.

8. REFERENCES

Passow, M.J., G. Iturrino, C. M. Assumpção , F. Baggio (2006) Bringing cutting-edge research to the classroom: Earth2Class. In American Meteorological Society 14th Symposium on Education, January 2004. (Poster Session P1.09) Extended Abstract

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