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Exploring Earth Systems Through STEM

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During the 2010 school year, grade 8 science teachers at Dwight D. Eisenhower Middle School in Wyckoff, New Jersey, began using the draft of *A Framework for K-12 Science Education* to transition to the Next Generation Science Standards. In an evolutionary process of testing and revising, teachers work collaboratively to develop problem-based science, technology, engineering, and mathematics (STEM) units that integrate earth science, physical science, and life science topics. Students explore the interconnections of Earth's atmosphere, lithosphere, hydrosphere, and biosphere through problem-based learning. Problem-based learning engages students in (1) direct observations in the field and classroom, (2) collection and analysis of data from remote sensors and hand-held sensors, and (3) analysis of physical, mathematical, and virtual models.

Students use a variety of technologies and applications in their investigations, for example iPad apps, Google Classroom, and Vernier sensors. Data from NASA, NOAA, non-government organizations, and scientific research papers inspire student questions and spark investigations. Teachers create materials and websites to support student learning. Teachers curate reading, video, simulations, and other Internet resources for students. Because curriculum is standards-based as opposed to textbook-based, teacher participation in workshops and institutes frequently translates into new or improved study units. Recent programs include Toyota International Teacher Program to Costa Rica, Japan Society Going Global, Siemens STEM Academy, U.S. Naval Academy SET Sail, and NJSTA Maitland P. Simmons Memorial Award Summer Institute.

Unit themes include weather and climate, introduction to general chemistry and biochemistry, and cells and heredity. Each if the three 12-week units has embedded engineering challenges inspired by current events, community needs, and/or the work of scientists. The unit segments begin with a problem, progress to observations and data collection, and end with an engineering application. English language arts and mathematics skills are developed through performance assessments that include written arguments that require students to state a claim and support the claim with evidence, analysis, and reasoning. Student selected capstone projects are completed during the final three weeks of the school year.

Partnerships with universities, research scientists, and science centers are essential to the development of unit challenges. Collaborative projects have included studies of iron cycling in the Ross Sea with scientists from Rutgers University, climate and climate change using NASA data and resources from Liberty Science Center, human and natural impacts on endangered species with San Diego Zoo Institute for Conservation Research, and air quality monitoring with the University of Northern Iowa. Grant funds have supported student research projects involving air quality improvement, urban heat island mitigation, alternative energies, and sustainability.