

EXPEDITION EARTH AND BEYOND: ENGAGING CLASSROOMS IN STUDENT-LED RESEARCH USING NASA DATA, ACCESS TO SCIENTISTS, AND INTEGRATED EDUCATIONAL STRATEGIES.

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Introduction: Classroom teachers are challenged with engaging and preparing today's students for the future. Activities are driven by state required skills, education standards, and high-stakes testing. Providing educators with standards-aligned, inquiry-based activities that will help them engage their students in student-led research in the classroom will help them teach required standards, essential skills, and help inspire their students to become motivated learners. The Astromaterials Research and Exploration Science (ARES) Education Program, classroom educators, and ARES scientists at the NASA Johnson Space Center created the Expedition Earth and Beyond education program [1] to help teachers promote student-led research in their classrooms (grades 5-14) by using NASA data, providing access to scientists, and using integrated educational strategies.

Expedition Earth and Beyond (EEAB): This Earth and planetary science education program is designed to engage, inspire, and educate teachers and students by getting them actively involved with NASA exploration, discovery, and the process of science. EEAB is an inquiry-based student involvement program that provides a structure for students in grades 5-14 to conduct authentic research about Earth and/or other planetary bodies. It is facilitated by the ARES Education Program at the NASA Johnson Space Center in Houston, Texas.

NASA Data: The EEAB project uses astronaut photographs provided by the Crew Earth Observations (CEO) payload on the International Space Station [2-3] as the hook to help students gain an interest in a topic of study. Students can investigate features related to meteorological, geological, environmental, or other topics based on interest and course standards. Hundreds of thousands of astronaut photographs are available through the Gateway to Astronaut Photography of Earth website (<http://eol.jsc.nasa.gov>). Students are encouraged to use recent or historical images along with available NASA data from other orbital platforms. In addition to using archived NASA data, participating student teams have the opportunity to submit new data requests for the International Space Station (ISS) crew. Student team data requests are reviewed, and approved requests are included as CEO targets sent up to astronauts on the ISS.

Students conducting planetary comparisons also have data and resources available through developed hands-on activities that help facilitate comparative planetology. These resources enable students to initiate planetary comparisons focusing on geologic features. Students learn to develop identification criteria for geologic features on Earth that they can use to investigate similar features observed on other planetary bodies such as Earth's Moon, Mercury, Venus, Mars, and moons of Jupiter.

Access to Scientists: One of the most inspiring and exciting aspects of EEAB is student team access to scientists. One way student teams can connect with science experts is through classroom connection distance learning events. These virtual connections help provide background knowledge for students and teachers, as well as reinforce concepts students may be learning in the classroom. Science experts are additionally linked to participating student teams as mentors through the use of the Expedition Earth and Beyond Team Workspace Wiki [4]. Each team's wiki allows students to log their progress through the process of science as they conduct their investigations. Science mentors are able to provide feedback, suggestions, and encouragement through discussions on the wiki. This type of access to a science mentor helps add to the rigor and relevance of student research; the motivation of students conducting investigations; and adds reinforcement to concepts educators are teaching in the classroom.

Integrated Educational Strategies: EEAB integrates a diverse set of project components or educational strategies that are designed to facilitate student-led investigations and authentic research in the classroom. These components ensure alignment to standards and teacher requirements and provide program flexibility to help meet the needs of diverse classroom environments. These strategies include 1) Creating standards-aligned, inquiry-based curricular resources; 2) Providing professional development opportunities for educators; and 3) Creating a Virtual Learning Environment.

Standards-aligned, inquiry-based curricular resources for EEAB have been developed using the 5-E inquiry model [5]. The 5-E model is an inquiry-based model of instruction based on a constructive approach

to learning. Learners build or construct ideas by comparing new experiences to their existing framework of knowledge. The 5-E model of instruction breaks this learning approach into 5 phases: engage, explore, explain, elaborate, and evaluate.

Professional development opportunities for educators are offered through in-person educator workshops as well as during virtual educator workshop sessions. Workshop sessions focus on active experiences using developed hands-on curricular resources. These experiences build teacher confidence in the use of the materials, help increase educators' content knowledge, and help expand their use of inquiry-based techniques and strategies in the classroom. Professional development opportunities are offered for both in-service and pre-service educators.

The Virtual Learning Environment is an important aspect of EEAB as it connects science experts to classrooms, enabling both teachers and students to gain knowledge from sources that may have been otherwise inaccessible. Educators can benefit from virtual professional development opportunities, and both educators and students can gain knowledge from the classroom connection distance learning events and feedback offered by a science mentor through the EEAB Team Workspace Wiki. These virtual experiences provide an educational opportunity that goes beyond the norm and helps to greatly enrich classroom activities. The Virtual Learning Environment additionally provides the opportunity for students to share their research with other participating students as well as professional scientists. This type of experience provides an even higher level of rigor and relevance to student research. Students are able to go beyond completing classroom activities for a grade to collaborative research, learning from one another, and getting feedback from professionals.

Conclusions: EEAB combines the expertise of teachers, who understand the everyday challenges of working with students, with scientists, who work through the process of science as they conduct their own research, to create a realistic and useable means in which to promote student-led research in the classroom. Classroom learning is enhanced by providing exciting and diverse opportunities inspired by views of Earth from space taken by astronauts onboard the ISS, along with meaningful connections with scientists. The interest and connection to viewing our home planet from space will inevitably spark questions that will drive students to pursue investigations, as well as forming a basis for comparisons to the exploration of other planetary bodies in our solar system.

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References: [1] *Expedition Earth and Beyond*, <http://ares.jsc.nasa.gov/ares/eeab/index.cfm>, [2] Stefanov W. L. (2008) *Phi Kappa Phi Forum*, 88 (1), 2-7, [3] Robinson J. A. et al. (2002) *International Journal of Remote Sensing*, 23 (20), 4403-4438, [4] *Expedition Earth and Beyond Team Workspace Wiki*, <http://eeabteamworkspace.wikispaces.com/>, [5], Bybee, R. W. et al. (2006) *The BSCS 5E Instructional Model: Origins and Effectiveness*.