



2011 AAAS/Subaru Essay Writing Competition for K-12 Educators Finalist Essay

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These Roots Run Deep: Exploring the Geology of Southern Appalachia

Teaching geology to middle-school students can be challenging; whereas their attention span tends to be measured in minutes, a true understanding of geologic development takes an expansion of awareness to vast stretches of time. In my teaching, I always try to look closest to home to find a connection between the content and the students. Looking behind the school to the peaks of the Black Mountains, the tallest range in Appalachia, my students and I found inspiration.

Evergreen Community Charter School is a K-8 school focusing on community service and environmental responsibility in Asheville, North Carolina. Teaching eighth-grade science to 13- and 14-year-olds, I am lucky to be able to integrate consistently with my teaching team, as well as travel to field experiences throughout the region to experience our learning firsthand.

As I began designing and planning the unit, I started with my goals for the students. Rather than using geology in a broad sense as a goal, I sought for my students to be able to recognize the forces which have acted on the Southern Appalachians throughout geologic time. Rather than seeing geology as a diagram in a textbook, I wanted students to see a garnet underfoot and envision metamorphic forces; to see the shining sides of Looking Glass Rock in Pisgah National Forest and envision magma cooling over

thousands of years. I wanted the students to live the science.

Five billion years. Yes, five billion years of the development of the earth, and I had a month to implement the unit. I began with activities to help the students grasp the breadth of the time involved in the development of the Appalachians, the oldest mountains in the world. The students created a scale on the field, and placed major geologic and evolutionary events along the scale, finally placing all of human history in the last eight centimeters. Needless to say, the Social Studies teacher was not happy to have his entire curriculum represented as such a negligible period.

A few days later, we packed the students into cars and busses and drove over the crest of the Appalachians, past road cuts of folded and warped metamorphic formations, into Tennessee to the Gray Fossil Site. This site was uncovered only in 2000, as a highway was expanding, and provides a fascinating opportunity for students to witness paleontology in action, with late Miocene tapirs and red pandas being excavated on site within feet of students. The students found the excavation astounding, although their excitement was slightly abated when they learned of the many hours of reconstruction and analysis in the laboratory that accompanies a fossil find.

We next completed a short investigation into basic rock types and plate tectonics, which is memorialized in student memory by seeing me dance (or at least a bold attempt) to a Hip-Hop track, mimicking transform, convergent, and divergent boundaries. Once the big picture was set, I sought to bring the focus of the students from the grand scale of geologic change through time to the



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development of the mountains underneath their feet; it was time for the students to know their roots.

The United States Geological Survey (USGS) is one of the oldest departments in the federal government which advances the study of science. While originally charged with "classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain," they have expanded to study biology, hydrology, geography, and geology. As a part of the latter, they created a series of General Interest Publications which seek to inform the public about geology.

Birth of the Mountains: The Geologic Story of the Southern Appalachian Mountains, by Sandra H.B. Clark and published by the USGS, provided my students with a place-specific nonfiction text, which allowed for deepening their knowledge of the geology of the region in which they live. Through the use of independent reading and structured collaborative discussion, the students both increased their conceptual understanding as well as their ability to evaluate and communicate scientifically.

To set the stage for their investigation of the mountains surrounding them, we began with the study of a series of exposed rocks on our campus. Using basic tenets of environmental education, the students made detailed observations of these rocks and the natural world surrounding them, and wrote short "autobiographies" of these rocks. These short stories served as both a pre-assessment of their knowledge of the geology

of the area, as well as a chance for them to connect to their local environment.

The day came to introduce the text. The classic model of providing a text for students to read, then answer specific questions, provides little room for student questioning and discussion. There has been a move in many fiction-centered classrooms towards more collaborative guided reading and discussion, commonly referred to as literature circles, where small groups of students gather to discuss a piece of literature in depth.

I wanted the students not only to read about Appalachian geology, but to share with their peers and deepen their understanding, and I felt that a non-fiction "text circle" could provide this opportunity. Prior to assigning the students the text, I created four different "roles," which would focus the students' reading and allow them to share a different area of expertise with the group during discussion. The four roles assigned were: Visual Visionary, who analyzed and summarized diagrams in the text; Vocabulary Guru, who defined geologic and other terms; Map Maker, who located regions discussed in the text on a regional map; and finally a Summarizer, who created an overview summary.

When the students were provided with the text, they were also paired into groups of four students. The different roles were explained, and the students discussed with their group members and chose their roles. This led to self-differentiation, with students choosing the role that fit their strengths. Special Education students were guided to choose the Visual Visionary, and gifted students were challenged to take on the Summarizer role. Each student began their reading with a focus for



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their own experience that they had selected, which empowered their learning.

Once the roles were decided, the classical music was turned on and the lights were lowered, and the students read *The Birth of the Mountains* independently. Looking upon the class of students reading, recording, and learning about a scientific topic to which they related showed the power of relevant scientific texts.

Several days later, the seed that was planted in their reading took to the soil. The students came to class with their books and their notes based on their role, and joined their groups for a lively discussion. The students were provided with a series of open-ended discussion questions, which pushed the students to not only identify information but evaluate and form connections with previous learning experiences. The groups recorded their major learning on butcher paper, which adorned the halls and classroom afterwards.

Moving about the classroom on this day, I reconnected to why I wanted to teach—the pure

joy of watching students make connections and learn. It was not a silent classroom, but one filled with raucous debate, with cries of “There is no way gneiss could be found...” and “Were the island arcs destroyed in the convergence?” My role was to listen, clarify, and occasionally cool tempers, but the students were the active learners, and felt confident in their scientific knowledge. Using a science text as a forum for discussion rather than a podium for information changed the students’ approach and attitude towards science.

The next day, the students revisited the rock faces for which they had written autobiographies a few days before, and wrote an addendum. Whereas before they had written superficial information, I now witnessed them describing the pain as they were sheared off their friends in what once was Africa, or lamenting the loss of species with the changes from the last ice age (even in science, teenagers tend toward the dramatic). The dynamic use of this nonfiction text provided the content and connections which made geology meaningful, local, and ultimately personal.