# COMMENTARY

## Spatial analysis of fossil sites in the northern plains: A unique model for teacher education

***George D. Stanley, Jr.,*** *The University of Montana Paleontology Center, 32 Campus Drive, Missoula, Montana 59812, USA, and* ***Heather Almquist,*** *College of Arts and Sciences and Department of Geography, The University of Montana, Missoula, Montana 59812, USA*

### INTRODUCTION

Understanding science and technology is key to our next generation's success. Conveying the excitement of science and effectively melding it with technology in both field and classroom settings can be a challenge for many K–12 educators. Middle school is a critical juncture in a child's educational experience, when interest in science and technology is budding. If this interest is captured, it can lead to a lifetime of learning and, for some, a rewarding profession. At the University of Montana, the Paleo Exploration Project (PEP) was developed to meet these challenges. Now entering its second year, the PEP program aims to motivate school children in the STEM areas (science, technology, engineering, and mathematics). It focuses on both middle school teachers and students in rural parts of Montana and utilizes geospatial technology and paleontology to achieve these goals.

Students investigate a site. Image courtesy http://pep.explore-ed.com/photos/imgpages/.

Funded by the National Science Foundation (NSF), the PEP project is a professional development program for math, science, and technology teachers. The primary goal of the program is to enable middle school teachers to effectively integrate geospatial technologies into the classroom and to create inquiry-based science experiences for students using fossils from key sites in Montana. The PEP project serves teachers and middle school students selected from a large area of eastern Montana, including three Indian reservations. Schools in this region tend to be small (fewer than 50 students) and isolated, with only 49 middle schools in a 50,000 mi$^2$ area. Most educators in the PEP teach diverse subjects and are over 50 years old. In general, they begin the PEP with little experience in technology and science.

Geographic information system (GIS) technology is valuable for developing practical technology skills. Dinosaurs and diverse terrestrial, fresh water, and marine fossils are natural drawing cards for the program, eliciting both excitement and curiosity. Cretaceous fossils also include turtles, ammonites, and marine reptiles. Layer-cake stratigraphy and the colorful landscapes in northeastern Montana combine to create a naturally attractive backdrop for the project. Several Upper Cretaceous units, such as the Hell Creek Formation and the Bear Paw Shale, contain the richest, most diverse fossil assemblages on the continent and perhaps in the world.

### COURSE DESCRIPTION

The PEP funded a series of weekend training workshops for the teachers, held in the Glasgow School District and on the University of Montana campus. Teachers selected to participate in the PEP program had the option to register for university credit at the graduate level. Both teachers and middle school students took part in summer classroom and field experiences near Fort Peck, Montana. During the workshops, teachers were introduced to simple, intuitive geospatial technologies such as Google™ Earth and global positioning systems (GPS). Later, they were introduced to ESRI ArcGIS 9.2 software and learned to add data layers, navigate, select and display features, and conduct queries. Teachers attending the PEP were given hands-on classroom instruction with fossil vertebrates, invertebrates, and plants and were instructed on taxonomy, fossil preservation, preparation techniques, and stratigraphy of Cretaceous units in eastern Montana. They also learned to use a geospatial database with information on geological formations, roads, land ownership, streams, and lakes.

During the summer research institute, hosted at the University of Montana Field Station of Paleontology and Fort Peck Paleontology, PEP teachers were later joined by selected middle school students. Together, they investigated a 14,000 mi$^2$ area around Fort Peck Dam, Montana, for stratigraphy, paleontology, and sedimentology. Teams of students, accompanied by teachers and PEP staff, learned fossil field survey

methods as well as methods for excavation of vertebrate and plant fossils. Participants described the fossils and enclosed rock types and then created geologic maps using GPS, Total Station surveys, and ArcView. The resulting geologic maps and fossil finds were then used by the teachers and students to develop and test scientific hypotheses and to decipher relationships among fossils in time and space.

## RESULTS

Results from the first year of this NSF project were positive. Teachers developed inquiry-based projects and later implemented them in their own schools. For example, teachers from Plentywood, Montana, developed a learning unit using GPS and GIS to determine the relationship between an erosion channel and the artifacts found at the Shippe Canyon drainage channel. Another teacher from Whitewater, Montana, challenged her students to determine whether dinosaur fossils found in northern Phillips County were buried in the same stratigraphic layer. To date, 17 such projects involving 22 teachers and over 400 students are being developed across northeastern Montana.

This approach, combining geospatial technology and paleontology to engage middle school teachers and students in a rural field setting, presents a unique model of education. It has the potential to motivate future generations of learners and to steer them toward careers in technology and science. As we begin our second year, readers are invited to gain further information by visiting our Web site for the Paleo Exploration Project: **http://pep.explore-ed.com.**

Aerial view of Fort Peck. Image courtesy http://pep.explore-ed.com/photos/imgpages/.