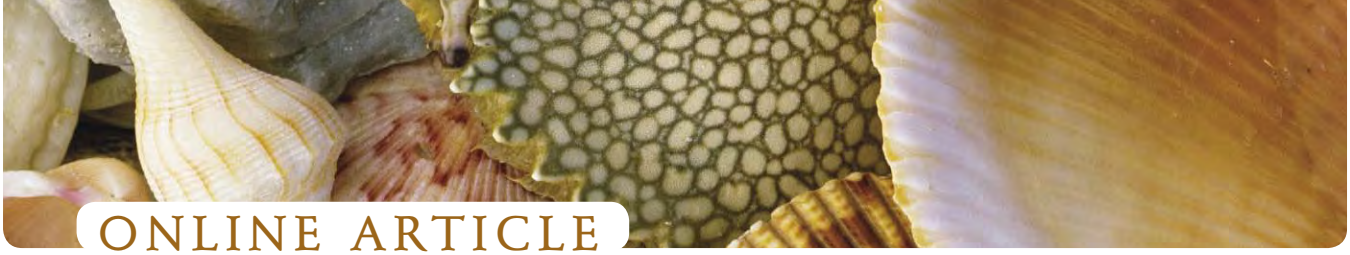

ONLINE ARTICLE

Field Trips as Cognitive Motivators for High Level Science Learning

MARLENE M. HURLEY

It was just after 7:30 on a Friday morning in late October when my tenth grade biology students washed the last of the breakfast dishes, put on their coats, and headed out the door and down the road. Thick fog hid the meadow as it followed Henry's Fork River. Several days at the ranch had taught us that the fog would soon dissipate and leave us with another clear, crisp day for exploring the beauty and wonders of the greater Yellowstone area.

Our target this morning was Silver Lake, at the end of a path through the southern woods. This early there would be plenty of waterfowl and maybe even the elusive moose. The students were in high spirits as we moved through the lodgepole pine forest. We planned to bus into the park after our walk to investigate its wildlife and habitats and compare them to those of the volcanic caldera where we were staying at Harriman State Park in Idaho. As we approached the lake, it began.

The tall, thin pines whipped back and forth as the ground undulated up and down. The usually calm lake was choppy; it seemed that the trees would break and crash to the ground. A swim in the icy lake waters seemed preferable to being struck by a falling tree. As we hit the edge of the lake, the earthquake ended.

The year was 1983. The earthquake, with a magnitude of 7.3, became known as the Mount Borah Earthquake. Due to the remoteness of the epicenter, only two lives were lost: two small children hit by a falling building on their way to school. There was structural damage to buildings and roads and extensive land upheaval as the mountain ranges in and around the Rocky Mountains continued to expand. The immediate effect on my group of students was the wonder that everything in our little forest apparently returned to normal immediately after the earthquake. Everything, that is, except us.

We rushed back to the bus and then hurried to the Old Faithful area of Yellowstone to view seismographic readings and to monitor geyser behavior. Our field trip took on a persona of its own that consisted of integrated science and the scientific investigation of a real world phenomenon. I couldn't have planned a better learning experience.

Field Trips as High Level Learning Experiences

This timely field trip to the Yellowstone area was one of many excursions to a variety of places I have made with student groups over the years. The writings from the Nature Study movement of the early twentieth century, of Thoreau, of Aldo Leopold, Rachel Carson, and others are the foundation for the value I place on firsthand nature experiences for student learning. My personal experiences in this area solidified these beliefs, but they are also supported by research that shows 96% of all people questioned recalled school field trips (from 9-year-olds through adults) and the most frequently remembered field trips were to natural sites and nature centers (Falk & Dierking, 1997). Yellowstone has been a location for many field trips, including trips involving hundreds of students designed to improve both attitudes and behavior (Giacalone, 2003). While improving attitudes and behavior may be adequate reasons for a field trip, learning should also occur.

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Much has been written about the structure and purpose of an educational field trip, particularly the pre- and post-field trip activities (see Rudmann's 1994 review article). Studies have been designed to measure learning during informal outings (e.g., Falk & Dierking, 2000) and to measure retention of learning months after an outing (e.g., Knapp, 2000). Few have addressed how to focus on the cognitive aspects of a field trip (DeGolier, 2002; McLoughlin, 2004; Morrell, 2003). Even fewer have addressed the idea of seizing this rare learning experience and turning it into an opportunity for higher level learning. In fact, the majority of reports on field trip outcomes concentrate on factual learning–learning at the lowest level–the knowledge level of Bloom's taxonomy of the cognitive domain.

Field trips (also known as "excursions") are universal; i.e., they are performed globally in the education world. Twenty-eight secondary science teachers in Australia were interviewed concerning the value of field trips (Michie, 1998). In terms of student outcomes, a number of values were mentioned by the teachers: cognitive, affective, firsthand experience, variety, motivation, and the "best way" to do things for the content. Most of these teachers used focus questions, worksheets, or field notebooks for students to record observations during the field trip. This information was verified in an Australian study (Griffin & Symington, 1997) that found teachers to be task-oriented rather than learning-oriented. Few studies report the use of a field trip to extend learning back into the classroom.

This article examines what teachers can do to raise the level of both teaching and learning in all three phases of a field trip (pre, during, and post). It also illustrates the natural progression of learning through Bloom's taxonomic stages of cognition as the phases of the field trip progress. In other words, the highest levels of cognition (analysis, synthesis, and evaluation) occur after the field trip ends. I offer my own experiences and the original field trip as examples of how to achieve this.

Learning *Before* the Field Trip

Prior to the field trip, familiarize students with the field trip site. This will decrease the necessary exploratory time before focusing on the teacher's planned lessons. Offer a slide show of major features and use maps that geographically situate the field trip (of an outdoor site) or show the floor plan (of an indoor site).

We began planning the field trip to Yellowstone two weeks before the actual trip. The planning began with students making their own maps. Essentially, they created a large map of the western half of the park by using large sheets of paper that allowed tracing of roads and boundaries. Features such as mountains, rivers, lakes, geysers, and likely places to see large animals (such as moose and buffalo) were added by hand, using colored pencils, based upon research and discussions. The addition of a key, a scale, and the direction of "north" completed the maps. They folded these large maps to a size that would fit within the "field packets" that we continued to develop. Small maps were then made that showed greater detail in certain areas; for example, Harriman State Park and the Old Faithful area of Yellowstone. In addition, the students made small field guide booklets (plants, birds, and mammals of Yellowstone).

Each completed field packet contained the following: maps, field guide booklets, field notebook, pen, pencil, colored pencils (optional), plastic bags and plastic vials, a small paint brush, eye droppers, hand lens, compass, and a bottle of water. Students were encouraged to bring cameras and binoculars. They were randomly assigned to specific scientific roles during the trip, such as mammalogist (large or small), ornithologist, botanist, geologist, and meteorologist. All students were expected to be ecologists. These assignments created the need for specific additional items in certain field packets (e.g., small bags of plaster for mixing and making casts of animal tracks), as well as additional research and pre-trip learning for each student.

Once the field packets were complete, brainstorming sessions were held that determined what else was needed for the trip in the categories of food, bedding, clothing, and first aid. For a field trip of this extent (nearly a week), food, its preparation, and its mess were a most important category. Pairs of students were assigned to plan a nutritional meal, provide enough food, prepare the meal, serve it, and provide clean-up afterward. This included bringing in recipes, preparing the menu, and calculating ingredients for the entire group.

The lessons during the pre-field trip preparations utilized technology (calculators, computers, compasses, binoculars), mathematics, integrated science, and inquiry, all advocated by the *National Science Education Standards*. They were also activities classified at the knowledge, comprehension, and application levels of Bloom's taxonomy (Table 1).

Learning *During* the Field Trip

Having the students pack the bus for the several-hour ride to Yellowstone enabled them to make niches for themselves within the milieu of food, sleeping bags, and suitcases. My only instructions were: 1) Everyone needed a spot, and 2) We had to be able to unload food at the cookhouse before the personal items at the bunkhouse. Once we arrived and the food was put away in the cookhouse, we thoroughly explored the kitchen supplies and equipment so that everyone knew what was available for meal preparation. While the students created new niches in the bunkhouse, a chaperone and I prepared lunch. This was the "model" meal that showed students my expectations for their own meal preparations and clean-up.

Hiking around the state park that first afternoon was largely exploratory—a tour of the barn and facilities–followed by a hike to acquaint the students with the lakes, river, woods, marsh, and habitats from caldera bottom to rim. Each day ended with dinner, free time, and a campfire with informal discussions about the day's events, followed

by bed. During breakfast each morning, we discussed the day's itinerary. Beginning with the first full day, each student was expected to fulfill his/her scientific responsibilities. These responsibilities are shown in Table 2.

As students practiced their scientific roles, the quantity of data grew. They collected and labeled what was legally permissible, and they made various types of observations including notes, drawings, photographs, plaster casts of tracks, and recordings of birds and elk. Each night, we discussed the major sightings, data collection, and any problems or issues encountered during the day. I noted these in my own field journal as possible topics for continued learning back in the classroom.

Table 1. Using Bloom's Taxonomy for Higher Level Field Trip Learning.

Bloom's Level of Cognitive Learning	Pre-Trip	Field Trip	Post-Trip
Knowledge	Location details Animal details What to bring Research		
Comprehension	Making maps Making field guides Planning meals Discussing	Observing Discussing Notetaking	
Application	Preparing packets Creating proportional recipes Packing for the trip Operating technology	Gathering data: --collecting --identifying species --measuring geysers Preparing meals	Preparing exhibits from collected data. Presenting collected data from specific science perspective.
Analysis		Fireside discussions: --identifying problems --identifying issues --analyzing data collection	Analyzing data for exhibits. Analyzing problems & issues. Responding to questions. Completing field journals.
Synthesis			Synthesizing data for exhibits. Synthesizing responses to problems, issues, & questions. Completing field journals.
Evaluation			Evaluating data for exhibits. Evaluating problems, issues, & responses to questions. Completing field journals.

Learning *After* the Field Trip

In the classroom, the collected items were organized and turned into collections that would convey messages to viewers. For example, moss-covered rocks and plants from a boggy area were placed in a large terrarium that represented a model of the location. Plaster casts of various tracks became part of entire bird and/or mammal exhibits complete with location maps, drawings, photographs, and scat. Plant data were turned into exhibits that identified plants through leaves, branches, fruit, and form. The classroom was turned into a small museum of treasures from the greater Yellowstone area that represented our travels, experiences, and endeavors. Additionally, we all completed our field journals about the trip, which were placed on display. Figure 1 provides an example entry from one student's journal.

The biology students continued their studies through additional research and discussion to respond to questions such as: How do the habitats of Harriman State Park compare to those of Yellowstone? What will eventually happen to Yellowstone as the North American plate carries it beyond the "hot spot" over which it currently resides? How could differences between the needs of the local ranchers and the needs of the wildlife in the Park be resolved? Which has greater value to the continued existence of Yellowstone: the "let it burn" policy or a policy of fighting fires? What effect has the reintroduction of wolves to Yellowstone had on the ecological balance of animal and plant life established during the approximately 70 years since their disappearance?

About two weeks after returning from the field trip, both students and classroom were ready to invite the

parents and other interested community members in for a slide show, presentations, informal discussions, and refreshments. Parents viewed their children doing science in the slides, their accomplishments in the exhibits, and their understanding during presentations and discussions. Table 1 illustrates the cognitive activity levels attained during the post-field trip activities.

Assessment of Learning

There are many opportunities to employ a multifaceted assessment system during a course of study that centers on a field trip with learning occurring before, during, and after. Essentially, the assessment can be categorized as individual learning, small group learning, and whole group learning and can be assessed based upon major field trip conceptual goals, as shown in Table 3.

Continuous interactions with students provide ample opportunities for teachers to observe and question individuals. Keeping individual field journals and a labeling system that denotes individual collectors for all artifacts provides additional grades for individuals. The assignment of students to scientific roles places each student in a small group with other students assigned to the same scientific role. Small group and individual grades can be assigned for scientific role performance and the subsequent exhibit construction and presentations. Issue and problem discussions can be assigned in a variety of ways, including individual writings, panel debates, or large group participative discussions (but are shown in Table 3 only as individual products). In the case of a working field trip such as the one described, it is appropriate to also provide a whole group grade based upon the total field trip success. Additionally, a teacher wishing to show the learning value of a field trip for standardized examinations and for future field trips may opt to give either a pre- and post-test or only a post-test that is performance-based yet parallels content that may be found in standardized exams.

Table 2. Scientific Roles & Responsibilities of Students During a Field Trip.

SCIENTIFIC ROLES	RESPONSIBILITIES
Botanists	To gather data that identifies plants of specific ecosystems (leaf collection, drawings or photos of plants, branches, fruit).
Geologists	To gather data that identifies various geologic processes at work (soil, rock, water samples; drawings or photos of geologic processes).
Mammalogists, large animal	To gather data that identifies large mammals, their location & behavior (scat, tracks, drawings or photos).
Mammalogists, small animal	To gather data that identifies small mammals, their location & behavior (scat, tracks, drawings or photos).
Meteorologists	To gather data that identifies the weather & climate of the area & their effects on the various ecosystems & future of the park.
Ornithologists	To gather data that identifies various birds, their location & behavior (drawings or photos, song, scat, tracks).
Ecologists	To reach a holistic understanding of the dynamic environments studied and the interdependence of all their living inhabitants.

Figure 1. Exerpt from Student Journal.

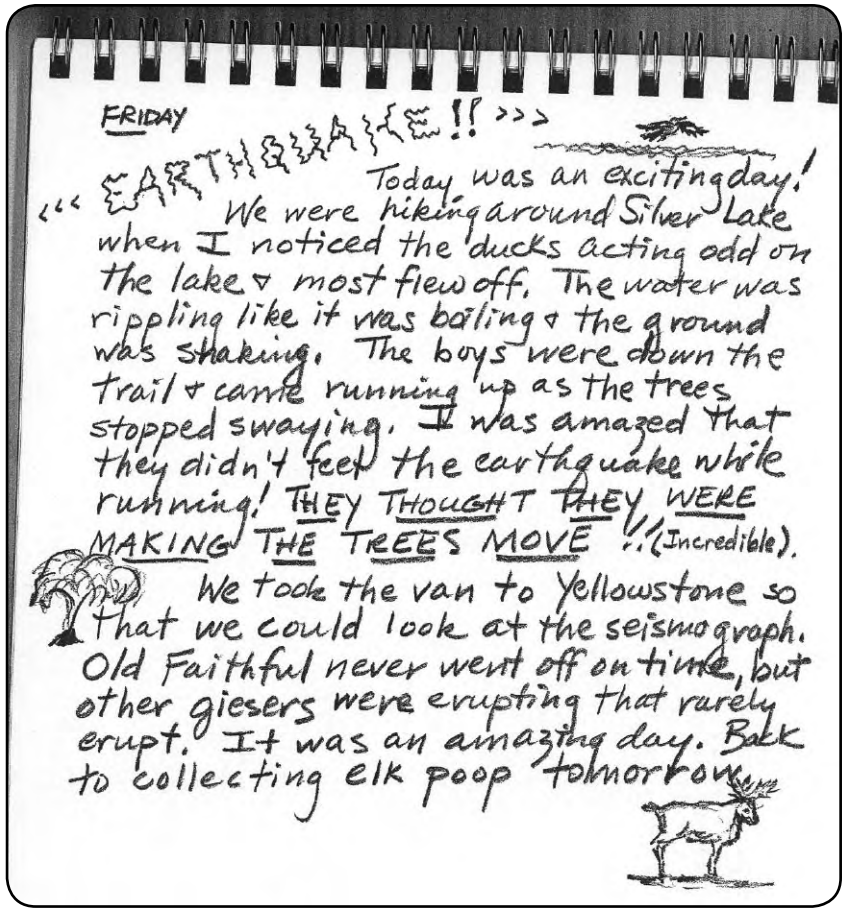

Table 3. Example of Multifaceted Assessment of Learning from a Field Trip.

Major Concepts to Assess:	Individual Learning	Small Group Learning	Whole Group Learning
Goal 1: To gain conceptual understanding of Yellowstone & Harriman State Park environments & issues.	Participation before, during, & after Responses to questions Field Journals Reactions to problems & issues	Exhibits Presentations	Success of the environmental aspect of the field trip
Goal 2: To gain conceptual understanding of the wildlife/plants existing within both parks & related issues.	Participation before, during, & after Responses to questions Field Journals Reactions to problems & issues	Exhibits Presentations	Success of the life sciences aspect of the field trip
Goal 3: To gain conceptual understanding of the physical sciences at work within both parks & related issues.	Participation before, during, & after Responses to questions Field Journals Reactions to problems & issues	Exhibits Presentations	Success of the physical sciences aspect of the field trip
Goal 4: To gain appreciation for the park environments & residents.	Participation before, during, & after Field Journals Responses to questions Reactions to problems & issues		
Appropriate Assessment:	Participation grade based upon teacher observations & data collected; field journal grade based upon quality of reflective entries; grades for written/oral reactions to problem/issues based upon level of thinking & communication; final examination should be performance-based	Small group grades for all members based upon a rubric for group expectations; self & peer grades based upon performance within the group (separate grades for exhibits & presentations preferable)	A single measure of goal fulfillment for all students based upon field trip goals

Discussion

An examination of Table 1 reveals the progression of instructional activities through the cognitive domain of Bloom's taxonomy while simultaneously proceeding through the field trip phases. It demonstrates the high level of instruction that can occur with field trips; it cannot, however, convey the many affective gains of the students. After years of taking field trips to many places both within the United States and beyond, I have become a firm believer that no other single event from schooling is retained longer in the memories of students (based upon feedback from students). The research done on field trip learning retention would also support this statement. Few other

Table 4. Example of Parent Survey

1. On a scale of 1 to 5 (with 5 as the highest rating), how do you feel about your child's field trip? (please circle one) 1 2 3 4 5
   Please explain:
2. What do you like best about your child's field trip experience?
3. What do you like least about your child's field trip experience?
4. Please provide a story or describe ways in which this field trip has impacted your child (for example: through learning, through attitude, and/or through behavior):
5. Would you support this (or a similar) field trip for students in the future? Please explain:

learning tools can provide richer resources or better real world experiences for learning than a well-selected location and a well-planned field trip. And, few other school-related activities have the capability of impressing both parents and administration the way a well-executed field trip does.

I have had occasion to observe teachers and students on field trips at the Natural History Museum in New York City and saw a scenario that gets repeated endlessly by well-meaning teachers "talking at" kids who are bored surrounded by a wealth of learning riches. It doesn't matter if you have a week, a day, or a half-day, a teacher can turn a field trip into high level learning with pre- and post-field trip activities by giving the students responsibilities to plan the trip, to perform science process skills during the trip, and to continue the learning toward an impressive ending (such as a parents' night or a major project) after the trip.

With parental support, the earned good will of administration, and proof that the students are gaining cognitively, money can be found for field trips even during times of fiscal hardship. Even the threat of high stakes (and other) testing can become a supportive component for field trips when your community views the results from the totality of the three phases of field trip learning. One last thing a teacher should do at the end of parents' night is to distribute a survey to attendees and students asking for their feedback on the affective, behavioral, and cognitive values of the field trip (see Table 4 for an example of a brief parent survey). This will provide the teacher with evidence of effectiveness for approval of the next trip.

Conclusion

It was a memorable week. Phone calls to parents and the school assured everyone that we survived the earthquake. While we experienced several aftershocks on Friday and Saturday, our departure Sunday morning was uneventful. Our return trip took us through Craters of the Moon National Monument where we planned to take a break, eat lunch, explore the strange landscape, and do some cave spelunking. Unfortunately, the earthquake at last took its toll on our field trip by closing the caves until they could pass a damage inspection. We continued on ... carrying memories that would last far beyond those created sitting in a schoolroom ... perhaps even a lifetime.

References

Bloom, B. S. (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain.* New York: Longman.

DeGolier, T. (2002). Cold war: Flora's undercover agents. *The American Biology Teacher, 64*(1), 45-51.

Falk, J. H. & Dierking, L. D. (1997). School field trips: Assessing their long-term impact. *Curator, 40,* 211-218.

Falk, J. H. & Dierking, L. D. (2000). *Learning from Museums: Visitors Experiences and Their Making of Meaning.* Walnut Creek, CA: Altamira Press.

Giacalone, V. (2003). How to plan, survive, and even enjoy an overnight field trip with 200 students. *Science Scope, 26*(4), 22-26.

Griffin, J. & Symington, D. (1997). Moving from task-oriented to learning-oriented strategies on school excursions to museums. *Science Education, 81*(6), 763-779.

Knapp, D. (2000). Memorable experiences of a science field trip. *School Science and Mathematics, 100*(2), 65-72.

McLoughlin, A. S. (2004). Engineering active and effective field trips. *The Clearing House, 77*(4), 160-163.

Michie, M. (1998). Factors influencing secondary science teachers to organize and conduct field trips. *Australian Science Teachers Journal, 44*(4), 43-50.

Morrell, P. D. (2003). Cognitive impact of a grade school field trip. *Journal of Elementary Science Education, 15*(1), 27-36.

Rudmann, C. L. (1994). A review of the use and implementation of science field trips. *School Science and Mathematics, 94*(3), 138-141.