

A Paleontology Internship Program Serving High-School Students from Montana's "Frontier" Communities

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ABSTRACT

The Paleo Exploration Project's (PEP) Summer Internship Program was part of a multi-dimensional, regional, education outreach program conducted by The University of Montana (authors) and funded by the National Science Foundation. The objective of the program was to provide high school students from underserved, "frontier" communities in north central and eastern Montana, with hands-on work experience in paleontology at a field station or museum setting along Montana's "Dinosaur Trail" (<http://mtdinotrail.org/>). The primary goals of the program were to increase students' understanding of what scientists do, increase their self-efficacy in science, and inspire them to consider STEM career pathways. The program was conducted over three summers¹ from 2007 through 2009 and involved 12 students, aged 15 to 19. Here we describe the program and responses to it from participating interns and mentors. Challenges and pitfalls encountered are also presented with recommendations for program improvement.

INTRODUCTION

"Authentic" science experiences, or those that resemble how scientists and technicians work in the real-world, have long been considered valuable in improving student understandings of, appreciation for, and motivation to pursue science and technology (Roth et al. 2008). Internships, in particular, in which students work closely with professionals in real-world settings, learning techniques, participating in discussion, and observing how science is practiced, have received particular attention and praise (Richmond & Kurth, 1999; Abraham, 2002; Bell, Blair, Crawford, & Lederman, 2003; Stake & Mares, 2005; Roth, van Eijck, Hsu, Marshall, & Mazumder, 2009; Hsu & Roth, 2010). Although science-based apprenticeships are generally seen as very positive, enriching experiences for students, in the reality of most students' educational experience, they are still the exception rather than the rule.

Providing these types of experiences for students in very small, remote, and economically disadvantaged communities, which lack research universities or private R&D laboratories, presents additional challenges. In these settings, smaller facilities and local expertise must be leveraged to expand opportunities for students. The focus of the experience must also reflect local scientific resources, in order to make it accessible and meaningful to students. Whether similar positive outcomes can be achieved in such settings, what factors influence those outcomes, and how those outcomes are mitigated by local socio-economic conditions over time, are matters deserving of further study. A first step in this process in rural eastern Montana, was to bring together willing partners to design, implement, and evaluate outcomes of a science-based summer internship program for local high school students. If the approach

proved efficacious in this context, specific programmatic adjustments could be made, plans for sustaining the program could be developed, and specific research questions addressed.

PROGRAM DESCRIPTION

Montana is home to a number of museums, interpretive centers, and field stations devoted to the discovery, study, and presentation of the state's rich diversity of Late Cretaceous dinosaurs and other fossils. These provided an exciting and meaningful science context for local students, who have grown up with awareness of, if not curiosity about, their fossil-rich landscape. The PEP summer internship program was conducted at four facilities, including the Fort Peck Field Station of Paleontology in Fort Peck, the Great Plains Dinosaur Museum and Field Station in Malta, Makoshika Dinosaur Museum in Glendive, and Two Medicine Dinosaur Center in Bynum (Figure 1). Each offers public viewing of unique paleontology displays, interpretation, replicas or actual skeletons of dinosaurs and other fossils found in Montana, as well as visitor education programs and/or guided tours of paleontology displays. Each facility also operates or is affiliated with organizations conducting paleontology field digs.

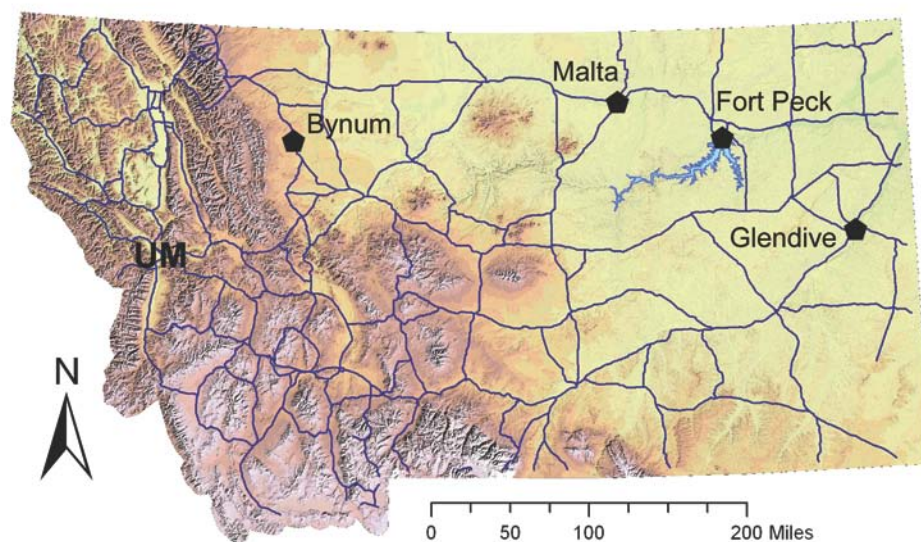


Figure 1: Locations of internship host facilities. UM = The University of Montana.

The facilities are all relatively small, with few staff and limited resources. However, each facility agreed to provide a qualified staff member to act as mentor to the interns. The mentors developed the interns' work assignments and provided guidance on all assigned tasks. In addition, visiting graduate students, faculty, and other professionals shepherded interns through various activities on an ad hoc basis.

Internships ranged from six to 12 weeks in duration, with work schedules of 20 to 40 hours per week. Interns were paid minimum wage (\$6.15 per hour). They were required to be at least 15 years of age to provide their own transportation. Applicants submitted information on their favorite subjects, work experience, interests, and availability, a short essay on why they were interested in the program, a letter of support from a teacher, and a signed parental

permission form. Applications were reviewed by both university program staff and mentors at the respective internship sites, who made the final selections.

The Fort Peck Field Station of Paleontology in Fort Peck hosted one intern in the 2007 program. This field station is associated with The University of Montana Paleontology Center (UMPC) and the Fort Peck Station is a fossil repository for many fossils, including dinosaurs. Station activities include excavating, preparing, cataloguing, and storing fossil finds. The station also houses a large, well-equipped facility for replicating (molding and casting) fossil specimens. These fossil replicas are used in museum exhibits and sold to the general public.

The Great Plains Dinosaur Museum and Field Station in Malta mentored two interns in both 2008 and 2009. This facility houses some of Montana's finest fossil specimens including *Brachylophosaurus* "Roberta" and "Leonardo," an unusually well-preserved mummy dinosaur; Montana's first Jurassic dinosaur, *Stegosaurus*; and a new species of Sauropod. The station includes a fossil preparation laboratory where station personnel prepare fossils for study and display.

The Makoshika Dinosaur Museum in Glendive had four interns in 2008 and two in 2009. One of the Glendive interns participated in both years. The museum displays late Cretaceous and Jurassic fossils from Montana and around the world. It offers week-long, hands-on field programs for the public and has fossil preparation and replication facilities.

Two Medicine Dinosaur Center in Bynum joined the program in 2009, mentoring two interns. This Center also offers numerous unique displays, including the first baby dinosaur bones found in North America, and the largest, scientifically accurate dinosaur reconstruction (*Seismosaurus halli*, the earth-shaker lizard). The Center is known for its public, hands-on dinosaur research and education programs ranging from 3 hrs to 10 days in length.

The 12 interns included eight girls and four boys. All were Caucasian. Two were entering grade 9, one was entering grade 10, one was entering grade 11, five would be seniors, and four had just completed high school. (One intern was involved for the two summers following her junior and senior years.) Only one intern had any prior work experience related to science and four reported no past work experience at all.

ACTIVITIES

Students received no formal coursework in conjunction with their internship work. They did receive instruction from mentors on a task-by-task basis and were free to ask questions and participate in discussions. Interns maintained daily blogs of their activities. These activities varied depending on the specific projects being undertaken at each location and on interns' interests and abilities. Overall, interns spent most of their time (about 40%) preparing fossils, including cleaning, gluing, preparing molds for replicas, pouring silica into molds, and sanding and painting replicas. They spent about 20% of the time working on displays or exhibits, including painting, building, making informational cards or posters, plastering and organizing information. Fieldwork, including prospecting, jacketing and excavating fossils, and digging trenches to protect fossils in situ, consumed about 10% of the interns' time. The remaining 30% was spent on research activities, including conducting internet searches for information

on dinosaurs or environments, curatorial activities, such as sorting, labeling, storing fossils in cabinets, and data entry, and other museum chores.

In 2008 and 2009 students were asked to take a pre and post-program scientific inquiry assessment consisting of 11 multiple choice items (Table 1). Seven interns completed both surveys. Scores on pre-program tests ranged from 64% to 100%, and those of post-program tests ranged from 73% to 100%, resulting in an average gain of 4% per student. Two students scored slightly lower on the post-test than on the pre-test. The largest gains (2 to 3 additional correct answers) concerned the underlying reasons for conducting scientific investigations (item 3), and methods and procedures used (item 1). The largest decrease (3 additional incorrect answers) concerned how scientists do their work (item 8).

OUTCOMES FOR INTERNS

Scientific Inquiry Assessment

Table 1: Count of answers and summary results for individual items on the pre- and post-program Scientific Inquiry Assessment. Correct answers are italicized.

1. The methods and procedures used in a scientific investigation:	PRE	POST
a. <i>should be clearly reported along with results.</i>	4	6
b. are unique and personal to each person who does science.	1	0
c. are fixed and standard for each kind of study.	1	1
d. should be updated each time a study is done.	1	0
Summary: Pre-correct = 4; post-correct= 6; change = 2		
2. Which of the following is the LEAST IMPORTANT part of good scientific arguments?	PRE	POST
a. background historical information.	0	0
b. <i>current majority opinion of scientists.</i>	7	7
c. results from systematic studies or investigations.	0	0
d. observations of natural systems and materials.	0	0
Summary: Pre-correct = 7; post-correct= 7; change = 0		
3. Which of the following is the LEAST IMPORTANT reason to conduct a scientific investigation?	PRE	POST
a. discover new aspects of the natural world.	2	1
b. explain recently observed events, systems, or materials.	1	0
c. <i>to maintain a cycle of investigation and reporting.</i>	3	6

d.	test conclusions of prior studies.	4	0
e.	test predictions of current theories	0	0
Summary: Pre-correct = 3; post-correct= 6; change = 3			
4. The most important role of mathematics in scientific inquiry studies is to:		PRE	POST
a.	make it easier to convince others about a new conclusion.	0	0
b.	generate new ideas.	0	0
c.	meet scientific journal requirements for tables and graphs.	0	0
d.	<i>observe and communicate patterns in systems or materials.</i>	7	7
e.	make sure that amateurs cannot interfere with theory building	0	0
Summary: Pre-correct = 7; post-correct= 7; change = 0			
5. The most important role of information technology in scientific investigations is to:		PRE	POST
a.	make it easier to convince other scientists about a new conclusion.	0	0

Intern Interviews

External evaluators from Education Northwest in Portland, Oregon conducted post-program interviews with 10 of the 12 interns. The interview protocol was designed to capture what the interns did, what they had learned, changes in their ideas about science and scientists, and changes in their attitudes towards careers in science. They were also asked about program strengths and areas that needed improvement.

What Interns Did

The amount of time interns spent in the field depended on which facility they were working at and when. The intern at Fort Peck spent five days in the field under a hot August sun with a University of Montana graduate student. They collected and wrapped fossils from a hadrosaur. The intern said, "It was hot and tough work. It was pretty fun."

In 2008, the Malta interns had one field experience lasting for five days and the remainder of their internships was spent in the field station. The 2009 Malta interns spent only one day in the field. One Malta intern recalled this day as her best experience of the entire internship. They found an exposed rib and got to excavate it, jacket it in burlap and plaster of Paris, and return it to the field station. "On that day, we got to work with a paleontologist who taught us how to clean a bone using brushes".

In 2008, interns in Glendive had multiple opportunities to perform field work. The amount of time in the field accounted for 25% to 80% of their internship experience; the remainder of their internship was spent in the museum. In 2009 the Glendive interns spent about five days in the field working with a paleontologist and conducting field excursions for Make-a-Wish

Foundation children. The 2009 interns from Bynum spent about ten days in the field and the remainder of the time working at the field station.

Specific field station or museum activities also varied by location. In Fort Peck the intern worked on cleaning fossils including hand bones of a *Tyrannosaurus rex*, which had been unearthed from the Hell Creek formation. The Glendive interns worked in the laboratory constructing an *Allosaurus* display and making coral for an “Ages of the Sea” exhibit. One very artistic intern learned to reconstruct and flesh out a shark, sanding and airbrushing it to match pictures researched on the Internet. She also enthusiastically learned how to make dioramas for displays. The Malta interns help to unpack a dinosaur and set it up for display. They also prepared various fossils from previous digs using “paleo-bond” to glue bones together for display. In 2009, development of a preschool program called “Peanut's Playhouse” (<http://www.greatplainsdinosaurs.org/education.html>) was a major focus of their work. They worked on creating materials for the program and then helped to implement it. The interns at Glendive and Malta were involved in various other museum-related activities including giving museum tours, working the front desk, and ordering supplies for the gift shop. The Bynum interns spent much of their in-station time working on displays.

What Interns Learned

A typical general comment was, “Really, everything I’ve done in here has been new to me.” However, most comments were about fossil preparation, bones, fossils, and dinosaurs in general, and field techniques. The intern from Fort Peck said, “I got to take bones out of jackets (casts) from the Peck’s Rex site. I got to take out a triceratops hip bone. It took about two hours. It was fantastic. It was cool. Other days I was taught to fill the mold in so that you could make replicates, and how to paint them. It was easy.” She also learned how to clean away dirt and rock from fossils and then how to try to match the various pieces to rebuild the fossil.

While working on hand bones from a *Tyrannosaurus rex*, this intern made an interesting observation about the muscle attachment sites present on the base of the metacarpal, which led to a new understanding about how the wrists may have functioned. Later that fall, the intern presented a poster on those findings at the Geological Society of America (GSA) annual meeting in Denver, Colorado (Quinlan, Derstler, & Miller, 2007), where several university faculty tried to recruit her. “I’m only a freshman in high school!” she told them.

Interns at Malta were excited to learn about preparing fossils and about the anatomy of dinosaurs. One was amazed at how delicate dinosaur bone really is. She “learned the process for putting fossils back together. It is so hard to find pieces that fit together perfectly.” Another intern became accomplished at creating fossil replicas for display. “I learned how to make molds properly, and also the 10-to-1 ratio for the silicone latex, and what is better for which. Latex is for detail, if you’re really looking for fine detail; silicone is if you’re going to make mass production.”

Regarding bones, fossils, and dinosaurs, one intern said, “I’ve learned a lot about dinosaurs. All the bones...I’ve learned to tell the difference.” One intern was pleased to learn so much about dinosaurs during his days in the field that when tourists came into the museum, he could “answer their questions from my own experience.” He explained that the entire area

around Glendive was once “teeming with sea life;” and fossils of turtles, alligators, and ancient fish are commonly found there. He also came to appreciate the value of professional sharing, saying that he really valued “learning from someone who had learned from direct experience in the field.”

One intern said that he has always been intrigued by science, but this experience with paleontology was all new to him. He learned about the intricacies of finding and digging up fossils and the value of the tools that paleontologists use. He was amazed at how long it takes to dig up a little bone. He was impressed that the more he delved into the subject of dinosaurs, the more he realized “how much is unknown to us”.

One intern commented that she felt “smarter” because of the internship, and when probed for more explanation, she stated, “I feel smarter after taking this job – maybe knowing that I can learn this much and knowing that I can learn makes me feel smarter.”

Ideas about Science and Scientists

All of the interns said they came into the program with ideas about science and scientists and every one changed his or her ideas as a result of the internship. Every intern reported that they found science more interesting than they did before the internship. When asked if she was now more interested in science, one student responded, “Definitely, definitely...definitely paleontology and biology!” Another intern commented, “I didn’t really know anything about it [paleontology] before, and now I do; it’s interesting to me.” Another said, “Biology is a little more interesting; bone structure, I guess.”

As one intern put it, “I thought science was more chemistry and biology—well this is biology, too—but I thought it was nothing like paleontology. I didn’t think that was really science...I think I just never really thought of it, it never got brought up, I never learned about it.” Another intern said, “Normally, I think of scientists, I think studying animals and live things. This has more to do with history and stuff, but it’s still science; and I didn’t really think about that before.” Learning more about the profession made it more interesting for one intern who said, “It’s such a different profession from normal—doctors and lawyers—paleontology is so different from normal.”

Interns made comments about the nature of the work of scientists such as, “I see that they work very slowly and very carefully. I didn’t realize they worked so cautiously and so slowly.” “You need a lot of patience,” another commented. One intern was very impressed by the strict procedures a scientist goes through. He concluded that “even though some of those things are a hassle, I now have respect for it.”

Another intern thought he had had a pretty good idea about scientific endeavors before this experience, but he learned from personal experience “how scientists study the natural workings of the world using reason to understand what they experience.” A couple of the interns expressed surprise that there were so many areas to study as scientists. One had thought that science was all about chemicals; now she knows otherwise. One intern commented that “scientists really don’t get enough credit for what they do.”

Attitudes toward Careers in Science

The internship was a transformative experience for several students, with about half indicating that they would consider a career in science. One intern said “Before, I thought of it as complicated and boring and something I would never want to do. But everything changed, and now I want to be a scientist. It was a great experience and amazing.”

Another talked about how her experience made a related career more interesting to her. She noted, “I think it’s good because I can see more about the field itself...I’ll be able to see what I’d have to do if I was a paleontologist or archaeologist. I’d actually get some hands-on experience beforehand.” Several interns said they might consider becoming a paleontologist, and one student had a specific focus for her paleontology career. She said, “I know I want to work with small stuff; I like working the micro-sites. Micro-sites are lots of fun. I like looking for the little shark teeth, and one time I found what I thought was a tooth, but it was actually a jaw of a small fish...” Another intern described herself as an artist whose interest is to take scientific information and translate it into a visual display. She did not do the internship because of her interest in science, but because of her interest in applying her artistic ability to promote scientific understanding.

One student, who began the program as an intern in 2008 and played a mentoring role to other interns in 2009, appears very serious about a career in paleontology. After entering college in 2010, she was selected as one of nine Montana college students considering careers in research to participate in a six-week research experience at the Natural History Museum in Hangzhou, China (Boswell, 2010). The program, which was organized by Montana State University and funded by the National Science Foundation, involved the study of a large collection of fossil dinosaur eggs. While in China, the students spent part of their time in the laboratory and part of the time conducting fieldwork together with geology students from Zhejiang University.

Program Strengths

All of the interns reported being satisfied with their internship experience. A typical comment was, “It is a lot of fun, and we’ve learned a lot, but it’s still fun.” They all expressed that they had enough support and encouragement to make the internship meaningful. One Malta intern said, “...when I’ve had questions, I can definitely ask and feel comfortable.” A Glendive intern said that her mentor “goes over everything more than one time. Usually we get it the first time, and if I don’t know, I’ll ask.”

A few participants mentioned the flexibility of the scheduling as a strength of the program. One said, “The appealing parts of the internship are that you get to choose your hours; and you get paid to learn, unlike school.” A participant relayed what her mentor told her, “‘When you’re starting to feel tired, it’s OK. You can work up to 8 hours, but you don’t have to do the full 8 [hours].’ Most days we work the full 8 anyway, just because we enjoy it, and we want to get the stuff done.” The flexible timeline was a motivation for one intern to enter the program. She commented, “I like it [the internship] quite a bit. Especially that I can just try it for a while—for the summer—and see if I might want to continue. I like the idea that I’m not going to be forced to keep doing it if I don’t want to.”

Another area of strength was the diversity of tasks in which interns could engage. As one participant put it, “If you enjoy digging in the dirt, the field is good for you. If you like cataloging and organizing stuff—curator. If you like working in the back, not being seen, you’re a preparator.” One participant noted that the mentor helped in dividing assignments. She said, “He’ll stick us at what he thinks is best. [intern name], she’s really good with clay, so she works in that. And [intern name] is also good with the molding portion of it, the silicone. I’m really good at making display cards and information for the museum itself...[The mentor] looks at our strong points.”

Areas Needing Improvement

Fieldwork seemed to be the highlight for each of the interns. Those who had less time in the field wanted more opportunity to get outside and see firsthand what a paleontologist does. Their mentor mentioned that she felt ill-equipped to provide the kinds of experiences that a field paleontologist would have provided. Both interns at this site agreed that “students would be more attracted to the internship if they got out into the field more. Most people don’t know much about how this is actually done and a hands-on experience in the field would teach them a lot.”

MENTORS’ PERSPECTIVES

The mentors at each participating facility were also interviewed following the summer internships. The interview protocol was based on a Mentor Exit Survey created by the National Mentoring Center at Education Northwest. The interview protocol was designed to capture the nature of the mentor/intern interactions, strengths, and areas to improve in the mentorship structure and the internship program structure, as well as ideas for sustaining the internship program.

All of the mentors were positive about their experience with the PEP internship program and spoke fondly about the interns they worked with, understanding and acknowledging the effort and growth of every one of them. The interns were described as “enthusiastic, hardworking, and open to new learning and experiences. [They are] very intelligent. They’re fast learners, and they’re very independent.” The mentor at one site was supportive of his interns while recognizing that they brought various limitations with them to the experience.

Nature of the Mentor/Intern Interactions

Mentors said that having interns learn and be actively engaged in the work of their facilities was the most rewarding aspect of their experience. One mentor said that the most rewarding part was, “...to be able to teach and know I’m reaching them.” However, another mentor said that communication with interns was a challenge, saying “... just a difference of communication with a younger group. They have their own language. Everything is looked upon differently. It’s like I have come from an alien world to speak with them. I sometimes feel that way. Other times I feel very close.”

Mentors described a full range of intern personalities from shy and withdrawn to tireless and totally engaging. At one site, the mentor reported that his relationships with his interns

became “fairly friendly” as time went on. However, he was disappointed that for one of the interns, it “was just a job,” and “no matter what I did to motivate him, it didn’t make any difference.” What was most rewarding for him was seeing the growth of his other intern’s interest in the project as the summer progressed.

Strengths and Areas to Improve

The mentors identified both strengths and ways to improve the internship program. The hands-on nature of intern activity was cited by mentors as a strength. As one mentor put it, “I think what works really well is that they’re getting to have hands-on, versus they’re watching you through a glass.” Mentors also felt that the opportunity for teenagers to have a “real” job and learn to be responsible and responsive to the requirements of the job was important. For the most part, the interns were receptive to the varied aspects of the job. At one site, the mentor noted that just finding the resources to do projects was a valuable learning experience for the interns. To make displays, interns had to search for materials and supplies on the Internet and ultimately buy what they could afford at the local market. This activity involved some creative problem solving that resulted in a satisfying experience for the mentor and the interns.

For one mentor, an area that needed improvement was her preparation for the job. Without access to a paleontologist at her site, she was not equipped to direct field and laboratory activities related to prospecting, digging, or bone and fossil preparation. The mentor said that limited access to scientific expertise made it hard to keep the interns busy; “You can’t clean bones for eight hours a day.”

One mentor suggested offering course credit as a way to improve the program. The mentor said, “I was kind of disappointed that this wasn’t accredited.” Another mentor suggested that dissemination of information about program participation could be improved. The mentor stated that their efforts to solicit participation were not as successful as they had hoped and noted, “I guess if there’s a way to get the information to the other teachers? I don’t know how you do it in other facilities.”

Sustaining the Internship Program

The only suggestion mentors had for sustaining the program was to solicit community support from families and business. One mentor felt that there was enough money at the state, district, and in tribes to fund programs like this, but that “it would difficult to convince them that it was worth their while.” It was his opinion that “programs like PEP just don’t get funded in Montana like they might in other places.” And another mentor felt that at the current level of funding, there was barely enough money to do much as it was. It was also pointed out that taking advantage of this opportunity “required resources that students who could benefit the most [from it] just don’t have.”

DISCUSSION AND RECOMMENDATIONS

The PEP internship experience resulted in several areas of learning and personal growth for students. Every intern interviewed admitted to having had some notions about science before

starting the internship, but all agreed that they learned a great deal about scientific procedures and scientific inquiry from their experience. Many reported finding science more interesting because of their internship experience, and half expressed increased interest in careers in science. The fact that only modest gains were seen in the scientific inquiry assessment might be expected because scores were high to begin with. The seeming confusion about how scientists work (item 8), may have resulted from the diversity of people interns interacted with at the facilities and the diversity of work they conducted. Few of the interns were working side by side with scientists for much of the time. Most tasks involved developing technical rather than research skills.

Interns also felt that this internship gave them an opportunity to learn about the kind of independence and self-reliance they would need in the “world of work.” As one intern said, “Some projects might not seem as fun as others, but once you push through that, more things open up for you.” He conjectured that “there will always be a task that you don’t enjoy, but this is actually a very good set up for a real job.” Most of the interns also felt that they had been given a great opportunity to learn about something they knew little about before and to feel accomplished at the end of the experience. One intern said, “It is a great feeling when new people come into the museum and really enjoy what I’ve done and think it’s great.” Each intern acknowledged that working in the museum was a way of giving service to the community even though they were paid for their work.

All interns interviewed reported satisfaction with their experience in the program, although the reasons for that varied. Most interns were excited by the science, but for one intern whose parents had lost their jobs in the recession, the mentor felt that the internship was just a means to help him put food on the table. Another intern had a significant learning disability, which the mentor felt restricted what he was able to do or get out of the experience. In addition, the length of time interns were willing or able to commit to the program ranged from 100 to 300 hours, which almost certainly affected what they were able to gain from the experience.

One reality of conducting a daily summer program at such isolated facilities is the limited pool of interested and qualified applicants able to commute to one of the sites. Some mentors appeared to have difficulty filling the positions available and suggested broader dissemination of program materials. However, recruitment materials were sent to all schools within commuting distance of the facilities, and beyond. With increased funding, a residential program serving students from a broader region might be considered. In this way, the program could serve applicants with the greatest commitment to it and greatest potential to benefit from it.

One model worth considering is a two phase structure as described by Woska, Collins, Canney, Arcario, & Reilly (2005). In their program, students first participate in a one-semester course introducing them to content, techniques, and facilities, and then go through a selection process to compete for internship positions at a research facility. On the other hand, those authors admit that this model tends to target highly motivated, academically accomplished students, rather than those who may not be at the top of their class academically, are unsure about their futures, or lack support for college.

That model would, however, provide the structure required for course credit to be given, which was suggested by some of the mentors. The challenge would be to shift to a more formalized program, with specific work hour requirements, assignments, and assessments of student learning, with minimal reduction in the flexibility of the program schedule and diversity of work available, both of which were noted by interns as strengths. In addition, although providing course credit might be achieved relatively easily within an individual facility, it would be more difficult to implement across a suite of sites as diverse as those involved in PEP.

A revised internship program should also include more formalized preparation of mentors, some of whom lacked experience working with adolescents or wanted to enhance specific scientific skills. Additional expertise could be provided where needed, at least on a temporary basis. Greater assistance to mentors in identifying student interests and abilities and matching them with specific field and laboratory tasks is also recommended. In the current program, mentors were left on their own to handle these logistics. While this approach worked well for some, others had some difficulty.

SUMMARY

The PEP internship program provided participating high school students a real-world scientific work experience that helped them build significant new skills and content knowledge in paleontology, increased their self efficacy in science, and improved their understandings of science and scientists. The experience also led some of them to consider science as a career. For many, the internship experience also gave them increased confidence in their ability to perform in a real-world work environment. These outcomes of science-based internship programs appear to transcend the specific context, whether among the sites of the PEP internships, between rural versus urban settings, or among various scientific disciplines. Whether or not these experiences will actually translate into the pursuit of science coursework in college, or ultimately to careers in science, is unknown. Certainly, some of the PEP interns appear to be headed in that direction. However, whether or not this enthusiasm can be maintained within such small, isolated communities is less clear. In any case, the responses of both interns and mentors to the PEP summer internship program validate the overall approach in the context of rural Montana. With improved mentor preparation, broader student recruitment, the addition of course credit, and increased and sustained financial support, the impacts of this program could be maximized and long-term effects studied. As the saying goes, it will “take a village” to incorporate meaningful and effective science internships into the nation’s mainstream science education practice.

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